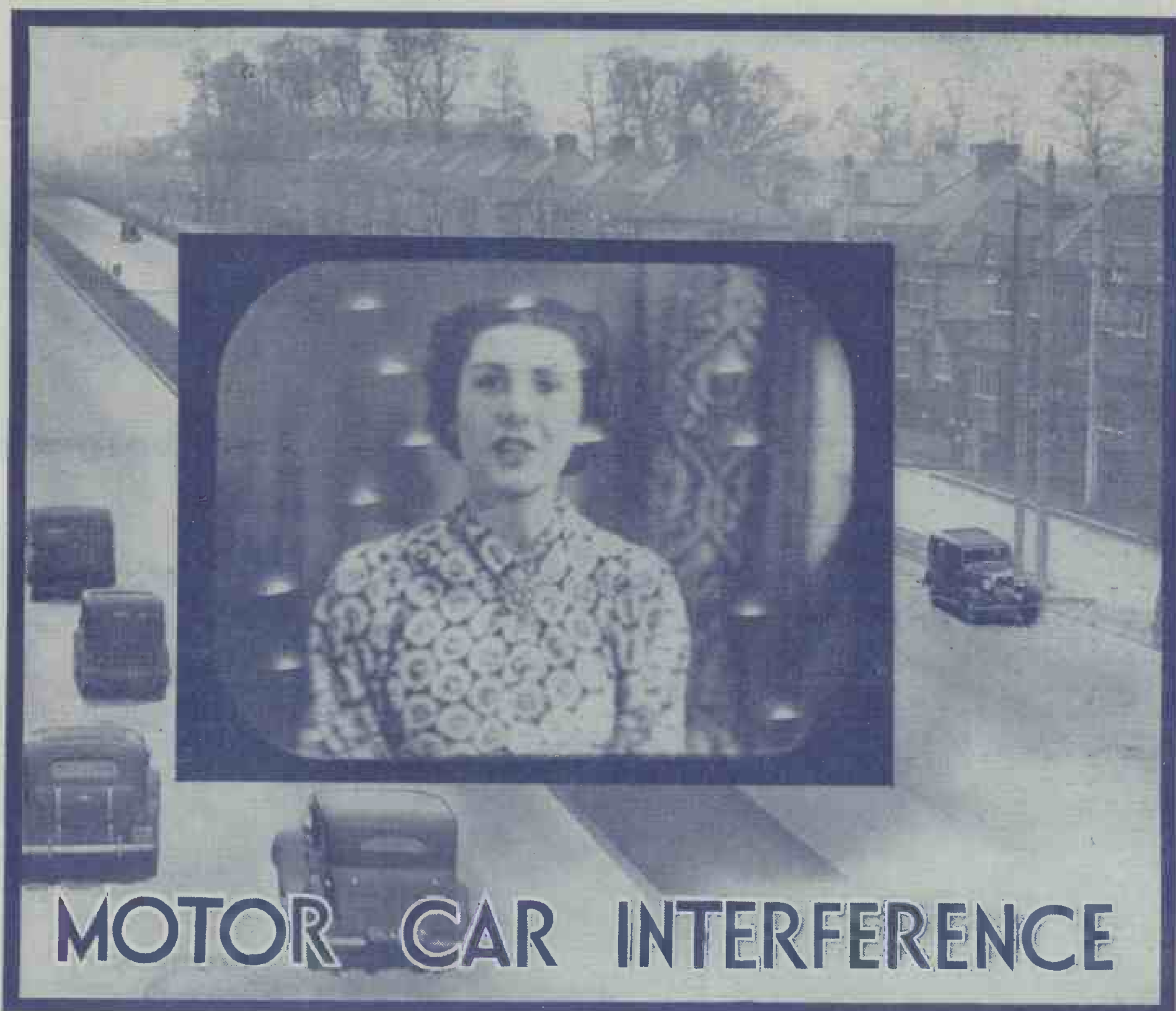
HEIGHT INDICATOR FOR AIRCRAFT

The Wireless World

6D

THE PRACTICAL RADIO & TELEVISION JOURNAL

Thursday, February 2nd, 1939.



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The Wireless World

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EDITORIAL COMMENT

Television

Accelerating Rate of Progress

THE combined efforts of the Government-appointed Committee, the B.B.C. and manufacturers have succeeded in establishing here a television service which is the envy of all other countries. It is a service of which we may very justly be proud ; but public response has been slow and when we consider the excellence of the pictures, the reliability of the sets and the continually improving programmes put out by the B.B.C., there seems to be something wrong if the public does not respond and take advantage of it.

In a recent Address which he gave before the Royal Society of Arts, Mr. Kirke, of the B.B.C. Research Department, said that the television service was being seriously handicapped because the public was not responding by buying a sufficient number of sets. He emphasised the difficulties which lay in the way of justifying an extension of the service to other areas, which would involve great expenditure, until a really enthusiastic interest on the part of the public in London to the service already operating is assured.

It is not surprising, in these circumstances, that the manufacturers, in co-operation with the B.B.C., should now be launching a campaign with the object of bringing home to the public the fact that a television service is now really established and that sets can be bought at prices which are remarkably low for the entertainment provided. Whatever steps are possible will be taken to make the public television conscious, and the slogan of the campaign is " Television is here : you cannot shut your eyes to it ! "

There have been, during recent weeks, indications that the public is beginning to show greater enthusiasm and every possible encouragement should be given to this attitude, not only to ensure that the present expenditure on programmes and transmissions can be justified, but to pave the way for the further extension of television to other parts of the country.

National Service

The Wireless Register

IN this issue we publish again the National Wireless Register Form which first appeared last week. *The Wireless World* has inaugurated this National Wireless Register in conjunction with the Wireless Telegraphy Board in order that the Authorities may be able to assess the potential resources in trained or partially trained wireless personnel in the country.

As we have already explained, filling up the form does not involve any liability, but will provide a means of classifying those experienced in wireless, so that in the event of an emergency which would require that everyone should put himself at the service of the country, the right job could be found for every person with wireless qualifications ; either continuing in his present occupation or in some other where the utmost use could be made of his capabilities.

Those who are in reserved occupations would not, of course, be required to volunteer for other work, but it would still be valuable that they should be included in the Register for the sake of completeness, and because no matter what occupation of value you may at present be in there is always the possibility that you can render still more valuable service in another capacity.

It is hoped then that every reader will make it his business to complete and post this form as early as possible

Wireless Altimeter

"ECHO SOUNDING" FOR AIRCRAFT

By Our New York Correspondent

THE radio altimeter for aeroplanes has been something of a will-o'-the-wisp. Though presenting the attractive theoretical possibility of measuring the plane's height above the ground, rather than the sea level, it has encountered major difficulties in a rather long experimental life. One such difficulty was that the simplest of the radio altimeters has the unfortunate property of repeating the same indication for a number of altitudes at regular intervals, making possible an error somewhat like that of confusing a.m. and p.m. when reading a clock. Such uncertainty may be serious. Another outstanding shortcoming was that with the commoner schemes the readings of altitude were only as accurate as the frequency constancy of the transmitter which sent the radio signal employed in making the measurements. Since the ultra-high-frequency transmitter is installed in the plane, and aircraft conditions are severe, this is no minor problem. Both difficulties have been avoided very neatly in the new Western Electric Model 1 altimeter recently described before the American Institute of the Aeronautical Sciences by Lloyd Espenschied and R. C. Newhouse, of the Bell Telephone Laboratories (New York City).

The Model 1 altimeter begins with the familiar basis of an ultra-high-frequency transmitter carried by the plane and transmitting to a receiver in the same plane as suggested by the block diagram of Fig. 1. The UHF oscillator at the left feeds the small half-wave dipole transmitting antenna via a short concentric feeder line. The transmitting antenna radiates in most directions, hence the dipole "receiving antenna" at the other end of the wing of the plane receives both a "direct signal" and a signal which has gone down to earth and rebounded to the plane ("reflected signal" in the diagram). Both paths are shown in Fig. 1. Since the two paths are not of the same length, the two signals do not arrive at the same time. To be of practical use a radio altimeter must be able to measure this time-difference automatically, translate it into terms of plane height, and indicate this result promptly. The Model 1 altimeter differs from others principally in the manner of making this measurement and indicating the result. The transmitter does not operate at a fixed frequency, but is "wobbled" rapidly in a regular manner. The frequency modulation is in a saw-tooth pattern as shown by the solid line in Fig. 2 marked "direct signal." When such a frequency-modulated signal is received it is impossible for the frequency variation of the direct signal to be in step with the variations of frequency of the reflected signal, because of the difference in travel time. The delay of the modulation pattern is proportional to the difference in path length, which difference is almost exactly twice the plane's height. The use of the saw-tooth variation pattern, which is made up of straight-line sections, insures that the frequency difference between the two signals is likewise proportional to the delay. Now this difference-frequency can be taken out by an ordinary detector, amplified and made to operate a direct-reading frequency meter calibrated in feet of ground clearance. The process of detection of the difference-frequency is very much like the analogous process effected by the first detector of a superheterodyne.

Describing the functioning of the device, the Western Electric Company states "a city usually causes rapid fluctuations of the order of 50 feet . . .

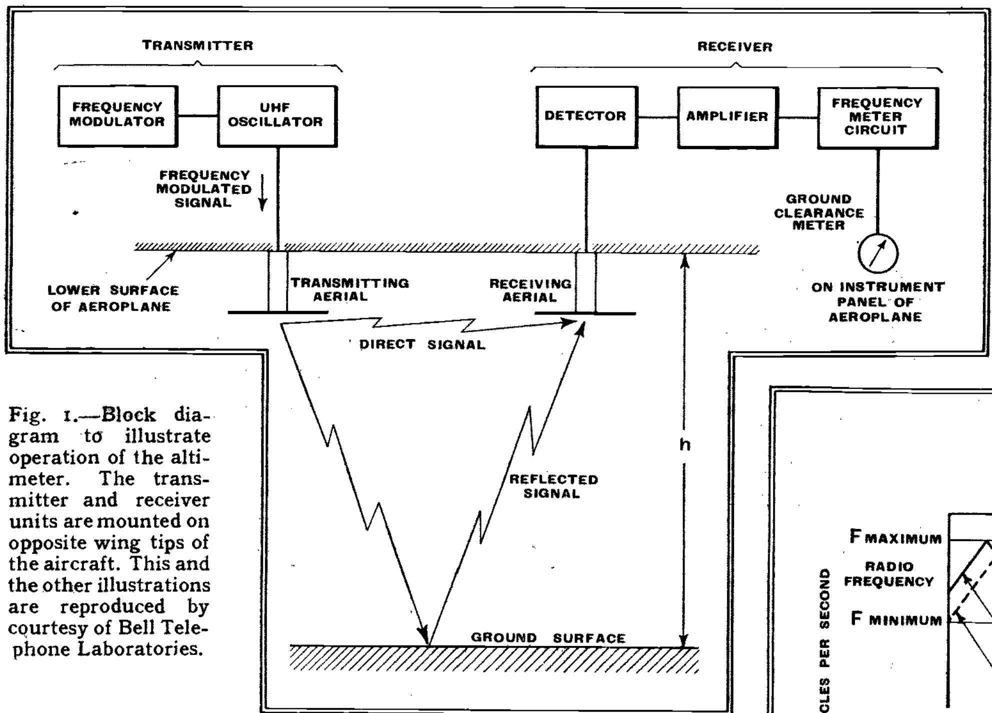


Fig. 1.—Block diagram to illustrate operation of the altimeter. The transmitter and receiver units are mounted on opposite wing tips of the aircraft. This and the other illustrations are reproduced by courtesy of Bell Telephone Laboratories.

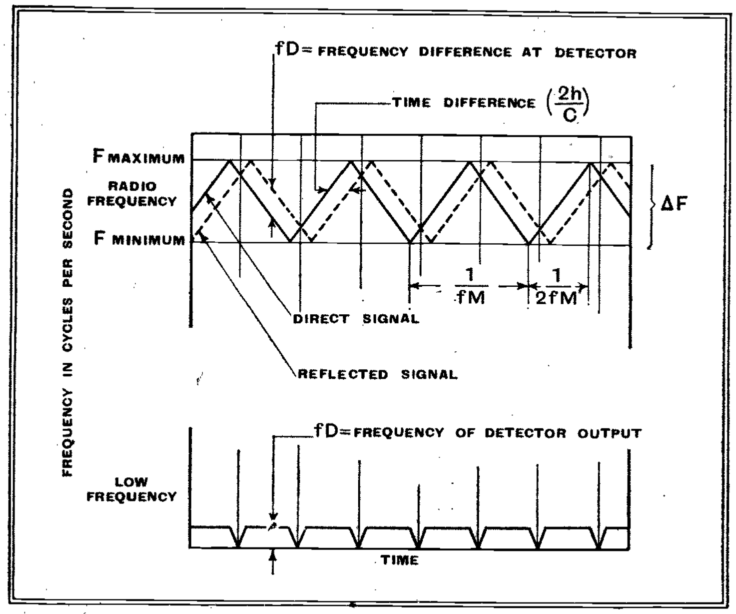
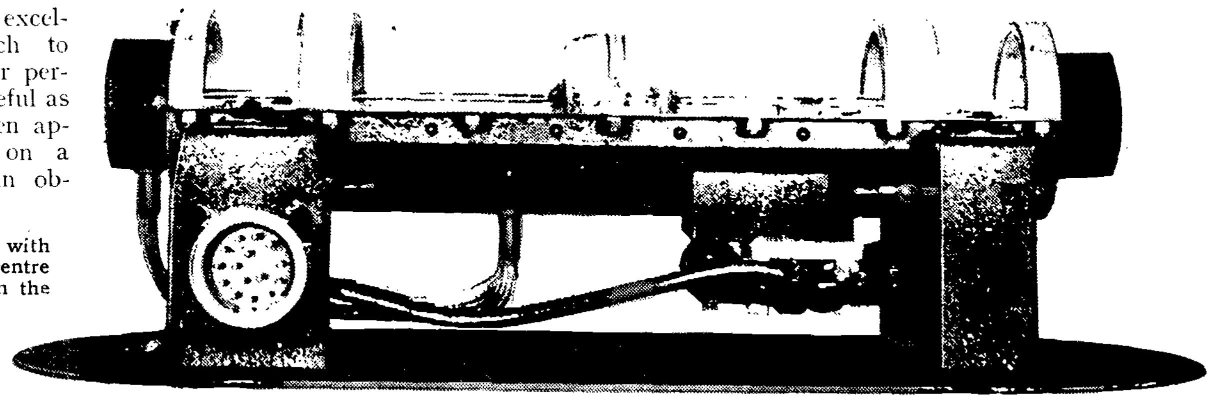


Fig. 2.—Method of obtaining a frequency proportional to altitude.

Wireless Altimeter—

FOR fairly obvious reasons, the pilot of an aircraft flying over, say, hilly country in conditions of poor visibility is less interested in knowing his height above sea level than in the height above the surface of the earth immediately below him. The Western Electric Altimeter described in this article gives a direct indication of ground clearance (height above the surface of the earth) which is precisely the information needed under the conditions envisaged.

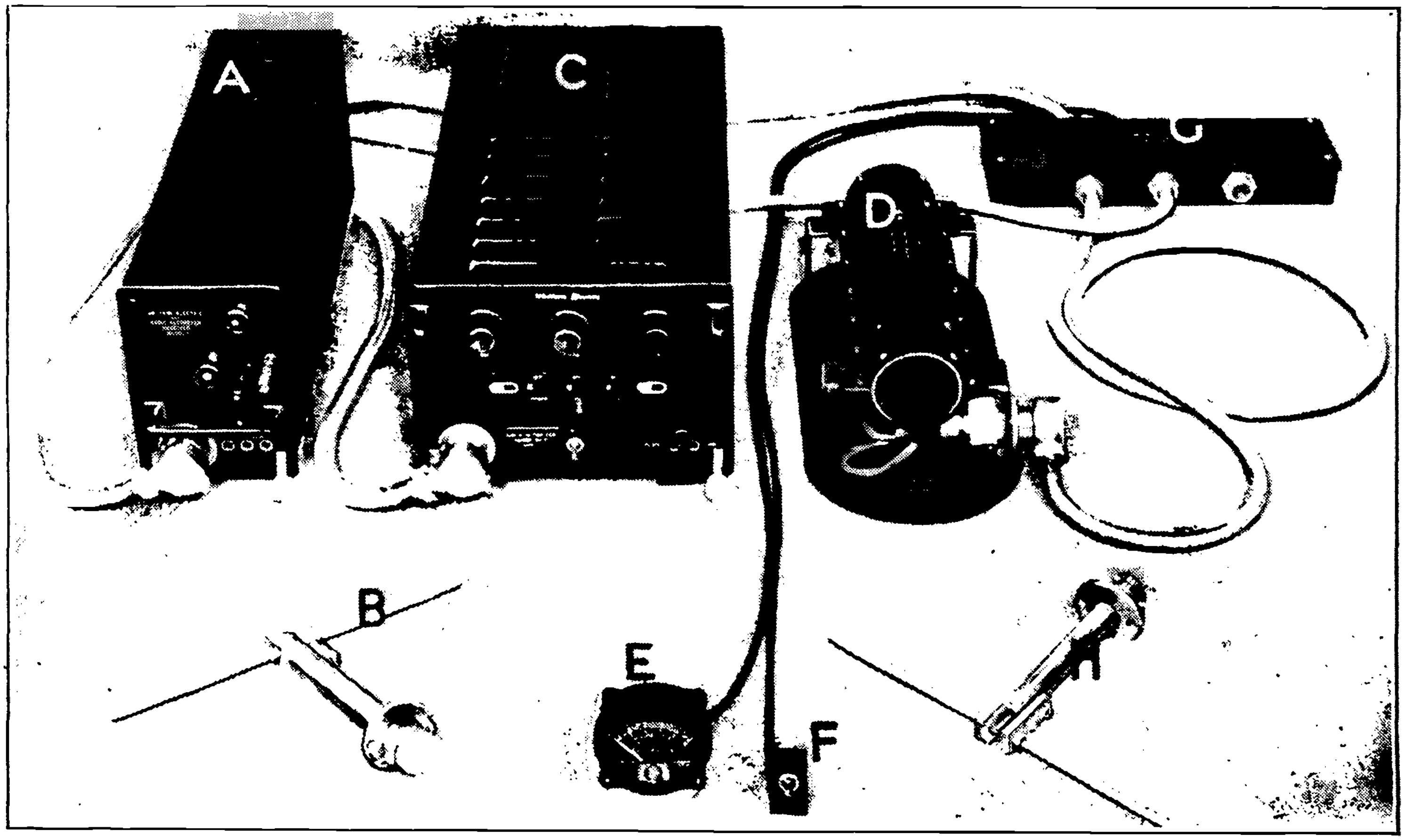
farmland causes fluctuations of lower frequency and amplitude. An isolated high object such as a skyscraper or a chimney is indicated only by a slight meter kick as the aeroplane passes over it, which may not be noticed by the observer. . . . The gas storage tank near the Chicago airport is an excellent thing upon which to demonstrate the altimeter performance. It is very useful as a position indicator when approaching an airport on a course which crosses an obstruction of appreciable height and size, since the moment of passage over the obstruction is clearly indicated."



View of the transmitter, with cover removed. At the centre of the framework is seen the double triode "door-knob" valve, mounted directly on the Lecher wire tuning system.

Fig. 2 is largely self explanatory, except as to the symbols employed. "h" is the height of the plane, "C" the speed of propagation, and "ΔF" the peak value of the frequency variation or modulation. The proportionality between time-difference and frequency-difference is due to the use of a modulation curve made up of straight-line sections. The difference-frequency is not actually constant for a fixed altitude, but drops to zero momentarily at each point where the dashed and solid curves cross. This is shown by the lower pattern which is the form of the detector output. The flat tops of this curve predominate and represent the frequency to which the indicating meter responds. The height of the tops changes with the plane's height, but their length depends upon the frequency of the modulation.

It is very desirable to provide two ranges for an altimeter, one for normal use and one for landing or other close approaches to the earth. The Model 1 altimeter provides snap-switch selection of ranges of 0-1,000 and 0-5,000 feet. It is interesting to note that multiple ranges can be obtained in several ways with a circuit of this sort, since it is possible to cause a selector switch to operate on the meter itself, or on the frequency modulating device. The latter is possible because the difference-frequency is proportional to both the number of frequency-modulation cycles per second and to the amplitude (f) of these cycles. This is true because these two factors multiplied together represent the rate-of-change of the transmitter frequency, which when multiplied by the time difference (2 h C) becomes equal to the detector output frequency fD. It is,



The various units of the altimeter equipment. A, receiver ; B, transmitter dipole (length is about 11in.) ; C, power supply unit, including HT generator ; D, UHF oscillator ; E, indicating meter, calibrated in hundreds and thousands of feet ; F, range switch (hundreds to thousands of feet) ; G, junction box ; H, receiving dipole. Total weight of equipment is 70 lbs.

Wireless Altimeter—

therefore, necessary that the modulation be very constant. This problem partially replaces the one of oscillator constancy. Frequency variations of the oscillator, unless they are rapid and of considerable amplitude, do not have the serious consequences which would appear in a system attempting to establish standing waves between the plane and earth on the basis of a single frequency.

"Door-knob" Valve

The transmitter is shown partially disassembled in the first photograph. It employs one of the special double-ended Western Electric triodes previously described in *The Wireless World*. These "door-knob" tubes have the plate and grid support rods carried straight through the bulb so that the tube may be inserted in the centre of a Lecher wire tuning system whose ends are short-circuited (for RF). This arrangement minimises radiation losses from the rods forming the tuned system and approximately halves the RF current flowing into each lead-in wire of the tube. Since the wavelength is below 1 meter this effects a considerable gain in efficiency. The adjustable tuning bridges and the upper tuned rod are visible in the photograph, as is the tube at the centre of the housing.

The second photograph shows the essential component parts of a Model 1 equipment. The front row consists of the sending and receiving dipoles and the indicating meter with its range-selecting switch. The dipoles are less than a foot long. They are carried on short lengths of tubing which with the enclosed concentric rod act as impedance-matching devices and in turn connect to the feeders (not shown) from sender and receiver. The indicating meter is a normal DC meter working in conjunction with a frequency-measuring circuit. In the rear row from left to right are the receiver, the power supply and control box, the transmitter, and a junction box, all connected by such lengths of shielded multiple-conductor cable as may fit the particular installation. Definite information is lacking, but the frequency employed and the appearance of the receiver both make it fairly certain that the coupling devices are concentric tuned lines with trombone adjustment at the front panel.

PROBLEM CORNER—5

Test Your Powers of Deduction

HENRY FARRAD, another sample of whose correspondence is given below, has a reputation for correctly diagnosing his friends' radio troubles. Readers are invited to work this one out for themselves before turning to p. 112.

99, Blomfontein Parade,
Surbiton.

Dear Henry,

Since you last heard from me I, too, have been confined to my room—sciatica, it seems. A most unfortunate time, for I wanted to give the garden a good digging before the winter is too far advanced, and now I have had to pay a fool of a man to do it for me.

Another regrettable occurrence is that just when I wanted the wireless most it has let me down. Not altogether, you understand, but it is definitely not as good as it was, and there seems to be more hum than usual. Another thing—when your aunt was connecting up the extension loud speaker for me she says she got quite a shock from it. I am quite certain that has never happened before. Can you understand it, my boy?

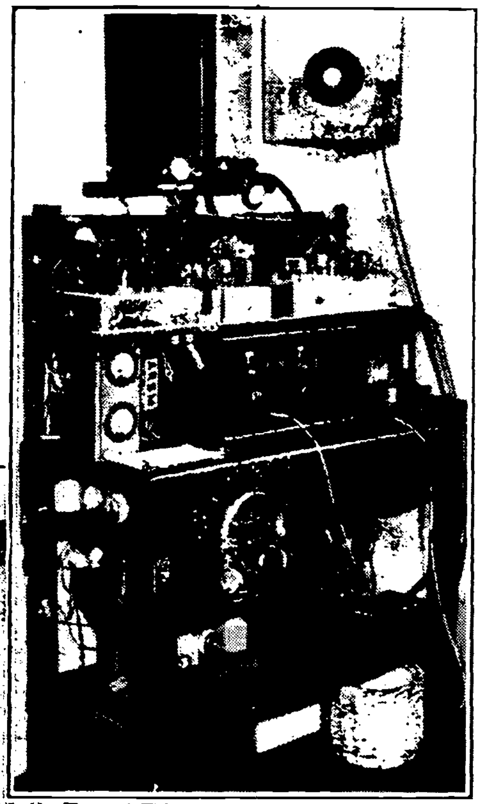
Your affectionate
Uncle Adrian.

What was wrong with "the wireless," and why?

Amateur Transmitting Station G5CD

At Hendon, London, N.W.4

This station, owned and operated by Mr. D. N. Corfield, carries out experimental transmissions on 1.7, 3.5, 28 and 56 Mc/s wavebands.



A considerable amount of work is done under artificial aerial conditions. The inset picture above shows the equipment used for transmission on 57.68 Mc/s, which can operate on an input up to 100 watts. The station is usually to be heard on Sundays, in the morning on 1.7 and 3.5 Mc/s bands and in the evening on 3.5 and 56 Mc/s bands. HT voltage supply for the various transmitters and test equipment is derived from a comprehensive unit seen on the left of the lower picture.

Motor Car Interference

Part I.—HOW IGNITION SYSTEMS AFFECT TELEVISION RECEPTION

By
F. R. W. STRAFFORD
(Research Dept.,
Belling and Lee, Ltd.)

The white spots on this untouched photograph of a television screen are due to interference from a near-by motor car. The "annoyance value" of the interference has been greatly reduced by photographic reproduction.

IN addition to describing how interference is generated by the ignition systems of motor vehicles, this article discusses in detail the effects of the interfering pulses on television reception.

IT is fortunate that those types of electrical interference which are so prevalent on medium and long waves have, in most cases, negligible effects on the ultra-short wavelengths earmarked for television and other important services. It is unfortunate, however, that the reverse can occur and that certain forms of electrical interference, while producing negligible effects on medium and long waves, can bring utter confusion into the ultra-short wavebands by virtue of the effects they produce.

Of the few forms of interference which may mar either or both vision and sound channels of our television broadcasts one may tabulate:—

(1) Ignition systems of internal combustion engines.

(2) High-frequency medical apparatus.

(3) Oscillation from certain badly designed broadcast receivers.

The interference due to the ignition systems of motor vehicles of private and commercial type is by far the worst offender in this respect, not only on account of the effects of the interference upon both the vision and sound channels, but because of its widespread influence; it will accordingly be the only form to be discussed in this article.

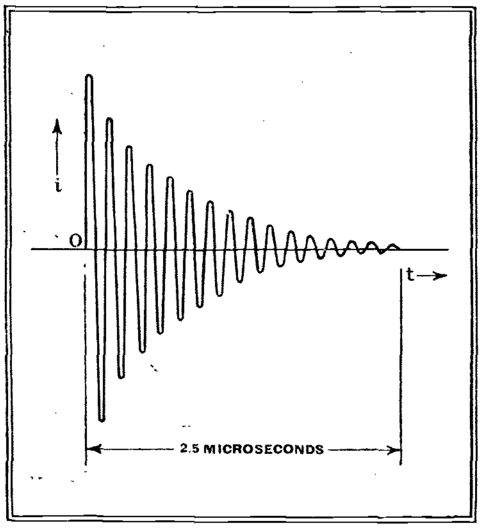


Fig. 1.—Diagram showing waveform of an interfering pulse produced by a discharge from an ignition coil across the gap of a sparking plug.

The interference is primarily due to the high-voltage circuit of the ignition system which provides a spark across the sparking plug gap. At each spark a train of highly damped oscillatory currents will flow through the high-tension wiring system, and from it will radiate electro-magnetic fields. The reason why these currents are oscillatory is due to the fact that the distributed constants of the ignition wiring system comprise inherent inductances and capacities, and these are set into oscillation by the momentary voltage pulse applied to the circuit by the spark coil, or magneto.

The British Electrical and Allied Industries Research Association have conducted a series of investigations into the sparking mechanism of ignition systems with a view to finding out the nature of the oscillatory currents produced thereby. Their studies include some excellent high-speed oscillography. These oscillograms show that the current through the sparking plug, at the time of discharge, consists of a series of decaying oscillations whose fundamental frequency is of the order of 35 megacycles per second. These oscillations rapidly decay to a negligible magnitude in a time not generally greater than 2½ microseconds, depending rather upon the general disposition of the high-voltage circuit and the length of lead employed. A typical pulse of this oscillatory current would look something like that depicted in Fig. 1.

A very surprising and original finding was that the peak amplitude of this current pulse at or around its starting time was of the order of 100 amperes, depending to some extent upon the gap length of the sparking plug. It is interesting to note that the instantaneous peak amplitude of the current in the transmitting aerial at Alexandra Palace never attains anything near so great a value! It is indeed fortunate that the radiating efficiency of the high-voltage wiring in a vehicle is less than that of the Palace aerial!

It is a simple matter to provide a suitable measuring equipment to verify that the interfering fields from ignition systems are mainly vertically polarised. The response of a horizontal doublet to this form of interference is some ten times less than when the same doublet is vertically disposed. It is wondered whether the Radio Corporation of America have adopted horizontal polarisation for their experimental television service for the same reason.

It is difficult to measure or express the field strength of ignition interference because of the transient nature of the disturbance.

Effect on Television Reception

If one sets up a television receiver and drives a motor vehicle close to the aerial it will be observed that the picture will be covered by longitudinal flashes of light, exhibiting the general appearance of a driving snowstorm in which the snow is moving horizontally. Now, as the car is driven away from the aerial it will be noted that the flashes of light will diminish in size rather than in brightness until they ultimately become mere specks and appear to become merged into the picture. The most important point to realise here is that the spot never appears to become grey or dim, but rather to decrease in size and ultimately vanish. Now, although the shape of the initial pulse of ignition current is known, it cannot truthfully be said that we know much about the shape of the pulse after it has passed as an electromagnetic wave through the ether, and as a current through the aerial feeder, the tuned circuits and detector of the receiver. All we know from experiment is that the

Motor Car Interference—
length rather than the brightness of the actual spot appears to decrease as the intensity of the field is made to decrease (for example, by driving the car to a remote point).

Now, having a knowledge of the original pulse shape and its effect upon the picture, particularly as the magnitude of interference is decreased, a logical determination of what modifications to the pulse shape are effected during its transmission may be established.

As a start, let us suppose that the original oscillatory impulse as depicted in Fig. 1 is undisturbed in its general shape in the process of being transmitted through the ether and the complicated network comprising the television receiver until it arrives at the terminals of the detector. After detection (rectification) it is clear that the pulse will become uni-directional, and will be represented as shown in Fig. 2(a), which is, of course, an outline of one side of the envelope of Fig. 1. This is the pulse of voltage which would be applied to the controlling electrode of the cathode-ray tube. Now, supposing at the instant of time T the amplitude v of the voltage applied to the controlling electrode of the cathode-ray tube is of sufficient intensity to produce full-vision white intensity on the screen, then the amplitude over the time from the origination of the pulse up to time T would have the same effect. It is quite clear, therefore, that an intensity corresponding to full-vision white will occur over a time of duration OT.

Now let us take the vehicle to a more distant point so that the magnitude of the impulse when it arrives at the aerial system of the receiver is much smaller, as depicted in Fig. 2 (*b*). It is clear now that the time between initiation and the instant T_1, over which the pulse is of sufficient amplitude to give full-vision white, has been reduced by quite a considerable amount; for example, at a distance of a few feet the impulse may be of such magnitude that it has the effect of maintaining full-vision white amplitude at the cathode-ray tube for a period of 2½ microseconds, wheras when taken 30 or 40 yards away the effective time over which this full-vision white is maintained may be less than ½ microsecond.

The electron beam which is scanning the surface of the screen at a fixed velocity travels from one side of the screen to the other in approximately 100 microseconds. On a screen 7 inches in width a pulse producing full-vision white for 2½ microseconds will, by a little calculation, produce a spot between one-eighth and one-fifth of an inch long, the spot due to a pulse occupying an effective time of ½ microsecond for the full-vision white period would be reduced in length to approximately one twenty-fifth of an inch, and so on, pro rata.

This theory fits in with the observed facts very nicely, and it can therefore be assumed, with some degree of certainty, that the envelope shape of the initial pulse is not modified to any vast extent by the circuit network through which the disturbance has to travel before it ultimately reaches the controlling electrode of the cathode-ray tube.

When Interference Disappears

The foregoing may also explain in some measure the reason why the brightness of the spot does not seem to change to a very great extent, although its dimensions do; for we can visualise the limiting time interval becoming so short that the length of the interfering spot becomes comparable, or small, in relation to the diameter of the spot due to the electron beam, thus producing the effect of the interference becoming submerged into the picture mosaic.

While the theory is undoubtedly speculative, it does appear that the annoyance factor of television interference from the viewpoint of its effect on the picture must be expressed in terms of the size of the spot rather than by its brightness, for a number of large dull spots would be far more objectionable than the same number of minute bright spots.

From the foregoing it is evident that any instrument which is to measure the peak intensity of the interfering field will be very different from that intended to measure what might be regarded as the annoyance factor, and due consideration must be given as to which type of measurement will be preferable.

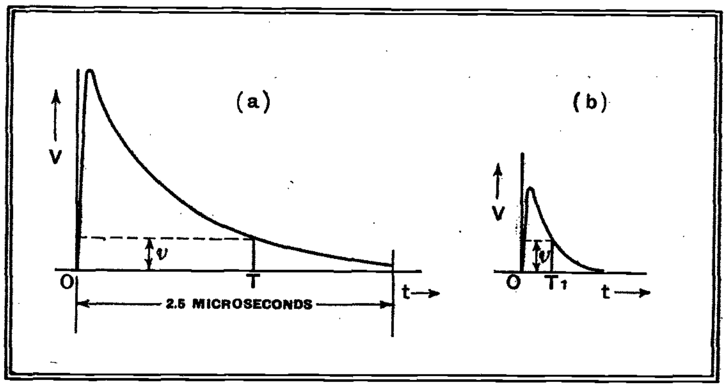


Fig. 2.—The interfering pulse of Fig. 1, after rectification; the diagrams represent two different amplitudes.

It is evident, from an inspection of the interfering pattern obtained on pictures in known field strengths exceeding 10 millivolts per metre, that at a distance of 30 to 40 feet from the side of a main road the peak intensity of the interfering field, from the ignition systems, must be of a similar order to those of the incoming signals themselves, that is, to the peak amplitude at full-vision white modulation.

Apparatus is not as yet available whereby the exact instantaneous peak amplitude of the ignition interference can be measured, but it is safe to predict that very high figures would be obtained, because the indications in practice so obviously point that way.

So far as the interference with the sound reproduction is concerned, this is another matter, since the principles involved are so very much different in that the ear is now involved instead of the eye.

If we assume, as we did in the case of vision, that the actual envelope shape of the pulse is relatively unaffected by the aerial and receiver network, then the loud speaker will receive pulses of current of similar shape to that shown in Fig. 2. Now these pulses occur rhythmically in the firing order of the engine; at an engine speed corresponding to 30 miles per hour for average vehicles, the number of sparking impulses per second is of the order of 50, but the pulse itself lasts for a very much shorter period than the actual time between each pulse; hence the effect of the pulse current in the voice coil of the loud speaker will be to cause the diaphragm to be set into oscillation at its own natural frequency, and the time over which it tends to oscillate will be determined largely by its own electrical and mechanical damping. The result is a rhythmic clicking sound, very much like that produced by a distant machine gun. In either the measurement or the expression of the interfering effects of ignition systems with television reception, it must be made clear whether reference is being made to the vision or sound channel.

Independent of the method used for the measurement of the interfering field intensity, it will be interesting to see how this intensity changes with the distance from the source. If an initial measurement is taken at a distance of about 10 yards from the bonnet of the vehicle it will be observed that the intensity has fallen to approximately one-thirtieth at a distance of about 130 yards. At a distance of about 60 yards the interference will have fallen to approximately one-tenth of its original value.[1]

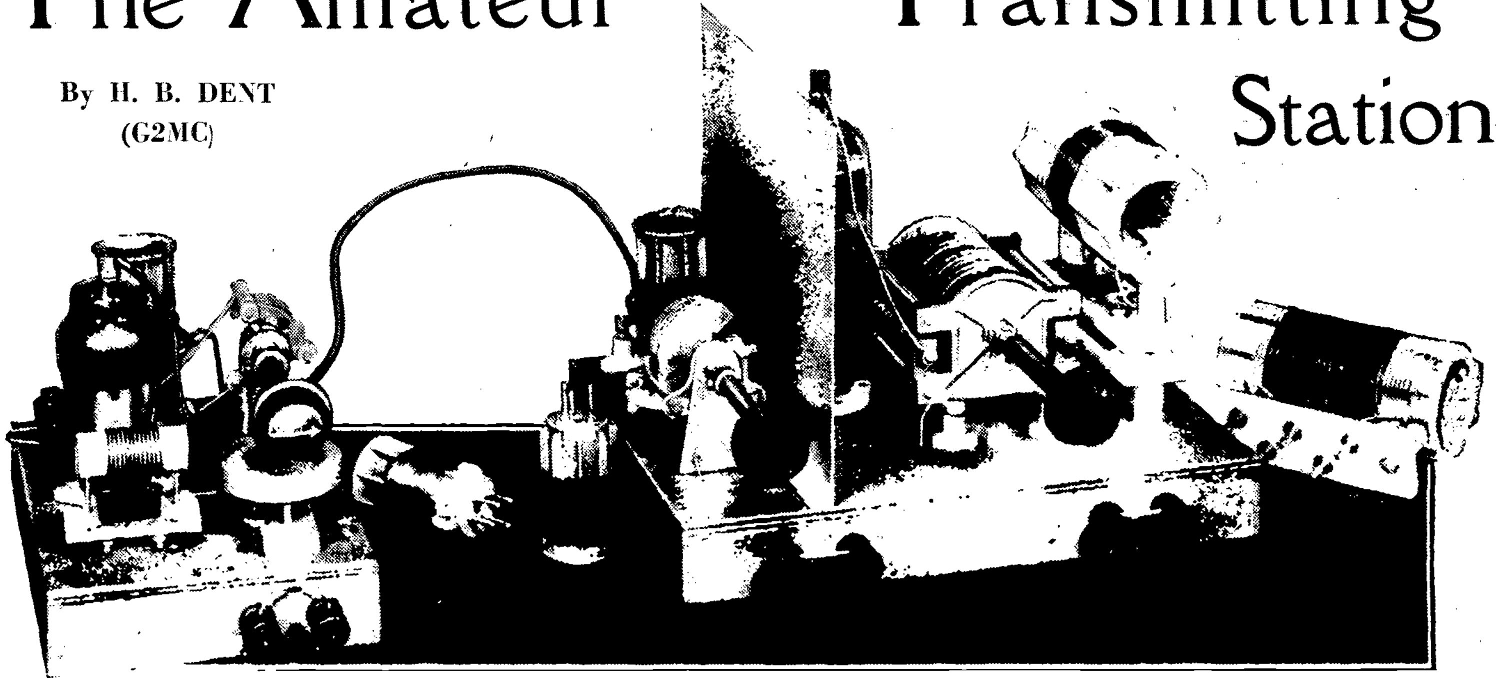
It must not be forgotten that these measurements must be taken under conditions where no stray effects can be introduced. It is well known, for example, that the interference can be picked up by telephone and telegraph wires and carried some distance and re-radiated on to the receiving aerial, but this is hardly a fair test. It is also possible for reflections to occur, so that as one recedes from the source of interference the actual field intensity exhibits a succession of maxima and minima. Here again the presence of some conducting obstacle or obstacles is indicated.

Having given quite a lot of consideration to the cause, and nature of the effects, of ignition interference, it is now necessary to deal at some length with the means whereby the effects may be eliminated from the response of a television receiving system. Part II of this article will attempt to cover that important aspect of the subject.

[1] ERA Report M/T47. *Short Wave Interference from Ignition Systems.*

The Amateur Transmitting Station

By H. B. DENT
(G2MC)



Part V.—Constructing and Adjusting the Power Amplifier

THIS instalment deals with the construction of the PA stage (from which energy is fed to the radiating aerial system). Detailed instructions for making initial tuning and neutralising adjustments to the unit are given.

AS the exciter unit is designed to operate on two wavelengths, viz., 21 and 42 metres, the same provision must be made in the power amplifier. We can use either switching or plug-in coils for waveband changing, but the latter are in general the more satisfactory. RF currents of some magnitude circulate in these circuits and a very little resistance in the wrong place can lead to quite a serious loss in power.

Idle coils may also prove troublesome, for if with the stray capacities they resonate to the working frequency, losses will take place through absorption. By properly designing the amplifier the neutralising will hold with any set of coils likely to be used. We can now draw the complete circuit of the amplifying stage which takes the form of Fig. 11.

If a metal chassis is used the grid circuit tuning condenser, C1, should be mounted on an insulated bracket, as the moving vanes are not actually connected to the earth line. If this is inconvenient they could be made "earthy" by shifting C2 and connecting it between R1 and the moving vanes of C1.

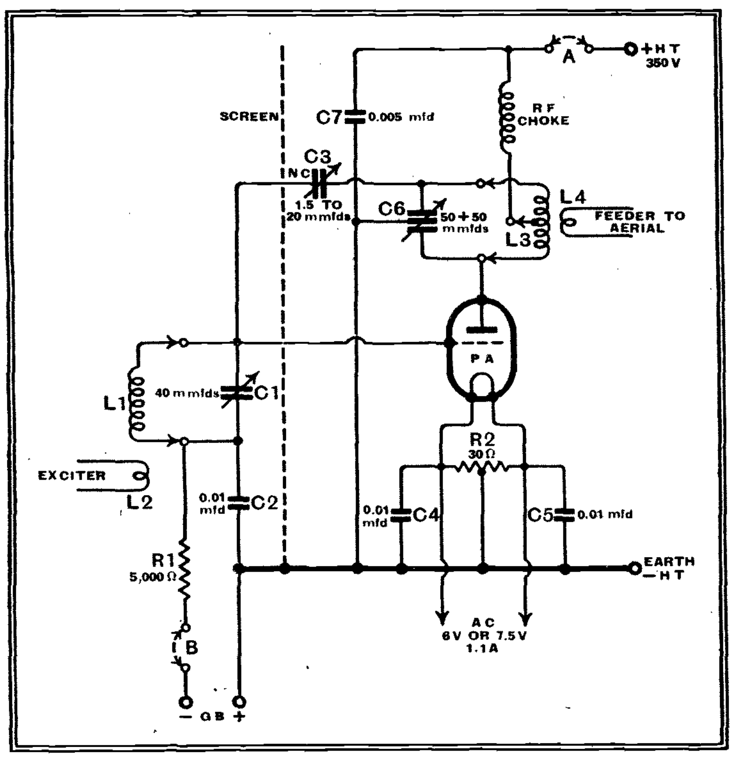


Fig. 11.—Theoretical circuit of the power amplifier. The neutralising condenser C3 must be proof against short circuits and capable of withstanding the full HT voltage.

There would probably be no noticeable difference in the performance by making this change though it is a good policy to complete all tuned circuits in transmitters in the most direct way and avoid including non-essential components that may have an appreciable RF resistance at the frequency of operation.

For the grid circuit the coil L1 can be wound on a standard four-pin former and the extra pair of pins utilised for the small coupling coil connections.

Another method of coupling that has been found very satisfactory in practice is to make up a two-turn coil from stiff wire, and of larger diameter than the coil former, and mount it so that it encircles L1 and is coupled to the lower or earthy end of the grid coil. The illustrations show how this can be arranged.

Grid Bias Arrangements

As the valve is operated as a Class "C" amplifier, grid bias has to be obtained from a battery, or at least from a source of constant voltage, but it is also an advantage to include a resistance as well, R1 in Fig. 11. This has a compensating effect, as the extra grid bias obtained with the resistance will depend on the RF input. If the excitation increases, so will the grid bias and vice versa.

The circuit shows the inclusion of a screen between the grid and anode circuits of the valve. It has been included to prevent, or at least minimise, direct coupling between L1 and L3. Any coupling between these two coils not only makes neutralisation more difficult but when the stage is stabilised it only remains

The Amateur Transmitting Station—

so at or near to one particular frequency. By eliminating the unwanted coupling the valve can be neutralised at, say, 42 metres, and it will also be correctly neutralised when the 21-metre coils are plugged in, or coils for any other wavelength for that matter. The alternative would be to screen individually the coils, but this is neither desirable nor practical; first because screening cans of very large size would be required, and secondly, it hinders the charging of the coils.

The salient features of the anode circuit have already been discussed, and now we are only left with the coils for L3 position. Two coils are needed, one for 42 metres and the other for 21 metres, and they have been wound on the Eddystone glazed Frequentite formers. These formers measure 2½in. in diameter and they are grooved for winding 7½ turns to the inch. As the coil is centre-tapped it is most convenient if we have an even number of turns, as an odd number would entail bringing the tapping down from the top and there are no holes on the top of the former through which wires can be passed.

For the 42-metre coil, 20 turns of No. 14 enam. wire are employed, while for the 21-metre coil 8 turns of the same gauge wire are required. Though there are holes in the lower part of the former at every alternate groove it is well nigh impossible to thread the thick wire through them and bring it out again and down to the plugs on the sub-base. At least, the writer found it to be so.

It is suggested that about one inch of wire be passed through and turned over to anchor the ends of the coil. The connecting wires are then soldered to the last turn at each end just before it enters the former.

The only other part of the circuit that needs comment is the resistance R2 and condensers C4 and C5. R2 takes the place of the usual centre tap on the filament winding while C4 and C5 are RF by-pass condensers. This combination provides the shortest possible return path for both anode and grid circuits and also confines the RF to the wiring in the unit and keeps it out of the filament leads. A resistance of about 30 ohms is suitable for R2 and the one actually used was a Claud Lyons H.D.30 Hum-Dinger.

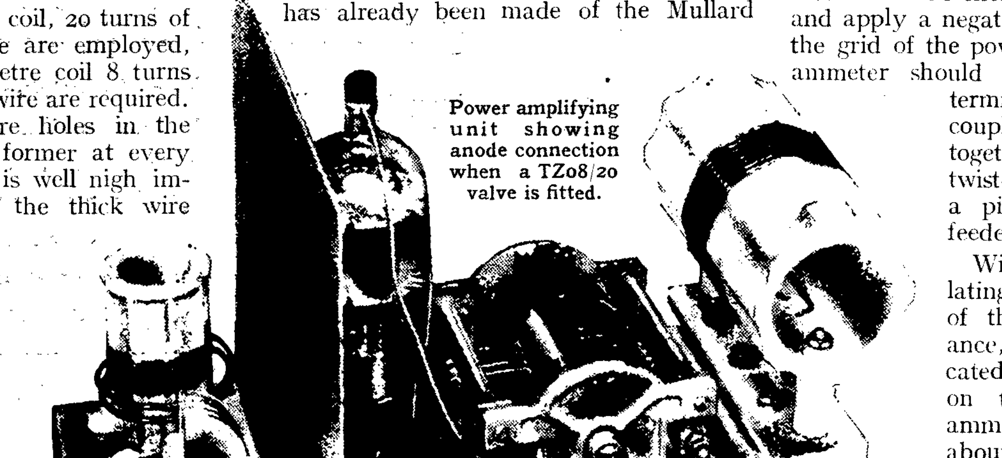
In order to keep check on the operation of the transmitter we shall require to know the anode current of the valve and occasionally the grid current. An anode current meter should be regarded as an essential part of the set and it is connected in the HT positive line at the point marked A. In the illustration of the unit the two terminals for connection of this meter are the pair on the right-hand side of the chassis, while the two on the left are those marked B in the grid circuit.

With 10 watts input the anode current will be about 30 mA under normal conditions of operation, but bearing in mind future requirements a meter capable of recording up to 75 mA at least should be obtained.

Multi-Purpose Meter

For grid current measurements a milliammeter reading up to 20 mA will suffice as the average value of current in this circuit is of the order of 10 mA only. If it is desired to make one meter serve for all purposes, at least at the outset, then a multi-range instrument should be acquired, as a grid-circuit meter will be necessary when neutralising the amplifier.

We now come to the important question of the valve for the amplifier. Mention has already been made of the Mullard TZ05/20, and this is a very good example of an inexpensive power triode for amateur wavelengths. Its filament requires 6 volts at 1.1 amps and the valve capacities are not unduly high. This firm have just introduced a new transmitting valve of the same power rating but with appreciably smaller valve capacities and having the anode lead brought out to a plug connection on the top of the bulb. It is suitable for use down to five metres and it is known as the TZ08/20.



Power amplifying unit showing anode connection when a TZ08/20 valve is fitted.

The unit was built before this new valve came to hand and if a TZ08/20 had been available at the time we would have fitted a chassis valveholder instead of the baseboard one shown, as this enables a shorter anode lead to be used. Though the grid lead will come up from below the chassis its length will be only about ½in. longer than the existing one, but the anode lead will be shortened by about 1½in. This will make no difference to the operation on 42 or 21 metres, but the shorter anode lead will be an advantage if the unit is used as a straight amplifier on 10 metres, by interposing a frequency doubling stage between it and the exciter. The initial adjustments for neutralising will, however, be the same whichever valve is used. The TZ08/20 has a 7.5-volt filament and requires 1.1 amps.

Before HT is applied to the power amplifier it must be neutralised, which is done with the filament hot and an RF voltage applied to the grid circuit.

This adjustment can be made on either 42 or 21 metres; we will for explanatory purposes decide on 42 metres. First set the neutralising condenser C3 to about one-tenth of its full capacity, plug the 42-metre coils in exciter and amplifier units and apply a negative bias of -48 volts to the grid of the power amplifier. A milliammeter should be connected to the terminals B. Join the coupling coils on the units together by a length of twisted flex, or better still, a piece of low-impedance feeder cable (70-80 ohms).

With the exciter oscillating, tune the grid circuit of the amplifier to resonance, which will be indicated by the highest reading on the grid-circuit milliammeter. It should read about 15 mA.

If the link-circuit coils are coupled too tightly more grid current than is desirable will flow, and it is quite possible for the coupling to be so tight that it stops the exciter valve from oscillating.

Now couple the absorption wavemeter, previously tuned to the working wavelength and in which a small flash lamp has been fitted, to the anode coil of the PA and tune this circuit to resonance. The lamp should glow and the needle of the grid circuit meter will kick violently. Now increase the capacity of the neutralising condenser C3, using a tool with a long insulated handle, until the lamp ceases to glow, at the same time making any necessary corrections to the grid and anode circuit condensers C1 and C6, as any change in C3 will affect the tuning of these two circuits, especially the grid circuit.

The final adjustments of C3 should be made without the wavemeter and by

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noting the effect on the grid current. A setting for this condenser must be found that on swinging C6 slowly through resonance no flutter is seen on the grid current meter.

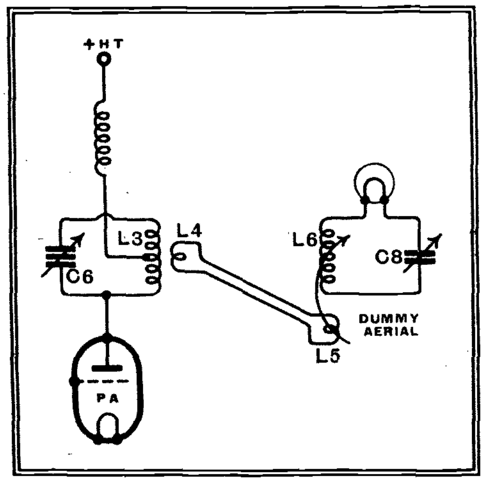


Fig. 12.—Method of coupling the PA anode circuit to a dummy aerial, using a low-impedance link (twisted flex).

There will be a gradual fall in grid current as C6 is rotated towards minimum capacity, but if the stage is incorrectly neutralised the needle will flicker as C6 passes through the resonant position.

Having neutralised the amplifier a reduced value of HT, say 250 volts, can be applied to its anode. Now when L3 C6 is tuned to resonance the anode current, measured by a meter inserted at A, will fall to a very low value, about 5 to 6 mA only, but any movement of C6 each way will cause a rapid rise in current.

This fall in current at resonance is characteristic of Class "C" amplification. One would not usually run a transmitting valve without power being drawn from the anode circuit as valves can be quickly damaged by so doing, but in the present transmitter those valves mentioned will safely withstand this treatment as they are rated to dissipate on the anode far more power than is actually being put into them.

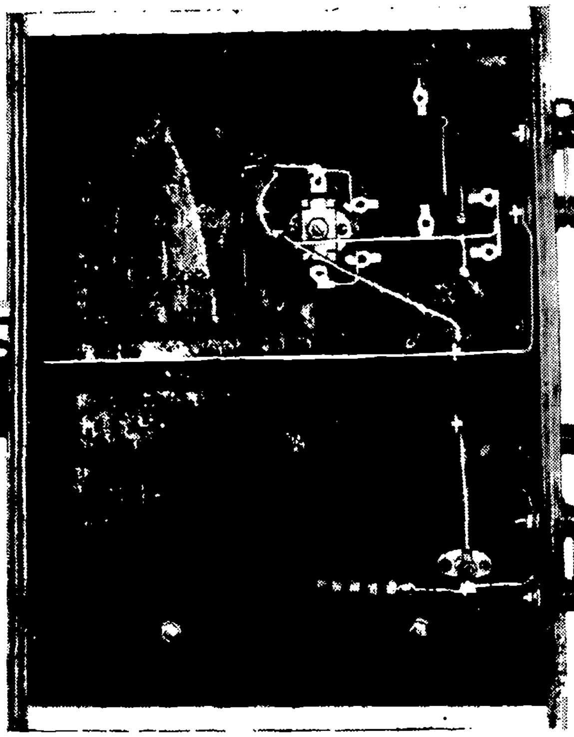
Anode dissipation is the difference between the power applied to the anode and the power taken out by the load. Thus if we apply 10 watts to the anode and draw 5 watts of RF for the aerial, the anode dissipation is 5 watts. Now both the TZ05/20 and the TZ08/20 have an anode dissipation rating of 20 watts and one of the advantages of the beginner choosing a larger valve than the immediate requirement demand is that it is not likely to be damaged while initial adjustments are being carried out and experience gained in handling the transmitter.

The next step is to make up a simple dummy aerial in which the power from the transmitter can be absorbed while making the final adjustments as it would be contrary to one's licence to do this on a radiating aerial. It need be nothing more elaborate than an absorption wave-meter fitted with a six-watt car lamp.

A single turn of wire wound round the centre of L3 and joined by a low-impedance link to another single-turn coupling coil on the dummy aerial, as shown in Fig. 12, serves quite well for this testing circuit.

The full HT of 350 volts can now be applied to the amplifier valve and leaving L3 C6 tuned as previously described for *minimum* anode current the dummy aerial is tuned to resonance, when the lamp will light quite brightly.

If the adjustments have been made correctly the anode current of the amplifier will rise when power is taken from the anode circuit. At the same time there will be a fall in grid current.



The arrangement of the components housed underneath the baseboard.

If the coupling between L5 and L6 is varied there will be a corresponding increase or decrease, according to the nature of the change in coupling, in the brightness of the lamp, an increase being accompanied by a rise in anode current and a decrease by a fall.

The point to remember is that C6 is always tuned for *lowest* anode current while the coupling between the aerial, or dummy aerial, and the PA tank circuit is adjusted for ***highest*** anode current. The grid circuit is always tuned for maximum grid current.

The correct operating conditions with 10 watts input and with 350 volts HT is with the dummy aerial coupling adjusted so that the amplifier draws 29 mA. It can be made any value up to about 50 mA by adjusting the coupling. The grid current will be of the order of 8 to 9 mA.

If all the circuits of the transmitter are properly in tune then the lamp in the dummy aerial will be almost at full brilliancy, indicating that an RF output of about six watts is being obtained.

This experiment repeated with the 21-metre coils will show that the RF output is approximately the same on both waves.

There will be no need to re-neutralise after changing the coils as this process needs carrying out only on one wavelength for it holds good on all others. Of course, if the valve is changed then the amplifier will have to be reneutralised. Of the two valves mentioned the TZ08/20 is slightly more efficient on the higher frequencies and if it is proposed to transmit on 10 and 5 metres later it will prove a good investment. Incidentally, the transmitter as described can be arranged to give a moderately good RF output on ten metres by operating the amplifier as a frequency doubler, but we will defer a discussion on this matter to a later date, as there are several matters of more importance, such as the design of the power supply unit and the method of keying the transmitter, also the possibilities of applying modulation for telephony transmission, to be dealt with before we need consider its use on the ultra-high frequencies.

LIST OF PARTS REQUIRED

2 Glazed Frequentite coil formers — Eddystone No. 1090
2 Frequentite sub-bases — Eddystone No. 1091
1 Frequentite base — Eddystone No. 1092
2 Four-pin coil formers threaded 14 T.P.I. — Eddystone No. 936
7 Midget stand-off insulators — Eddystone No. 1019
2 S.W. baseboard mounting valveholders 4-pin — Eddystone No. 949
1 Split-stator transmitting condenser, 50 mmfds. each section, **C6** — Eddystone No. 1081
1 Short-wave RF choke transmitting type — Eddystone No. 1022
1 40 mmfds. variable condenser, double-spaced vanes, **C1** — Premier Tro 40T
1 Neutralising condenser, 1.5 to 20 mmfds., **C3** — J.B.
3 0.01 mfd. mica condensers, **C2, C4, C5** — T.C.C. Type "M" or Dubilier 691W
1 0.005 mfd. mica condenser, 500 volts DC working, **C7** — T.C.C. Type 340 or Dubilier Type 620
1 Hum-dinger, 30 ohms, **R2** — Claude Lyons HD.30
1 5,000 ohm resistance, 2 watt, **R1** — Erie
4 Insulated terminals — Belling-Lee Type "B"
2 Insulated extension spindles — Eddystone, Bulgin or Premier
1 6-way connector — Bryce
2 Knobs — Bulgin K16
1 Chassis (plywood), 12×9×1½in.
1 Aluminium screen 9×7½in.
Quantity No. 20 SWG En. wire, No. 14 SWG En. and No. 16 SWG tinned copper wire.
1 Valve, Mullard TZ05/20 or TZ08/20

UNBIASED

A Case for Legislation

I AM not, as many of you know, one who places much faith in proverbs—or wisecracks, as the younger generation term them—but the one which states that it is an ill wind that blows nobody any good has certainly proved true of late in my own case. I dare say that there are quite a number of you who sometimes have an idle moment after studying the sporting pages in your daily paper and endeavour to fill it by turning to less important sections of the journal dealing with the daily doings of dictators and *divorcées*, and probably you may have noticed that a month or so ago a large part of the Thames Valley was plunged into darkness for several hours owing to what the B.B.C. would euphemistically call a technical hitch.

At the time it occurred I was engaged in endeavouring to trace the source of certain very aggravating interference to television which a friend who lives in that area was experiencing. Naturally, I was exceedingly annoyed when the lights went out, as, of course, the television set went off also, and I complained bitterly of my wasted journey, as there was no longer any television to be interfered with.

I had, as a matter of fact, spent many fruitless evenings in endeavouring to trace interference, which affected both the vision and the sound side of the Alexandra Palace transmission, but was not apparent on the ordinary broadcasting wavelengths. I had patiently scoured the neighbourhood

An acidulous spinster.

with my interference tracking outfit and had succeeded in tracing it, as I believed, to the residence of a rather acidulous spinster living next door, who was, however, not very helpful and had taken umbrage at my enquiry as to whether she had recently installed an electric beauty-treatment apparatus.

When the power suddenly failed, my friend brought an up-to-date battery set into service to beguile the time, and endeavoured to tune in America on the 13-metre waveband. I was distinctly surprised to hear obvious signs of man-made static of a type which appeared familiar, and, hastily switching on my portable interference-tracking gear, I discovered that on the television wavelength the trouble was as bad as ever, even though the mains were off. I at once realised that this was a very important discovery and that the black-out was a blessing in disguise. The fact that the power was off did not, of course, affect the interference-conducting properties of the mains in any way, but it did mean that all the host of mains-operated devices were ruled out as sources of interference.

Distinctly puzzled, I went into the street with my gear and once more traced the

By

FREE GRID

trouble to the house of the acidulous spinster, and, feeling thoroughly aroused, I determined to solve the mystery once and for all, even at the cost of being arrested on the time-honoured charge of conduct whereby a breach of the peace might have been occasioned. When she responded to my knock I noticed the same peculiar phenomenon that I had observed before, namely, that during the actual time she was with me the interference ceased. I therefore determined to discover what she did after slamming the door in my face.

With this end in view, I peered through a chink in the blind of the front room and beheld her sitting by the light of a guttering candle doing nothing more depraved than stroking one of a large number of cats with which she was surrounded. I was completely nonplussed until the interference suddenly and temporarily cleared up as she paused to put down one cat and take up another, and in an instant the truth flashed upon me, and I recollected my old schoolboy experiments of rubbing catskin to produce static charges. Although I have discovered the cause of the trouble, I am no nearer to eliminating it. The obvious cure would be to earth all the cats permanently, a task which I would gladly undertake.

One for Henry Farrad

A letter from a friend.

IT has always been one of the guiding principles of my life to give even the devil his due, and consequently when I received a letter the other day from a friend up North, in which he somewhat bitterly anathematised the manufacturer of a certain anti-static aerial, which he declared to be a dud, I at once constituted myself as counsel for the defence, and informed him that it was much more likely that it was the maker of the set who was deserving of censure.

In a subsequent letter my friend said that the set was new and completely up to date and was, therefore, beyond reproach, a piece of utterly illogical reasoning to which I fear far too many people are prone nowadays. I did not attempt to shuffle out of the difficulty by telling the sufferer that he must expect any interference that was present to show up more on a new set than on an old one because of the far greater sensitivity of the former. This easy get-out is one which many so-called technical advisers frequently use in order to cover up their inability to diagnose the trouble accurately.

It is quite true that the more sensitive the set the more interference it will pick up and, therefore, a modern receiver might be expected to be more noisy than an old one. The obvious solution would, on the face of it, seem to be to employ a suppressor in the mains lead and a good anti-static aerial, and this is another instance of where many so-called technicians come unstuck, for with many modern sets such a remedy will have very little effect at all.

The truth is that it is, after all, the set that is the cause of the trouble, but not because of its great sensitivity as the technically ill-informed would have us think, but because so many set-makers neglect the elementary precaution of screening the wire which connects the aerial terminal to the first tuning circuit in the set. With a modern superhet, these few inches of wire are all that are required to pick up nearly all the interference that is going and completely nullify the efforts of the anti-static aerial, the makers of which wrongly get blamed for a delinquency of the set manufacturer.

This was, as I expected, the cause of the trouble in this case. My friend had hitherto been using one of the earliest all-mains sets made in which the makers had very wisely gone to a lot of trouble to screen the lead I have referred to and, indeed, every other lead in the receiver (Philips Type 2511, Vintage 1928). This set had been displaced by a modern one in which complete screening of the internal connecting leads had been neglected (no names, no libel actions) with the results that I have indicated. I have left my friend to argue it out with the set makers who, I feel sure, will not be at a loss for an excuse.

NEWS OF THE WEEK

B.B.C. FOREIGN SERVICE

Revised Schedules and Staff Reorganisation

AT the request of many European listeners, all B.B.C. Regional transmitters, except those for Scotland, Wales, and Northern Ireland, are broadcasting news in French and German from 6 till 6.45 p.m. on Sundays, and from 7 till 7.45 p.m. on weekdays. These transmissions, as well as a bulletin in Italian, which will immediately follow them, will also be broadcast from Daventry GSA on 49.59 metres. This wavelength varies with the seasons, and will be replaced by GSE, 25.29 metres, on February 12th.

Items which are considered to be of sufficient importance to justify the interruption of home programmes for five minutes are now broadcast in German from medium-wave transmitters at 10.45 p.m. on weekdays.

As a measure of co-ordination, the B.B.C.'s Empire News Service and Foreign Language News Service, previously under separate Editors, have been brought together in an enlarged Overseas News Section under an Overseas News Editor. Mr. A. E. Barker, former Editor of the Foreign Language News Service, has been appointed to this post.

The Arabic and Spanish-Portuguese services, also included in the new section, remain under the same Editors as hitherto.

U.S. GOVERNMENT STATION

Plan for Latin American Transmissions

A BILL calling for an appropriation of $700,000 for the construction of a Federal Broadcasting station in Washington, with provision for a further $100,000 per annum for maintenance, was presented to the United States Congress by a Representative a few days ago. It is proposed that the Navy Department should operate the station, which would be primarily concerned with counteracting the propaganda broadcasts for Latin America transmitted by totalitarian States.

The Paris edition of the *New York Herald Tribune* calls attention to reports which state that the Government will take over the 20-kW short-wave station at San Francisco at the close of the World's Fair in that city.

TELEVISION CAMPAIGN LAUNCHED

Hopes for a Nation-wide Service

MR. F. W. OGILVIE, Director-General of the B.B.C., who, with Mr. C. O. Stanley, Chairman of the Television Development Sub-Committee of the R.M.A., was televised last Thursday morning when they launched the campaign to popularise television in London and the Home Counties. Speaking principally to the industry, he said: "Television cannot help going forward, but the pace at which it is to go forward will depend upon the close and friendly co-operation between you, who make and market television sets, and ourselves at the B.B.C."

A Nation-wide Service

Whilst recalling that we are only at the beginning of television as a nation-wide service, Mr. Ogilvie gave the assurance that "no change that we make will affect sets for some years to come."

Mr. Stanley, who spoke immediately following the D.G., said, "To-day we begin a campaign to make everybody television conscious; to show that the effort and money expended on launching television has not been wasted, but on the contrary has laid the foundation for a great new public service of entertainment. Television must continue to progress. Its service area must be extended. It must become a national service."

MR. F. W. OGILVIE before the Emitron camera at Alexandra Palace when he launched the R.M.A.-B.B.C. television campaign.

Referring to the present prices of televisors he said, "I can assure you and the public there will be no further reductions."

Transatlantic Sales Contest

It has been stated in the American periodical *Business Week* that 1939 will be a television year in the U.S.A. and that more sets will be sold in New York than in London. Mr. Stanley read a cablegram which was sent from the Television Development Sub-Committee accepting the challenge for a friendly transatlantic sales contest—London v. New York.

In an earlier speech Mr. Stanley stated that British television receiver sales were approaching the million-pound mark.

C.B.S. EXPERIMENTS

High-frequency Broadcasts in America

EIGHT high-frequency stations located in widely separated sections of the United States will be available to the Columbia Broadcasting System following the inauguration this week of W6XDA, and the opening in April of its already famous television transmitter.

W2XDV in New York, W9XHW in Minneapolis, and W6XDA in Los Angeles broadcast regular C.B.S. network programmes several hours a day for experimental purposes. The first two stations operate on 31.6 Mc/s (9.5 metres), and the third on 35.6 Mc/s (8.4 metres). These transmitters offer considerable scope for research into the behaviour of ultra-high frequencies under different conditions. W2XDV is surrounded by steel skyscrapers, W9XHW is situated on flat ground in a city with few high buildings, while W6XDA is located in close proximity to the Sierra Madre Mountains.

With the advent of television in America, receivers will be put on the market capable of picking up high-fidelity programmes from such stations as these.

B.B.C. STAFF AND NATIONAL SERVICE

WHO is an executive on the B.B.C. staff? Everyone at Broadcasting House is asking this question following the inclusion of B.B.C. executive and administrative staff in the National Service Schedule of reserved occupations. In the strict interpretation of the term there are only four "executives" in the Corporation—one to each of the four Divisions, namely, Programmes, Administration, Public Relations and Engineering. It is considered, however, that "executive" is a generic term for the purposes of the Schedule, and in practice will include the majority of officials on the staff over the age of 25.

BROADCASTING IN WAR

Confiscated Wireless Sets in Barcelona

THE importance of wireless in time of war was illustrated practically in Barcelona during the days immediately preceding the entry of Nationalist troops into the city. By order of the Government, all wireless receivers had been confiscated for a period, in consequence of General Franco's propaganda transmissions.

Before the city fell, General Franco made a broadcast in which he gave assurance that he would not bomb or shell the city. His words were not generally heard. If they had been they would, as observed in *The Times*, have disposed of the one menace of which the inhabitants lived in greatest terror—an attempt such as was made in March to bomb Barcelona into submission.

P.A. AT THE WORLD'S FAIR

Three-Thousand-Watt Output

SIXTY powerful high-fidelity loud speakers, delivering an output of three thousand watts, are being installed for the extensive PA system at the World's Fair, Treasure Island, in San Francisco Bay. The system, which was designed by the R.C.A., provides for picking up programmes at any one of twelve points in the grounds, and for the handling of six different programmes simultaneously. This sound system, which provides loud speakers in thirty-six parts of the grounds, is only half of the installation, for an immense broadcasting control centre is being incorporated in the State of California Broadcast and Auditorium Building.

Adjacent to the control centre is a large broadcasting studio, seating 3,200, and several smaller studios. From what is called a

News of the Week—
radio promenade, the programmes presented in three of the studios will be visible to visitors through sound-proof windows and audible through concealed loud speakers.

EDUCATIONAL BROADCASTS
The Position in India

WIRELESS as a means of education is rapidly gaining ground in popularity throughout the world. The organisers of broadcasting in India have not been slow in realising this and, as has already been announced, transmissions for schools are regularly being radiated from Delhi, Bombay, Calcutta and Madras.

It is, however, little use broadcasting programmes for schools that are not equipped with receivers. With a view to raising money for equipping schools, the A.I.R. Calcutta station recently held a concert at the New Empire Theatre under the title "Radio on View" for which the stage was fitted out to represent a studio. The proceeds of the concert, after deducting expenses, has been added to the School Broadcast Fund.

The Government of Bengal is to equip, as an experiment, eleven schools with receivers, and if this proves satisfactory other schools in the Province will also be equipped.

The Educational Department of the Calcutta Corporation has been approached, and it is hoped that it will undertake in the near future the equipment of the city's model schools.

STUDIO ON SPRINGS
Hollywood's Room Within a Room

STUDIO "G" in the Hollywood headquarters of the National Broadcasting Company is actually a room within a room. Specially designed to accommodate the 1,800-pipe organ which has just been installed there and to keep the sound from carrying beyond the walls (such as is the unfortunate case with the B.B.C.'s Concert Hall at Broadcasting House), the studio is hung on springs. It is literally a box suspended within a room; even the air ducts are joined with flexible joints. The walls are designed to give the amount of resonance desired for perfect reproduction of the organ tone, being partially treated with a sound-absorbing material and partially finished in smooth texture for sound reflection.

INDIAN ADVISORY COMMITTEE

THE Government of India is soon to constitute an Advisory Committee in Madras for All-India Radio. It will be composed of the Controller of Broadcasting (president), the station director and four or five non-officials. The Committee will meet quarterly and lay down broad lines of policy on the programme side.

As part of the plan for the expansion of their rural broadcast department, the Madras Government also propose to afford radio engineers the facilities of a fully equipped laboratory in order to carry on research with a view to the production of cheap receiving sets.

THE MOST POPULAR NEWS BULLETIN

THE Listener Research staff at Broadcasting House have discovered that the 6 o'clock news bulletin has the biggest audience. The 9, 10 and 7 o'clock bulletins follow in that order.

Following correspondence received from listeners, the B.B.C. is considering the transfer of the 10 p.m. Regional News to the National wavelength at 9 p.m., the former being especially popular owing to the inclusion of topical talks.

FROM ALL QUARTERS

Amateurs in Czecho-Slovakia

ABOUT two hundred amateur wireless operators in Czecho-Slovakia, who were licensed before October 10th, 1938, have been granted permission to recommence their transmissions. The authorities, however, are not prepared to issue new licences.

News from China

MR. H. E. SCOTT, of Hayes, Kent, reports good reception of the Chinese short-wave station XGOY (? XGRY), working on 9.5 Mc/s last Sunday, January 29th. Announcements were made in English and French, and transmissions are radiated between 8 and 10 p.m. G.M.T. each evening, with news in English at 9 o'clock.

Newfoundland and Broadcasting

THE broadcasting possibilities opened up by the new radio-telephone service which links Newfoundland to the outside world through the Canadian Marconi beam station at Yamachiche, Quebec, are considered important, since Canadian and United States advertisers have been sending recorded programmes for transmission by the Newfoundland broadcasting stations. It may now be possible to transmit direct programmes by means of the new radio link.

RADIO IN THE CANADIAN ROCKIES.—Sunshine Valley, one of the best ski-ing districts in the Rocky Mountains, is now linked directly with the town of Banff, 16 miles away, by using two-way short-wave wireless installations. Unaffected by storms, snow-slides and other enemies of line telephone systems, the short-wave stations CZ7Z at Sunshine Lodge, shown here, and CZ7Y at the Mount Royal Hotel, Banff, which are operated by members of the hotel staffs provide intercommunication across miles of difficult trail.

B.B.C. Television Programme Relayed by N.B.C.

LISTENERS to the National and Empire programmes as well as listeners to the National Broadcasting Company of America heard the television tour of the Post Office International Telephone Exchange at Faraday House, London, last Sunday. Leslie Mitchell who conducted the tour spoke by radio telephone with R.M.S. *Aquitania* in the Atlantic. Mr. Gerald Cock at Alexandra Palace conversed with Mr. John Royal, Vice-President of the N.B.C., who was located by the Post Office "chaser" service in the studios of the N.B.C., New York.

Peak Listening Hours

AMONG the many coloured charts which adorn the walls of the Listener Research Section of the B.B.C. is a graph showing the potential audience to the B.B.C. programmes. Between 6 and 6.30 p.m., this is estimated at 83 per cent., at 7 o'clock it rises to 93 per cent., whilst at 8 o'clock it has reached 99 per cent., which level is maintained until 10 o'clock, when it begins to drop—less steeply, however, on Saturdays than on other weekdays.

Out of Action

THE Norwegian commercial radio station, Torkildsbu Radio, in South-east Greenland, was recently practically destroyed by a violent blizzard which tore off the roof and blew in the walls. No member of the staff was seriously hurt and they were able to salvage the most valuable of the equipment.

Station at Yarmouth

A TRANSMITTER-RECEIVER station, PR9, has been opened by Section Lieutenant Wingrave, of the Yarmouth Branch of the Royal Naval Wireless Auxiliary Reserve, for the purpose of maintaining a voluntary service with the Cross Sands and Haisbro' lightships.

Landing in Fog

IN conjunction with the Lorenz radio directional beam which is to be installed at Ringway Airport, Manchester, the Air Ministry is to lay down a powerfully illuminated glass-covered "fog line" 1,400 yards long running across the aerodrome flush with the ground.

Television Receiver Tax

THE French Senate recently approved of a 100-franc tax to be levied on television receivers. Fortunately for the industry, the Chamber of Deputies rejected the tax as being *premature*.

Denmark Halves Licence Fee

To increase the number of listeners the Danish Broadcasting Council has reduced the annual radio licence fee from ten crowns to five. The concession holds good until March 31st next.

Interference Permanently Waived

THE Vilno (Poland) Hairdressers' Union has instructed its members to fit anti-interference devices to all electrical equipment.

Receiving Conditions in the Arctic

By I. M. HUNTER

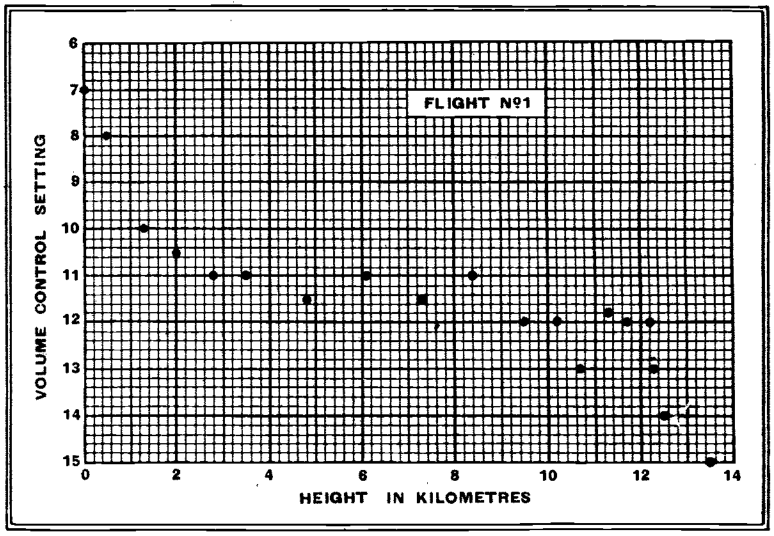
A BRIEF SUMMARY OF RADIO RESULTS OBTAINED BY THE WORDIE EXPEDITION

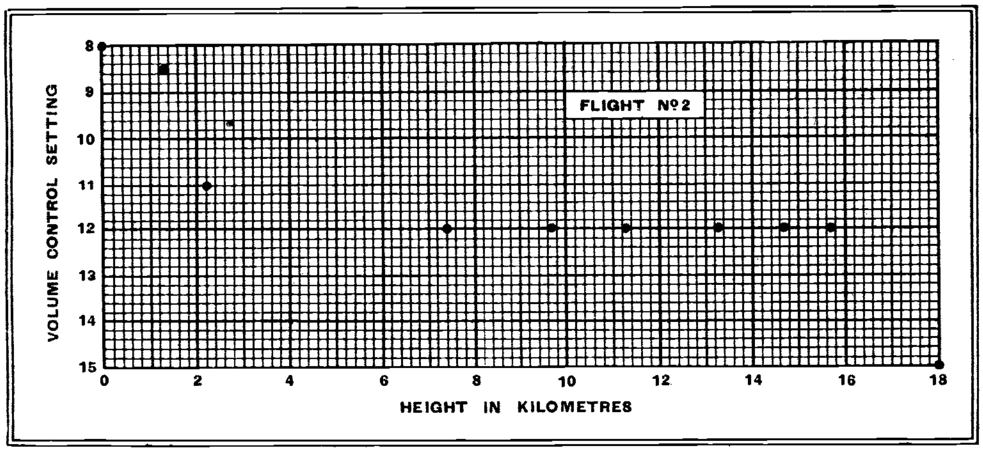
ALTHOUGH used primarily to study cosmic radiation, the balloon transmitters and ground receiving stations, described in our issue of December 29th, 1938, also produced some interesting data on long-distance short-wave conditions.

IN the summer of 1937 Mr. J. M. Wordie, of Cambridge, led a scientific expedition to West Greenland. One of the objects of this expedition was to examine the variation with altitude of the cosmic radiation near the geomagnetic pole, and for this purpose automatic radio transmitting apparatus was sent to great heights (20 km.) by means of free balloons. The present writer had been partly responsible for the development of this apparatus, and accompanied the expedition to help with the experiments. It was also found possible to use the radio apparatus to investigate some of the electrical properties of the lower regions of the stratosphere, and this note is intended to give some account of the results obtained.

A fuller account of the development and use of the apparatus has already appeared in this journal,[1] but a short description may be advisable here. The apparatus consisted of a number of Geiger-Müller counters whose output was arranged to modulate a radio transmitter operating on 40 megacycles, the output of these counters consisting of a single pulse of electric current corresponding to the passage of each cosmic ray. Modulation was effected by first paralysing the RF oscillator with negative bias, and arranging that the impulses fed to the grid were of such a direction as to reduce the bias, and to cause a momentary burst of oscillation. The whole assembly, counter and transmitter, was placed in a gondola which could be raised to considerable heights by means of balloons; and since two balloons were employed the apparatus would descend to earth after one of them had burst owing to reduction in atmospheric pressure. There was further in the apparatus a switch mechanism designed periodically to suppress the cosmic ray impulses and to make the oscillator "squegg" with an audio-frequency of approximately three cycles per second. This switch came into operation whenever it was desired to transmit the value of atmospheric pressure. The measurement was effected by tuning the oscillator with a variable condenser whose capacity was governed by the pressure.

The signals, which were received on a commercial ultra-short-wave receiver, consisted therefore of pulses of radio-frequency oscillation occurring either at a frequency of three per second or at a frequency determined by the number of cosmic rays. The amplitude was, however, approximately constant for any one flight. It was found possible to estimate the change in intensity of received signals during a flight, and to plot the relation between field strength of the signals and altitude of the balloon.





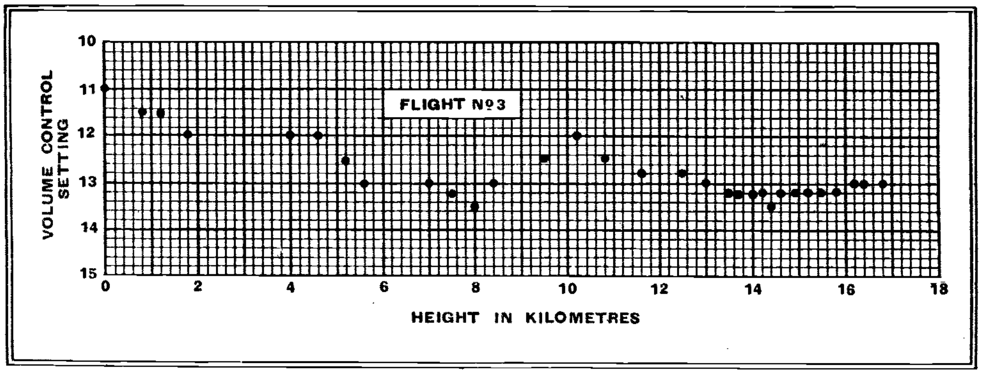
Some description is necessary of the scale of field strength. The volume control of the receiver was calibrated with a scale from 0 to 15, 0 being the minimum

Observation of signal strength from three typical balloon ascents.

FLIGHT NO. 1. July 26th, 1937, at Nuqsuaq (Latitude 71° N, Longitude 54° W Height by radio). Horizontal distance unknown owing to fog. Volume control for threshold.

FLIGHT NO. 2. July 28th, 1937, at Nuqsuaq (Height by radio). Maximum horizontal distance, 12.5 km. Volume control for threshold.

FLIGHT NO. 3. August 8th, 1937, at Thule (Latitude 77° N., Longitude 72° W. Height from Bosch Meteorograph). Maximum horizontal distance, 15 km. Working value of volume control on coincidence.



[1] *The Wireless World*, Vol. XLIII, No. 26, December 29th, 1938.

Receiving Conditions in the Arctic—

setting; and in the case of flights Nos. 1 and 2 the volume control setting for signals to disappear is recorded. In the case of flight No. 3, no squegging was employed, and therefore recording of the volume control setting during reception of cosmic ray impulses was made. These readings are by no means so arbitrary as might appear, since the output of the receiver was examined on an oscillograph and had to be kept constant for suitable operation of the recording counter.

It will be seen that there are a number of temporary fluctuations confined chiefly to the beginning of the flights. Some of these fluctuations may be traced to the balloons being nearly overhead, the aerial hanging vertically; others, possibly, to buffeting of the apparatus, causing changes in the transmission frequency. The time of fade-out of flight No. 1 agrees almost exactly with the time at which low-tension supply was expected to fail, this occurring very early in this flight, as immediately before launching one of the filament batteries was seen to be faulty and was therefore abandoned, thus throwing a double load on the remaining one. The severe fall in signal strength during flight No. 2, when the balloon was between 2 and 7 kilometres in height, has, however, no adequate explanation; particularly as signal strength during the remainder of this flight was remarkably steady.

Effect of Low-level Layers

Apart from these fluctuations it will be seen that signal strength fell off gradually, unmarked by any severe or permanent discontinuities. Decay of this nature was to be expected, and was due more to increasing distance between balloon and receiver than to any other cause; though no doubt there was some slight falling off in the power transmitted. Most remarkable is the absence of absorption due to the newly discovered low altitude layers,[2] for in no case is there any suggestion of their effect on signal strength. It seems that in high latitudes their intensity is not sufficient to absorb to an appreciable degree waves of the frequency employed, though further experiment with specially designed apparatus might be expected to yield more conclusive results.

When the major part of the balloon work was completed, general listening was carried out on two commercial receivers, one of which was designed to operate off batteries and the other off an alternating supply. The latter had to be converted to battery operation on account of severe interference from the ship's dynamo. Even so, this was the most sensitive receiver, though somewhat deficient in audio-frequency amplification. Results are best classified as follows:—

(1) Throughout the period of listening (July 19th to August 29th, 1937) there was continuous daylight, and therefore all long-distance reception took place on short waves (6 to 21.5 Mc/s). Reliable reception was effected of European and American stations on all bands except 6 Mc/s, though occasional reception was recorded on this band. In particular, reception from Daventry was extremely regular, so that on only two occasions was it impossible to receive at least one of the Empire stations.

(2) Periods of bad reception took place from July 29th to 31st; August 15th to 16th; August 18th to 19th; and on August 24th; September 11th and September 21st. Of these periods, Nos. 1 and 3 were very severe and affected the local Greenland stations. That on September 21st was a short period complete fade-out. The beginning of this was missed, but it was estimated that it began between 23.45 GMT on September 20th and 00.00 GMT on September 21st. The fade-out concluded at 01.15 GMT on September 21st. Recovery was complete in two hours.

(3) Auroræ were observed on September 13th; September 14th; September 20th; September 22nd; September 23rd; and September 26th. That on the 20th was very dim, whereas that on the 26th was bright. On all these occasions reception was normal to good. The auroræ were not heard either directly or on the wireless, though any slight defect would have been masked by the sea or by electrical noise from the ship's dynamo.

(4) Atmospheric disturbances were negligible; only two records of such interference occurring during the period of listening. Other work of the expedition showed that the atmosphere was extremely still up to great heights, and in some cases balloons, having ascended to a height of 28 kilometres, descended to within two kilometres of the send-off station. Though there may be correlation between these facts it is also likely that the absence of atmospheric disturbance may be connected with the great distance from the Equator.

(5) The best reception from Japan and China coincided with bad periods of reception from Europe. No reception was obtained from Australia even during these periods.

Further observations upon sections (4) and (5) have been made by the Danish Government wireless operators. These results agree with observations made by the expedition; full results, however, are in possession of the Danish Government.

[2] Watson Watt, Williams, Bowen. "The Return of Radio Waves from the Middle Atmosphere." Proc. Royal Soc., London. Vol. 161, pp. 181-196. July, 1937.

Television Programmes

Sound, 41.5 Mc/s. Vision, 45 Mc/s.

An hour's special film transmission, intended for demonstration purposes, will be given from 11 a.m. to 12 noon each week-day. The National or Regional programme will be radiated on 41.5 Mc/s from approximately 7.45 to 9 p.m. every day.

THURSDAY, FEBRUARY 2nd.

3, Jack Jackson and his Band. **3.30,** Gaumont-British News. **3.40,** 213th edition of Picture Page.

9, "Re-View," with Phyllis Monkman, Morris Harvey and Queenie Leonard. **9.30,** British Movietonews. **9.40,** 214th edition of Picture Page. **10.10,** News.

FRIDAY, FEBRUARY 3rd.

3-4.5, "Death at Newtownstewart," a reconstruction of an unparalleled murder of the 'seventies compiled from the records of the Ulster Assizes.

9, News Map, No. 10—Germany. **9.20,** Cartoon Film. **9.25,** The London Ballet directed by Antony Tudor in "Soirée Musicale." **9.35,** Dora Clarke: Making a Life Mask. **9.50,** Gaumont-British News. **10,** The London Ballet in "Gala Performance." **10.20,** News.

SATURDAY, FEBRUARY 4th.

3, "Re-View," (as on Thursday at 9 p.m.). **3.30,** Cartoon Film. **3.35,** Margaretta Scott in "A Marriage has been Arranged," **3.50,** Gaumont-British News.

9, "1066—And All That," the "historical" success by Reginald Arkell. **10,** British Movietonews. **10.10,** Rawicz and Landauer at two pianos. **10.20,** News.

SUNDAY, FEBRUARY 5th.

3, O.B. from the North Circular Road of Police Patrols at Work. **3.20,** Cartoon Film. **3.25,** British Movietonews. **3.35,** Interest Film.

8.50, News. **9.5-10.35,** "The Tempest," by William Shakespeare; cast includes Alan Wheatley, Peggy Ashcroft and members of the London Ballet.

MONDAY, FEBRUARY 6th.

3, "Soirée Musicale" and "Gala Performance" (as on Friday at 9.25 and 10 p.m.). **3.35,** Gaumont-British News. **3.45,** "A Voice Said 'Goodnight'," a play in one act by Roland Pertwee.

9, British Movietonews. **9.10,** "Death at Newtownstewart" (as on Friday at 3 p.m.). **10.15,** News.

TUESDAY, FEBRUARY 7th.

3, Eric Wild and his Band. **3.20,** British Movietonews. **3.30,** Dora Clarke; Making a Life Mask. **3.40,** Cartoon Film. **3.45,** Coffee Stall, devised by S. E. Reynolds.

9, Henry Sherek's Cabaret from the Dorchester Hotel. **9.20,** Cabaret Cartoons. **9.40,** Gaumont-British News. **9.50,** Music Makers; Eileen Joyce, pianoforte. **10,** Art and Animals, a talk by John Skeaping. **10.20,** News.

WEDNESDAY, FEBRUARY 8th.

3-4, "The Tempest" (as on Sunday at 9.5 p.m.).

9.5, Speaking Personally—Wickham Steed. **9.15,** Cartoon Film. **9.20,** British Movietonews. **9.30-10.50,** "Money for Jam," a farce by Bernauer and Osterreischer.

HENRY FARRAD'S SOLUTION

(See page 102)

A SHOCK can be given by extension loud speaker connections if they are taken across the primary of the output transformer, as was quite common some years ago. But as this one used not to administer shocks it is presumably connected to the secondary side, and therefore of low impedance. No possible signal voltage across a low-impedance speaker is nearly enough to cause a shock, and if it is connected at all to any other part of the set it is connected to "earth." But if the set has become unearthed, a moderate shock would be possible from the AC mains via the anti-modulation-hum condensers connected between mains and receiver chassis. The other symptoms—inferior performance and increased hum—are entirely consistent with this explanation. It is likely that if an apparently rather unintelligent man had been digging up the garden he may have put his spade through the lead to an earthing tube, and the master of the house was not in a position to inspect the work.

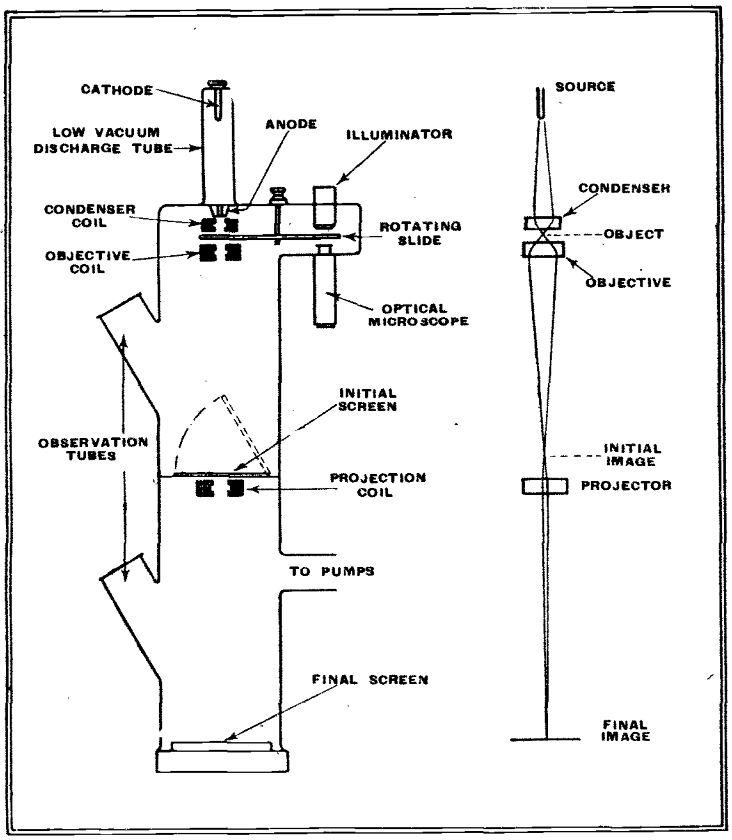
The Cathode Ray Microscope

OUR TECHNIQUE INVADES THE WORLD OF OPTICS

By "CATHODE RAY"

NOW that television is a going concern one is beginning to get used to optical terms encroaching on our preserve. A few years ago the idea of *focusing* by adjusting potentiometers would have seemed very odd both to the photographer and the radio man. But when one actually sees the same result on a screen as the photographer does when he moves his lenses to and fro, there is obviously some close connection between the two. That being so, there should now be nothing very strange in the idea of an electrical microscope.

The ordinary optical microscope has gone about as far as it can, and that is not very far. Sam Weller had doubts even about his "pair o' patent double million magnifyin' gas microscopes of hextra power." The trouble is not so much that it is impossible to magnify things more, but that nothing is gained by doing so. It is the same sort of thing as with television pictures. Even if the picture could be made as big as a house it wouldn't reveal any more detail, because the ability to show detail—technically known as the *resolving power*—is limited by the number of lines in the television system. The resolving power of a microscope is limited by the wavelength of the light used. Although the wavelength of visible light is very small compared with even the shortest radio waves, it is no smaller than some of the tiny things one wants to see, and it is impossible to see clearly a detail that is much smaller than the wavelength of the light. So the useful magnification with visible light is limited to about 500. That is really more than it may seem because it is magnification of *length;* the corresponding magnification of the area of an object is, of course, 250,000.



Explanatory sketch showing an electron microscope in simplified form. On the right is an electron-optical diagram to illustrate its operation

You may have noticed that I said *visible* light. Some time ago it would have sounded like saying "wet water" or "lifeless death," and, no doubt, would have provoked similar rude remarks about tautology or redundancy. But "light" is now generally understood to cover electromagnetic radiation not only within the band of wavelengths that is visible but also the invisible radiation of longer wavelength (infra-red) as far as the boundary of the band described as "heat," and of shorter wavelength (ultra-violet) as far as the next known band—I forget what it is but it is a long way off. Obviously for extending the power of the microscope ultra-violet light offers possibilities, and is actually used to some extent, but the band that can be generated and detected in practice is quite narrow and only a slight advantage is gained.

There is a device called the ultra-microscope for detecting specks much smaller than the wavelength of light, in much the same way as specks of dust invisible to the naked eye can be seen in a beam of sunlight, but it is unable to disclose shape or form.

Greater Resolving Power

The development of cathode-ray tubes, particularly the specialised sorts used in television cameras, has shown that in many ways a ray of electrons can be manipulated like a beam of light, using either electrostatic deflecting plates or magnetic coils in place of lenses. The important difference is that the "wavelength" is thousands of times smaller and the theoretical resolving power therefore thousands of times greater, opening up new possibilities for examining the minutenesses of Nature.

The technique of generating and controlling rays of electrons and rendering them visible on a screen is all ready to hand, but there is one rather awkward difference between electrons and light. There is no difficulty in finding a substance—glass—through which light can easily pass when the thickness is amply great enough not only to bear the tiny weight of the objects to be examined but also to stand handling. But to allow an electron beam to pass, the "slide" must be of

The Cathode Ray Microscope—
even less than gossamer thickness, otherwise it would not only stop the beam but be destroyed by it. Another thing that makes the electron microscope awkward for amateur microscopists is that the object has to be put inside the cathode ray tube, which means having handy all the apparatus for pumping the tube to a high vacuum. Still another limitation is that objects cannot be examined by the reflected beam as with light.

In spite of these drawbacks the electron microscope is very valuable for revealing particles that are quite invisible under the most powerful light microscope, and for showing the distinctive forms of microbes or powders that are otherwise only seen as undefinable specks. A magnification of 100,000 has already been claimed.

Illustration showing bacteria magnified 4,200 times by the electron microscope and subsequently enlarged up to 10,000 times.

The photograph shows the Siemens electron microscope. It is a modified form of a television cathode-ray tube. A much higher anode voltage is used—something like 100,000. The beam is first made to converge on the object, which is supported on an incredibly thin film of collodion. Collodion is the stuff dissolved in ether that can be poured over a wound and is left as "new skin" when the ether has evaporated. But this film has to be very much thinner—only about 0.00001 millimetre thick—and as it is naturally very delicate and fragile it is caught on a plate with a "window" that may be only a thirtieth of a millimetre in diameter. I should imagine that threading a No. 12 needle is as easy as hitting the side of a house compared with the job of getting the desired object exactly placed on this window. And if things are not properly arranged it is just too bad, because the vacuum has to be let down and repumped every time the slide is actually got at. Of course, if the object is on the collodion window at all the slide can be shifted by external adjustments to bring the desired part on to the screen. Even with a comparatively low-power microscope it may be quite difficult to "find the place," and to make this easier in the electron microscope there is a screen for preliminary adjustment, at a position where the magnification is much less. After adjustment this screen is taken away and the final image appears on an enlarged scale.

The diagram shows in greatly simplified form a British electron microscope described by Martin, Whelpton and Parnum,* and alongside is the electron-optical diagram. The electron beam is produced from a cold cathode in a low-vacuum tube at the top, and the hole in the anode is so small that it is possible to maintain a high vacuum in the main body of the apparatus. To help solve the problem of getting the desired object in the path of the beam it is placed on a revolving plate so that it can first be examined and adjusted by an optical microscope and then rotated into the electron beam. An image on a fluorescent screen (or photographic plate) is given at a moderate magnification half-way down for adjustment purposes; another stage of magnification yields the final image at the foot.

Apart from the obvious uses for the electron microscope, one wonders if it will be the means for extending our knowledge of the nature of matter and electricity. In a much simpler form it has been helpful in studying emitting surfaces—cathodes, in other words. In the early days valves depended on plain tungsten filaments run at bright white heat. Then came the "thoriated" dull-emitter filament. And now the oxide-coated cathode, run at a still lower temperature. The way in which emission takes place from these surfaces is of great interest to the valve and cathode-ray tube designer. By suitable adjustment of the electrode voltages it is possible to get an enlarged image of the cathode on a screen. If you have played about with the focusing of a torch or headlight you may have hit on an adjustment that projects an enlarged image of the lamp filament on the wall. An exactly analogous process gives this cathode image. I have watched a cathode being over-run and then rejuvenated, using this method. The bright parts of the picture are not necessarily the parts of the cathode that are hottest, they are those that are emitting most electrons. A spot of emissive coating, which might be seen as a dark patch on the cathode viewed direct, would appear on the screen as a patch of bright light on a dark ground.

* *Journal of Scientific Instruments*; Jan., 1937.

The European Wavelength Conference

PROPOSED MEDIUM- AND LONG-WAVE ALTERATIONS

DELEGATES from some thirty countries will meet at Montreux, Switzerland, on March 1st to decide upon a new wavelength plan for broadcasting stations in the European zone. The delegates will have plenipotentiary powers from their Governments, and the new wave plan, which will become operative on October 1st this year, will be binding after ratification by the countries whose delegates were signatories.

Before dealing with the problems which will have to be solved at Montreux, it is well to recall that at the time of the first official European wavelength conference, in 1933, seven countries represented were not signatories, and therefore did not adhere to the convention. These countries, Holland, Finland, Hungary, Sweden, Poland, Luxemburg and Lithuania, have therefore continued broadcasting on unofficial wavelengths, with resultant chaos.

The foundations for the European wavelength conference have been well laid. At the International Telecommunications Conference at Cairo in February, the frequency bands to be used by European broadcasting stations were decided upon, and the International Broadcasting Union was requested to prepare a new wave plan.

The project for a plan, which was prepared in Brussels and of which we gave details in our November 24th issue, may still undergo many changes in detail, but its general principles will, it is expected, remain unaltered.

It is, of course, quite impossible to accommodate with a 9-kc/s separation in the available space the 200 or so European stations with a power of more than 1 kW. "European," in this case, includes stations in Algeria, Morocco (French and Spanish), Tunis, Egypt, Algiers, Palestine, Syria and Turkey. At Cairo, space for a further six channels in the medium band, bringing the total to 116, was made possible by lowering the bottom end of the band to below 200 metres, i.e., to 1,560 kc/s. There are 14 channels on the long-wave band, allowing for proper separation, although at present over 20 stations are accommodated.

Non-signatories to Lucerne, i.e., Holland, Luxemburg and Lithuania, are to be removed from the long-wave band, some Norwegians will share wavelengths, and Iceland and Turkey will also share a wavelength (Iceland should not interfere with Turkey's transmissions as Brasov (Radio Romania) does with Holland at the moment), thereby considerably reducing the number of stations to share the 14 channels.

The so-called "intermediate" wavelengths between the medium- and long-wave bands, which some stations are allowed to share with other services under special conditions, will contain 14 low-powered stations on 9 channels.

The European Wavelength Conference—

The question of exclusive wavelengths in the medium band has become increasingly difficult during the past few years until it is now almost as bad as the long-wave situation. The old maxim, laid down many years ago, that in all international discussions of a technical nature, national requirements only are to be considered, has long been dead in spirit, and every nation thinks in terms of its foreign listeners. Exclusive wavelengths, therefore, become an all-important subject. It is proposed that of the available 116 medium-wave channels 54 should be exclusive, whilst on the long-wave band, 13 should be exclusive.

The following are some of the allocations proposed in the new arrangement of exclusive wavelengths :—

	Medium.	Long.
Germany	9	1
Russia	5	3
France	5	1
Italy	6	—
Great Britain	2	1
Sweden	2	1
Poland, Yugoslavia, Hungary and Czechoslovakia	3 each	—
Spain and Belgium	2 each	—

Of the thirty countries which have broadcasting stations in the European zone, nine will not have an exclusive wavelength. According to the proposed plan, Russia will lose four exclusive wavelengths, France three, Germany two and Britain one, whilst Italy gains two.

The bulk of the shared wavelengths, which are of considerably less importance from an international point of view, are suggested to be distributed as follows :— France 16, Germany 11, Russia 11, Italy 10, Spain 10, Norway 9, Great Britain 8, Poland 6, Belgium 4.

France has an individual problem : the private stations. No indication was given by the French Delegation at Brussels for the suggested new wavelengths of the private stations, and she will, moreover, lose three of her exclusive medium wavelengths.

Delegates to Montreux will also consider international conventions regarding the power of transmitters, and it is probable that permission will be granted for 500-kW long-wave stations and generally to permit medium-wave stations to go up to 120 kW.

WANDERING WAVE.

Letters to the Editor

The Editor does not necessarily endorse the opinions of his correspondents

Ignition Interference

IN your Editorial note on the voluntary suppression of interference you did not mention one point that I regard as important. I refer to the size of the suppressors needed and their method of attachment to sparking plugs and distributor ; the presence of these components may cause considerable annoyance when the removal of a plug becomes necessary. This operation must sometimes be effected on the roadside, perhaps in pouring rain, and not always in a conveniently arranged and well-lighted garage.

I do a fair amount of work on my car, and so am all in favour of simplicity and accessibility under the bonnet. For the last few years things have been getting worse and worse in that respect, and one does not want to increase the difficulties by adding awkward wireless gadgets.

Purley. J. M. SELLORS.

Television Transmissions

YOUR recent Editorial criticism of over-ambitious television programme items brings up another matter—that of technical shortcomings in the transmissions.

As an example of a minor form of technical irritation, one invariably finds that at least one of the six camera channels in use suffers from inherent parasitic oscillation, giving a fine heterodyne pattern over the picture each time that particular camera is faded in (the oscillation mentioned in Mr. P. Scales' recent letter was probably transmitted by the B.B.C.).

Again, the camera used for an O.B. of a football match has invariably an inconveniently placed spot of extremely high or low sensitivity on the mosaic, with the result that one has to sort out two balls in order to follow the play. It is hard to explain away such a happening to a non-technical observer, who, incidentally, may be a prospective purchaser of a television set.

R. POLLOCK.

N. Wembley, Middlesex.

Non-removable Valves

AS one who has long admired "Cathode Ray's" ability to hit the nail on the head with scientific precision, I was astonished to read his views on the valve of the future in an article based entirely on misconceptions.

It is apparent that "Cathode Ray" has forgotten the difficulties of servicing the modern superhet when he makes the astonishing assumption that given sound mechanical design valves can be left to "lie low and say nuffin' "—except what is in the programme.

Briefly the following are the reasons why valves are, and must remain, easily removable from the chassis :—

1. The more complicated types are liable to intermittent faults of a nature requiring rapid interchange with known "good" valves to identify. These intermittencies may be of the rapidly fluctuating type, or may not become apparent until after some hours of use. Particularly when sets are serviced *in situ*, changing valves can often be the only hope of rapid and efficient service. Further, these defects are not necessarily caused by faulty mechanical structure, but are frequently due to changing gas content in the valve and faults in the cathode surface.

2. With the coming of four- and five-wave band sets, frequency-changers present many problems, failing to oscillate in localised regions of the lower wave-bands, and frequency drift among them.

3. Most important of all, modern servicing is effected by analysis of the various currents through the valve circuits, the method adopted being the removal of the valve and the substitution by a plug and cable to the meter and valve. This is for the testing and servicing not only of the valve, but of the entire instrument. It will be a sorry day for servicemen when valves are riveted to the chassis with a cluster of soldering tags to be tackled before analysis can be effected.

And so, although I will still turn to "Cathode Ray" each week, I can only hope that he has included in his New Year resolutions one to remember the poor service engineer.

C. GORDON.

Short-range Fading

THE assumption by Mr. P. H. Earl, that the fading of London National at short distances is due to its synchronisation with the North, is untenable for the following reasons :—

1. This fading takes place just the same when the Northern transmitter is out of action.

2. The magnitude of the fading is greater than that of the Northern carrier.

3. Exactly the same type of fading is observable from the Regional transmitter at somewhat longer "short" distances—forty miles or so.

The effect is purely night fading.

It is interesting to note that in this same issue of *The Wireless World* Sir Noel Ashbridge is reported to covet the 600-metre shipping band for broadcasting, as being ideal for the purpose.

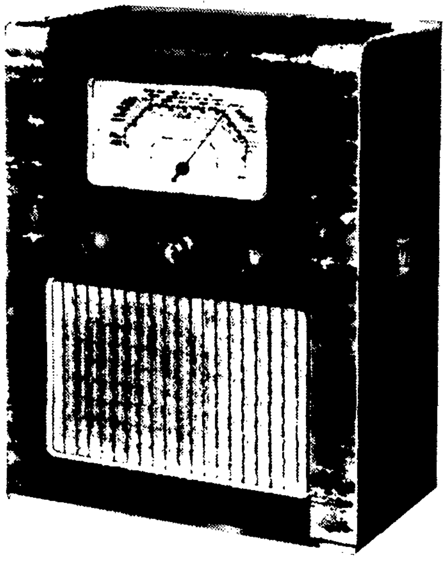
There is one very good reason for this. It is free from troublesome night fading up to a distance of approximately 80 miles from the transmitter. B. S. T. WALLACE.

London, S.W.16.

THREE NEW COSSOR RECEIVERS

THE Model 31 battery receiver recently released is a four-valve superhet with triode-heptode frequency changer, high gain pentode IF amplifier, double diode triode second detector and high slope "economy" pentode or tetrode output valve. Three wave-ranges cover 16.3-51.5, 190-590 and 815-2,180 metres, and the semi-circular dial carries forty-three station names. The specification includes automatic grid bias, and the price is 7 guineas excluding batteries.

A *de luxe* version of this receiver (Model 32) is available at 8 guineas without batteries.



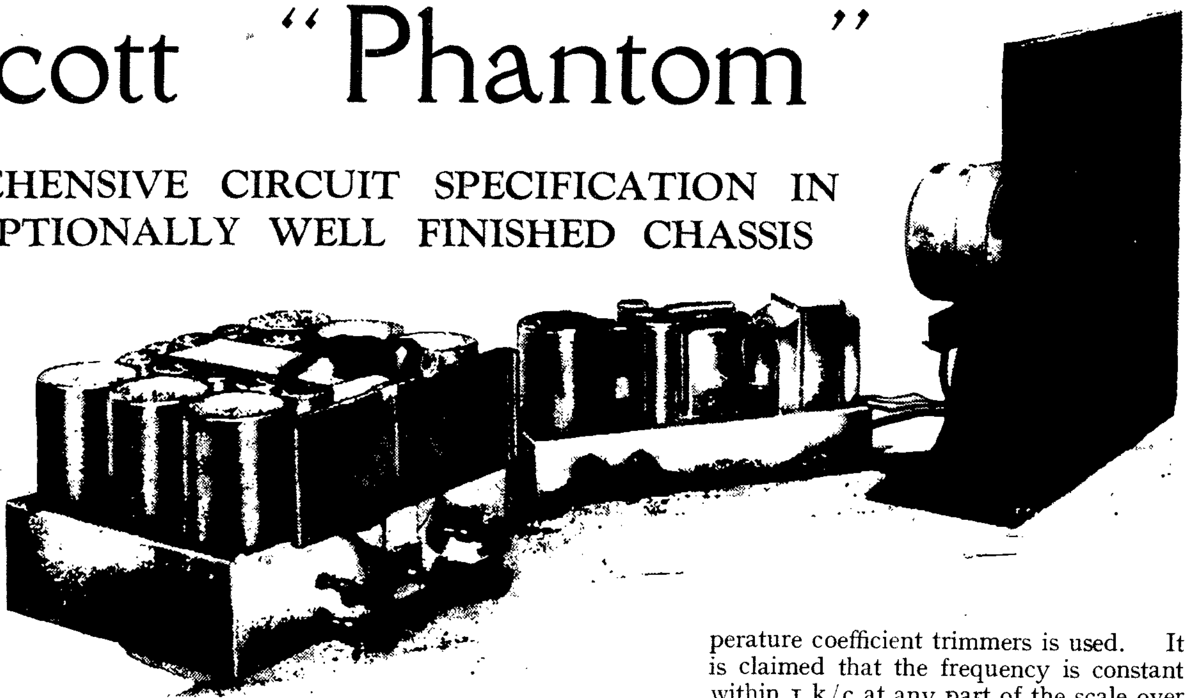
Cossor Model 31 all-wave 4-valve battery receiver.

The principal difference from the Model 31 is in the loud speaker, which employs a special magnet with a flux density of 10,500 lines per sq. cm.

The Model 71 for AC mains at 8½ guineas makes use of a similar circuit, but the output valve in this case is a triode. The cabinet is of similar design to that of the battery models and measures 16in. × 9½in. × 20in.

Scott "Phantom"

A COMPREHENSIVE CIRCUIT SPECIFICATION IN AN EXCEPTIONALLY WELL FINISHED CHASSIS



As pioneers of the "custom built" receiver in America, Scott Laboratories have a unique experience of the design of multi-valve circuits and of their presentation in attractive chromium-finished chassis.

Since 1930, when a Scott receiver was first demonstrated over here, these sets have been available in this country through a number of agencies. Now a factory and service department have been established in London, and the latest designs are built up in this country in close technical collaboration with E. H. Scott Radio Laboratories, Inc., of Chicago.

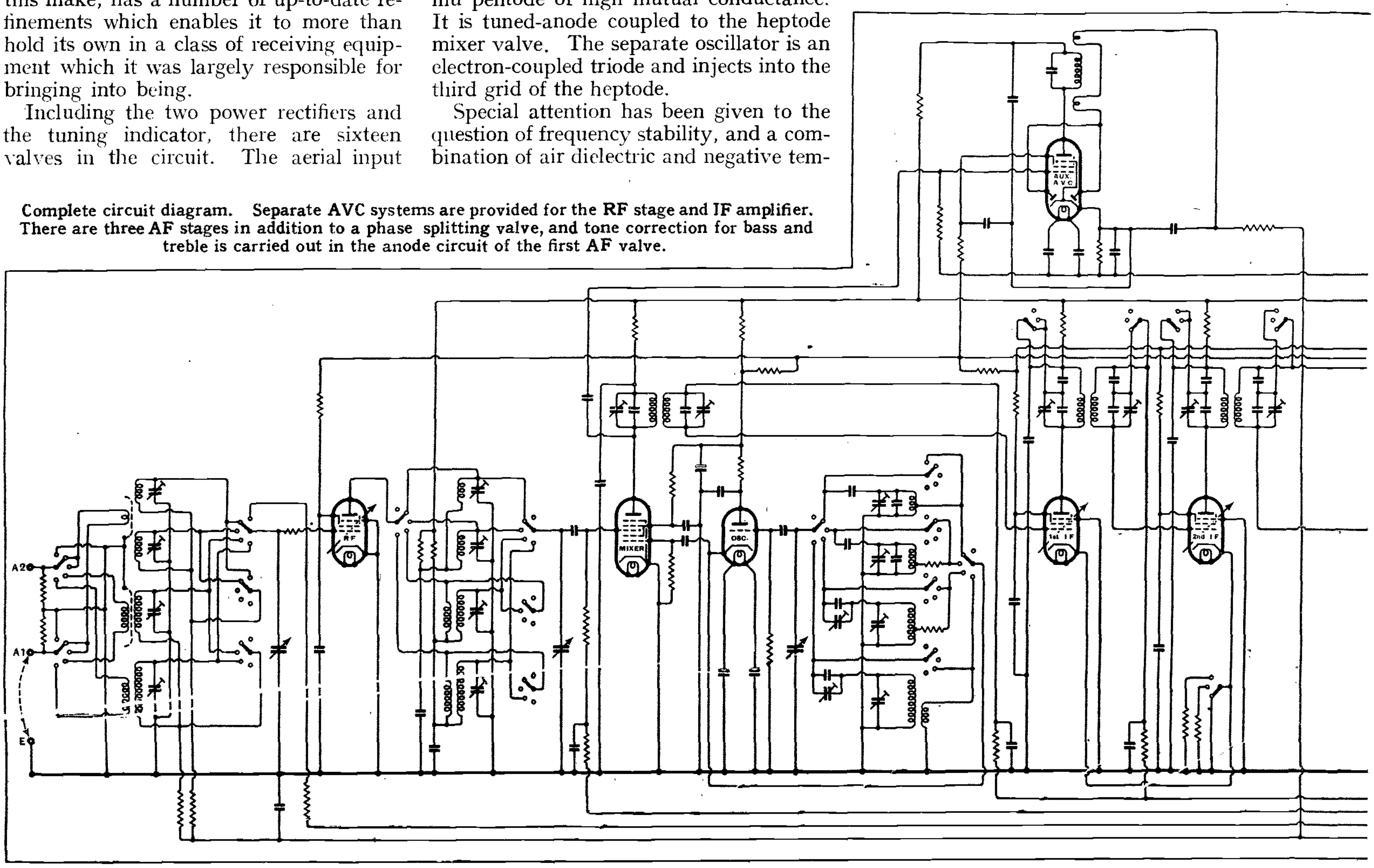
The latest model, while retaining all the qualities of range, selectivity and power output which have been associated with this make, has a number of up-to-date refinements which enables it to more than hold its own in a class of receiving equipment which it was largely responsible for bringing into being.

Including the two power rectifiers and the tuning indicator, there are sixteen valves in the circuit. The aerial input transformer has been designed to work with an anti-interference aerial system, but may be used with the conventional elevated single wire. To reduce the effects of electrostatic pick-up in the down leads the primary windings for the short- and medium-wave ranges are screened from their secondaries by a gapped metal shield.

The RF stage makes use of a variable-mu pentode of high mutual conductance. It is tuned-anode coupled to the heptode mixer valve. The separate oscillator is an electron-coupled triode and injects into the third grid of the heptode.

Special attention has been given to the question of frequency stability, and a combination of air dielectric and negative temperature coefficient trimmers is used. It is claimed that the frequency is constant within 1 k/c at any part of the scale over the usual range of room or receiver temperatures.

Three IF stages amplify the resulting intermediate frequency of 470 kc/s and three degrees of selectivity are provided by mistuning the second and third coupling transformers. The input transformer is fixed and serves to fill in the middle of the response curve when in the broad or double-humped setting. In the position of maximum selectivity the circuits are



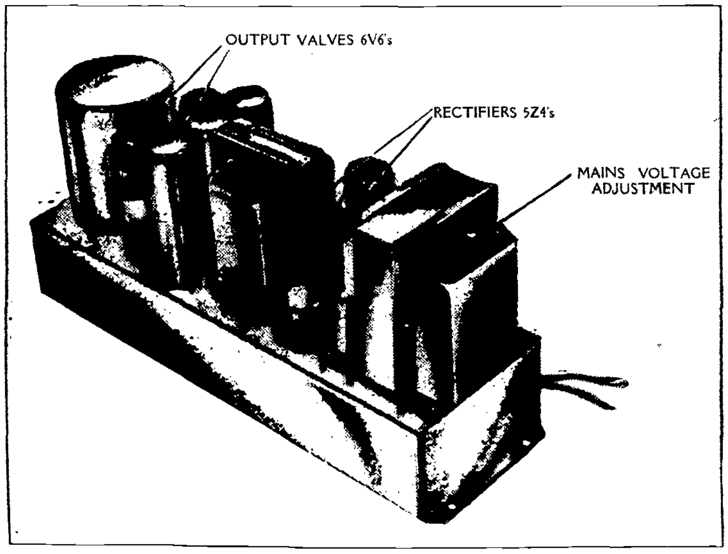
Complete circuit diagram. Separate AVC systems are provided for the RF stage and IF amplifier. There are three AF stages in addition to a phase splitting valve, and tone correction for bass and treble is carried out in the anode circuit of the first AF valve.

FEATURES. ***Waveranges.***—*(A) 800-2,000 metres. (B) 200-550 metres. (C) 9.5-3.9 Mc/s. (D) 22-8.8 Mc/s.* ***Circuit.***—*RF ampl.—mixer—osc.—1st IF ampl.—2nd IF ampl.—3rd IF ampl., 2nd det. and AVC rect.—auxiliary IF ampl. and AVC rect. for RF stage—tuning indicator —1st AF ampl.—phase splitter—push-pull 2nd AF ampl.—push-pull output stage. Full wave valve rectifiers.* ***Controls.***—*(1) Tuning. (2) Volume. (3) Sensitivity. (4) Bass tone control. (5) Treble tone control. (6) Selectivity. (7) Waverange.* ***Price.***—*(Receiver chassis, power amplifier and loud speaker), 36 guineas.* ***Makers.***—*E. H. Scott Radio Laboratories, Ltd., 72a, Carlton Hill, London, N.W.8.*

aligned at 470 kc/s with the fixed series condensers shorted in the second IF transformer and in circuit in the third. For minimum selectivity and the widest audio-frequency response (8,500 c/s) these conditions are reversed, so that the second transformer is tuned above, and the third below, 470 kc/s.

The total trimming capacity in the IF circuits is large, so that the alignment is not seriously affected by changing valves. High circuit efficiency is ensured by the use of stranded wire in the coils and large-diameter ($3\frac{1}{2}$ inch) screening cans. Decoupling is provided for each circuit and a high overall gain is achieved with stability. The overall gain is not appreciably disturbed by changes in selectivity, as the standing bias in the two IF valves is automatically adjusted by contacts in the selectivity switch assembly.

An exceptionally wide range of control is provided by the dual AVC system. The normal control for the IF valve is derived from the second detector stage, and the RF amplifier is controlled by an auxiliary AVC amplifier and rectifier taking its voltage from the anode of the mixer valve. This gives exceptionally good control on weak signals.



The rectifiers, output valves and smoothing equipment are mounted in a separate chassis, which, like the main chassis, is finished throughout in polished chromium.

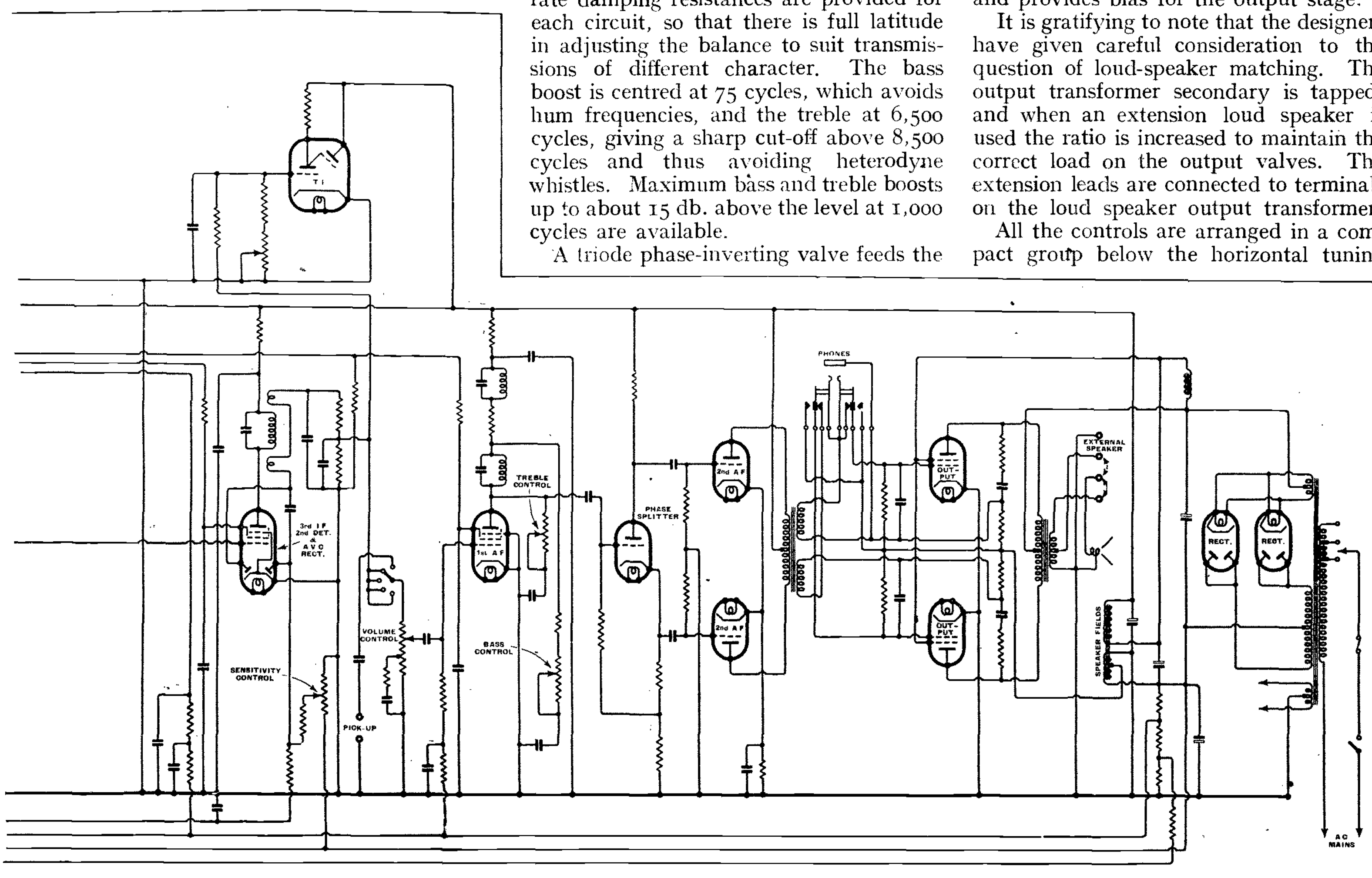
After rectification by one of the diodes associated with the third IF stage the signal passes through a tone-compensated volume control to the first AF amplifier, which is a pentode with a double resonant choke system in the anode circuit. Separate damping resistances are provided for each circuit, so that there is full latitude in adjusting the balance to suit transmissions of different character. The bass boost is centred at 75 cycles, which avoids hum frequencies, and the treble at 6,500 cycles, giving a sharp cut-off above 8,500 cycles and thus avoiding heterodyne whistles. Maximum bass and treble boosts up to about 15 db. above the level at 1,000 cycles are available.

A triode phase-inverting valve feeds the second AF stage proper, which consists of two more triodes in push-pull. These are coupled to the output valves through a transformer with split secondary, and both bias and negative feed-back are applied separately to each valve. There is provision for connecting headphones through a double-contact jack across one half of the intervalve transformer secondary.

The output valves are mounted on a separate chassis with the twin rectifiers and smoothing equipment for the power supply. The field winding of the Magnavox "55" loud speaker is in two sections, one of which is in the negative HT lead and provides bias for the output stage.

It is gratifying to note that the designers have given careful consideration to the question of loud-speaker matching. The output transformer secondary is tapped, and when an extension loud speaker is used the ratio is increased to maintain the correct load on the output valves. The extension leads are connected to terminals on the loud speaker output transformer.

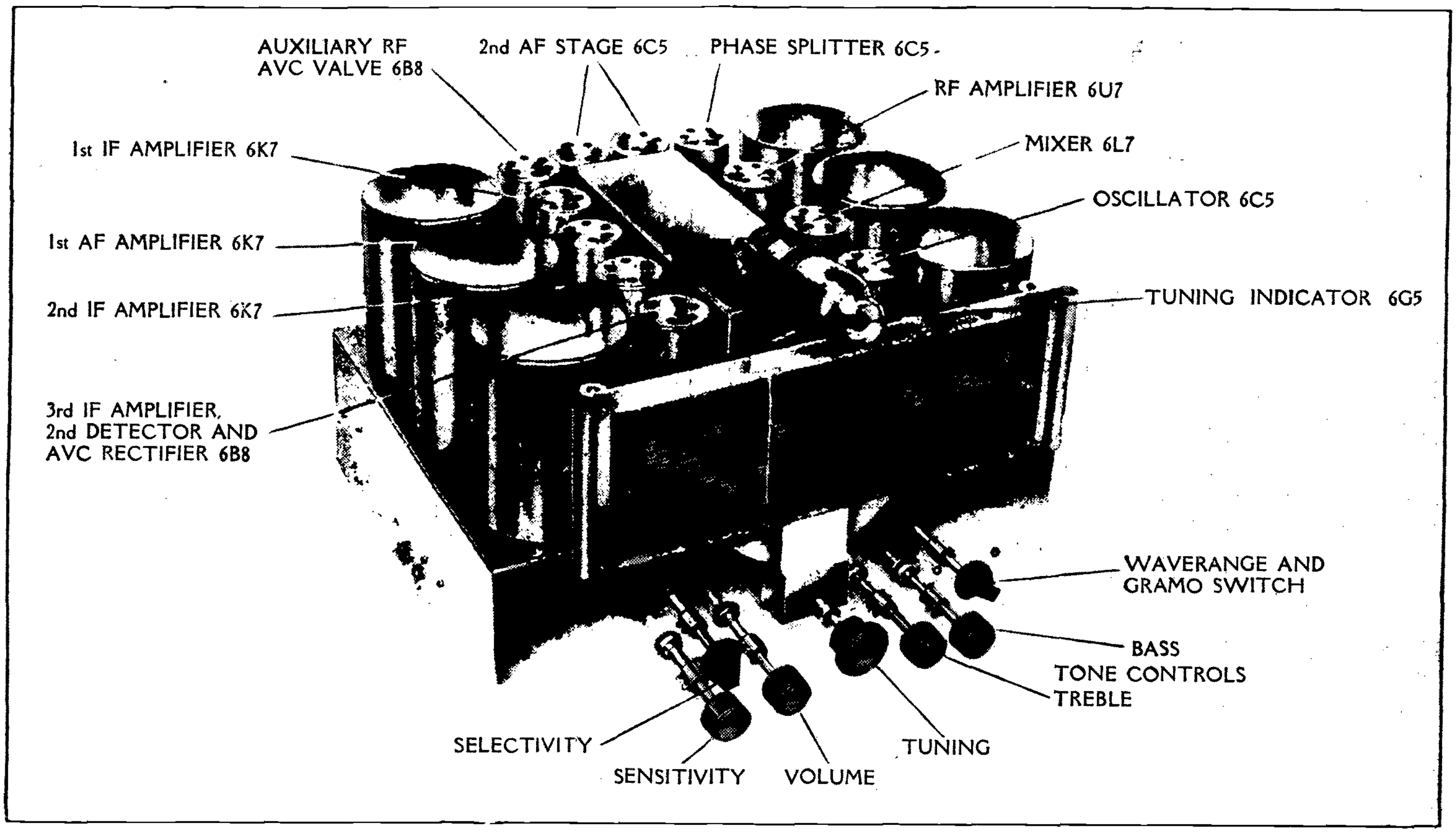
All the controls are arranged in a compact group below the horizontal tuning



Scott "Phantom"—

scale. They are well graded and not so closely spaced as to be uncomfortable in operation. We should have welcomed poses of heterodynes between stations. Nevertheless, the quality is not lacking in brilliance and this is obtained without resonances of the type which produce sible to use this much volume before the maximum output is reached even on weak signals.

This is a set which amply justifies the



Large diameter screening cans make for high efficiency in the IF circuits. The tuning scale is indirectly illuminated and calibrated in wavelengths on medium and long waves, and megacycles on the two short-wave ranges.

some method of showing the setting of the waverange switch and also a slightly higher ratio in the slow-motion drive for tuning on short waves, but these are minor criticisms. In all the important aspects of performance the receiver acquits itself with distinction.

High Selectivity

Expectations of an ample reserve of volume and sensitivity were fully justified, but the selectivity deserves special commendation. Even in the medium position of the selectivity switch the performance is better than most receivers and gives clear reception of the Deutschlandsender with very little sideband interference. With maximum selectivity the neighbouring stations might not exist, yet the quality, thanks to the tone correcting circuits, is very little affected. On medium waves we had the unique experience (in London at a distance of 15 miles from Brookmans Park) of hearing the Poznan station announced and enjoying its programme with negligible interference from London Regional working on the adjacent channel. Few commercial receivers which we have previously tested have approached this performance.

The whole of the waverange covered by the set is free from second-channel interference and other self-generated whistles, and the sharp cut-off at 8,500 cycles dis- harshness when the volume is turned up. The continuously variable bass control is a refinement well worth having and one can greatly improve the reproduction of organ and other broadcasts by its use. The maximum output of 13.5 watts gives plenty of latitude for peaks at the average levels which can be tolerated in the home.

When the megacycle settings of the principal American and European short-wave stations had been memorised, and the knack of handling the slow motion tuning mastered, some transmissions of unusual steadiness and volume were held over long periods, thanks to the efficient AVC system and the frequency stability of the oscillator. The performance on the 13-metre band was particularly good. The signal-to-noise ratio we would put at average for this type of set, but it should be understood that we were working with the usual single-wire aerial. A new type of anti-interference aerial is being adapted to work with this receiver and will be available in the near future.

Background Noise

With the aerial disconnected there is no direct pick up in the set at any wavelength and the background is silent over about three-quarters of the volume range. In the last quarter valve hiss is apparent, but under working conditions it is rarely pos-

use of so many valves and one which is very pleasant to handle. In the matter of AVC control and selectivity it is a receiver of outstanding merit.

"Designing a Filament Transformer"

A CORRECTION

TWO arithmetical errors unfortunately appeared in the article describing a filament transformer in our issue of January 19th last. The resistance of the primary section should be 0.055 ohm, not 0.55 ohm, while the core volume is 3.47 cu. in., not 3.7 cu. in.

It should be noted that in an auto-transformer, and under normal operation, the current in the common portion of the winding is the difference between the computed primary and secondary current, so that a smaller gauge of wire than specified could have been used.

When a transformer is required to be reversible, compensation for voltage drop in the windings is difficult unless extra tappings are included, and it is therefore suggested that the winding be calculated on the turns per volt factor alone and that the largest size of wire that can be accommodated should be used. A total of 76 turns of No. 16 SWG enamelled copper wire with tappings at 14 and 62 turns would satisfy this requirement. Larger sizes of wire are very difficult to wind on bobbins of small diameter.

Frequency-Changing Problems

Concluded from page 82 of last issue.

THE LATEST OCTODES

By E. LUKACS and J. A. SARGROVE (*Tungsram Research Laboratory*)

CONTINUING the discussion of modern frequency-changing valves the authors now consider the effect of HT voltage fluctuations and show that they are of relatively small importance. The electrode structure and operation of the latest octodes are also discussed.

WITH valves of the hexode type, fluctuating mains voltage does not cause any material frequency drift. The size of the virtual cathode is but slightly affected by changes in the first accelerator grid voltage. Although an increase in the voltage of the accelerator grid does not extract more electrons from the cathode space charge, the velocity of the electrons also increases and at higher speeds, the density of the space charge diminishes. These effects will balance each other fairly accurately, and the change in the oscillator anode voltage has but a slight effect on the impedance of the triode, and consequently on the phase lag of the anode current. With triode-hexode types (and, of course, triode-heptodes) a 10 per cent. fluctuation in mains voltage causes about 2 kc/s frequency drift at a frequency of 17 Mc/s.

As against this in the older octodes VO4 and EK2, fluctuations of supply voltage cause fluctuations in the transit time of the electrons reaching the oscillator anode and produce considerable frequency drift.

The efforts to eliminate the observed defects in the older octodes led to the development of type EK3. This makes use of electron-optical principles and represents a radical departure from previous frequency-changer design.

Fig. 4 shows how the four side rods of the first grid G1 divide the electron stream into four beams. Two opposite beams impinge upon the oscillator anodes G2, which are constructed to have angle-iron profile. Thus, the transit time of the electrons is as short as in a normal triode. The first accelerator electrode G3 is made of solid sheet metal, electrostatically screening the oscillator anode, and partly screening the first control grid as well. The pairs of side rods of the first grid and the aperture of the first accelerator electrode are so designed that the electrons flying towards the second control grid G4 are accelerated by it without, however, impinging upon it. Thus, a virtual cathode is formed between the first accelerator G3 and the second control grid G4 and, consequently, a part of the electron stream returns towards the accelerator. This, being made of solid sheet metal, absorbs all returning electrons and prevents their return into the neighbourhood of the first space charge. Those edges of the first accelerator aperture which face the second control grid are so formed that their electrostatic suction effect attracts even those electrons which would otherwise fly back through the aperture of the first accelerator. It is clear, therefore, that by this means, all the aforementioned defects are simultaneously eliminated.

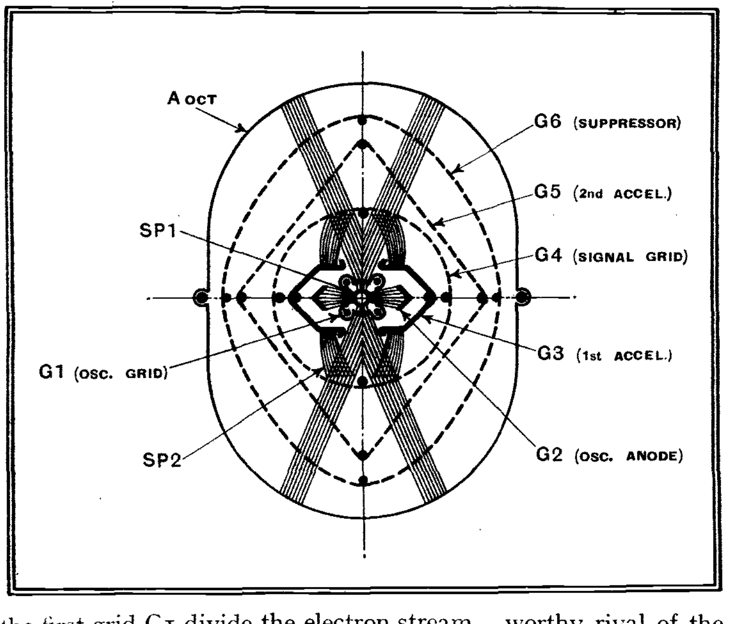


Fig. 4.—The arrangement of the electrodes of a modern octode is shown in this diagram. The bar structure of the oscillator grid divides the electrons into four beams.

The principal operating characteristics of the EK3 are a conversion conductance of 0.65 mA/V, with an oscillator peak voltage of 10 volts; the working slope of the triode is 4.5 mA/V.

From the above it will be seen that the EK3 is a worthy rival of the triode-hexode type of valve, since the gravest defect of octode valves, namely, frequency drift, is entirely eliminated in it. In octode types, however, space-charge coupling is still a drawback which even if neutralised can still cause some defects. On the other hand, the disadvantages of the triode-hexodes are low input impedance and variations in grid capacity.

Space charge coupling and its elimination have been dealt with in earlier articles.[1] We will now only add the following observations: the neutralisation of space charge coupling by means of capacity coupling only is never a complete success because the finite transit time of the electrons retards the grid current due to space charge. In order to adjust the phase error, therefore, we must connect an additional resistance in series with the coupling capacity. The time constant of this resistance-capacity system is approximately equal to the transit time of the electrons, which in type EK3 is 2×10^{-9} sec. Hence, the coupling elements introduced between the first and second control grids have values of 1,600 ohms and 1.3 $\mu\mu$F. However, this manner of neutralisation is only perfect at a single predetermined oscillator voltage. This is due to the fact that the voltage induced by space charge coupling becomes practically constant above a certain oscillator voltage while the capacitively transferred voltage compensating it will increase continuously with the oscillator voltage. The above values give a good practical balance to an oscillator voltage of 12 volts eff. (The dissimilarity of this effect to that of the limitation of conversion conductance should be noted.)

The Oscillator Circuit

As these coupling elements are built into the EK3, it is not advisable to connect the oscillator tuned circuit to the first control grid for two reasons:—

The resistance-capacity combination, while stopping the effect of the oscillator grid upon the signal grid actually assists the transference of signal-frequency voltage from the second control grid to the first control grid. If the oscillator tuned circuit is connected to the first control grid, a signal voltage will consequently appear on it. It must be remembered that at short waves, where the percentage difference between the input frequency and the oscillator frequency is very small, the oscillator circuit will have quite a high impedance to

[1] *The Wireless World*, March 17th, 1938.

Frequency-Changing Problems—
the signal frequency. This unintended signal voltage on the first grid will be additively mixed with the oscillator-frequency voltage, thus creating an intermediate-frequency component in the anode current, which will either increase or decrease the normal multiplicatively produced conversion gain of the valve. This in itself would not be a serious defect except that the valves are not quite uniform with reference to this unintended function, there being a likelihood that in a batch of EK3 valves used in one and the same receiving set a difference in sensitivity of 1 to 4 may occur.

If a tuned-grid oscillator circuit is used trouble also arises due to AVC, as the neutralising balance will not be at an optimum through changes in signal-grid bias. Thus, the signal voltage on the second control grid will influence the first grid potential and thus the frequency of the oscillator. However, if the tuned circuit is connected to the oscillator anode, both these defects are reduced to a negligible minimum.

Hexode-type Valves

In hexodes, space charge coupling also occurs, but of a somewhat different type, the injector grid repelling more or less electrons towards the first accelerator in step with the oscillator frequency. Some of these electrons pass through the first accelerator and increase the cathode space charge, producing an oscillator-frequency voltage upon the first grid by influence. It is clear, however, that the magnitude of this coupling is practically negligible, its value being of the order of 0.01 $\mu\mu$F. in comparison with 0.1 $\mu\mu$F. for the electrostatic coupling between the first and third grid of the hexode.

The returning electron current in hexode valves causes other serious disorders which are by no means negligible. The space charge increment near the first grid increases the input capacity and this varies in inverse proportion to the signal grid bias, and will disappear completely above a certain signal grid bias value. The change in input capacity due to the action of AVC in triode-hexodes is about 2-2.5 $\mu\mu$F. Distortion occurs through the RF input circuit becoming detuned, which can be in unfavourable cases as much as 3 to 5 per cent., a perceptible amount in high-fidelity receivers. Detuning of the input circuit is, of course, not as detrimental as detuning the oscillator circuit, since it mainly has the effect of altering the impedance offered to the signal frequency, whereas the oscillator circuit will affect all intermediate frequency circuits.

Severe changes in capacity will increase the input damping of the signal grid as well. This effect has been fully expounded in other earlier publications where it was shown that the dephasing of the capacitive current in consequence of the electron transit time will produce a resistive current component. This damping causes a perceptible decrease in gain at wavelengths as long as 12 metres, so that on ultra-short wavelengths it is advisable to connect the signal grid to a tapping point on the input tuned circuit.

The capacity variation and damping of the signal grid, the EK3, is much less than that with the triode-hexodes, and is even better in this respect than RF amplifier pentodes.

This is due to the fact that the virtual cathode in the EK3 is mainly a function of the cathode current, so that the change in capacity under the influence of AVC amounts to only a few tenths of one $\mu\mu$F, the input impedance at 15 metres being approximately 100,000 ohms.

From the foregoing it is clear that very vast improvements have taken place in mixer valves, and their use in receiving sets is now almost as simple as that of ordinary amplifier valves. They do not as yet function faultlessly on the ultra-short wave-band, but further improvements no doubt will bring the solution of this problem also.

Random Radiations

By "DIALLIST"

Major Armstrong's Scheme

A CONSIDERABLE amount of fuss was made by some of the lay papers over what was described as Major Armstrong's new system of wireless transmission. It appears, though, that the system isn't new at all; it is merely a fresh application of a very old method of transmission. What Major Armstrong has done is to develop a means of using frequency modulation to reduce interference from atmospherics and man-made static. He has long been a champion of this kind of modulation; three years ago he published a long account of his experiments with frequency-modulated transmitters, in which he made certain points very strongly. One was that radio engineers were all wrong in regarding amplitude modulation as the one and only satisfactory method for broadcasting and for telephonic communications; another, that a noticeable decrease in interference occurred when frequency-modulated transmissions were received in areas regarded as abnormally noisy for the reception of amplitude-modulated transmissions.

Transatlantic Expectations

TELEVISION is having a great run just now in both the technical and the lay papers across the Atlantic. Everything is nearly ready for the inauguration of the New York services at the opening of the World's Fair, and the man-in-the-street is in much the same keyed-up condition of expectancy as was his counterpart here four or five years ago. There seems to be just the same two widely different opinions amongst those in the business in America as there were with us just before the opening of the A.P. station. One school holds that present listeners in the area to be served will stampede to become viewers; the other believes that the story of television in the U.S.A. will follow much the same lines as it followed in this country. In other words, the general public will be eager to attend demonstrations, but will be very slow at first to acquire receiving apparatus of their own.

Conditions Different

RASHLY venturing into the realms of prophecy I predict that neither of these views will prove to be the correct one. I've always held that what put the brakes on to television here after the high-definition service had come into being and many firms were offering excellent receiving equipment at prices that weren't too stiff was the public's memory of the way in which it had been led up the television garden so frequently and with such sickening results during the preceding decade. Nothing could have been more ill-advised than the preposterous claims made for television in its early days here. Eleven years ago it was trumpeted at the public that practical television had arrived; that in a matter of weeks or, at the worst, months, it would be possible to sit in one's home and see Test matches at Lord's or even at Sydney! *The Wireless World* did splendid work in sorting out laboratory achievements from figments of the imagination, and the Postmaster General of the time issued a public warning to those who contemplated buying low-definition television receivers that they did so at their own risk: he couldn't see that television had yet any real entertainment value.

A Wiser Policy

IN America they have adopted what I think are sounder methods of approach. There have been no irresponsible promises of impossible things; television was not presented to the public until it was a going concern. Further, manufacturers have realised thoroughly the need for educating the average man and woman to appreciate the standards of television. An endeavour is to be made to make people get used to the comparatively small images of the six-by-ten viewing screen; television, in a word, is to be accepted as television and not as something that compares or competes with the movies. Whether the American public will respond is another matter; I think you will agree, though, that the situation is being soundly dealt with. For these reasons my forecast is that the American people won't be so chary as we were a few years ago about taking up television as a hobby. If the programmes are reasonably good I believe that television may get off the mark rather more quickly in the United States. I don't see, though, how there can be a boom, since the areas served for some time to come will be so small a proportion of the whole of that great country.

Hard Lines

DID you happen to see the story of the arrival in New York of the gifts sent by the Pitcairn Islanders to the lady who had done so much to put them into regular touch by wireless with the rest of the world? She is one of the best known of

American amateurs, and it was owing to her reception of a faint message that their decrepit wireless gear must shortly go out of action that a fund was started in America which led to the presentation to the Island of up-to-date transmitting and receiving equipment. As a mark of their gratitude the people at Pitcairn sent her an offering of baskets and other specimens of their handicraft. When the ship was approaching the coast her operator got into touch with the lady and wirelessed: "We'll be in port only 24 hours; come and collect your stuff as soon as we berth." The ever-vigilant Customs service intercepted the message and at once saw visions of large-scale smuggling. When the ship tied up battalions of sleuths searched her from truck to keelson, whilst others captured the lady and bore her off for examination. It took a long time to straighten matters out, and when finally the Customs men were convinced that they had been looking for a mare's nest, they exacted their pound of flesh by charging her duty to the tune of 50 cents!

Spoonerisms

STRANGE how rarely one hears a Spoonerism on the wireless, for in the ordinary way such things are by no means rare when speakers are nervous or are letting their thoughts run ahead of their words. However, one does occasionally hear a good one, as, for instance, when the bucking broncho, introduced during a recent tour behind the scenes of a circus, became a brocking bunko. I'm sure that if I were an announcer and found myself, as announcers often do, faced with the task of reading some rather involved news item at sight, I should be constantly pouring Spoonerisms into the microphone. Is the making of Spoonerisms, by the way, confined to those who use the English language? I don't ever remember hearing one or hearing of one from a foreign station. Nor does one seem to come across the Spoonerism as a cause for mirth in books written in other languages.

Communication Receivers

THE communication receiver shows signs of catching on amongst long-distance enthusiasts, and it is small wonder that it should do so, for it is the ideal instrument for their particular kind of work. We'd have seen a good many more communication receivers in use before now if people hadn't formed the idea that they must necessarily be highly expensive things. Of course, if you want the very best you've got to pay for it, and a high-grade receiver of this kind may cost you anything between £40 and £80, or even more. But less expensive sets are now making their appearance, and though they, naturally, haven't all the refinements of the more costly apparatus, many of them are very pleasant things to handle, and they're useful gatherers of difficult stations. For short-wave work they're streets ahead of the domestic "all-wave" set, which too often can spare no more than a quarter of an inch of its tuning scale for a band containing a score or more of stations.

Better Tuning Wanted

It isn't that the domestic set is insensitive or that it's incapable of bringing in the short-wave stations that you want to hear, provided that their transmissions are arriving at reasonable strength. The main troubles are two: in the first place it's mighty difficult with some of them to make the minute adjustments that are often called for; in the second place it's often almost impossible to make a note of the setting of a station that you've heard so that you can go back to it when you want to. Some kind of bandspreading in "all-wave" sets would make a power of difference to the growth of short-wave listening as a hobby. I don't see why it shouldn't be done, though it certainly won't if makers are determined to compete with one another to see who can produce the cheapest sets.

What We Miss

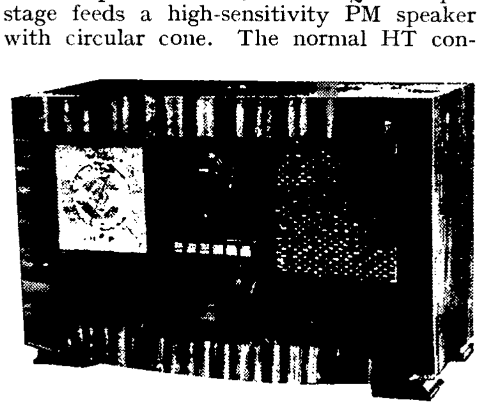
That's just one example of the good things that listeners are missing because of the low price of receiving sets. To introduce bandspreading costs money, and though it would treble the attractiveness of the short-wave range of the "all-wave" receiver, it can't be done if every penny has to be considered. And there are many others as well. Real tone-control is a comparative rarity; we have to put up with self-generated whistles because the price won't run to an RF valve and proper image suppression. I needn't continue the catalogue, for you'll think of plenty of other things for yourself. Cheap sets there must be; but why the wireless industry has, intentionally or otherwise, led the public to believe that you can get everything that you want in a receiving set for ten pounds or a bit less will always be a mystery to me.

NEW H.M.V. SETS

FOUR new receivers have been released by the Gramophone Co., Ltd., this week. They include a radiogramophone with automatic record changer at 29 guineas. This is the Model 489, which employs an eight-valve superhet circuit with four wavebands going down to 11 metres. Separate bass and treble tone controls are provided, and the output is 5 watts into an elliptical type loud speaker.

The Model 1101 is housed in a new style of cabinet with tapering sides and is a 5-valve superhet for AC mains. There are three wavebands, the lowest wavelength being 13.5 metres. Simplicity of control has been given close attention, and the large rectangular dial carries a vernier scale as well as a waveband indicator. The price is 10½ guineas.

In the Model 1400 battery receiver at 12½ guineas there are six push buttons for automatic station selection. The lowest wavelength is 16.5 metres and there are three wavebands. Five valves are included in the superhet circuit, and the QPP output stage feeds a high-sensitivity PM speaker with circular cone. The normal HT consumption is 9 mA., but an economy control is fitted, by means of which the total current may be reduced to 6 mA. for moderate volume levels.



H.M.V. Model 1400 battery superhet with push-button tuning.

A three-valve TRF circuit is employed in the Model 1401 battery receiver. It includes a filter for Droitwich when the set is to be worked near that station, and there are three wavebands going down to 16.5 metres. The HT consumption is 7.5 mA., and the set, complete with batteries, sells for 8 guineas.

Due for release early in March is a new push-button superhet for AC mains. It will be known as the Model 1102, and has push-button selection for waverange as well as eight pre-tuned stations. The lowest wavelength is 13.8 metres and there are three wavebands. An attractive cabinet design has been evolved for this receiver with a sloping front and figured silk fret cover. The price will be 15 guineas.

Club News

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road. South Croydon.

At the last meeting Mr. F. G. G. Davey, the inventor of the Davey Gramophone Pick-up, lectured on the design of his Communications Receiver. During the course of the lecture many interesting features of the set were demonstrated.

South London and District Radio Transmitters' Society

Headquarters: Brotherhood Hall, West Norwood.
Meetings: First Wednesday in every month.
Hon. Sec.: Mr. H. D. Cullen, 164, West Hill, London, S.W.15.

At the December meeting Mr. Stuart Davis demonstrated his high quality reproducing and recording apparatus, the former being based on the "Wireless World" Quality Amplifier. The January meeting was devoted to a demonstration of the Hallicrafter Diversity Receiver by Mr. H. D. Cullen. At the February meeting Mr. Stone gave a talk on "Home-constructed S.W. Superhets." The annual dinner took place on January 26th.

Slough and District Short-Wave Club

Headquarters: 35, High Street, Slough.
Meetings: Alternate Thursdays at 7.30 p.m.
Hon. Sec.: Mr. R. J. Sly, 16, Buckland Avenue, Slough.

The annual general meeting was held on January 3rd, when a new committee was elected. This was followed by a talk on "Aerials," by the chairman. On January 19th, the first meeting at the new headquarters, a television receiver was demonstrated. The next meeting is to be held this evening (February 2nd), when 2FAU will talk on "Oscillators."

Midland Amateur Radio Society

Headquarters: The Hope & Anchor Hotel, Edmund Street, Birmingham.
Meetings: Second Tuesday of each month at 8 p.m.
Hon. Sec.: Mr. F. E. Barlow, "Drakeford," Poolehead Lane, Wood End, Tanworth-in-Arden.

This Society, which has been in existence for 10 years, has over 120 members, of whom 75 per cent. are licensed transmitters. The next meeting will be on February 14th at 8 p.m., when there will be a sale of apparatus in aid of the Hospital Radio Fund.

Radio Society of Great Britain, District 13 (Wimbledon and District Section)

Headquarters: Raynes Park Co-operative Hall.
Meetings: Monthly.
Hon. Sec.: Mr. H. M. Blaber, 9, Stanton Road, London, S.W.20.

This section has now secured a place for its meetings at the Raynes Park Co-operative Hall.

Radio, Physical and Television Society

Headquarters: 72a, North End Road, London, W.14.
Meetings: Fridays at 8.15 p.m.
Hon. Sec.: Mr. C. W. Ednams, 15, Cambridge Road, North Harrow.

Dr. C. G. Lemon lectured at the January 13th meeting on "Experiments in Surface Tension and Bubble Blowing." He illustrated his lecture with several experiments, including jets of water used in conjunction with a beat frequency oscillator.

On January 20th Mr. Walters, of Belling & Lee, Ltd., gave an interesting lecture and demonstration, his subject being "The Suppression of Electrical Interference." On February 3rd a lecture will be given by a representative of the Automatic Coil Winder & Electrical Equipment Co., Ltd., and on March 11th the Society will visit the printing works of the *Sunday Graphic*.

PRINCIPAL BROADCASTING STATIONS OF EUROPE

Arranged in Order of Frequency and Wavelength (Stations with an Aerial Power of 50 kW and above in heavy type)

Station.	kc/s.	Tuning Positions.	Metres.	kW.
Istanbul (Turkey)	152		1973.5	5
Kaunas (Lithuania)	153		1961	7
Hilversum (No. 1) (Holland)	160		1875	10-150
Radio Romania (Romania)	160		1875	150
Lahti (Finland)	166		1807	150
Moscow (No. 1) (U.S.S.R.)	172		1744	500
Paris (Radio Paris) (France)	182		1648	80
Ankara (Turkey)	183		1639	5
Irkutsk (U.S.S.R.)	187.5		1600	20
Deutschlandsender (Germany)	191		1571	60
National (Droitwich)	200		1500	150
Minsk (U.S.S.R.)	208		1442	35
Reykjavik (Iceland)	208		1442	100
Motala (Sweden)	216		1389	150
Novosibirsk (U.S.S.R.)	217.5		1379	100
Warsaw (No. 1) (Poland)	224		1339	120
Luxembourg	232		1293	150
Moscow (No. 2) (U.S.S.R.)	232		1293	100
Kalundborg (Denmark)	240		1250	60
Kiev (No. 1) (U.S.S.R.)	248		1209.6	100
Tashkent (U.S.S.R.)	256.4		1170	25
Bergen (Norway)	260		1153.8	20
Oslo (Norway)	260		1153.8	60
Vigra (Aalesund) (Norway)	260		1153.8	10
Leningrad (No. 1) (U.S.S.R.)	271		1107	100
Tromsö (Norway)	282		1065	10
Tiflis (U.S.S.R.)	283		1060	35
Moscow (No. 3) (U.S.S.R.)	300		1000	100
Saratov (U.S.S.R.)	340		882.3	20
Finmark (Norway)	347		864	10
Archangel (U.S.S.R.)	350		857.1	10
Rostov-on-Don (U.S.S.R.)	355		845.1	20
Budapest (No. 2) (Hungary)	359.5		834.5	18
Sverdlovsk (U.S.S.R.)	375		800	40
Banská-Bystrica (Czechoslovakia)	392		765	15–30
Lulea (Sweden)	392		765	10
Rostov-on-Don (U.S.S.R.)	395		759	20
Voronezh (U.S.S.R.)	413.5		726	10
Oulu (Uleaborg) (Finland)	431		696	10
Baranowicze (Poland)	520		576	50
Ljubljana (Yugoslavia)	527		569.3	6.3
Viipuri (Finland)	527		569.3	10
Bolzano (Italy)	536		559.7	10
Wilno (Poland)	536		559.7	50
Budapest (No. 1) (Hungary)	546		549.5	120
Beromünster (Switzerland)	556		539.6	100
Klaipeda (Lithuania)	565		531	10
Catania (Italy)	565		531	3
Palermo (Italy)	565		531	3
Radio Eireann (Ireland)	565		531	100
Stuttgart (Germany)	574		522.6	100
Alpes-Grenoble, (P.T.T.) (France)	583		514.6	20
Madona (Latvia)	583		514.6	50
Vienna (Germany)	592		506.8	100
Athens (Greece)	601		499.2	15
Rabat (Morocco)	601		499.2	20
Sundsvall (Sweden)	601		499.2	10
Florence (No. 1) (Italy)	610		491.8	20
Brussels (No. 1) (Belgium)	620		483.9	15
Cairo (No. 1) (Egypt)	620		483.9	20
Konibyshev (U.S.S.R.)	625		480	10
Christiansand (Norway)	629		476.9	20
Lisbon (Emissora Nacional) (Portugal)	629		476.9	20
Vigra (Norway)	629		476.9	100
Prague (No. 1) (Czechoslovakia)	638		470.2	120
Lyons (P.T.T.) (France)	648		463	100
Petrozavodsk (U.S.S.R.)	648		463	10
Cologne (Germany)	658		455.9	100
Jerusalem (Palestine)	668		449.1	20
North Regional (Slaithwaite)	668		449.1	70
Sottens (Switzerland)	677		443.1	100
Belgrade (Yugoslavia)	686		437.3	20
Paris (P.T.T.) (France)	695		431.7	120
Stockholm (Sweden)	704		426.1	55
Rome (No. 1) (Italy)	713		420.8	120
Hilversum (Jaarsveld) (Holland)	722		415.4	17
Kharkov, (No. 1) (U.S.S.R.)	722		415.4	10
Madrid (EAJ2) (Spain)	731		410.4	3
Seville (EAJ5) (Spain)	731		410.4	5
Turi (Estonia)	731		410.4	38
Munich (Germany)	740		405.4	100
Marseilles (P.T.T.) (France)	749		400.5	100
Katowice (Poland)	758		395.8	12
Scottish Regional (Burghead)	767		391.1	60
Scottish Regional (Westerglen)	767		391.1	70
Stalino (U.S.S.R.)	776		386.6	10
Toulouse (P.T.T.) (France)	776		386.6	120
Leipzig (Germany)	785		382.2	120
Barcelona (EAJ1) (Spain)	795		377.4	7.5
Lwów (Poland)	795		377.4	50
Welsh Regional (Penmon) (Anglesey)	804		373.1	5
Welsh Regional (Washford)	804		373.1	70
Milan (No. 1) (Italy)	814		368.6	50
Bucharest (Romania)	823		364.5	12
Bodö (Norway)	823		364.5	10
Kiev (No. 2) (U.S.S.R.)	832		360.6	35
Trondheim (Norway)	832		360.6	20
Berlin (Germany)	841		356.7	100
Sofia (Bulgaria)	850		352.9	100
Valencia (Spain)	850		352.9	3
Simferopol (U.S.S.R.)	859		349.2	10
Strasbourg (France)	859		349.2	100
Poznań (Poland)	868		345.6	50
London Regional (Brookmans Park)	877		342.1	70
Graz (Germany)	886		338.6	15
Linz (Germany)	886		338.6	15
Helsinki (Finland)	895		335.2	10
Hamburg (Germany)	904		331.9	100
Dniepropetrovsk (U.S.S.R.)	913		328.6	10
Toulouse (Radio Toulouse) (France)	913		328.6	60
Brno (Czechoslovakia)	922		325.4	32
Brussels (No. 2) (Belgium)	932		321.9	15
Algiers (Algeria)	941		318.8	12
Göteborg (Sweden)	941		318.8	10
Breslau (Germany)	950		315.8	100
Paris (Poste Parisien) (France)	959		312.8	60
Odessa (U.S.S.R.)	968		309.9	10
Northern Ireland Regional (Lisnagarvey)	977		307.1	100
Bologna (Radio Marconi) (Italy)	986		304.3	50
Toruń (Poland)	986		304.3	60
Hilversum (No. 2) (Holland)	995		301.5	65
Bratislava (Czechoslovakia)	1004		298.8	13.5
Chernigov (U.S.S.R.)	1013		296.2	4
Midland Regional (Droitwich)	1013		296.2	70
Barcelona (EAJ15) (Spain)	1022		293.5	3
Cracow (Poland)	1022		293.5	10
Königsberg (No. 1) (Germany)	1031		291	100
Parede (Portugal)	1031		291	5
Leningrad (No. 2) (U.S.S.R.)	1040		288.5	10
Rennes-Bretagne (France)	1040		288.5	120
West of England Regional (Washford)	1050		285.7	50
Bari (No. 1) (Italy)	1059		283.3	20
Tiraspol (U.S.S.R.)	1068		280.9	10
Bordeaux-Lafayette (France)	1077		278.6	60
Radio Normandie (France)	1095		274	20
Madrid (EAJ7) (Spain)	1095		274	5
Vinnitsa (U.S.S.R.)	1095		274	10
Kuldiga (Latvia)	1104		271.7	25
Tripoli (Libya)	1104		271.7	50
Melnik (Czechoslovakia)	1113		269.5	100
Nyiregyhaza (Hungary)	1122		267.4	6.25
North-East Regional (Stagshaw)	1122		267.4	60
Hörby (Sweden)	1131		265.3	60-100
Genoa (No. 1) (Italy)	1140		263.2	10
Trieste (Italy)	1140		263.2	10
Turin (No. 1) (Italy)	1140		263.2	100
London National (Brookmans Park)	1149		261.1	40
North National (Slaithwaite)	1149		261.1	40
Scottish National (Westerglen)	1149		261.1	50
Kassa (Hungary)	1158		259.1	10
Monte Ceneri (Switzerland)	1167		257.1	15
Copenhagen (Denmark)	1176		255.1	10
Nice-Côte d'Azur (France)	1185		253.2	60
Frankfurt (Germany)	1195		251	25
Freiburg-im-Breisgau (Germany)	1195		251	5
Troppau (Germany)	1204		249.2	5
Lille (Radio P.T.T. Nord) (France)	1213		247.3	60
Rome (No. 2) (Italy)	1222		245.5	60
Gleiwitz (Germany)	1231		243.7	5
Görlitz (Germany)	1231		243.7	5
Cork (Ireland)	1235		242.9	1
Saarbrücken (Germany)	1249		240.2	17
Riga (Latvia)	1258		238.5	15
Burgos (Spain)	1258		238.5	20
Salamanca (Spain)	1258		238.5	20
Aberdeen	1285		233.5	5
Klagenfurt (Germany)	1294		231.8	5
Vorarlberg (Germany)	1294		231.8	5
Radio Mediterranée (France)	1303		230.2	27
Naples (No. 1) (Italy)	1303		230.2	10
Malmö (Sweden)	1312		228.7	2.5
Bremen (Germany)	1330		225.6	2
Dublin (Ireland)	1348		222.6	0.5
Genoa (No. 2) (Italy)	1357		221.1	5
Turin (No. 2) (Italy)	1357		221.1	5
Milan (No. 2) (Italy)	1357		221.1	4
Bordeaux-Sud-Ouest (France)	1366		219.6	25
Warsaw (No. 2) (Poland)	1384		216.8	7
Lyons (Radio Lyons) (France)	1393		215.4	25
Vaasa (Finland)	1420		211.3	10
Kaiserlautern (Germany)	1429		209.9	2.5
Turin (No. 3) (Italy)	1429		209.9	5
Paris (Eiffel Tower) (France)	1456		206	7
Bournemouth	1474		203.5	1
Plymouth	1474		203.5	0.3

Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section

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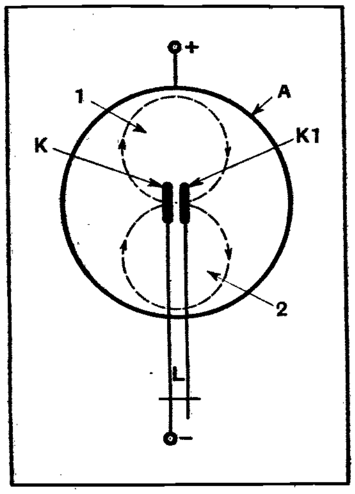
SECONDARY-EMISSION "OSCILLATORS"

A FORM of oscillation generator is known in which an electron stream is forced to travel to and fro between a pair of "target" electrodes so as to build up a large current by secondary emission. In this case an accelerating anode is usually arranged between the two targets, and tends to create a space-charge which limits the output. According to the invention, the two electron streams are forced to take separate paths, instead of vibrating along a common one, so that one does not tend to "choke" the other.

As shown in the Figure, two



Oscillation generator depending on secondary emission.

"cold" cathodes K, K1 co-operate with a common cylindrical anode A which is biased to provide an accelerating field. An external winding (not shown) supplies a magnetic field, the lines of which run at right angles to the plane of the paper. The action is explained as follows:—

An electron leaving the cathode K is forced by the combined effect of the electric and magnetic fields to describe the circular path marked 1. As the electron strikes against the cathode K1 on its return journey, secondary electrons are emitted, and necessarily travel away from the cathode in the opposite direction. The action of the magnetic field, therefore, compels them to follow the circular path marked 2. As they return to the cathode K and produce more secondary electrons, the latter are now forced to follow the circular path 1, and so on. To ensure that the impact always occurs with sufficient force, an oscillating voltage is applied to both cathodes from a Lecher wire circuit L, tuned to the working frequency.

Telefunken Ges. für drahtlose Telegraphie m.b.h. Convention date (Germany) April 20th, 1936. No. 494230.

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REMOTE CONTROL FOR LOUD SPEAKERS

A LOUD speaker is arranged to be supervised from a central station which may be so far distant as to be out of audible range. To allow this to be done the speaker is energised by carrier current modulated with the signal frequencies. Near the transmission and control point the carrier current is passed through a high-pass filter, from the further side of which a low-pass branch line goes back to the control.

Near the speaker the usual amplifier and detector unit is shunted by a similar low-pass circuit. This allows part of the rectified current to be fed back, from the speaker terminals, into the carrier wave transmission line. This "return" current can then pass, via the low-pass branch near the transmitter, direct to the control points so that an attendant there is able to hear the signals and can adjust the volume of the distant speaker accordingly.

C. Lorenz Akt. Convention date (Germany), December 22nd, 1936. No. 490497.

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PRODUCING TELEVISION SIGNALS

LIGHT rays are focused on to a photo-sensitive screen mounted at one end of a cathode-ray tube, and the electric "image" so formed is scanned by an electron stream projected from the other end of the same tube.

The screen liberates electrons corresponding to the light intensity of each picture point. These are focused by a magnetic coil which automatically deflects the "picture" stream out of the path of the oncoming "scanning" stream, because the two streams are travelling in opposite directions.

The picture stream is first accelerated by one or more "suction" rings, and is then projected on to target electrodes, which amplify it by secondary emission.

Radio-Akt. D. S. Loewe. Convention date (Germany) March 3rd, 1936. No. 492961.

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AUTOMATIC "HOMING"

ARRANGEMENTS are already known in which a rotary frame aerial, mounted on an aeroplane, is made to set itself automatically into line with a distant beacon station and to remain so set, even should the aeroplane yaw away from the "homing" course. Any off-course movement operates a differential relay, and so brings the machine back again on to its predetermined course.

According to the invention, the differential relay used to correct the steering includes a commutator device which applies the voltage picked up by the aerial (this being positive or negative according to whether the deviation is to port or starboard) to "trigger" one or other of a pair of gas-filled tubes. The resulting discharge current then drives a motor in one direction or the other, so as to restore the craft to its original course.

Telefunken Ges. für drahtlose Telegraphie m.b.h. Convention date (Germany) September 9th, 1936. No. 493393.

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RADIO BEACONS

FOR direction-finding purposes a beacon station is made to radiate two waves of the same frequency, one being modulated and the other not. The phase of one wave varies constantly with its direction in azimuth, whilst the phase of the other varies with time.

This produces, at a distance, a field of constant average amplitude, which is independent both of time and direction. The rate of modulation is, however, varied in accordance with the direction of the modulated beam, so that at a given moment it is zero along the North-South line, and at maximum along the East-West line. This "zero" characteristic is made to rotate at constant angular speed.

The arrangement, in effect, provides a "zero modulation" datum line for the receiver in place of the usual "zero field" indication, the advantage claimed being a longer range for a given power output.

Soc. Anon. des Ondes Dirigées. Convention date (France) February 14th, 1936. No. 491963.

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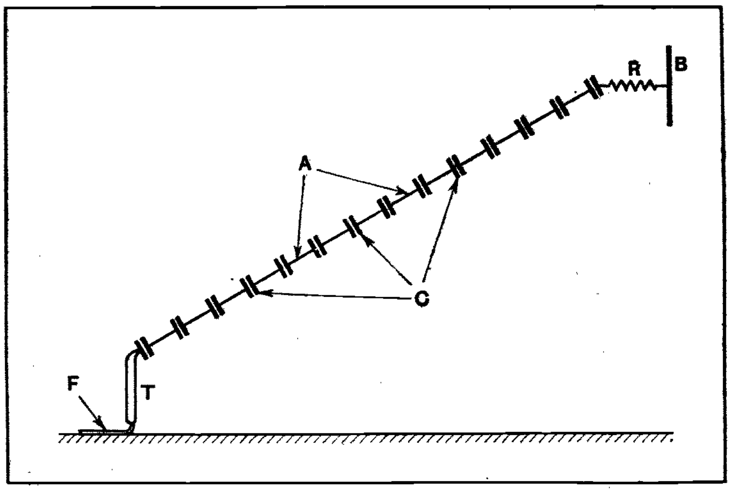
SHORT-WAVE AERIALS

THE drawing shows a "wide-band" aerial, suitable for receiving television signals, and less liable to inductive interference than the ordinary dipole. The aerial consists of a "conductor" A having an overall length of 50 to 60 feet, and loaded at intervals of 15 inches by small series condensers C of 50 m-mfds. The capacity loading creates a phase-velocity greater than that of the wave travelling freely in space. This, in combination with the "tilt" of the conductor, gives a pronounced directional effect, pointing away from the feeder end.

The loaded aerial is connected through a surge resistance R of 320 ohms to the centre point of an elevated wire B, which for signals on 45 megacycles is made 11 feet long, and acts as an effective "earth point," i.e., as a "half-wave" termination to the aerial proper. The lower end of the aerial A is connected through a matching transformer T, and the usual feed-line F, to the receiver.

E. C. Cork; M. Bowman-Manifold and J. L. Pawsey. Application dates February 9th and June 30th, 1937. No. 493758.



Television aerial with condensers inserted at short intervals in the lead-in wire.

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HIGH-FREQUENCY OSCILLATORS

A PIEZO-ELECTRIC crystal is frequently used to stabilise the frequency of short-wave generators, though for wavelengths below 5 metres tuned Lecher wire circuits are to be preferred. However, even the latter prove difficult to adjust on wavelengths of two metres or less, because the length of the connecting leads between the electrodes and the Lecher wire circuit may be sufficient to prevent the whole system from oscillating at a single natural frequency.

According to the invention, the split anodes of a magnetron valve, used for generating wavelengths of the order of one or two metres, are connected across voltage nodes on a tuned Lecher wire output circuit through connecting wires which are made telescopic, so that their electrical length can be made equal to a quarter-wave. Under these circumstances the

Recent Inventions—

combined wavelength of the valve electrodes and the connecting wires can be made equal to that of the Lecher wire output circuit so that the two circuits will oscillate as one at this stabilised frequency.

The General Electric Co., Ltd., and E. C. S. Megaw. Application date March 22nd, 1937. No. 492610.

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DIRECTION FINDERS

THE ordinary direction finder gives a maximum or minimum reading (as the case may be) at two points diametrically opposite to each other. It is therefore necessary to indicate which of the two readings is the correct one from the point of view of "sense." This is usually done by coupling the frame to a vertical aerial, when the two signal voltages combine to give a "heart-shaped" curve with only one minimum point, which can easily be ascertained by operating a reversing switch. The "minimum" of the heart-shaped curve is, however, not in line with the true bearing, but is displaced by 90° from it.

According to the invention, "sense finding" is simplified by connecting a single frame to a vertical aerial in such a way that at the correct minimum reading the indicator needle will "follow" any slight movement of the frame aerial, whereas at the other or incorrect minimum the indicator needle moves "against" a testing swing of the frame.

Telefunken Ges. fur drahtlose Telegraphie m.b.h. Convention date (Germany) April 7th, 1937. No. 492643.

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SECONDARY-EMISSION MULTIPLIERS

ZWORYKIN and Malter have recently discovered that it is possible to obtain a much higher ratio of secondary electrons from a target electrode when the sensitive material, such as cæsiated silver, is separated from the metal backing plate by a very thin layer of insulating material. The target is first subjected to an initial bombardment of electrons, which appear to have a polarising effect, so that the composite surface becomes abnormally sensitive. So much so that it will release as many as 3,000 secondary electrons for each primary electron which strikes against it. This so-called "anomalous" emission compares with a ratio of nine or ten—which was previously considered to be the best obtainable.

According to the invention, a target electrode, capable of giving anomalous secondary emission, is prepared by depositing a very thin layer (of the order of one-thousandth of an inch) of an alkaline-earth borate upon a metal backing plate, and then covering the borate with an equally thin layer of cæsium.

Marconi's Wireless Telegraph Co., Ltd. (assignees of F. R. Pidre). Convention date (U.S.A.), January 30th, 1937. No. 491287.

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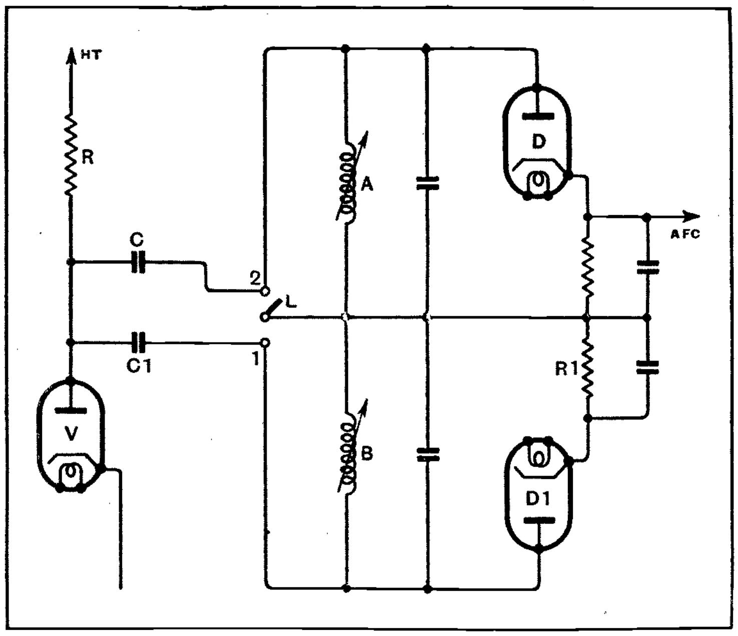
AUTOMATIC TUNING CONTROL

FOR automatic frequency control it is usual to provide two "discriminator" circuits, one tuned a little above, and the other a little below the fixed intermediate frequency of the set, the "unbalanced" voltage produced across these circuits by any initial mistuning then being applied to correct the mistake. In assembling the sets, however, it is found to be difficult to pre-fix the tuning of the two "offset" circuits with sufficient accuracy to produce the required results. The object of the invention is to simplify the operation.

As shown in the Figure, the anode of one of the IF valves V of a superhet receiver is connected to the HT supply through a resistance R, and is coupled to the two discriminator circuits A, B, through condensers C, C1. When assembling the set the movable connection L is first placed on the contact 1 as shown, and the two circuits A, B, are then tuned exactly to the IF frequency. The connection L is next moved over to the contact 2, the tuning of both circuits thus being altered by equal and opposite amounts. The connection L is then permanently soldered in position. The required AFC voltage is taken off, as shown, from the load resistance R1 of the diodes D, D1.

E. K. Cole, Ltd., and H. C. Rowe, Jr. Application date April 26th, 1937. No. 493788.



Method of facilitating the initial adjustment of AFC circuits.

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FIDELITY CONTROL IN TELEVISION

WHEN televising a scene, say, from a cinema film, the volume of sound heard from the receiver remains more or less the same, irrespective of the apparent size of the actors. That is to say, it is the same when a large field of view is being shown, where the actors appear comparatively small, as when a close-up is being given of one of the principal characters.

In order to produce a more perfect illusion an automatic control is applied to make the speech heard during a close-up sound as though it came from a nearer point than that heard during a normal scene.

The effect is secured by using a photo-sensitive cell to explore a selected point, which is representative of the character of the picture as a whole. The current from the cell is then applied either to regulate a tone control or to send out a pilot signal from the transmitter which automatically produces the required effect at the receiver.

Kolster-Brandes, Ltd., and C. N. Smyth. Application date March 2nd, 1937. No. 491502.

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RADIOGONIOMETERS

IN direction-finders of the Bellini-Tosi and Adcock types the aerial pick-up currents are transferred to a pair of small field-coils which produce a magnetic field orientated in the same direction as the incoming signal. This direction is then ascertained by means of a small rotary search-coil, the whole arrangement being known as a radiogoniometer.

For correct operation the EMF induced in the search-coil, as the latter is rotated in the field, should conform strictly to a sine curve. Otherwise the directional readings are confused by what is known as octantal error.

According to the invention the conditions likely to give rise to octantal error are avoided by winding each of the field-coils in two layers, one of which is laid at an angle of 60 deg. to the other. The two sets of windings are connected in series.

Standard Telephones and Cables, Ltd., I. R. J. James and C. F. A. Wagstaffe. Application date, March 19th, 1937. No. 492323.

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ELECTRON CAMERAS

A PICTURE to be televised is projected on to a photo-sensitive cathode, and the resulting electron stream is focused on to the plane of an anode, where it is swept to and fro, past a central aperture, by an applied scanning voltage. The electrons that pass through the aperture strike against a series of target electrodes, which form an electron multiplier housed in the same tube as the camera.

According to the invention the whole device is rendered inoperative, during the idle or flyback stroke of the scanning operation, by applying an intermittent negative pulse to one of the target electrodes of the electron multiplier. Preferably two pulses of opposite sign are applied simultaneously to two electrodes, so that the signal current is cut off during the "flyback" stroke without producing any unbalanced impulse in the output circuit.

Baird Television, Ltd., and V. A. Jones (addition to 470785). Application date March 23rd, 1937. No. 492602.

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AVC DISTORTION

WHEN, in order to prevent fading, an AVC voltage is applied to one or more of the RF stages in a wireless receiver, it is liable to do more than what is expected of it, namely, to increase the amplification of those valves. As we know from the methods used to secure automatic tuning control, any change of grid voltage tends to alter the effective reactance of a valve, and, therefore, the tuning of any circuit across which it is shunted. This sets a definite limit to the degree to which AVC can be applied without causing distortion of the received signals.

In order to remove this limitation, particularly in the case of the mixing valve in a superhet set, the frequency change due to AVC voltage is offset by a compensating voltage, which is derived from a resistance in the anode circuit and is applied through a condenser to the oscillating grid of the valve.

E. K. Cole, Ltd. Convention date (Sweden) May 15th, 1937. No. 492624.

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"ANTI-FADING" AERIALS

THE useful range of broadcast transmission is seriously diminished, particularly at night, by the reflection of high-angle radiation from the Heaviside layer. As is well known, the reflected energy interferes with the direct or earthbound wave to produce fading.

There are various known ways of reducing this high-angle or space-wave radiation. One is to use a single-mast antenna of sufficient height, and another is to use a shorter aerial provided with a top capacity or "roof," but both are costly expedients.

According to the invention, the required result is secured by using a mast antenna only slightly more than half a wavelength high, and by energising it, at a point about one-fifth of its height above ground, so that the phase of the current fed to the upper section is substantially 180 deg. out of phase with that supplied to the lower section. The resulting form-factor, or distribution of aerial current, is then such as to radiate a predominantly earthbound wave, with a relatively small vertical component.

Marconi's Wireless Telegraph Co., Ltd. (assignees of W. D. Duttera). Convention date (U.S.A.), April 16th, 1937. No. 491485.

MISCELLANEOUS ADVERTISEMENTS

NOTICES

THE CHARGE FOR ADVERTISEMENTS in these columns is

12 words or less, 3/- and 3d. for every additional word.

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ADVERTISEMENTS for these columns are accepted up to FIRST POST on MONDAY MORNING (previous to date of issue) at the Head Offices of "The Wireless World," Dorset House, Stamford Street, London, S.E.1, or on SATURDAY MORNING at the Branch Offices, 8-10, Corporation Street, Coventry; Guildhall Buildings, Navigation Street, Birmingham, 2; 260, Deansgate, Manchester, 3; 26b, Renfield Street, Glasgow, C.2.

Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section must be strictly prepaid.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and Cheques sent in payment for advertisements should be made payable to ILIFFE & SONS Ltd., and crossed & Co. Notes being untraceable if lost in transit should not be sent as remittances.

All letters relating to advertisements should quote the number which is printed at the end of each advertisement and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

NEW RECEIVERS AND AMPLIFIERS

DEGALLIERS, Ltd.—See our advertisement on Page 1.

NOTE New Address.—31, Craven Terrace, Lancaster Gate, W.2. Paddington 2745. [7934

BAKER'S New Quality Receiver and Corner Horn Speaker for Realistic Reproduction.—Details from Baker's Selhurst Radio, South Croydon. [7965

ARMSTRONG Co. Have Nine New Radio Chassis of Outstanding Merit, from the press-button model at £7/18/6 to the large variable selectivity model at £17/17.

ARMSTRONG Announce Model A46/FC Amplifier.—This new unit is a 6-watt push-pull amplifier having in addition to the normal flat frequency response, both a bass and treble boost circuit giving control of the frequency response at both ends of the audio spectrum; the price of model A46/FC is 11 gns.

ADVANCE Details of the New Amplifier, together with particulars of our standard 6-watt amplifier model A46/7 at 9 gns., the 12-watt amplifier model 127/PX at 12 gns. and the local station feeder unit RF2/4 at 3 gns., are available on request.

ARMSTRONG Co., 100, St. Pancras Way, Camden Town, London, N.W.1. [7974

ALBA, Ferguson, Ever-Ready, Halcyon, Portadyne, Sparton, Spencer and other first class makes always in stock; wholesale only.—Trade enquiries to Leonard Heys, 36, Henry St., Blackpool. [0610

MIDWEST (American) 1939 Receivers.—17-valve, five wavebands, 10 to 2,400 meters, two speaker combination; chassis complete, £21/10; cash only; send 1/- P.O. for detailed brochure.—Bennett's, 4, Humberstone Drive, Leicester. [7962

GENUINE Bargain.—Quality amplifiers, 8 watts, undistorted PP output, latest British octal base valves, tone control, matched energised speaker, wired and tested; £6 c.o.d., carriage paid.—Radio Chassis Supplies, Balmoral, Pavilion Drive, Leigh-on-Sea. [7940

RECEIVERS AND AMPLIFIERS
CLEARANCE, SURPLUS, ETC.

STOCKTAKING Sale.

BRAND New Receiver 1939 Models:—

59/6.—A.C.-D.C. Compact, with M.C. speaker 2-waveband, self-contained aerial.

£4/19/6.—All-wave superhet, push-button, 6 valve, M.C. speaker, marvellous tone, supersensitive, works on any mains, anywhere.

£12/12.—All-wave A.C. radiogram, very latest model, 6 valves, massive cabinet, quality output, lovely tone; worth £20.

WRITE for Lists of Components and Spares, etc.

RADIOGRAPIC, Ltd., 66, Osborne St., Glasgow. Bell 848. [7882

ARMSTRONG

NEW VARIABLE SELECTIVITY
MODEL AW125PP

12-V. 5-BAND ALL-WAVE RADIOGRAM CHASSIS

(12—550 continuous, 1000—2000 m.)

with R.F. Pre-Amplifier, 2 I.F. stages with Variable Selectivity. Manual R.F. gain control and 10 watts R.C. coupled Triode P.P. Output. **£17.17**

A few extracts from The Wireless World *TEST REPORT, Jan. 5th, 1939*

"IN compiling the specification of this receiver the makers have drawn upon the salient features of both long-range communication sets and quality amplifiers for local station reception. . . .

We had no difficulty in logging American broadcasting stations on the 13-, 16- and 19-metre bands . . . and comparison with ordinary all-wave sets leaves no doubt that the AW125PP is worthy of classification with the 'communication' type receivers as far as sensitivity is concerned.

. . . keen selectivity which enables one to get well within one channel on either side of the London Regional transmitter before the side bands begin to appear.

On long waves separation of the Deutschlandsender from Droitwich and Radio-Paris requires no skill in the handling of the controls, and the performance on this band is exceptionally good with ample sensitivity in reserve and very little background noise.

. . . A momentary test up to full volume on the local station failed to reveal any marked threshold of distortion, though judging from the sound level the output must have been very close to the rated upper limit of 10 watts.

. . . Full marks are due to the designer for the skill with which a 12-valve circuit has been compressed into a chassis very little bigger than that of the average 5-valve superheterodyne."

Copy of complete Report FREE upon request.

DEMONSTRATIONS

Extended hours for convenience of customers. Engineer in attendance until 5.30 p.m. on Saturdays and 7.30 p.m. Monday to Friday.

All Models Gladly Demonstrated

All Chassis sent on 7 days' approval, carriage paid

12 MONTHS' GUARANTEE

ARMSTRONG MANFG. CO.

100 ST. PANCRAS WAY, CAMDEN TOWN, N.W.1

'Phone: GULliver 3105

NUMBERED ADDRESSES

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." All replies should be addressed to the Box number shown in the advertisement, c/o "The Wireless World," Dorset House, Stamford Street, London, S.E.1. *Readers who reply to Box No. advertisements are warned against sending remittances through the post except in registered envelopes; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."*

DEPOSIT SYSTEM

Readers who hesitate to send money to advertisers in these columns may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged; on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Stamford Street, London, S.E.1, and cheques and money orders should be made payable to Iliffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post. When sending remittances direct to an advertiser, stamp for return should also be included for use in the event of the application proving unsuccessful.

RECEIVERS AND AMPLIFIERS, CLEARANCE, SURPLUS, ETC.

BANKRUPT Stock.—Brand new 1938 radio sets in makers' cartons with guarantees at less than half retail prices; send 1½d. stamp for list bargains.—261-3, Lichfield Rd., Aston, Birmingham. [7956

1938 Ekco 5v. Battery Superhet, £3/3; 1938 Cossor Allwave battery superhet, £4/4; 1939 2w. band Midget, A.C./D.C., 57/6; quotations submitted on all 1939 receivers, chassis, car radio.—Superadio, Dantzic St., Manchester. [7947

Wanted

WANTED.—Communication receiver or kit.—K. Oliver, 5, Ennismore Avenue, Guildford, Surrey. [7957

CHASSIS and Speaker for High-quality Reception; state price, demonstration required, London.—Box 8561, c/o *The Wireless World*. [7959

CAR RADIO

CAR Roof Aerials, improved type, chromium plated, 17/6 complete; vertical telescopic type, 12/6; American undercar aerials, single dipole, 9/6; De Luxe twins, rubber covered, 20/- pair; carriage paid.

WIRELESS SUPPLIES UNLIMITED, Essex House, Stratford, E.15. Maryland 3191. [0577

IF You Own a Car Radio, it is bound to "go wrong" some time; be a good friend to it and get it repaired quickly, and at reasonable cost; all makes overhauled; free quotations.—Scott-Sessions Co., Car Radio Department Exchange Works, Muswell Hill, N.10. Tudor 4101-2. [7498

PUBLIC ADDRESS

V

VORTEXION P.A. Equipment;

IMITATED, but unequalled.

WE Invite You to a Demonstration.

10-WATT Dance Band Amplifier for A.C.-D.C., complete in case with moving-coil microphone and speaker; £12/12.

15-20-WATT Amplifier, 30-18,000 cycles, independent mike and gram., inputs and controls, 0.037 volts required to full load, output for 4, 7.5 and 15 ohms speakers or to specification, inaudible hum level; 12-volt car battery and A.C. mains model, 12 gns.; A.C. only model, 8½ gns., complete, as reviewed by "Wireless World."

VENTILATED Steel Cases for Above; 12/6.

15-20 Watts Portable Amplifier, in case, with Collaro motor and Rothermel Piezo pick-up; £14.

(This advertisement continued on next page.)

PUBLIC ADDRESS

(This advertisement continued from previous page.)

50-WATT Output 6L6s, under 60-watt conditions, with negative feed back, separate rectifiers for anode, screen and bias, with better than 4% regulation, level response, 20-25,000 cycles, excellent driver, driver transformer and output transformer matching 2-30 ohms impedance, electronic mixing for mike and pick-up, with tone control, complete with valves and plugs; £15.

COMPLETE in Case, with turntable, B.T.H. Piezo pick-up and shielded microphone transformer, £20.

80-WATT Model, with negative feed back; £25, complete.

120-WATT Model, with negative feed back; £40, complete.

250-VOLT 250 m.a. Full Wave Speaker, field supply unit; 25/-, with valve.

ALL P.A. Accessories in Stock.

VORTEXION, Ltd., 182, The Broadway, Wimbledon, S.W.19. 'Phone: Lib. 2814. [7951

MARK DAVIS, Radio and Electrical Stores, 22, Lisle St., London, W.C.2.

EPOCH Speaker Super Cinema Model, 18½ cone, A.C. mains operation, brand new, £17/10 list, bargain; £6/10.

EPOCH Domino, 500 ohms field, 14½ cone, perfect condition; £4/10.

EPOCH Super Cinema Speaker, 18½ cone, 2,500 field, good condition; £4.

EPOCH Super Cinema Speaker, 6-volt field, no cone; 35/- each.

ERICSSON P.A. Speaker, 6-volt D.C. or 100-volt A.C., perfect condition; £3/10.

ROLA 10in. P.M. Speakers, latest type 15-ohm voice coil, brand new, boxed, a real bargain; 15/-.

ROLA 10in. 6-volt field, 10/-; 2,500 field, 10/-; 8in. 5,000 ohms field, 10/-.

BRITISH Acoustics Portable Recording Outfit, built-in amplifier, push-pull output, fitted with condenser, mike and crystal pick-up, latest type, listed at 27 gns., a real gift at £15.

SAYER Recording Motor and Tracking Gear, complete with low imp. cutting head, brand new A.C. mains 100-250 volt, listed 17 gns., bargain; £7/10.

SAYER Recording Motor, voltage as above, two only; 55/- each.

TRUVOICE Portable Amplified Electric Guitar, incorporating A.C., D.C. amplifier, push-pull output, 9 watts, for use as Spanish or Hawaiian, provision for mike, etc., brand new, listed at 27 gns.; £15; a wonderful bargain.

OPERADIO Portable Public Address Amplifier, 14 watts, push-pull output, moving coil mike, stand, etc., A.C. mains, 100-250 volts, brand new and listed at £36; don't miss this opportunity; £17/10.

PHILIPS Rack-built Double Channel Amplifier, 20 watts each, recently purchased from Ace Studios, fitted pre-amplifiers, Monitor speaker, etc., cost £128, condition as new, guaranteed working order; a real bargain at £15.

MARK DAVIS, Radio and Electrical Stores, 22, Lisle St., London, W.C.2. [7984

FOR Hire of Microphone and Amplification Equipment Write Harmony House, 116, Cambridge Rd., Southport. [7873

ALEXANDER BLACK, Ltd., Established 1925.—For microphone equipment when quality counts. Booklet on request.—55, Ebury St., S.W.1. Sloane 6129. [0596

NEW MAINS EQUIPMENT

V.

ALL Transformers at Last Week's Prices.

VORTEXION, Ltd., 182, The Broadway, Wimbledon, S.W.19. 'Phone Lib. 2814. [7978

TANTALUM for A.C. Chargers, H.T. and L.T.—Blackwell's Metallurgical Works, Ltd., Garston, Liverpool. [7263

MAINS EQUIPMENT

SECOND-HAND, CLEARANCE, SURPLUS, ETC.

SOUND Sales Transformer for W.W. 12-watt Amplifier, £2/5 or offer.—Jordan, 31, Egerton Gdns., Ealing. [7950

CABINETS

A CABINET for Every Radio Purpose.

CONVERT Your Set into a Radiogram at Minimum Cost; surplus cabinets from noted makers under cost of manufacture (undrilled), 30/- upwards; motors at wholesale price.

"FIT-A-GRAM" Cabinet, 31×17×15; 21/-.

UNDRILLED Table, console and loud-speaker cabinets from 3/6.

INSPECTION Invited, photos loaned to country customers.

H. L. SMITH and Co., Ltd., 289, Edgware Rd., W.2. Tel.: Pad. 5891. [0485

BRAND New Radiogram Cabinets (undrilled), 55/- each, worth 10 gns.; money back guarantee.—Haines and Son, 23, Denmark St., W.C.2. Tem. 5900. [7933

A BAKER Corner Horn Cabinet will Immensely Improve Reproduction from Your Present Speaker.—Details from Baker's Selhurst Radio, South Croydon. [7966

DYNAMOS, MOTORS, ETC.

D.C.-A.C. Convertors, motors, all voltages, for sale and wanted.—Easco, 18w, Brixton Rd., S.W.9. [0558

ALL Types of Rotary Converters, electric motors, battery chargers, petrol electric generator sets, etc., in stock, new and second-hand.

A.C.-D.C. Conversion Units for Operating D.C. Receivers from A.C. Mains, 100 watts output, £2/10; 150 watts output, £3/10.

WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0518

PREMIER
1939 RADIO

PREMIER BATTERY CHARGERS. Westinghouse Rectification. Complete. Ready for use. To charge 2 volts at ½ amp., 10/-; 6 volts at ½ amp., 16/6; 6 volts at 1 amp., 19/6; 12 volts at 1 amp., 21/-; 6 volts at 2 amps., 32/6.
AUTO TRANSFORMERS. Step up or down A.C. mains between 100—250 volts. 60 watts, 9/-; 100 watts, 11/6.
Premier Transverse Current Microphone, 20/-. Microphone Transformer, 6/-. Table Mike Stand, 7/6.
BRAIDED METAL SCREENED WIRE for mikes, pick-ups, etc. Single, 4d. yd.; Twin, 6d. yd.
PREMIER U.S.A. QUARTZ TRANSMITTING CRYSTALS, 7 mc. and 3.5 mc., 10/- each, with certificate. Enclosed holder and base, 3/-.
CARDBOARD ELECTROLYTIC CONDENSERS, 4 mf. or 8 mf. 500 v., 1/6 each, 8+4 mf. 500 v., 2/3, 8+8 mf. 500 v., 2/6, 4+4+4 mf. 500 v., 2/6, 16+8 mf. 500 v., 3/6.
TUBULAR METAL CAN ELECTROLYTICS hy famous makers. 4 or 8 mf. dry, 500 v., 2/6 each. 8 mf. wet, 450 v., 2/3. 8 mf. 650 v., Peak dry, 4/-.
BIAS CONDENSERS, 6 mf. 50 v., 6d.; 50 mf. 12 v., 1/-; 25 mf. 25 v., 1/-; 50 mf. 50 v., 1/9.
TUBULAR CONDENSERS, all values from .0001 to .5 mf., 6d. each.
U.S.A. VALVE HOLDERS, 4, 5, 6 and 7 pin., 6d. each. Octals, 9d.
CERAMIC U.S.A. VALVE HOLDERS, all fittings, 1/- each.
PREMIER S.W. H.F. Chokes, 10-100 metres, 9d. each. Pie-wound, 1/6 each. Screened, 1/6 each.
SHORT-WAVE COILS, 4- and 6-pin types, 13-26, 22-47, 41-94, 78-170 metres, 1/9 each, with circuit. Special set of S.W. Coils, 14-150 metres, 4/- set, with circuit. Premier 3-band S.W. coil, 11-25, 19-43, 38-86 metres. Suitable any type circuit, 2/6.
UTILITY Micro Cursor Dials, Direct and 100-1 Ratios, 3/9.
PREMIER Short-Wave Condensers, all-brass construction, with Trolitul insulation. 15 mmf., 1/6; 25 mmf., 1/7; 40 mmf., 1/9; 100 mmf., 2/-; 160 mmf., 2/3; 250 mmf., 2/6.
COIL FORMERS, 4- or 6-pin low-loss, 1/- each.
LISSEN Power Packs in aluminium cases, 150 v., 25 m.a., with 6.3 v. L.T., 100-250 v. mains, 10/6, with Rectifier.
METAL RECTIFIERS, 250 v., 60 m.a. output, 4/6 each.
SPECIAL OFFER COLLARO AUTO RECORD CHANGERS, 100-250 v., A.C. Will play 8 records 8in., 10in. or 12in. A few only at £5 19s. 6d. AC/DC model, £7 7s.
AMERICAN VALVES. We hold the largest stocks of U.S.A. tubes in this country and are sole British Distributors for **TRIAD** High-grade American Valves. All types in stock. Standard types, 5/6 each. All the new Octal Base tubes at 6/6 each, 210 and 250, 8/6 each.
EUROPA MAINS VALVES, 4 v. A.C. Types, A.C./HL., A.C./L., A.C./S.G., A.C./V.M.S.G., A.C./H.P., A.C./V.H.P., A.C./P., and 1 watt D.H. Pentodes, all 4/6 each. A.C./Pens., I.H., 5/6; A.C./P.X.4, 6/6; Oct. Freq. Changers, 8/6; Double Diode Triodes, 7/6; Triode H. ex. Freq. Ch., 8/6; Tri. Grid Pen., 10/6; 3½-watt D.H. Triode, 7/6. 350 v. and 500 v. F.W. Rect., 5/6. 13 v. 2 amps. Gen. Purpose Triodes, 5/6; H.F. Pens. and Var.-Mu. H.F. Pens., Double Diode Triodes, Oct. Freq. Changers, 7/6 each. Full-wave and Half-wave Rectifiers, 5/9 each.

Premier Short-Wave Kits

Complete to the last detail including all Valves and coils, as well as theoretical and wiring diagrams and lucid instructions for building and working. Each kit is supplied with a steel Chassis and Panel and uses plug-in coils to tune from 13 to 170 metres.

1 Valve Short-Wave Receiver or Adapter Kit ...	17/6
1 Valve Short-Wave Superhet Converter Kit ...	20/-
1 Valve Short-Wave A.C. Superhet Converter Kit	22/6
2 Valve Short-Wave Receiver Kit	25/-
3 Valve Short-Wave Screen Grid and Pentode Kit	58/6

Premier Matchmaker Universal Modulation Transformers

Will match any modulator to any R.F. Secondary Load, Triodes, Tetrodes, and Pentodes Class A Single or Push-Pull Class "ABI" and "B" in Push-Pull or 500 ohms line input, can easily be matched to any of the following Radio Frequency final stages requiring modulation. Triodes, Tetrodes or Pentodes operating under Class "A," "B," "BC" and "C" conditions either Single or Push-Pull. Totally enclosed in cast cases with engraved Panel, and full instructions. Ratings are based on R.F. inputs. 50 Watt, 17/6. 150 Watt, 29/6. 300 Watt, 49/6.
A new range of "Matchmaker" Universal Output Transformers which are designed to match any output valves to any speaker impedance, are now ready. 11 ratios, from 13:1 to 80:1.
5-7 Watt, 13/6. 10-15 Watt, 17/6. 20-30 Watt, 29/6.

Our City Branch is moving from 165 to 169, Fleet Street. You are invited to inspect the many BARGAINS at our CLEARANCE SALE—NOW ON at 165, Fleet Street, E.C.4. *Callers only.*

Have you had our 1939 Catalogue. Handbook and Valve Manual? 90 pages of Radio Bargains and Interesting Data. Price 6d.

ALL POST ORDERS TO: Jubilee Works, 167, Lower Clapton Road, London, E.5. *Amherst* 4723.
CALLERS to:—Jubilee Works, or 165, Fleet Street, E.C.4. *Central* 2833, **or 50, High Street, Clapham, S.W.4** *Macaulay* 2381.

DYNAMOS, MOTORS, ETC.

MOTOR Generator Set, input 200 v. 50 cycle, output 400 v. 0.2 amps, and 12 v. 8 amps, with baseplate, smoothing circuit and screening box, condition as new; £12.

ALSO Set, input 200 v. A.C., output 420 v. 0.2 amps, and 10 v. 8 amps, condition as new; £7.

BAILY, GRUNDY and BARRETT, Ltd., 2, St. Mary's Passage, Cambridge. [7884

RECORDING EQUIPMENT

ALL Recording Discs and Materials in Stock; tracker units, £4/7/6; recording motors, £3/17/6.—Write for further details, Will Day, Ltd., 19, Lisle St., W.C.2. [0595

LIVERPOOL Sound Studios, 83a, Bold St., Liverpool. —Personal recordings from 3/6; amplifiers, microphones, recording motors and trackers, blank discs, etc. [7964

NEW LOUD-SPEAKERS

VOIGT, Manchester Agents.—Private demonstrations arranged.—Holiday and Hemmerdinger, Ltd., 74, Hardman St., Manchester. [7878

BAKER'S New Corner Horn Speakers set a New High Standard in the Realistic Re-creation of Speech and Music Which Will Appeal to All Music Lovers; your present receiver or speaker taken in part exchange.—Details from the Pioneer Manufacturers of Moving Coil Speakers, Baker's Selhurst Radio, 75, Sussex Rd., South Croydon. [7967

LOUD-SPEAKERS

SECOND-HAND, CLEARANCE, SURPLUS, ETC.

HARTLEY TURNER 40-watt Duode, £5/15, with rectifiers; cost £9 December.—Attwood, 8, Clare Gdns., Barking. [7955

ROLA G12 Energised, 44/-; P.M., 56/6; 8-inch P.M. Universal transformer, 12/6.—Superadio, Dantzic St., Manchester. [7945

G.12 Rolas, brand new; P.M., 59/6; energised, 47/6; Rola 8in., energised, 6/11.—Shippers, 18, Corporation St., Manchester. [0606

3,000 Speakers from 5/6 each, P.M. and energised 4in. to 14in. including several Epoch 18in. —Sinclair Speakers, Alma Grove, Copenhagen St., N.1. [0590

BAKER'S New Corner Horn Speakers Take the Place of all Previous Models; limited number of new surplus super power speakers, electro and permanent magnet, available at half price.—Details from Baker's Selhurst Radio, South Croydon. [7969

LOUD-SPEAKER CONVERSIONS

SINCLAIR SPEAKERS.—For conversions of all makes and types; advice given.—Alma Grove, Copenhagen St., N.1. [0593

BAKER'S New Triple Cone and Corner Horn Conversions Will Considerably Improve Reproduction from Your Present Speaker, whatever make, British or American.—Details from Baker's Selhurst Radio, South Croydon. [7968

TRANSMITTING APPARATUS

G5N1.—The recognised distributors for amateur equipment, National R.M.E., Thordarson, Hammarlund, McMurdo, Hallicrafters, etc.; send 1½d. stamp for catalogue.—G5N1 (Birmingham), Ltd., 44, Holloway Head, Birmingham. [0531

A.C.S. RADIO, specialists in short-wave apparatus; communication receivers, including Hallicrafters, National and R.M.E. transmitting equipment, valves and components.—Send for free catalogue to A.C.S. Radio, 16, Gray's Inn Rd., W.C.1. Holborn 9894-5. G2NK, Technical Manager. [0550

VALVES

ANDERSON.

ALL Types of American Valves, first grade only, Ken.-Rad., Philco, Hytron, Raytheon, all tubes fully guaranteed, 5/- each; also line cords, resistances and electrolytic condensers for replacements. Stamp with all enquiries.

ANDERSON, 34, Wadham Avenue, Walthamstow, E.17. Larkswood 1574. [7802

ALL Types of American Tubes in Stock of Impex and Arcturus makes, at competitive prices.

WE Can Also Supply a Full Range of Guaranteed Replacement Valves for Any British, non-ring, American or Continental type at an appreciably lower price.

SEND for Lists of These, and also electrolytic condensers, line cords, resistances, etc.

CHAS. F. WARD, 46, Farringdon St., London, E.C.4. Tel.: Holborn 9703. [0452

HIVAC, Tungsram, Triotron, Raytheon, Philco; wholesale only.—Leonard Heys, 36, Henry St., Blackpool. [0609

SPECIAL Offer.—American valves in makers' cartons; all types, including octals and 6L6, 3/- each.—Metropolitan Radio Service.

AMERICAN Valves, first grade, in all types; trade supplied.—Metropolitan Radio Service Co., 1021, Finchley Rd., N.W.11. Speedwell 3000. [0436

SPECIAL Offer, 80, 6A7, 42, 2/-; other numbers, 2/8; 6A8G, 2/8; Kenrad, Hytron, Acturus, from 3/6; Europa mains valves, from 3/6.—Superadio, Dantzic St., Manchester. [7948

2/9, American R.C.A.; popular types; guaranteed; 2,000 non-ring British, also National Union from less 50%; new lists free.—Shippers, 18, Corporation St., Manchester. [0607

TELEVISION APPARATUS

1938 Halcyon Television Receiver, 22 valves, 10BY8 picture incorporating all-wave receiver, brand new and in perfect order, cost 55 gns.; a bargain, £28.—Mark Davis, 22, Lisle St., W.C.2. [7985

METERS, ETC.

AVO, Weston, Taylor, Hunts, Triplett, Wearite, etc.; trade enquiries only.—Leonard Iley, 36, Henry St., Blackpool. [0608

TEST EQUIPMENT

ALL Kinds of Testing Equipment Wanted.—Box 8441, c/o *The Wireless World*. [7976

UNIVERSAL Avometer, perfect condition; £6/10.—R. A. Griffiths, 13, Stratford Rd., Southall. [7958

R.C.O. Oscilloscope, complete kit, including Hivac C.R.3; £3/12/6; less cabinet.—Superadio, Dantzic St., Manchester. [7946

PHILCO Valve Tester, A.C. 200-250, complete with two panels and elaborate display stand, embodying three coloured lights for good, bad or weak valves, which work in conjunction with meter, listed £17/10; £8/5, carriage paid.

HENRY'S, 72, Wellington Av., London, N.15. Stamford Hill 2907. [7982

NEW COMPONENTS

SPECIAL Offer, limited quantity.

1,000-VOLT Wkg.; 4 mfd., 5/-; 2 mfd., 3/- (metal case).

800-VOLT Wkg. Tubulars; 0.5 mfd., 9d.; 0.25 mfd., 6d.; 0.1 mfd., 4d.; 0.05 mfd., 3d.

400-VOLT Wkg. Tubulars; 1.0 mfd., 6d.; 0.5 mfd., 4d.; 0.25 mfd., 3d.; 0.05 mfd. and 0.01 mfd., 1/- doz.

ELECTROLYTIC Blocks, 500 p.v.

32+8 mfd., 3/9 each; 32 mfd., 3/3 each; 16 mfd., 2/- each; 8+8 mfd. 350 p.v., 1/6.

TUBULARS; 50 mfd. 50 p.v., 1/3; 25 mfd. 25 p.v., 9d.

ALUMINIUM Can Vertical, 8+8 mfd. 500 p.v., 4 leads; 2/- each.

CONDENSERS. British manufacture, metal case (paper); 800-volt wkg. 4 mfd., 4/-; 2 mfd., 2/6; 1 mfd., 1/9; 500-volt wkg. 4 mfd., 3/-; 2 mfd., 1/9; 1 mfd., 1/3; 400-volt wkg. 4 mfd., 1/9; 2 mfd., 1/-; 1 mfd., 7d.

ELECTROLYTIC: 500-volt pk.: 4 mfd., 1/3; 8 mfd., 1/6; 8+4 mfd., 2/3; 8+8 mfd., 2/9; post 6d., or c.o.d.

THE STATIC CONDENSER Co., 387a, King St., Hammersmith, London, W.6. [7972

ANGLO AMERICAN RADIO (and MOTORS), Ltd.

MEISSNER 1939 Products.

JUST Arrived.

47/6.—New 8-button push-button tuner, can be affixed to any superhet or T.R.F. receiver, any make, 2 or 3-gang mains or battery, only three wires to connect to top of gang condensers; the best push-button tuner the United States has produced; order now for immediate delivery; full instructions in each carton; ten minutes to fix.

£12/10.—Meissner signal shifter is completely assembled, wired and adjusted with one set of coils and has its own power supply, three provision switch providing "automatic stand-by," "continuous operation" and "manual stand-by"; in fact, makes your QSO's 100%.

£10/17/6.—All-wave tuning unit.

THE Meissner All-wave Tuning Assembly is the Complete Heart of the Receiver, consisting of 5 band coil and switch assembly, 6.8 to 2,140 metres, individual coils for each band, low loss bakelite forms, align-aire trimmers, 6-gang shorting switch, Meissner quality precision 3-gang variable tuning condenser, illuminated oblong dial, fully calibrated 5-band scale, completely mounted on rigid crackled steel chassis, all components carefully mounted and including all resistors, by-pass condensers, coupling condensers and A.V.C. network associated with the R.F. mixer and oscillator circuits; every unit completely aligned and padded and laboratory tested; 2d. stamp brings complete illustrated lists of Meissner products by return post from sole distributing agents of Meissner Manufacturing Company of U.S.A.

ANGLO-AMERICAN RADIO (and MOTORS), Ltd. (Dept. J/30), Albion House, New Oxford St., London, W.C.1. [7643

COMPONENTS

SECOND-HAND, CLEARANCE, SURPLUS, ETC.

PREMIER SUPPLY STORES.

PLEASE See Our Displayed Advertisement on page 3. [0488

18 s.w.g. Aluminium Chassis, 16in.×10in.×3in., undrilled, 6/6; any size constructed to order; stamp for quotation.

CARDBOARD Case Electrolytics, B.I., Ferranti, etc., 8 mfd., 1/9; 4 mfd., 1/6; 8 mfd.×8 mfd., 2/9.—Olivers, 676, Christchurch Rd., Boscombe, Hants. [7961

GARRARD A.C. 200-250 Record Changer, plays eight 10- or 12-in. records, model R.C4A; £5/5, sealed cartons, carriage paid.

ELECTRIC Dry Shaver, A.C./D.C., 200-250, "Minute Man," list price £2/10; our price £1/10, complete with leatherette case, one year's guarantee; send for details; trade supplied.

MARCONI K.25 Pick-up, unused and boxed; 14/-.

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COMPONENTS—SECOND-HAND, CLEARANCE, SURPLUS, ETC.

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22/6.—5-band pentode battery kits. Complete 1939 all-wave kits metal chassis and all accessories, 10-2,000 metres, world-wide reception; complete, less valves, 22/6; with 3 valves, 34/6.

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VALVES for American Receivers, all types; 5/3 each.

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36 Assorted 1-watt Wire-ended Resistances, 5/6; 24 tubular condensers, assorted capacities up to 0.5 mfd., 6/-; volume controls, assorted capacities (less switch), 7/6 dozen; with switch, 11/6 dozen; mica condensers, assorted, 1/9 dozen; Mainsbridge type condensers, 1 mfd., 2 mfd., 4 mfd., 8 mfd., 8/- dozen; valve holders, 5-pin, 7-pin, 9-pin, 2/6 dozen; battery leads, multi-way, 6/6 dozen; parcel of assorted servicing components comprising resistances; tubular, mica, variable, electrolytic and block condensers; wire; sleeving; volume controls; valve holders, etc., etc., 10/- each; parcel containing at least 100 articles.

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MAINS RADIO DEVELOPMENT COMPANY.

MAINS RADIO DEVELOPMENT COMPANY Offer Outstanding Bargains, carriage paid, delivery by return. Telephone Tudor 4046, or call mornings. Stamp for List 221.

TRANSATLANTIC 1939 4 Waveband Superhet Tuning Packs, covering 10-30, 30-82, 198-560, 800-2,200 metres, comprising all coils, J.B. bar-gang condenser, full vision coloured 2-speed drive, Yaxley switching, two 465 k/c. I.F. transformers, etc., completely wired, with A.V.C. line, aligned, tested, ready to connect, 3-gang, H.F., F.C. and I.F., 65/-; 2-gang F.C. and I.F., 47/6.

AMPLIFIERS, six-watt push-pull, for MH4 and two PX4's or equivalents. Absolute complete kit of parts, best tested components, with circuit; 52/6, less valves.

ERIE 1-watt Colour Coded Unused Resistors, wire ends, any size 50 ohms to 5 megohms, your selection, 3d. each, 2/6 dozen; 2-watt, 6d. each.

CENTRALAB Latest Potentiometers, unused, long spindle, all sizes, 5,000 ohms-1 megohm, 2/-; with mains switch, 2/3.

T.C.C. Card 8 mfd. 600-volt Peak Electrolytics, 1/6; T.C.C., metal, 8 mfd., 600-volt peak, 2/3; T.C.C., card, 8×8 mfd. 600-volt peak, 2/9.

4/-.—Famous make fully guaranteed American tubes, coloured boxes, first grade, all popular types, 4/-; popular glass Octals, 4/6.

CLIX Unused Chassis v.-holders, 5-, 7-, 9-pin, 3d. each; all American sizes, 6d.; best sleeving, 1½d. yard.

TUBULAR Condensers, 400-volt working, wire ends, best make, 0.0001-0.05 mfd., 4d.; 0.1 mfd., 4d.; 0.25, 0.5 mfd., 6d.

FIFTY N.S.F. ½-, 1- and 2-watt Resistors, wire ends, marked and colour coded, over 20 good sizes in each parcel; 2/6 per 50 only.

FERRANTI Twin H.F. Choke Mains Interference Filters, extraordinarily effective; to clear, 1/-.

MAINS RADIO DEVELOPMENT COMPANY, 4-6, Muswell Hill Rd., London, N.6. Tudor 4046. [7853

VAUXHALL.—All goods previously advertised are still available; send now for latest price list, free.—Vauxhall Utilities, 163a, Strand, W.C.2. [7980

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BROWN Type "A" Single Earpiece, 2,000 ohms, on handle with volume control, made for "Ardente"; 12/6.—Post Radio, 2, Copenhagen St., London, N.1. [7954

MEISSNER All-wave 1939 Tuning Assembly, listed, less valves, £10/17/6; bargain, £8/8, valves included; offers considered.—Hunt, Park Crescent, Torquay. [7949

FERRANTI af5cs, af11c, b5, 12/6 each; af5, af6, opm6, 6/6 each; Rola G12 speakers, 2,500 and 1,250 field, 45/- each; R.K. Senior, D.C. field, 35/-.—Claremont Radio, 112, Pentonville Rd., London. [7975

CRYSTAL Microphone, chromium, brush crystal, listed £4/10, new Xmas, £2; Ediswan photo cell, emission OK, cost £7, yours for £2; G12s, 42/6 while they last; B.T.H. Universal motor, B.T.H. pick-up on polished oak board, 32/6; Exide L.T. trickle charger, A.C., heavy job, 15/-; Ferranti transformers, all types, less 33⅓%; huge quantity components at fraction of original cost; all goods tested before despatch.—Broad, 137, Grange Rd., King's Heath, Birmingham. [7953

COMPONENTS—SECOND-HAND, CLEARANCE, SURPLUS, ETC.

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RADIO CLEARANCE, Ltd., 63, High Holborn, W.C.1, open the New Year with special offers of brand new receivers and components, etc., maintaining their reputation as the leading Mail Order House for surplus radio.

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BRITISH Belmont 8-valve Plus Magic Eye All-wave A.C. Superhet Chassis. 4 wave-bands, two short, medium and long, fitted latest Mullard octal base American type valves. Brief specification: Short wave 6-18 metres (covers television sound), short wave 2, 18-50 metres, medium band 200-550 metres, long 900-2.000 metres. Valve combination 6K7, Pre H.F., 6J7 oscillator, 6J7 mixer, 6K7 I.F., 6Q7 (DDT) detection, A.V.C. and first L.F. two 6F6s parallel output, 5Y3 rectifier, plus 6G5 Magic Eye visual tuning, handsome dial, station names etched on glass; controls 2-speed tuning, volume and on/off, combined variable tone control and selectivity switch wave change plus gramo. switch. Size of chassis, 13½in.×10in.×3in. Supplied complete with valves, escutcheon, knobs and chassis bolts, but less speaker; £5/19/6 each.

COMPLETE Receiver in Handsome Walnut Cabinet, details as above, complete with speaker; £7/7 each.

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DECCA 6-valve 3 Wave-band Battery Chassis, fitted complete with Mazda and Osram valves, QPP output; these chassis give a sparkling performance on all wave-bands, and are the product of a well-known manufacturer; complete with valves. £3/3 each.

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AMERICAN Valves, special offer, Majestic 6Z5 full wave rectifier, 6.3 v. 250 volts, 60 m.a., 9d. each; also 55 and 6D7, 9d. each.

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HUGE Purchase Plessey Mallory Electrolytics, at the following special prices.

8+4+4+4 Mfd., 570v. working, +4 mfd. 300v. working, metal case, size 2½in.×1½in.×4½in., common negative; for E.M.I. replacements, etc.; 3/6 each.

16+8 mfd., 470v. working, can neutral, common negative; 2/2 each.

8+12+2 Mfd., 500v. working, +2 mfd., 250v. working, cardboard type, wire ends, common negative; 2/6 each.

24 Mfd., 450v. working, can type, can negative; 2/- each.

32 Mfd., ditto; 2/- each.

16 Mfd., 475v. working, ditto; 1/6 each.

16 Mfd., 475v. working, can neutral, separate negative; 1/6 each.

8+8 Mfd., 475v. working, can negative; 2/- each.

8+8+2+1 Mfd., 450v. working, cardboard type, wire ends, common negative; 2/8 each.

8 Mfd., 450v. working, +16 mfd., 350v. working, can type, common negative; 1/6 each.

8 Mfd., 450v. working, +16 mfd., 350v. working, ditto, 1/6 each. (Neutral, can common negative.)

8 Mfd., 250v. working, cardboard; 10d. each.

6 Mfd., 450v. working, +4 mfd., 450v. working, common negative, cardboard; 1/2 each.

6 Mfd., 450v. working, can type; 1/- each.

8 Mfd., 350v. working, can type; 1/5 each.

60 Mfd., 150v. working, can type; 1/- each.

50 Mfd., 12v., wire end tubulars; 9d. each/

25 Mfd., 3-volt working, tubular, wire ends; 6d. each.

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B.I. 25 Mfd., 25-volt, wire end tubulars; 6d. each.

B.I. 4 Mfd., 200-volt, wire end tubulars; 10d. each.

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PLESSEY Rotary Switches, make and break Yaxley type, 18 contact; 4d. each.

PLESSEY Rotary Switches, make and break Yaxley type, 6 contact; 3d. each.

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YAXLEY Type Switches.

TYPE No. 1587, 2 pole, 5-way, 4 bank, 9½in. overall length, 1in. shaft; 2/6 each.

TYPE No. 1575, 4 pole, 4-way, 3 bank, 6½in. overall length, 1¼in. shaft; 2/- each.

TYPE No. 3077, 2 pole, 2 bank, W/C and R/G switch, 4in. overall length, 1in. shaft; 1/6 each.

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PLESSEY Wire Wound Volume Controls, with switch, 5,000 ohms, 1/- each.

BRADLEY Ohm Volume Controls, wire wound, with switch, 600,000 ohms, 8d. each.

CENTRALAB Volume Controls, with switch, long spindle, 1,000, 5,000, 10,000, 25,000, 50,000, 250,000, 500,000, 100,000; 2/3 each.

RADIO Clearance Bargains Continued in Third Column.

COMPONENTS—SECOND-HAND, CLEARANCE, SURPLUS, ETC.

RADIO CLEARANCE, Ltd., continuing bargains in components, etc.

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POLAR N.S.F. 1-watt Resistances, all sizes up to 2 meg; 3½d. each, 3/- dozen.

GRAHAM FARISH Ceramic Short Wave Valveholders, 4-pin only; 3d. each.

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SPECIAL Offer Plessey Slow Motion Drives.

TYPE 1841/1125, size of dial 5in. square, dual-speed friction drive, two bolt fixing; 2/- each.

TYPE 1393, size of dial 4in.×5in., single speed friction drive, two bolt fixing; 1/10 each.

TYPE 1510, size of dial 4in.×5in., single speed, two bolt fixing; 1/10 each.

TYPE 2077, clock face dial, two-speed, separate indicators, size of dial 5in.×5in., two bolt fixing to chassis (hour and minute hand type); 4/6.

TYPE 2806, friction drive, size of dial 8in.×3in., overall height 8in.; 2/- each.

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ALL The Above With Plain Unprinted Scales Only.

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BULGIN S.P. S.T. Twist Switches (on-off); 10d. each.

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ERIE, 500,000 ohms only, volume controls, with switches; 1/6 each.

ALL Other Lines Previously Advertised Still Available.

ALL Orders to the Value of 5/- Post Free, under this amount reasonable postage must be included; c.o.d. orders will be definitely refused for value of less than 5/-; enquiries 1½d. stamp if reply expected. Hours of business, week-days 9 a.m. to 7 p.m.; Saturdays 9 a.m. to 1 p.m. Postal rates as above apply to the United Kingdom only, orders for Ireland and abroad must include sufficient postage to cover whatever the value of same.

RADIO CLEARANCE, Ltd., 63, High Holborn, W.C.1. Telephone: Holborn 4631. [7973

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VARIABLE Condensers.—Plessey small screened twin gang with top trimmers, 2/9; Plessey midget semi-screened twin gang, 2/9; Plessey full size screened with top trimmers, 3-gang, 2/9; Cossor fully screened 3-gang with trimmers, 1/9.

SATOR Volume Controls, ½ meg. with switch, 10,000 ohm with switch, 10,000 broad base for tone control, 5,000 ohm wire wound less switch, all 1/3 each or 6/6 dozen.

SALE.—Last few sets iron core superhet coils, R.F. or band pass with coil details, padder values, 5 coils, including 2 I.F.s, 5/9. Note.—465K.C. 2-band.

AMERICAN Type Valves, 80 42, 43, 6a7, 6d6, 6c6, 12z3, 46, 57, 2/3 each; 6B8g, 6G5, 6K7g, 5Y4g, 25L6, 3/3 each; sockets, 4-, 5-, 6-, 7-pin, 4d. each, 3/- dozen.

ALL-WAVE Aerial Kits, complete with two transformers, wire and lead in, insulators and full instructions, U.S.A. make; 13/9 each.

B.I. Tubular Condensers, new stock, 4 mf. electrolytic, 200v. peak, 6d. each; B.I. 0.05 tubulars, 350v. wkg., 1/3 dozen or 4/6 half gross, 6/6 gross; B.I. 0.25 tubulars, 2/- dozen.

SATOR Silver Mica Type Condensers, .0001, .0002, .0005, 1/3 dozen; Sator tubulars, 1,500v. test, .001, .002, .003, .005, 1/3 dozen; .01, .03, 1/3 dozen or 4/6 half gross, 7/6 gross.

HAMMARLUND Midget 30 mm. Trimmers, Paxolin, 1/9 dozen; top cap thimbles, 18 for 1/3, 3/9 half gross; clip on bulb holders, 1/3 dozen, 4/6 half gross, 6/9 gross.

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SPECIAL Offer 1-watt Carbon Resistors, colour coded, usual type, sizes 7,500 to 150,000 ohms, about 15 sizes at 2/6 per 50; good assortment given.

B.I. Electrolytic Blocks, 12×8×4×25×25mf., 450v.-25v. wkg., 1/9, 15/- per dozen; B.I. 12×8×50 350v.-12v. wkg., 1/3; Ferranti midget 4×4 electrolytics, 450v. peak, size 2½in.×1¾×1¼, 1/3 each, or 10/- per dozen.

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ZENITH Wirewound Insulated Resistances, 550 ohms, tapped at 350-70-100; ex Ferranti, rating 0.3a., as used in A.C.-D.C. sets, 1/4 each, or 9/6 per dozen.—Ryall's Radio, see above. [7977

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HUGE Success of Our 2/6 Parcels of Surplus Components (5lb.). "Amazing value," writes one customer. "Please repeat," writes another. Each parcel guaranteed to contain 10/- worth useful parts, i.e., coils, trimmers, condensers, odds and ends, etc. Ideal for dealers.

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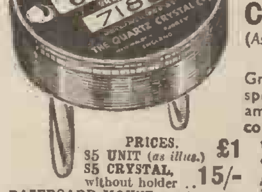

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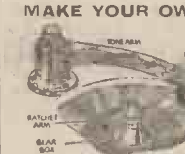

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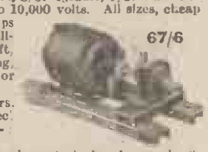

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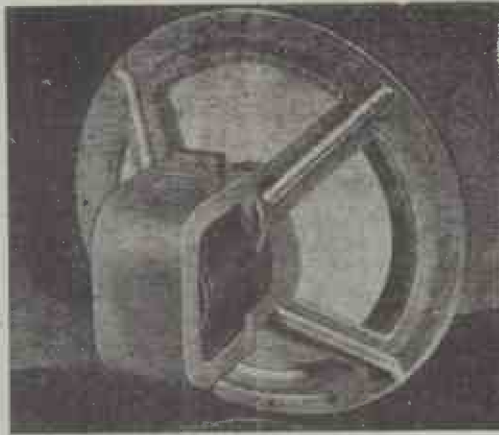

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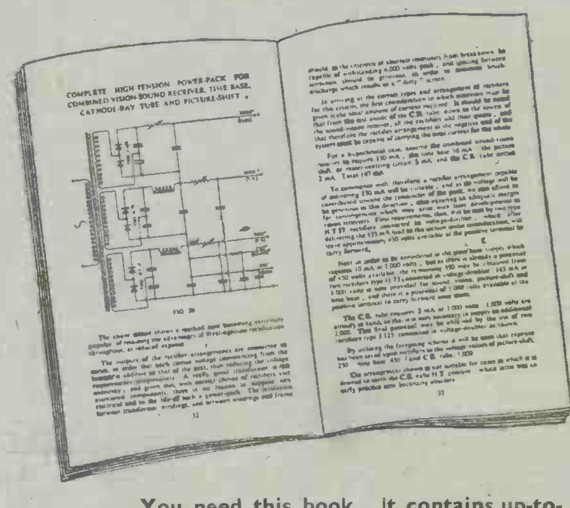

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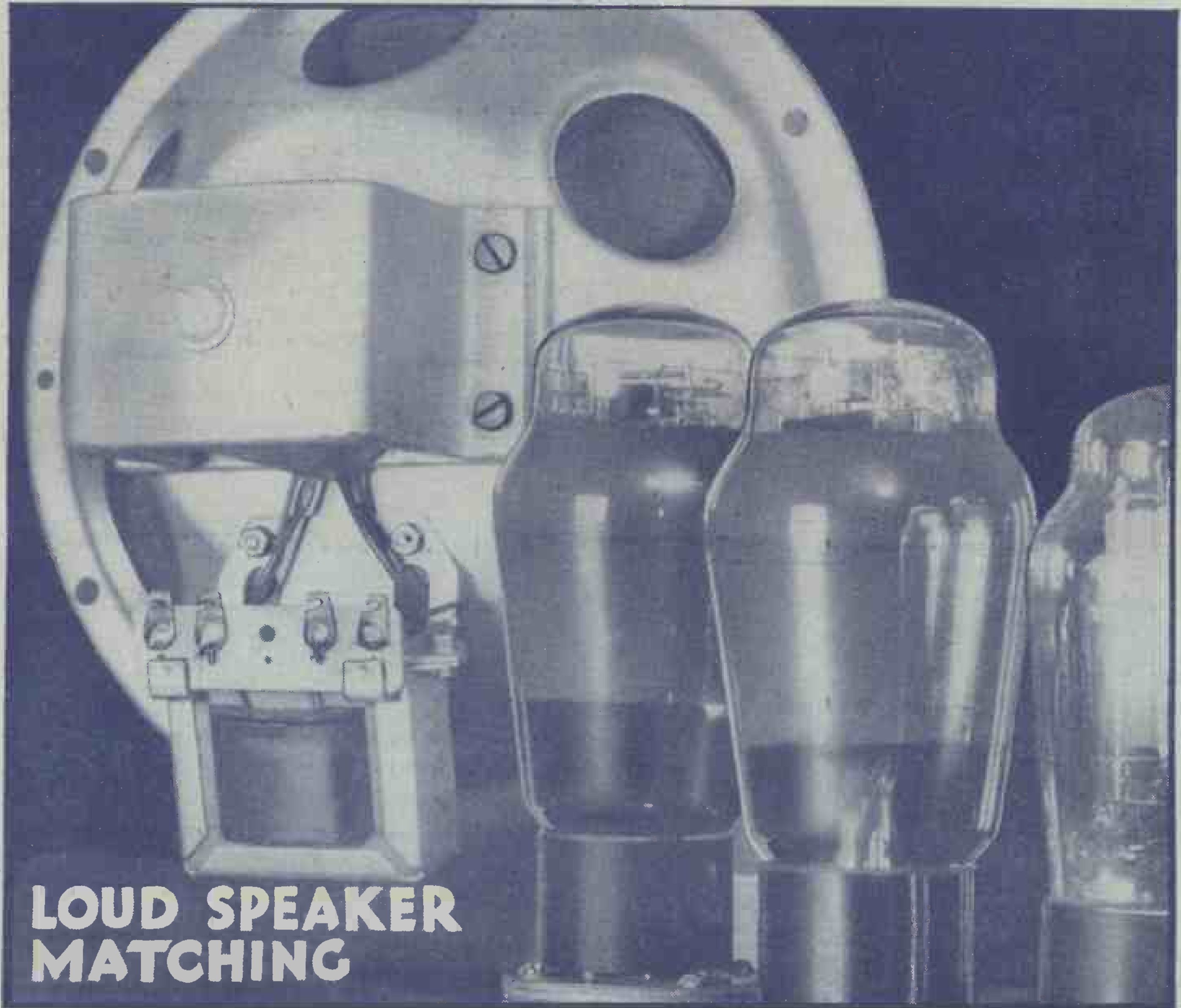

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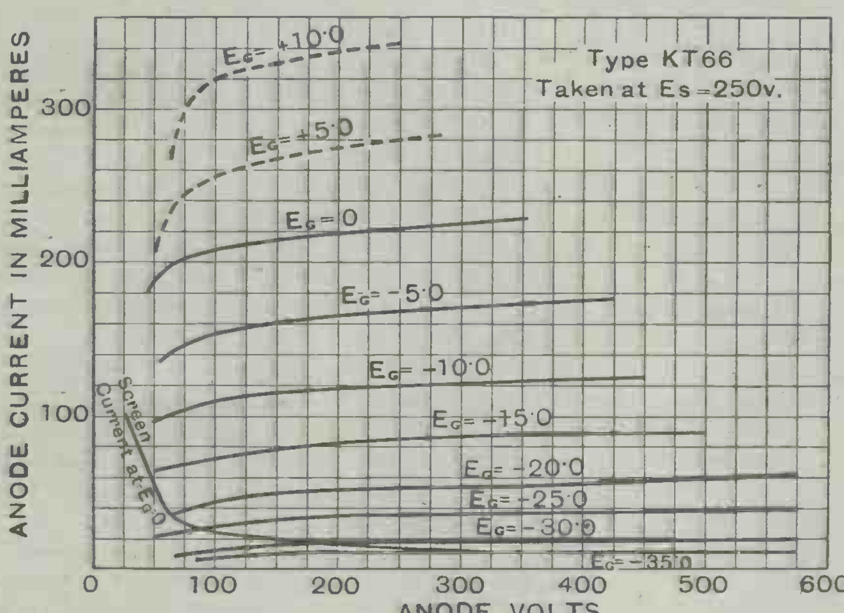

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CONTENTS

EDITORIAL COMMENT

A "People's" Television Set

Is It Possible?

GREAT efforts are being made this month to push the sale of television receivers because it is recognised by the Government and the B.B.C. that further developments in television on the programme side, or additional stations elsewhere in England, can hardly be proceeded with until evidence is forthcoming of more enthusiasm on the part of the public in the area already served in London.

We doubt ourselves whether enthusiasm for television is lacking, because wherever demonstrations are given attendances are good. It is merely, we believe, that the public is very cautious because of the novelty of this form of entertainment and for the reason that in spite of assurances to the contrary there is still a feeling that there will be big changes in television in the near future. Political uncertainties, too, have affected sales. The campaign now being carried out to popularise television will, we understand, emphasise the comparative permanence of the present methods of transmission and give the public the assurance that receivers bought now will be equally serviceable in years to come.

A New Market

We hope that the radio industry will recognise that the sale of television sets is an entirely different proposition from the sale of broadcast receivers. Television sets are catering for a new market; broadcast receivers to-day are nearly all replacement sales.

At the time that the "People's" broadcast receiver was launched in Germany vast numbers of homes there were without a wireless set at all and at the price which prevailed for sets at that time in Germany the authorities believed that receivers would remain out of reach of these homes for a very long while. Figures show that in spite of the enormous number of "People's" sets sold, no disturbing effect on the sale of the more luxurious types of receiver has occurred. Is there not an opportunity for our industry concerned with the sale of television receivers here to learn from this a lesson?

Standardisation

We have repeatedly suggested in these pages and have brought directly to the notice of manufacturers the view that British producers of television sets ought to co-operate to achieve standardisation as far as possible. Standardisation of parts would have the effect of reducing prices for the standard model and facilitating service to a very great extent, because those engaged in this work would concentrate on acquiring an expert knowledge of a standard instrument instead of having to become acquainted with a variety of different models.

If we push standardisation to the extreme length of getting all British manufacturers of television sets to sit round a conference table, as was done in the case of the "People's" receiver, and work out a standard set, in the manufacture and sale of which all of them would participate, it would be very necessary to see to it that such a set did not interfere with the sale of the more expensive types.

A "People's" television receiver would use a small cathode-ray tube.

It should be housed in the plainest of cabinets and should have no luxury frills about it, but should give a clear and satisfactory picture and accompanying sound.

The longer such a project is delayed the more difficult it will be to realise, and if a "People's" television receiver has already had the consideration of the Television Advisory Committee and the manufacturers and yet has not been proceeded with, we feel that the reasons ought to be disclosed for public information. After all, the public, via the Treasury, has a big stake in television and it is equally as important that the public should get the best service on the receiving side as that the best efforts of the B.B.C. and others concerned should be put into the production of programmes.

Broadcasting and Peace

"Across the Frontiers"

EIGHTEEN distinguished personalities in this country recently issued a manifesto appealing to the nations of the world to save civilisation from war. In the course of the manifesto the statement appears that "It is time, if we are not to be too late, that men of good will who value the fruits of civilisation . . . should speak 'across the frontiers' to those who feel as they do in order that they may use together their gifts of heart and mind to co-operate in preventing the supreme catastrophe."

Here, we think, is a direct challenge to broadcasting to undertake a task for which it stands alone as the ideal medium for its fulfilment.

Will the opportunity be grasped while there is time or is broadcasting to wait to become instead an instrument not of peace but of war?

We believe that those eminent men who have signed this manifesto would have the backing of the whole country if they were entrusted with the task of organising the use of broadcasting time to the project which they have so much at heart.

The broadcasts in foreign languages at present put out by the B.B.C. seem to be the responsibility of nobody in particular, and the broadcasts themselves, though fulfilling, no doubt, a useful purpose, seem to have no policy behind them and fail lamentably to offer any guidance; they are corrective perhaps as news broadcasts confined to statements of fact but not constructive, nor is there anything in them which constitutes an appeal to the "heart and mind" of listeners.

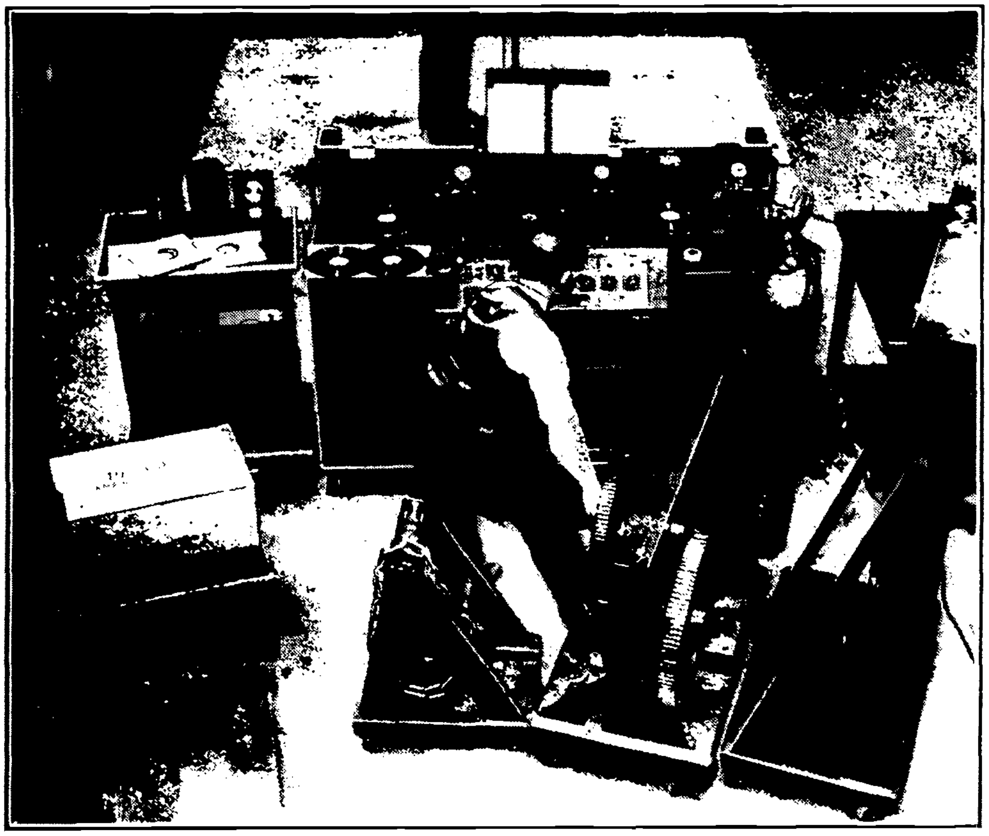
Suppressing Ignition Interference

Effect on the Engine

IN our issue of January 12th we urged the early publication of precise information on the effects of fitting interference-suppressing devices to the ignition systems of motor vehicles. At the same time we put forward the opinion that these effects were not serious, but that car owners could hardly be expected to go to the trouble and expense of fitting suppressors in the absence of an authoritative pronouncement on the subject.

Although no statement has yet been issued by any of the bodies or companies that are believed to have carried out quantitative investigations, we are able to publish in this number an article that does much to clear up the position. From opinions formed from first-hand experience of the subject, including the results of tests made with dynamometers, the author comes to the conclusion that the ease of starting and the power output of the ordinary engine are not adversely affected by fitting suppressor resistors of the usual kind. Although the spark is admittedly weakened, sufficient margin is allowed in the design of ignition systems to ensure satisfactory firing of the explosive mixture. All this applies to engines in good condition, and troubles may occasionally be provoked by the suppressors when the ignition system is suffering from prolonged neglect.

The position would, therefore, appear to be fairly satisfactory, but it certainly does not warrant any relaxation of efforts to devise methods of suppression that have no effect on engine performance under any conditions. To do so is obviously difficult, as the ignition spark is believed to depend for its intensity on the oscillatory nature of the discharge. But something might conceivably be done by deliberately shifting the predominant frequency of the oscillations to a value at which the radiating properties of the ignition wiring are low.



SOUND EFFECTS IN THE BROADCAST STUDIO. To provide a suitable background to dramatic presentations the National Broadcasting Company of America have portable equipment that can easily be grouped round the Sound Effects Man. Amongst the miscellaneous apparatus seen above can be identified a bank of turntables, megaphone, cylinder of compressed air, chains, gears and portable doors.

B.B.C. Programmes

Inflexibility of Time Schedules

MANY times complaints have been made against the B.B.C. because of the autocratic way in which items are faded out when they overrun their scheduled times. It is not only those who have been the victims of such treatment before the microphone who have complained, but also the listening public who have been deprived of the finish of some musical or other item.

This obsession on the part of the B.B.C. to adhere strictly to its time schedule takes practical shape far more often than most listeners are aware. Particularly on such occasions as debates, the parties concerned often find themselves embarrassingly hurried, or their scripts cut in order to finish on time.

Perhaps one of the worst of recent examples of silly adherence to a time schedule was when the B.B.C. broadcast their usual news service in German at a time which overlapped with Herr Hitler's speech. How could they have expected that German-speaking listeners would provide an audience for their news on that occasion?

We suspect that this inflexibility in the matter of time schedules is largely dictated by the fact that the published programmes in the *Radio Times* go to press at an early date and by the fear that changes made afterwards would lay that publication open to criticism on the grounds of inaccuracy.

Short-wave Oscillator Problems

AVOIDING PARASITIC OSCILLATION

By W. T. COCKING

IT is by no means uncommon for difficulties to arise in short-wave apparatus because the oscillator operates at a frequency widely different from the correct one. The causes of such parasitic oscillation are discussed in this article and the remedies are indicated.

ONE of the greatest troubles encountered when putting a new short-wave receiver into commission is parasitic oscillation. If a well-tried design is followed exactly, of course, one is unlikely to meet with any difficulty, for the designer has found and remedied the various sources of parasitic oscillation in his original models. The trouble starts, as a rule, when a design is modified or when an entirely new set is being tried out.

Parasitic oscillation is most noticeable in the oscillator of the frequency-changer, but it can occur equally readily in a reacting detector, and is possible but less likely in an RF amplifier. The symptoms of such oscillation depend upon its type, for there are a good many possible modes of oscillation. Perhaps the commonest gives rise in a frequency-changer to a series of spurious signals. As the tuning control is rotated, the band seems full of strong signals which bump in and out. Some of them are, indeed, genuine signals, but others will be found especially strong, and at first are apt to be mistaken for true carriers.

Optimum Oscillator Volts

They are, however, generated in the receiver itself, and in the writer's experience are almost invariably caused by excessive amplitude of oscillation at the correct frequency. A typical circuit is shown in Fig. 1, and a milliammeter is connected in series with the oscillator grid leak R1. This meter should preferably have a full-scale reading of 1 mA. The peak oscillator voltage on the grid is approximately 1.2 times the product of the grid current in amperes, and the resistance R1 in ohms.

Valve makers give a figure for the optimum oscillator grid voltage, and it is thus an easy matter to adjust it. The efficiency of the frequency-changer, however, does not vary greatly with the voltage, provided that it is not much less than the optimum. As the voltage always varies over the waveband, there is consequently a temptation to make it rather higher than the optimum.

The Marconi and Osram X65, for instance, has a conversion conductance of 0.2 mA/v. for 4.5 volts peak oscillator amplitude. The optimum is 0.225 mA/v. at 10 volts, and it is still about 0.21 mA/v. at 25 volts peak. Below 4.5 volts the conversion conductance falls off rapidly, and at 2.5 volts it is only 0.135 mA/v.

Unless care is taken in the design of the oscillator itself its output may vary in the ratio of perhaps 2 : 1 over the waveband. With a 500 $\mu\mu$F. tuning condenser it may vary more. At first sight, therefore, it seems desirable to make the mean amplitude about 10 volts, so that over the band it varies between about 6 volts and 14 volts, and the conversion conductance does not vary much.

This course seems satisfactory on the medium and long wavebands, but on short waves the writer's experience is that the maker's figure for optimum oscillator voltage should be regarded as a maximum figure. If it is much exceeded, a form of parasitic oscillation usually occurs and makes the receiver unusable.

The precise reason for the parasitic oscillation is a little obscure, but it seems to be connected with a negative resistance portion of the hexode section viewed from the injector grid. The probability is that this portion of the characteristic is swept over by the oscillator voltage when this is of large amplitude, and so parasitic oscillation occurs on the peaks of the oscillator input.

The trouble seems to occur with all valves of the triode-hexode and triode-heptode class, and the writer has found the only remedy to be to keep the oscillator amplitude equal to or less than the maker's optimum figure for the valve.

The "optimum" for the X65 is 10 volts, and, as R1 is 100,000 ohms for this valve, the current indicated by the meter should be about 83 μA. Parasitic oscillation almost invariably occurs if it exceeds some 120 μA.

The amplitude of oscillation is easily reduced by lowering the HT voltage or by stripping off reaction turns. If the coil is otherwise satisfactory, however, it is better to insert a resistance R2 in series with the reaction coil. This reduces the amplitude more at the high-frequency end of the tuning range than at the low, and, as the output usually falls off at the latter end, the resistance tends to even up the output over the band.

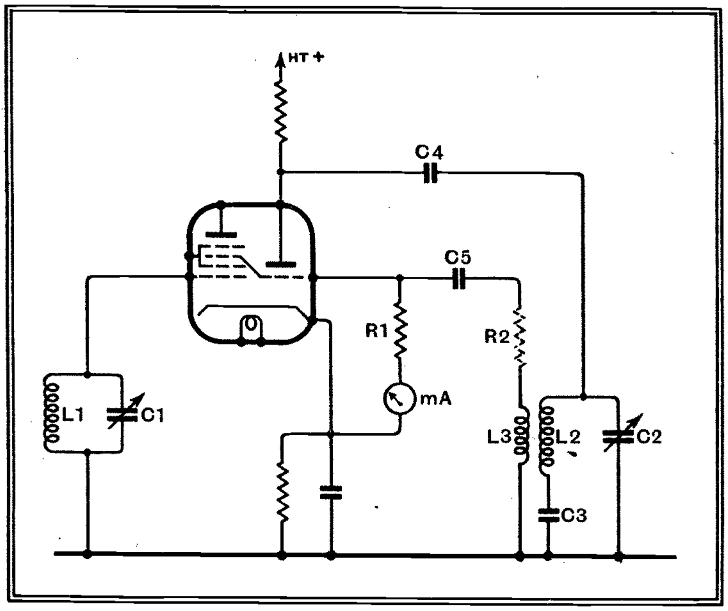


Fig. 1.—A typical triode-hexode frequency-changer with a tuned-anode reaction coil oscillator is shown here.

The value of resistance needed must be found experimentally, and is usually less than 50 ohms on short waves, but may be hundreds or thousands of ohms on the medium and long waves. Sometimes it will be found that this resistance R2 is too effective at the high-frequency end, and when the valve is right for the middle of the band the output is too low at higher frequencies. The simplest course is then to choose R2 so that the output is a little more than is wanted at the highest frequency, and then to shunt L2 with a resistance.

The value of shunt resistance required will depend upon the inductance and efficiency of the tuned circuit, but will usually lie between 2,000 ohms and 20,000

Short-wave Oscillator Problems—

ohms. With a little juggling of this sort it is usually possible to keep the oscillator output fairly constant over the band.

Little difficulty arises in carrying out the adjustments until one gets below 10 metres. The reaction coil oscillator then becomes rather troublesome, but in a different way. The parasitic oscillation effect just described does not occur because even without added resistance the amplitude of oscillation is likely to be below optimum.

In order to improve efficiency an attempt is often made to increase the amplitude of oscillation by increasing the number of turns on the reaction coil. When this is carried too far, however, the valve

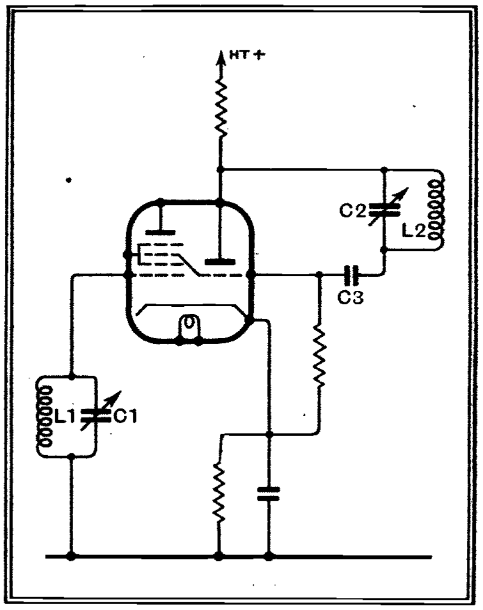


Fig. 2.—The modified Colpitt's oscillator can be used with a triode-hexode if the tuning condenser is not earthed.

will start oscillating at a frequency determined chiefly by the reaction coil L3 with its stray capacities. The tuning condenser then has little effect.

This tendency can be discouraged by winding the reaction coil with resistance wire, and this is always good practice. Often it is not enough, however, and in general it is necessary to keep the natural frequency of the reaction circuit higher than any to which the main circuit can tune. There is a strong likelihood of trouble of this nature if the reaction turns are not fewer in number than those of the tuned coil.

The Colpitt's Oscillator

On the ultra-short waveband one might use three turns for L2, and the reaction coil L3 should then not exceed 2-2.5 turns. To obtain oscillation the coupling must be very tight and the windings must be interleaved. In general, below some 7 metres it is useless to worry about the amplitude of oscillation, for it is difficult enough to make the valve oscillate at all and still cover the required tuning range. An amplitude greater than about 5 volts can hardly be expected.

These remarks apply to the reaction-coil oscillator. The Hartley or Colpitt's oscillator is much easier to deal with and there is little difficulty in obtaining the necessary amplitude down to 5 metres. The modified Colpitt's oscillator is shown in Fig. 2, and is particularly free from parasitic oscillation, only one mode being commonly found and one which it is easy to overcome.

If the amplitude of oscillation is too great, it can be controlled by shunting L2 by a suitable resistance, by reducing C3, or by connecting a condenser between grid or anode and cathode. Such a

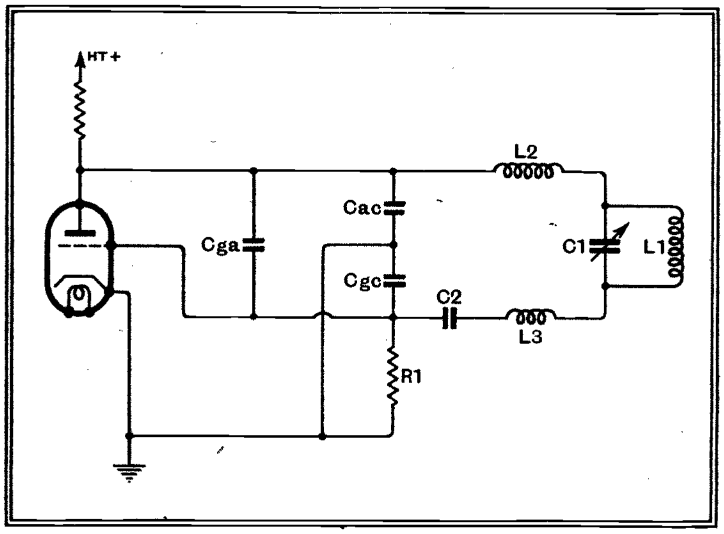


Fig. 3.—This diagram shows the equivalent circuit of a Colpitt's oscillator including the wiring inductance.

condenser should be adjustable with a minimum capacity of about 1-2 $\mu\mu$F. and a maximum of some 6-10 $\mu\mu$F. Additional capacity in either of these latter points enables the effective tapping point on the tuned circuit to be changed. Normally, the tapping point is provided by the valve capacities—the grid-cathode and anode-cathode capacities being in series across the circuit.

Unless care is taken, parasitic oscillation is likely to occur at a frequency of the order of 75 Mc/s, but determined chiefly by the valve and wiring. This oscillation is more likely to occur with large values of tuning capacity than with small, and it sometimes happens that the circuit will behave normally at low capacity settings of the condenser. As the capacity is increased, however, a point is reached at which the frequency ceases to fall and suddenly jumps to a high value and is hardly affected by a further increase in capacity of the variable condenser C2.

The reason for this behaviour is clear when the full circuit, Fig. 3, is considered. The tuned circuit is represented by L1 and C1 and Cac, Cgc, and Cga represent the anode-cathode, grid-cathode and grid-anode valve capacities; C2 is the grid condenser and R1 the grid leak. The inductance of the wiring is represented by the coils L2 and L3.

There are two possible modes of oscillation for such a circuit. One is the normal one at a frequency determined by L1 and the total capacity which comprises C1 and Cga in parallel and also in parallel with the series value of Cac and Cgc. At this frequency the reactance of L2 and L3 is usually negligible.

Parasitic Oscillation

At some higher frequency, and especially when C1 is fairly large, the reactance of this condenser is small compared with the reactance of the valve capacities and with the reactance of L2 and L3. At this frequency the tuned circuit is made up of L2 and L3 with a capacity comprising Cga in parallel with the series value of Cac and Cgc, the whole in series with C1. The coil proper, L1, then merely acts as an RF choke across C1.

The valve will usually oscillate at the frequency determined by the circuit having the higher dynamic resistance, measured across Cga. A small value of C1 results in the valve's being effectively tapped down the high-frequency circuit, for the valve is across the other capacities only. As C1 is increased, therefore, the amount of tapping down is reduced and oscillation conditions at the higher frequency get more favourable. At the same

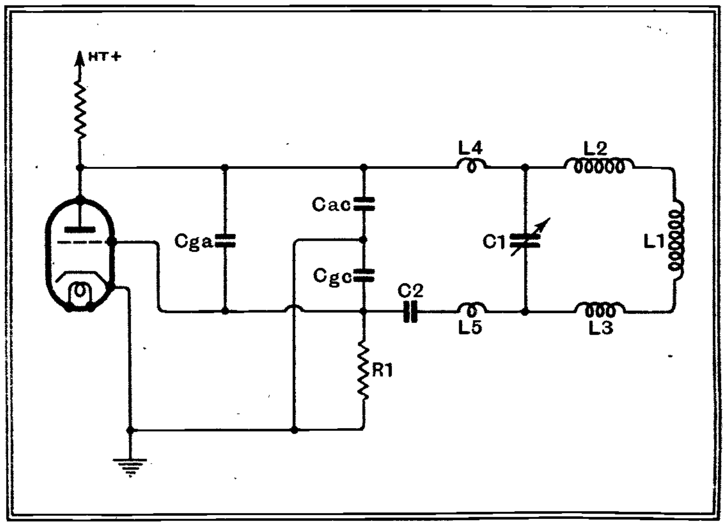


Fig. 4.—When the tuning condenser is connected directly to the valve the equivalent circuit takes this form.

Short-wave Oscillator Problems—

time, the total capacity on the lower frequency circuit is increasing and its dynamic resistance is falling so that conditions for oscillation at the lower frequency get less favourable. Eventually, the higher frequency conditions are better than the lower and oscillation changes over to the former.

The remedy is usually very simple and consists merely in arranging the condenser C_1 very close to the valve and connecting it with the shortest possible leads. Long leads in the coil circuit itself will not cause parasitic oscillation, but will only add to the inductance of the coil.

This course results in the equivalent circuit of Fig. 4. The main wiring inductance L_2 and L_3 is now only in series with L_1 and it does comparatively little harm.

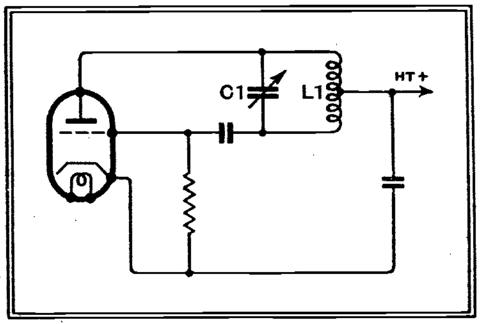


Fig. 5.—A typical Hartley oscillator.

There is. of course, still some wiring inductance in series with the condenser C_1, and this is represented by L_4 and L_5. The circuit is, therefore, still capable of generating parasitic oscillations. If the leads are made very short, however, L_4 and L_5 are very small, with the result that the possible frequency of parasitic oscillation is very high. In practice, it is not difficult to make it higher than any frequency at which an ordinary valve will oscillate.

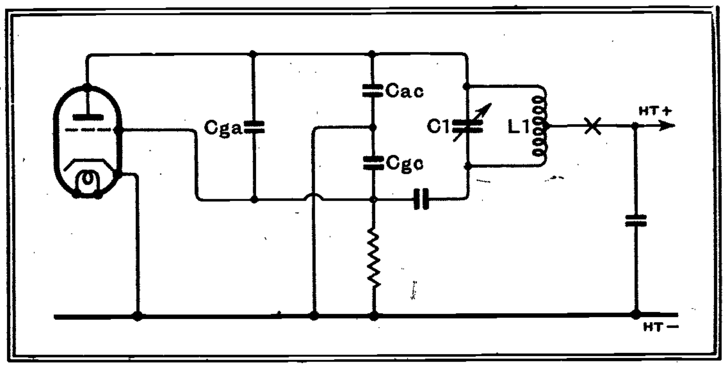


Fig. 6.—The equivalent of the Hartley oscillator is shown in this diagram.

Ordinary valves will not oscillate as a rule above about 100 Mc/s, so that if the frequency of the parasitic circuit is pushed above this figure, no trouble will be experienced. Of course, it may sometimes happen that the physical layout prevents short enough leads from being secured. In this case it is necessary to add resistance to prevent parasitic oscillation.

Examination of Fig. 3 shows that it is useless to add damping resistances in series or parallel with L_1, for they will have a negligible effect on the parasitic mode of oscillation, but will damp the wanted mode. Such resistance is more likely to increase any tendency to parasitic oscillation than to reduce it.

Resistance in series with C_1 will damp both modes, but it is clear that the right place for it is in series with L_2 or L_3 or both. It then has a maximum effect on the parasitic circuit and a minimum on the tuned circuit proper. Such resistances are actually the familiar grid or anode "stoppers," but the usual value of 50 ohms is generally far too high. A value of about 5 ohms is nearer the mark.

The Hartley oscillator of Fig. 5 can generate parasitic oscillations in exactly the same mode as the Colpitt's and the same remedies are applicable. On short waves, however, it is found that the circuit is inclined to be erratic in performance unless the tapping point on the coil is very carefully placed.

The Hartley Circuit

The reason for this will be clear from Fig. 6, which shows the valve capacities. There are actually two tapping points on the circuit—one is provided by the coil tapping and the other by Cgc and Cac. If C_1 is large in relation to these capacities, the "condenser earth" has little effect and the circuit functions as a true Hartley oscillator. When C_1 is small, however, the capacity tap can by no means be neglected, for it is sufficient to make the circuit oscillate without the inductance tap.

Unless the inductance tap is correctly adjusted in relation to the capacity tap, therefore, it is only to be expected that peculiar results will be obtained. The condition to be arrived at is to tap the coil at the point which would be at earth potential even if this tap were omitted; in other words, the tap should be at a nodal point.

This is, in practice, difficult to achieve, and experience shows that on ultra-short waves the circuit works much better if a resistance or RF choke is inserted at the point X in Fig. 6. Although often so called, the circuit is no longer that of a Hartley oscillator, but is really the modified Colpitt's. The only difference between it and that of Fig. 3 is the point at which the HT supply is connected. This gives it an advantage in that the tuned circuit is less affected by the HT feed resistance or choke. For receiving purposes, this advantage is often more than outweighed by the inconvenience of having to provide a tapping on the coil.

Oscillator squegging, at one time very troublesome, does not often occur nowadays because it is customary to use a fairly low value of grid leak and to employ a resistance feed for the HT supply. Squegging is much more likely to occur if a direct feed is used as in Figs. 5 and 6, or if an RF choke is employed in place of the resistance shown in the other circuits.

This is easy to see when the mechanism of squegging is considered. What happens is that the valve oscillates violently and it draws a heavy grid current. This drives the grid potential so negative that the valve stops oscillating and does not start again until the charge on the grid condenser has leaked away via the grid leak.

A reduction in the value of the grid leak at first does little more than increase the frequency of the squegging, for it allows the charge on the condenser to leak away quicker. At length, however, it tends to prevent it, because when it is very low the rectifying action of the grid circuit loses efficiency and the valve is no longer driven to anode current cut-off.

The use of a resistance feed to the anode is advantageous, however, because it permits the anode voltage to rise as the grid is driven negative and so shifts the point of current cut-off to a more negative grid potential. With reasonable values of components squegging hardly ever occurs, but it is a distinct possibility when the HT supply is fed directly to the valve or through decoupling circuits of high time-constant.

Acoustic Measurements at the N.P.L.

IN a recently issued pamphlet the testing services offered by the Acoustics Division of the National Physical Laboratory, Teddington, are described in detail together with the fees charged in representative cases where the work is of a routine character. Apparatus which may be sent for calibration includes microphones, loud speakers, telephone receivers, noise meters, gramophone pick-ups and deaf aids.

The sensitivity of microphones, expressed as the EMF generated by unit sound pressure, may be given for plane progressive waves or for actual pressure on the diaphragm. In the former test the sensitivity at frequencies above 250 c/s is measured in a lagged chamber and below that frequency is inferred from measurements usually made with stationary waves set up in a pipe. The charge for eight determinations at frequency intervals between 62.5 and 6,000 c/s is £6. Additional measurements at frequencies down to 30 c/s or up to 10,000 c/s are undertaken for a supplementary fee of £1 10s. per frequency.

Loud speakers are tested for frequency response in the open air over a band of frequencies from 30 to 10,000 c/s. The fee for a characteristic taken on the axis under one of five standard conditions of test is £4. Measurements of electro-acoustic efficiency or harmonic distortion, if undertaken at the same time as the frequency, cost 15s. for each frequency.

In addition to tests on instruments the Department also undertakes to investigate the properties of sound-insulating materials and to measure the characteristics of auditoriums and suggest methods of treatment where necessary.

Motor Car Interference

INTERFERENCE radiated from engine ignition systems has hitherto been discussed mainly in relation to its effects on built-in car receivers. In these articles the subject is treated from the point of view of reception (and particularly television reception) external to the vehicle.

By F. R. W. STRAFFORD
(Research Dept., Belling and Lee, Ltd.)

Part II.—Suppressing Radiation from Ignition Systems

THE first instalment of this article dealt mainly with the cause and effects of ignition interference, and its contents may be summarised briefly as follows: The interference is due to the high-voltage part of the ignition system of internal combustion engines and comprises a highly damped train of oscillations, the frequency of which is of the order of 40 Mc/s. The duration of the train is not generally greater than 2.5 microseconds. The maximum instantaneous current involved may reach the colossal value of 100 amperes, and the resultant electro-magnetic wave is substantially vertically polarised.

The effects of such a form of interference upon the audio response of a television receiver is likened to a machine-gun in action. On the vision channel the picture is covered by bright spots or bands of spots in which an individual spot is observed as a horizontal elongated blob becoming smaller in size as the intensity of the interference falls off.

This part of the article will deal with methods employed in reducing, partially or completely, this very undesirable effect. The alleviation or suppression of any form of electrical interference may be obtained by two distinct methods: (a) suppression at the source, (b) suppression at the receiver. Suppression at the source, that is, the removal of the phenomenon itself, is theoretically the correct method of attack.

Although electrical interference with medium and long-wave broadcasting is of such a nature that a great deal may be done at the receiving location, at television frequencies the position is different, and the writer puts forward his personal view that very little can be done at the receiving point either by the use of mains filters or elaborate aerial systems, particularly in the case of ignition interference.

It is unnecessary to delve deeply into the reasons for these views except to state that, first, the electro-magnetic waves of ignition interference are identical with those used for the television transmission, both in polarisation and physical properties. Secondly, their peak amplitude is very high, and aerials require to be removed at least 100 yards from traffic routes in cases where signal field strengths is low. Also the successful screening and balancing of aerial feeders against interfering fields at television frequencies is a doubtful achievement. Directional aerial systems are of real assistance, but it is surprising how rarely in practice the listener finds himself in a position to avail himself of the discriminating property of a directional aerial system.

Here, therefore, is a real case, technically and economically, for complete or at least adequate suppression at the source itself. Furthermore, the fact that certain ultra-high frequencies have been earmarked for Government Services, in addition to present and contemplated television services, indicates that legislation with respect to ignition interference must be enforced sooner or later.

We will now consider the ways and means of suppression and will first refer to Fig. 1, which depicts a typical coil ignition circuit applicable to automobiles. The heavy lines are those concerned with the high-voltage part of the circuit and comprise the interfering portions of the network. It is known that the interference produced in the primary circuit of the ignition system is negligible in its effect upon television reception, although it can cause trouble when used in conjunction with receivers designed for use in the automobile itself.

Both the contact-breaker and the rotary distributor arm are mechanically connected to the engine crankshaft in such a manner that the contact-breaker provides the necessary primary current and subsequent high-voltage secondary pulse at the appropriate firing time, while the distributor arm selects the appropriate sparking plug.

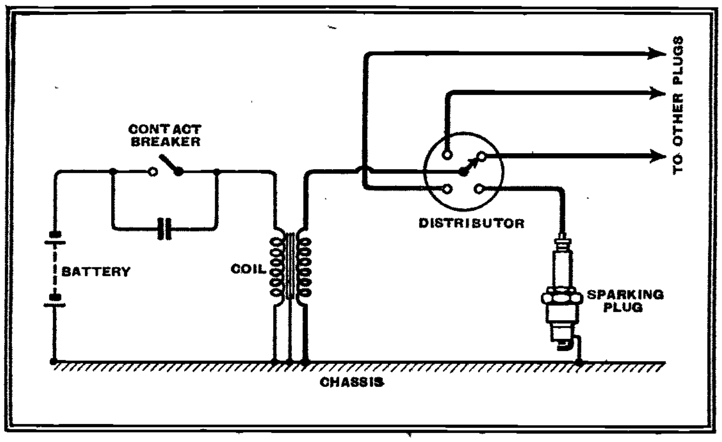


Fig. 1.—Typical arrangement of a coil ignition system as installed in a four-cylinder car.

If the whole of the high-voltage system, including the distributor and sparking plugs, could be screened by some kind of highly conductive material a very considerable degree of suppression would obtain. It is not a simple matter, however, to effect such screening, remembering the requirement of accessibility to the various parts requiring periodical attention. Automobile designers, looking ahead, could undoubtedly design an efficient wholly enclosed ignition circuit, but not without an additional manufacturing expense, which might be considerable.

Partial screening of certain portions of the high-voltage circuit may result in the requisite degree of suppression, but the disposition of such screening for successful suppression appears to vary between different makes of cars according to the layout of the ignition system.

In any case, screening, partial or complete, calls for care in locating the correct earthing point, which appears to vary between different cars. In fact, it is known that if the earthing of the screening is not carried out with meticulous care after much laborious experiment the resultant field of interference may be worse than before. At ultra-high frequencies mechanical shielding does not necessarily mean electrical shielding, and very often the correct disposition of the earthing of a poor mechanical shield may result in a generally greater suppression than the indefinite earthing of an elaborate and expensive system of shielding.

Taking the broad view, the writer does not feel optimistic about screening, unless it is incorporated during the manufacturing process; and a further technical consideration indicates that this method should be placed in abeyance since more successful suppression schemes are available.

It should be made quite clear at this stage that methods of ignition interference suppression which prove very satisfactory when applied to medium and long-wave reception on receivers installed in automobiles need not necessarily render television wavelengths immune. The physical aspects of the problem are wholly different because of the wide separation between television and

Motor Car Interference—

normal broadcast frequencies. This is a point which may be forgotten but is far too important to neglect.

Two further methods of suppression remain, namely, the fitting of resistors in the high-voltage leads to the sparking plugs and/or distributor, or the substitution of high-frequency chokes for these resistors.

High-frequency chokes of low inductance may be used with a high degree of success when connected in series with the sparking plug leads very close to the plug terminal, particularly if a short length of the lead is shielded and earthed to the plug body. It is not known whether such a method of suppression would be successful in all cases, but it is known that the suppression afforded occurs over a comparatively narrow band of frequencies and is by no means as uniform with frequency as that provided by resistor suppression. There is little doubt that greatest attention has been focused upon the inclusion of a suitable non-inductive high resistance in the plug and/or distributor lead of the ignition system.

The effect of including a resistor in the high-voltage lead is to increase the electrical damping of the circuit and probably render the oscillatory bank current dead beat. By so doing there is considerable attenuation of the high-frequency component of the subsequent spark current pulse, thus reducing very considerably the intensity of the resultant interfering field. It appears after considerable experiment by the Electrical Research Association that resistor suppressors up to 20,000 ohms, each fitted in the plug lead close to the plug terminal and in the distributor lead close to the distributor head, effect an average suppression of 30 db. If the high-voltage leads are made up as a distributed resistor, in other words, a number of resistors in series making up a total value of about 20,000 ohms, the suppression is rather greater than that obtained by the same value of resistor lumped at one spot. If a distributed resistor is used the inclusion of a small amount of earthed screening over the lead close to the plug results in a further degree of suppression leading to ultimate attenuation of the order 40 db. A typical arrangement, which is, incidentally, effective for car radio, comprises 5,000 ohms fitted in series with the lead from the coil where it meets the distributor head and 15,000 ohms in series with each plug lead, as close to the plug terminal as possible. From the television interference viewpoint adequate suppression is often obtained by the use of the 5,000-ohm resistor in the distributor lead only, but this depends upon the type of car concerned, and researches are insufficiently advanced to warrant any recommendations in this respect.

We now find ourselves on very dangerous ground. It has been averred, evidently with some truth in certain circumstances, that this form of suppression interferes with the proper functioning of internal combustion engines.

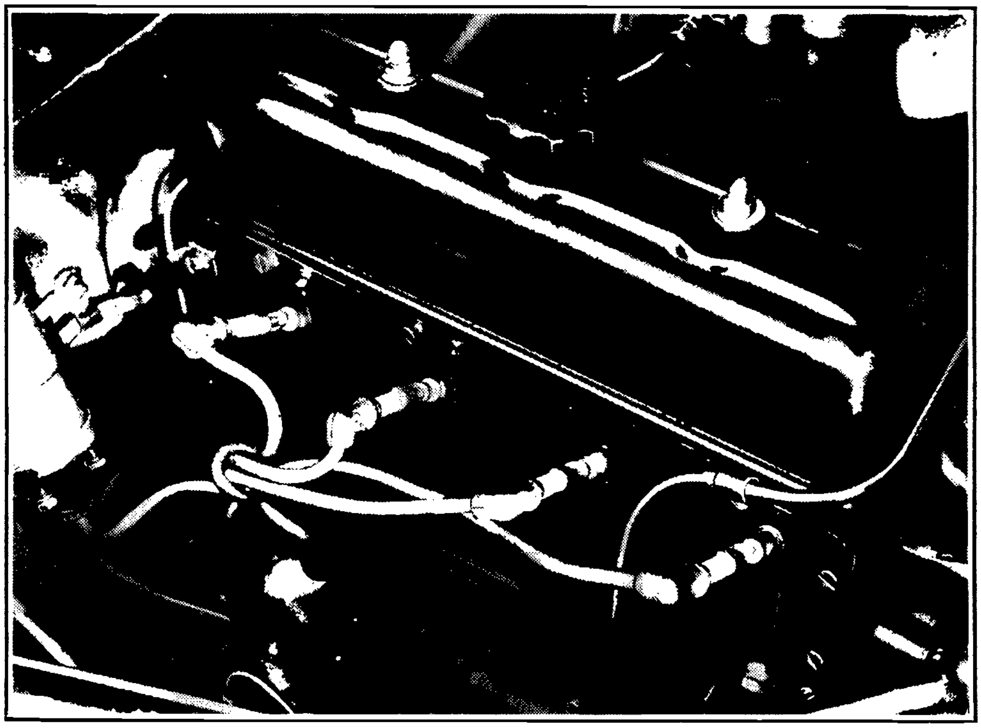
It is obvious that the fitting of these resistors must result in a weaker spark, weaker from the point of view of the electrical energy dissipated during the brief life of the spark. This does not necessarily indicate that the modified properties of the spark render it inadequate for the purpose of firing the volatile petrol mixture which is compressed in the cylinder. It is a certainty, however, that the 100 amperes of instantaneous current previously mentioned will no longer be attained when a resistor of the order of 15,000 ohms is fitted.

Tests on Engines

Detailed investigations of the effect of resistors on engine performance are being carried out by responsible bodies, and their results will undoubtedly become public in due course. In the meantime, the writer has conducted certain tests, and while these are by no means exhaustive they may throw a little general light on the subject. The reader is also referred to certain reports which have been published by the E.R.A., and which references are appended at the end of this article.

One of the first tests of the effect upon the developed brake-horse-power and "startability" of engines was carried out by the writer on a twelve-cylinder marine engine capable of developing a brake-horse-power of 550 at its maximum crankshaft revolutions. This engine was equipped with standard coil ignition, there being a separate coil and distributor for each of the six-cylinder sections so that each half was similar to that employed in an ordinary six-cylinder car.

The engine was coupled to a dynamometer for the purpose of measuring B.H.P. Power tests were made at certain engine speeds before and after the fitting of 15,000-ohm resistors in each of the twelve leads to the sparking plugs. No measurable difference in the resultant B.H.P. was noted, neither was the "startability" affected to any noticeable extent. With the kind co-operation of the Ford Motor Company of Dagenham, further dynamometer tests were carried out upon a 10 h.p. engine. Suppressors ranging from 1,000 to 100,000 ohms were fitted in each of the four leads to the sparking plugs, and over this range no measurable difference of B.H.P. was indicated.



Suppressors shown fitted between the distributor and the plugs of a modern four-cylinder car.

Now, it must be remembered that these tests were in all cases conducted on a new and carefully tuned engine. It cannot, therefore, be taken as granted that the same results will obtain under practical conditions.

For further information on this point one must resort to the experience of intelligent car owners. By intelligent one means those who have sufficient sense to pay a little attention to such matters as the maintenance of correct sparking plug gaps and contact-breaker spacing.

It does not need much imagination to foresee that an engine on the verge of misfiring through want of attention or adjustment to the ignition circuit may misfire and be difficult to start when suppressors are fitted. It is the writer's personal belief that most of the stories regarding the deleterious effects of suppressors on engine performance emanate from motorists who will not give their engines attention until they cry out for it by bad running or difficult starting.

It is known that certain types of high-compression engines as fitted in a few makes of expensive automobiles are prone to slow-running difficulties, but this does not appear to apply to most popular makes of vehicle.

Motor Car Interference—

The writer has fitted suppressors to the three makes of car he has used over the past three years and has not observed the slightest trouble as a result (with one exception). There have been no suggestions of plugs oiling up, poor starting, increased petrol consumption or loss of power. The one exception concerns the present car, which requires a sparking plug gap width of 0.04in. In this case misfiring was noted occasionally, but it was discovered to be due to the fact that the sparking plug gap had, to the writer's shame, been allowed to increase to 0.06in.

Finality in this matter has not yet been attained, and an anxious radio industry awaits with great patience the considered verdict of the investigators. On their findings will depend a great deal of the future success of television as an industry and a unique art in which we are proudly foremost.

References.—E.R.A. Report, Reference M/T28. The Suppression of Short-wave Radiations from Automobile Ignition Systems. E.R.A. Report, Reference M/T47. Short-wave Interference from Ignition Systems.

Ekco Television

THE problems of television demonstration and installation are being tackled by E. K. Cole, Ltd., in an especially interesting manner. This firm has equipped a 15-cwt. van, illustrated below, for the purpose.

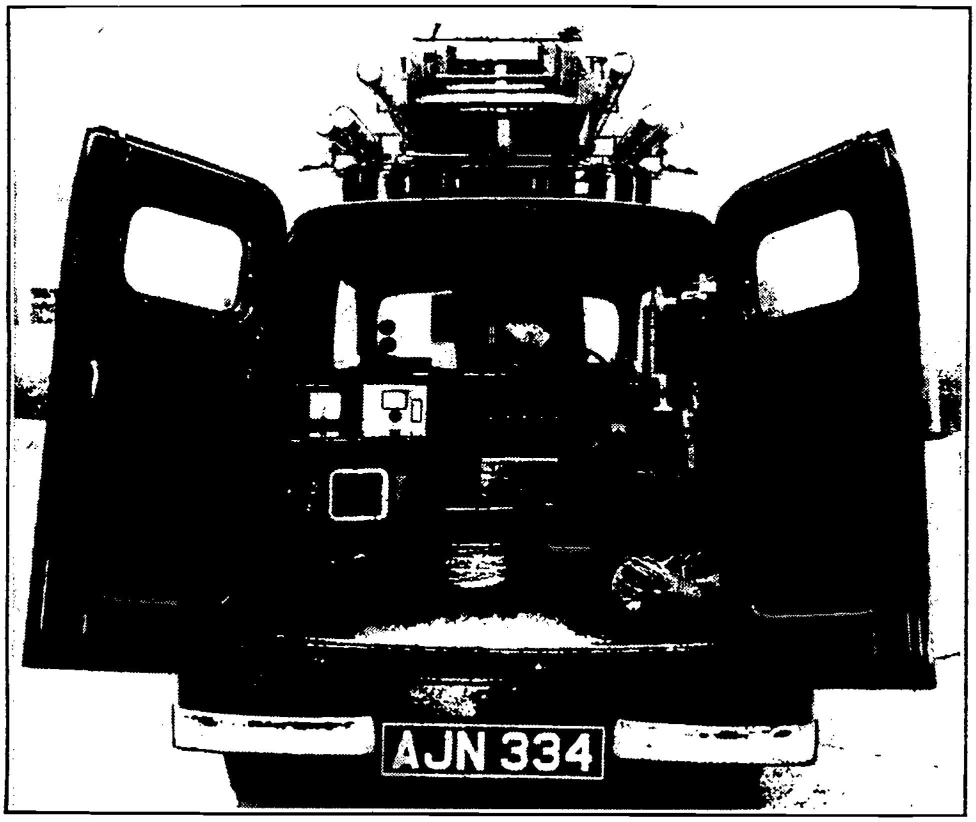
Standard Ekco dipole aerials, vision units and receivers are carried as well as spare valves and CR tubes, drums of co-axial cable and transmission line. Test gear, including high-voltage meters and signal generators, is also carried, while there is a complete range of tools.

An extending ladder is carried on the roof, and also two 30ft. collapsible masts. The ladder is naturally for use in aerial erection and the masts are for demonstration purposes. The aerial used is a special dipole with reflector made of duralumin and weighing less than one pound.

In common with all other vans and cars owned by this firm, the engine is fitted with suppressors to eliminate interference on television.

The receivers marketed by this firm are the model TS701 at 26 guineas and the TA201 at 22 guineas. The vision equipment is similar, but whereas the former gives both sound and vision the latter must be used in conjunction with an existing broadcast set for sound. Actually, the output of the sound channel is connected to the pick-up terminals of the existing receiver.

The picture size is 6¼in. by 5½in., and electromagnetic deflection and focusing are used. Larger models will be available shortly.



Manual Tuning Correction

Suggested Adjunct to Press-button Systems

IN all types of automatic tuning systems some form of correction, or provision for fine adjustment, is a desirable adjunct to the automatic station-selecting mechanism; in some cases correction may, indeed, be a virtual necessity. It is usually carried out by electrical AFC circuits, but it is also possible to apply manual control by means, say, of a so-called "vernier" condenser shunted across the main condenser.

Considering the latter method, suppose that a station has been selected and automatically tuned and the vernier has been brought into action and the precise tuning accomplished. Now suppose that automatic tuning is needed for another station. The automatic tuning system is operated and, before tuning is effected, it is clearly desirable that some device should come into play whereby the vernier is returned to a predetermined setting, say, midway in its range. Thus the automatic tuning of the second station, which may well be correct in itself without reference to the vernier, is not upset by the fact that the vernier has been already offset for the tuning of a previous station.

This system is also capable of extension to a receiver when used for normal manual tuning where, if the vernier device is not automatically returned to a preset position, the tuning scale would show inaccuracies of reading.

"Safety First" in Battery Works

Methods of Reducing Casualties

ALTHOUGH the battery industry is not one in which there is exceptional risk to life or limb, minor injuries to those working with lead and lead oxides may always lead to dangerous complications, and so full precautions must be taken.

All accidents involving loss of time in the Exide battery works are investigated by a committee of fifteen members, of which four are appointed by the company and eleven are elected by the employees. One result is that workers who are found to be particularly prone to accidents can be transferred to those departments where the risks are smallest.

Minor accidents are dealt with immediately by the Resident Medical Officer's staff. Every encouragement is given to employees to undergo precautionary treatment for apparently trifling injuries, with the gratifying result that, although attendances at the Accident Room have doubled of late, accidents involving loss of workers' time have been halved.

PROBLEM CORNER—6

Try Working this Out

ANOTHER exercise in logical deduction from the correspondence of Henry Farrad.

1, Keel Row,
Hull.

Dear Mr. Farrad,

Having heard that you are that good at solving wireless puzzles I am sending you this one, hoping you will be able to enlighten me. As often as not my reception of Regional programme is all mucked up by a terrible whistle. After a while I noticed that we never got whistle when our next-door neighbours were out. Being friendly with them I asked if they noticed whistle, but they said no. However, they generally listened to long-wave National. They have one of these new all-wave receivers. I must say it's a champion set, and I must be thinking of getting a new one myself. Do you think it would get rid of whistle?

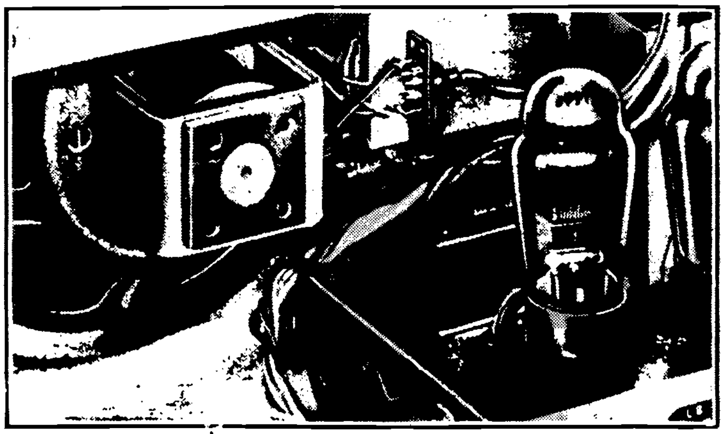
Yours truly,
Jonah Ironbotham.

Would you recommend Mr. Ironbotham to get a set like his neighbour's, and why or why not? Solution on page 142.

Output Stage and Loud Speaker

A SURVEY OF THE PROBLEMS OF MATCHING

By F. LANGFORD SMITH, B.Sc., B.E., M.Inst.R.E. (Aust.) A.M.I.E.E., A.M.I.E. (Aust.)



DISTORTION is considered in relation to the permissible limits for varying degrees of fidelity, and particularly in regard to spurious combination tones and cross modulation. Elliptical loading produces harmonic distortion, and the usual graphical treatment of elliptical load lines is shown to be only an approximation. Triodes, also tetrodes and pentodes with and without negative feedback, are compared on various types of loading, and the design of loud speaker transformers is considered in relation to each. The article is based on a paper read before the World Radio Convention organised in Sydney by the Australian Institute of Radio Engineers.

IN this it will be assumed that the amplifier and associated audio frequency equipment providing the voltage to the grid of the power valve is free from any form of distortion. This is, in most cases, a reasonable assumption having regard to the distortion which may occur from that point onwards.

The performance which may be expected of the output stage concerns the frequency range, amplitude distortion, phase distortion and response to transients.

The limits which may be set for varying degrees of fidelity have not yet adequately been determined, but some indication of the requirements is given in the list below.

(a) Frequency response to be approximately level within the limits of :—

Mediocre reproduction	100 to 5,000 c/s
Fair fidelity	80 to 7,000 c/s
Good fidelity	60 to 10,000 c/s
Indistinguishable from original	30 to 14,000 c/s

These values for frequency response depend largely on the hearing capabilities of the individual, and are therefore taken for persons with normally good hearing.

(b) Amplitude Distortion. It is generally regarded that 5 per cent. second harmonic distortion is inaudible, either directly or through any indirect effects associated with it. If the frequency range is restricted, it is probably that 10 per cent. second harmonic distortion is barely perceptible.

Third harmonic distortion is more distressing to the ear, both directly and indirectly, as will be shown later in this paper, and a limit of half that for second harmonic distortion appears to be a reasonable assumption, pending further investigation into the subject. This gives the limit of third harmonic distortion as 2.5 per cent. for wide frequency range and 5 per cent. for restricted frequency range.

Higher Harmonics

Higher order even harmonics may in most cases be neglected as being small in comparison with second harmonic distortion, while contributing generally similar effects.

Higher order odd harmonics are much more distressing to the ear than an equal percentage of third harmonic, and for this reason it is desirable to consider each audio harmonic separately. As a tentative approximation, fifth harmonic should be limited to 0.5 per cent. for wide frequency range, while seventh harmonic should be below the threshold of audibility.

The indirect effect of harmonic distortion, particularly that due to higher order odd harmonics, is to produce spurious combination tones together with cross modulation. These matters are considered individually.

(c) Phase distortion has not, so far, been found to have any audible effect on sustained tones, while its effect on transients, within certain limits, is probably quite small. Extremely bad cases of phase distortion are known to have an audible effect on the reproduction of certain types of sound.

(d) The response to transients is an extremely important factor which does not seem to have been given the attention which it deserves. No method of testing has so far been standardised owing to problems still not fully investigated.

The mathematical and graphical treatment of a triode valve on a resistive load has been given on many occasions [see bibliography next week, 1 (1) to 1 (7) inclusive]. The output of a class "A" power triode valve is generally given in terms of 5 per cent. second harmonic distortion, it being realised that a lower load gives increased distortion, combined in most cases with a slight increase of power output. An increasing load gives decreased output together with decreased distortion. It will be shown later that a loud speaker reflects an equivalent load which may vary in a ratio of 6 : 1 or even more, and therefore in considering an output valve it should be treated in conjunction with a load of impedance varying from a certain minimum up to six times that value.

The graphical treatment and calculations of a pentode or tetrode valve on a constant resistive load are well known. For maximum power output combined with reasonable distortion the load resistance of a pentode is usually adjusted to give zero second harmonic or low percentage of second harmonic, combined with about 7 per cent. of third harmonic distortion. A tetrode valve such as the 6L6 cannot conveniently be arranged to produce such low values of second harmonic distortion, and about 10 per cent. second harmonic distortion is usually found in such a valve. In the 6L6 the third harmonic distortion is reduced to about 3 per cent. and in this regard is different from a pentode.

Pentodes and Tetrodes

If a pentode valve is adjusted to give approximately zero second harmonic on a stated load resistance, an increase of the load resistance will result in an increase of the third, fifth and higher harmonics, together with an increase of second harmonic distortion. A decrease of load resistance, which rarely occurs in practice on a loud speaker load, results in increased second harmonic distortion but decreased third and higher order harmonic distortion. A tetrode valve behaves in a somewhat similar manner in that third harmonic distortion decreases as the load resistance is decreased, and increases as the load resistance is increased, under conditions of maximum grid voltage input, but zero second harmonic does not occur until the load is increased considerably above that for normal output.

The power output of pentode and tetrode valves increases as the load resistance is increased provided that reduced grid excitation is used, but with maximum grid excitation the maximum fundamental

Output Stage and Loud Speaker—
power output occurs with a load resistance only slightly greater than that for normal output. Beyond this point the distortion becomes so severe that the fundamental output is reduced, although the total power output continues to rise due to the rapid increase of harmonic output.

Reactive loads that normally occur in a power stage may be divided into two principal classes, the first when an inductance is in series with a resistance, and the second when an inductance is in shunt with a resistance.

In the case of series loading, an increase of inductance results in an increase of impedance at any particular frequency. As may be shown on the $I_a.E_a$ characteristic, the addition of an inductance in series with the resistance load results in a decrease of plate current excursion, and an increase of plate voltage excursion corresponding to that with a resistive load equal to the resultant impedance. The distortion is therefore only slightly higher than that with a resistive load of the same resultant impedance.

The case of shunt loading is very much more serious and is found to occur particularly at low audio frequencies due to the shunting effect of the inductance of the loud speaker transformer. A similar effect occurs at the higher audio frequencies in cases where a condenser is shunted across the load to form a "tone control." It has been stated [see bibliography next week 3 (4), 3 (5)] that the elliptical load line to be applied to the $I_a.E_a$ characteristic is a true ellipse, but further consideration has shown that this treatment is on the assumption that the alternating component of the plate current is of sine wave form. Since this assumption is not valid under most conditions for power valves, it appears that the treatment previously given is approximate only.

The procedure previously adopted in drawing the ellipse on the $I_a.E_a$ characteristic has been to make the ordinates passing through the points of extreme excursion along the resistive plate load line tangential to the ellipse. If the valve to which this is applied does not have any second harmonic component, the ellipse will be placed centrally on the load line, but if any second harmonic is present it is necessary to arrange the ellipse so that its minor axis does not pass through the working point on the load line. An examination of Fig. 1 will show the results obtained by applying the simple existing method. In these diagrams the reactance ellipses (and hence the resultant ellipses) are arranged to fit the load lines. In the case of the 6F6 in which the second harmonic is quite low, this does not cause any appreciable displacement. In the case of the 6L6 a very considerable displacement of the ellipse is necessary and the errors of the simple treatment are made very evident. Until further investigation has produced a more satisfactory treatment of the question, it appears that the arrangement illustrated in these diagrams is sufficiently satisfactory to indicate the major effects of the shunting of a resistive load by an inductance. In these three diagrams for triode, pentode and tetrode respectively, the inductance shunting the load was calculated so as to be proportional to the load in each case so that the three diagrams may be comparable. It will be seen that in each case the resultant ellipse reaches the point of zero plate current and appears as though it would cut this axis. A little consideration shows that it is obviously impossible for these lines to cut the zero current axis, and this being the case it is most unlikely that the path of the elliptical load line will be followed exactly in the region approaching zero plate current. It is suggested that the true shape of the load line will be modified so that a point of sharp curvature is avoided. This is confirmed by an examination of oscillograms.

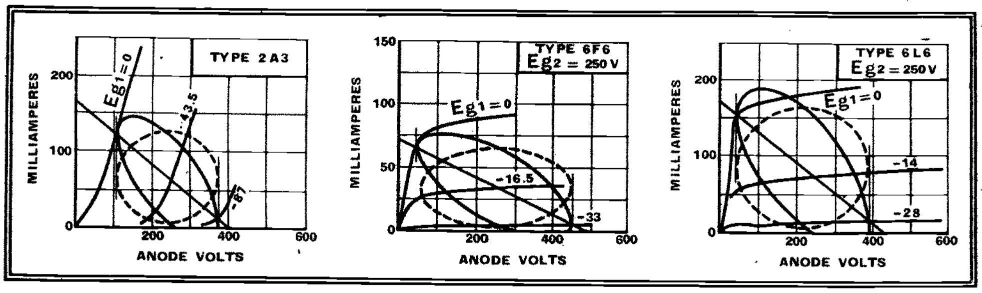


Fig. 1.—Typical load diagrams for triode, pentode and tetrode output valves, showing the possibility of distortion through the ellipse cutting the base line.

Whatever may be the detailed modifications of these elliptical load lines, it is apparent that the distortion obtained under such circumstances must be extremely high. This also has been confirmed by audible tests while watching the screen of a cathode ray oscillograph.

It is apparent that if the valve is operated with reduced grid signal input so that the extreme excursion of plate current does not come within the region of bottom bend distortion or of grid current, the total distortion even with an elliptical load line will be fairly small. Consequently the most obvious result of such an elliptical load line is that the power output is very seriously reduced for the same overall distortion. This has been appreciated although it is doubtful if the extent of the reduction in output has been fully realised. The diagrams were drawn with an inductance of 20 henrys at 50 c/s shunting a 7,000 ohm resistive load and with equivalent inductances shunting other resistances.

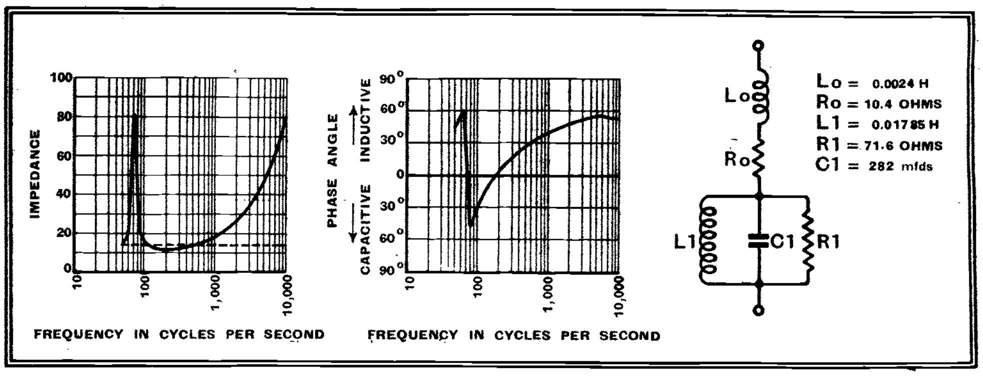


Fig. 2.—Electrical characteristics and equivalent circuit of a 10-inch moving coil loud speaker.

Loud Speaker Impedance

In considering the relationship between the power output stage and the loud speaker it is essential to consider the characteristics of the loud speaker itself. The loud speaker does not present a constant impedance at all frequencies, but one which varies very widely from a minimum at a frequency slightly below 400 c/s to a maximum at the bass resonance frequency and also increasing steadily at higher audio frequencies. The curve of impedance against frequency of a typical 10in. cone loud speaker with slight under-excitation on the field coil is shown in Fig. 2. It will be seen that the impedance at the resonant frequency of 71 c/s is approximately six times that at 400 c/s, while the impedance at 10,000 c/s is almost equal to that at the bass resonance frequency.

The power factor of a loud speaker load is not constant but varies very widely over the frequency range. In the speaker used for the curves the impedance of the speaker is inductive below 71 c/s, and has unity power factor at 71 c/s where the bass resonance occurs. Between this frequency and that of 190 c/s the impedance is capacitive. The resistive condition at 190 c/s occurs at the point at which the static and motional inductances are equal but opposite in sign. Above this frequency the loud speaker is inductive up to the highest audio frequencies.

The equivalent circuit diagram of a loud speaker is shown in Fig. 2, which has been checked experimentally and found to agree very closely with the actual loud speaker used for the tests of imped-

Output Stage and Loud Speaker—

ance and phase angle at frequencies up to 400 c/s. Of the values of the equivalent circuit diagram L_1 is the only one which remains constant. The remaining values all vary with frequency above 400 c/s. Provided that the necessary treatment is made with the values of L_0, R_0, R_1 and C_1, all being functions of the frequency, the same equivalent circuit diagram may be used to cover the whole band of audio frequencies. From this circuit it will be seen that the loud speaker is equivalent to a parallel resonant circuit tuned to the bass resonant frequency, in series with an impedance. At frequencies near this resonance point, or near its harmonics or sub-harmonics, the loud speaker needs to be considered as a tuned load, discriminating between the frequency of the input voltage and its harmonics. Further consideration will be given to this characteristic later in the paper.

One of the most important characteristics of a loud speaker is its response to transients. It is generally agreed that good transient response is given by a combination of good frequency coverage together with good damping. Of the two, it is the opinion of the writer that damping is more important than frequency response, and tests which have been made on loud speakers having poorer frequency response, but extremely heavy damping, have shown that the reproduction is preferable to some critical ears to that of a loud speaker having a wider frequency range but poorer damping. In considering the relationship between the power output stage and the loud speaker it is necessary to consider a loud speaker of known characteristics and to apply an output stage to it in such a way as to obtain satisfactory reproduction. Consequently the treatment may be referred to a typical loud speaker having known frequency response and internal damping, and the effect of variations in additional damping by the plate resistance of the power valve can be calculated. No increase of external damping is sufficient to make up for lack of damping in the loud speaker itself, but this is a matter concerning the design of the loud speaker and cannot be treated here.

If the loud speaker is matched so that the impedance at 400 c/s is equal to the ideal resistive load for the valve, then the load impedance at the bass resonant frequency and at high audio frequencies will be very much higher than the ideal load. It will be seen from Fig. 2 that in the regions of high impedance the variation of impedance with frequency is sufficient for the load to discriminate between the fundamental and its harmonics. In cases in which the load to a harmonic is greater than the load to the fundamental the amplitude of the harmonic voltage in the output will be increased in relation to that of the fundamental, and vice versa.

The Bass Resonance

In the case of a triode valve with an input voltage at the bass resonant frequency there will be a decrease of all harmonics due to the high load impedance, and a further decrease due to the load presented to the harmonics being lower than that presented to the fundamental, although the reduction of distortion may be partially offset by additional distortion due to the elliptical load line.

At frequencies below the bass resonant frequency the loud speaker, acting in a manner equivalent to a tuned circuit as previously explained, selects harmonics where they occur at the resonant frequency. Thus with the fundamental at half the resonant frequency the second harmonic output may be much greater than the fundamental.

At the higher audio frequencies there is also an accentuation of harmonic distortion due to the increase of loud impedance with frequency. This will, in the case of a triode valve, offset the reduction of harmonic distortion due to the increase of loud impedance presented to the fundamental.

These effects are shown by the curves of Fig. 3 (a), which applies to a triode valve on a loud speaker load, the bass resonant frequency being 71 c/s. The selective distortion of second and third harmonics at input frequencies of one-half and one-third the bass resonant frequency respectively is particularly apparent. The reduction of distortion slightly above the resonant frequency, and the increase of second harmonic distortion at higher frequencies are also demonstrated.

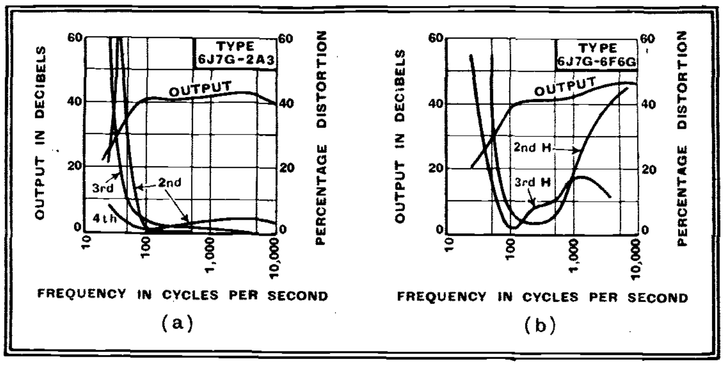


Fig. 3.—Curves of selective harmonic distortion resulting from variations of loud speaker impedance with frequency. Measurements were taken over two resistance-coupled stages. (a) Triode output valve. (b) Pentode output valve.

As a result of the excessive distortion existing at frequencies below the bass resonant frequency, whereby the output of the loud speaker may consist more of harmonics than of fundamental, overall response curves should be taken for the fundamental frequency only. This may be accomplished by a suitable filter in the microphone amplifier circuit, or alternatively the very interesting arrangement of Brittain and Williams [see bibliography next week (3)] may be adopted. This latter arrangement applies to the loud speaker an input voltage containing all frequencies, and the output is examined by means of suitable frequency selection.

In midget loud speakers the frequency multiplication effect at frequencies below the bass resonant frequency is often used in order to obtain a false bass, the human ear being capable of supplying the fundamental if sufficient harmonics are present.

The curves of Fig. 3 (a) were taken on a typical loud speaker with 10in. cone, and the distortion and output were measured over two stages incorporating a resistance-coupled pentode amplifier. The distortion in the first stage is slight compared with that of the output stage, but there is undoubtedly some combination between the two.

The "output" curve of Fig. 3 (a) was taken from the voltage measured across the primary of the loud speaker transformer. The slight rise in output from 400 to 4,000 c/s is due largely to the rise in impedance of the voice coil, but is offset by the leakage inductance of the transformer which is sufficient to cause a slight drop above 4,000 c/s. The drop below about 70 c/s is due to the combined effect of the falling impedance of the voice coil and the shunting effect of the primary inductance. It will be observed that the peak which would be expected at 70 c/s is much suppressed by this shunting effect. If a perfect transformer had been used, the shape of the output curve would have followed the general form of the impedance curve except that the peaks would be far less pronounced.

Advantages of Triodes

The comparatively level output curve of a triode valve on a loud speaker load is due to the good regulation of such a valve, which can be looked upon as a generator supplying power to a load. With perfect regulation, that is with a valve having zero plate resistance, the output curve would be a perfectly straight horizontal line, however the load impedance might vary. An ideal loud speaker, driven by a power valve of negligible plate resistance, would give uniform overall response. A practical power triode is a very close approach to this ideal of perfect regulation.

A pentode or tetrode valve has a comparatively high plate resistance, and hence also poor regulation, since variations in the impedance of the load cause large variations in the voltage applied to the load. It is for this reason that pentode or tetrode valves accentuate the response at the bass resonance frequency and at the higher audio frequencies. This rise of load impedance at certain frequencies is necessarily accompanied by increased distortion, as shown in Fig. 3 (b). If by means of a suitable shunt filter network the impedance of the load is maintained constant at all frequencies, the distortion will also be constant provided that

Output Stage and Loud Speaker—
the power factor is unity at all frequencies. It will therefore be seen that if a pentode valve is used to provide an accentuated response at the extremes of the audio frequency band, this can only be done to the accompaniment of increased distortion.

Fig. 3 (b) shows output and distortion curves for a pentode valve loaded by a typical loud speaker. Since these measurements were made with full grid excitation the output curve does not show an appreciable peak at the bass resonant frequency, the waveform having a severe flat-top on one half-cycle. With reduced grid excitation the output peak at the bass resonant frequency becomes very pronounced since overloading no longer masks the effect. A similar effect also occurs at the higher audio frequencies.

The harmonic distortion curves of Fig. 3 (b) are influenced by frequency discrimination in a similar manner to those of a triode in Fig. 3 (a). It will be seen that the distortion in the region of 100 c/s is considerably less than would be expected from a constant resistive load equal to the impedance at the bass resonant frequency. At the higher audio frequencies the second harmonic distortion rises very rapidly, due to the combined effects of high load impedance and frequency discrimination. The third harmonic indicates a partial cancellation above about 2,000 c/s.

In these curves the inductance of the loud speaker transformer acts as a shunt load and reduces the effective impedance, and therefore the output voltage, at low frequencies.

(To be concluded.)

New Apparatus Reviewed

Recent Products of the Manufacturers

SIMMONDS HT UNIT

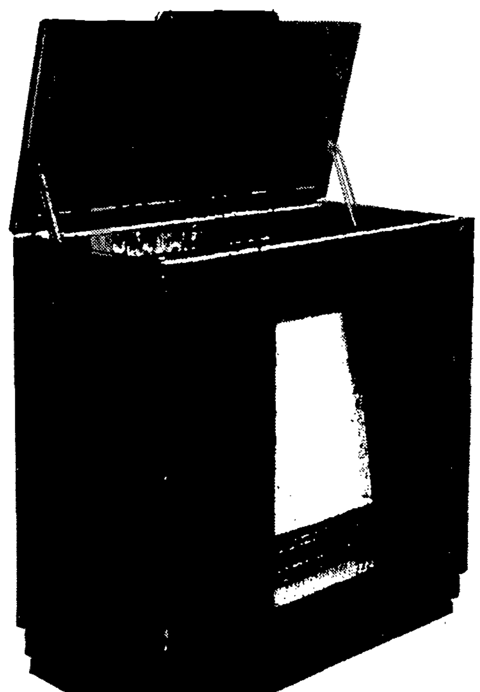
MESSRS. SIMMONDS BROS., of Rabone Lane, Smethwick, are marketing a range of HT supply units of the vibrator type. They are made in two sizes with outputs of 120 volts 10 mA and 135 volts 20 mA, and each is available for an input of 2, 4, or 6 volts.

The model 210 is of the smaller type and for a 2-volt accumulator; the makers claim that the current taken is 1.2 amps, giving an efficiency of 50 per cent. The vibrator is of the self-rectifying type and is claimed to have a life of 1,500-3,000 hours. It is sealed, and plugs into a standard valve-holder.

The accumulator used must be separate from that supplying the valve filaments, and the multi-plate type is advised. In the case of the 10 mA units a tapping giving an output of 70 volts at 1.6 mA is provided, while the 20 mA units have two tappings giving 70 volts at 1.3 mA and 90 volts at 1.8 mA.

On test the unit functioned well and drove an all-wave battery set satisfactorily, interference on all bands being negligible. The 10 mA models are priced at £3 5s., and the 20 mA type at £3 10s., while replacement vibrators cost 18s. 6d. for the 2- and 4-volt types, and 19s. 6d. for the 6-volt.

Simmonds vibrator HT supply unit, Model 210.



Lockwood radio gramophone cabinet.

RADIO-GRAMOPHONE CABINETS

A SERIES of radio-gramophone cabinets is listed by Lockwood Casework Mfg. Co., of 65, Lowlands Road, Harrow, Middlesex. The external appearance of the type AD500, which is priced at 6 guineas, can be seen from the photograph.

It measures 32in. long by 34in. high by 16¼in. deep, and is available in oak, mahogany, or walnut finish. The inside of the lid is lined to make a sound-proof joint.

The sides have long slots to prevent box-resonance, and the back is almost completely open save for a light cloth covering. For a small extra charge the cabinet is obtainable with a Celotex lining. Its acoustic properties should thus be good.

Smaller cabinets and loud speaker cabinets are also made by this firm, the latter being at prices ranging from 17s. 6d. to 30s.

OSRAM KT61

A NEW valve in the Osram range of 6.3-volt valves with the octal base is announced It is an output tetrode of the high-sensitivity type with a heater consuming 0.95 ampere.

The normal operating conditions of a single valve Class A output stage are anode and screen supplies of 250 volts, and currents of 40 mA and 7.5 mA respectively. The bias resistance should be 90 ohms, and the load resistance 6,000 ohms.

For full output of 4.6 watts at 9.5 per cent. distortion the signal input needed is only 3.5 volts peak.

It is important that only cathode bias be used and that a stopping resistance of 100 ohms be included in the screen circuit. The grid circuit resistance should not exceed 0.5 MΩ.

The valve has a mutual conductance of 10 mA/v, and if run at its full rating adequate ventilation must be provided. The valve is priced at 10s. 6d.

The Wireless Industry

THE proposed meeting of those interested in the formation of a trade radio service organisation (mentioned in the Correspondence section of our issue for Jan. 19th) is to be held in London on February 24th. All those interested are invited to communicate with National Radio and Television Service Company, 126, Elthorne Road, Holloway, London, N.19.

"Suppression at the Source" and "Radio and Electrical Accessories" are the self-explanatory titles of two catalogues recently issued by Belling and Lee, Ltd., Cambridge Arterial Road, Enfield, Middx.

A leaflet describing the Ardente "Touchphone" system of loud speaker intercommunication has been issued by Ardente Acoustic Laboratories, Ltd., 11-12, Pollen Street, Maddox Street, London, W.1.

Erie Resistor, Ltd., wish to emphasise the fact that they distribute their products themselves direct to wholesalers, trade, service specialists and retailers. To assist in the campaign for reduction of ignition interference, Erie sparking plug suppressors have been reduced in price to 1s. 6d.

New leaflets on Trix sound equipment are available from Trix Electrical Company, Ltd., 65, Bolsover Street, Great Portland Street, London, W.1.

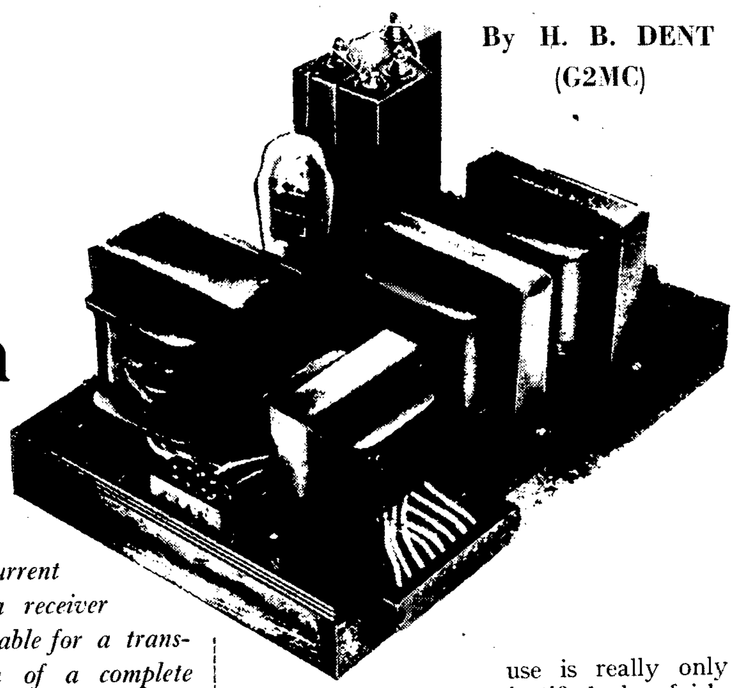
The 1939 catalogue issued by Premier Radio Company is now available at a cost of 6d. In addition to general components and accessories, it deals at length with transmitting gear, communication receivers and specialised short-wave equipment. Amplifiers, tuning units, etc., are also described. Address: Jubilee Works, 167, Lower Clapton Road, London, E.5.

The London office of Claude Lyons, Ltd., has been moved to Queen's House, 180-182a, Tottenham Court Road, London, W.1. Telephone: Museum 3025.

The Amateur Transmitting Station

Part VI.—Designing and Building the Power Supply Unit

By H. B. DENT (G2MC)



In this instalment it is shown why the anode current supply system of a receiver is inherently unsuitable for a transmitter; the design of a complete power unit is then discussed at length.

ALL the preliminary tests of the transmitter units can be carried out with the HT taken from a standard type receiving power pack giving about 350 volts at 60 to 80 mA but with the addition of a potential divider to maintain a reasonable minimum load and also to provide the 250 volts needed for the oscillator valve.

As a temporary measure such a source of power is quite satisfactory, but we would not build a unit of this kind for a transmitter, as its voltage regulation is hardly good enough. A receiver, unless it includes some form of Class "B" output stage, which is most unusual in mains sets, takes a steady current from the power unit once the valves have attained their working temperature.

In a small transmitter which is being used for telegraphy work the HT current will be continually changing from a few milliamps to, say, 60 mA or more, and unless the voltage regulation is very good we shall find the output varying from the normal calculated value of, say, 350 to very nearly 500 volts.

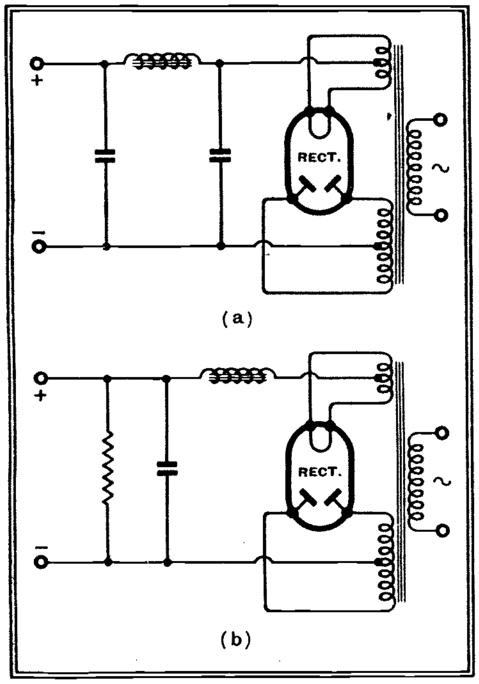


Fig. 13. The conventional reservoir condenser circuit (a) compared with a choke input filter (b).

This comes about because with the orthodox rectifying circuits in which a reservoir condenser follows the valve, the no-load DC voltage across this condenser can rise to 1.41 times the RMS voltage of the secondary winding on the transformer.

Obviously we shall have to fit in the power unit condensers having a working voltage one and a half times that of the full load output voltage, and the same rating will have to apply to all the condensers in the transmitter, which seems an unnecessary waste of money if it can be avoided.

There is fortunately quite a simple way out of this difficulty and that is to omit the reservoir condenser and employ what is known as a choke input, as distinct from a condenser input, filter; the two arrangements are shown in Fig. 13.

The output that is typical of these two rectifying systems is shown in Fig. 14, where curve A is with a condenser input filter and curve B with a choke input filter. In both cases the same RMS voltage is delivered by the transformer, viz., 350 volts AC.

Voltage Regulation

Whilst a higher DC voltage is obtained with the reservoir condenser, the regulation, as indicated by the slope of the curve, is by no means as good as that without this condenser. One point, however, must not be overlooked: the output voltage is of the same order in both cases when only a few milliamps are taken from the supply unit. The choke input filter arrangement only gives good regulation when the load current exceeds a certain critical value, and this varies with different types of rectifying valve.

The best regulation is obtained with a valve of low internal resistance and preferably one in which the voltage dropped across the valve does not change to any extent with the load current.

Mercury-vapour, or similar gas-filled rectifiers, exhibit this feature, but their use is really only justified when fairly heavy current loads have to be considered, such as 200 mA and over; for other purposes a vacuum-type rectifier will usually suffice.

It is always necessary to include a loading resistance across the output terminals of a power unit having a choke input filter, and this resistance must have such a value that it passes slightly more than the critical current to give good regulation. This resistance is generally referred to as a "bleeder resistance."

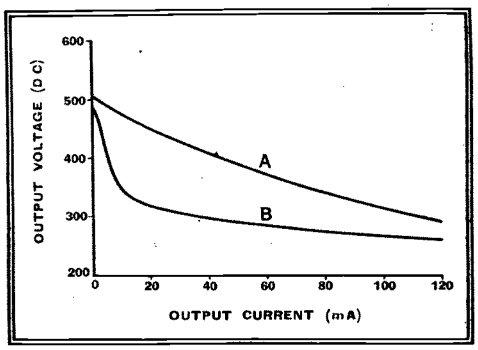


Fig. 14. The output voltage of a condenser input filter (A) is lower but better regulated than that of a choke input filter (B).

When choosing a smoothing choke for a condenser input filter of the orthodox kind, the characteristics required are, reasonably constant inductance at different current loads and a sufficiently low DC resistance to avoid unnecessary voltage drop. Its inductance should also be high enough to give the required amount of smoothing with the input and output condensers fitted.

With the choke input filters a different set of conditions is encountered. In the first case quite high peak voltages are developed across the choke so that its internal insulation has to be exceptionally good. Its inductance should vary with the load on the supply unit since there is a critical value for light loads and an optimum value for the full working load.

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The method of arriving at these values will not be discussed here, but the information can be found in most handbooks dealing with amateur transmitting equipment. Actually no advantage would accrue by going deeply into the matter as the choice of suitable chokes is limited to two or three models at the most.

The requirements for the input choke are that its inductance should be high with only the critical value of current flowing, and moderately low with the full load current. An ungapped choke satisfies these requirements, and "swinging" chokes, as this type is called, are marked with two inductance values, such as "10/30 henrys, 150 mA," for example, or

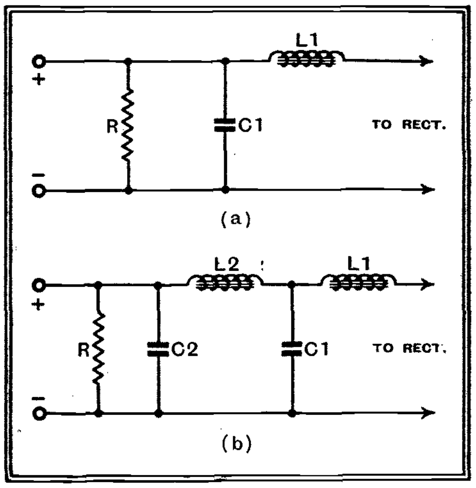


Fig. 15. Designs for smoothing filters for telegraphy and telephony transmissions.

"5/25 henrys, 200 mA," or markings to this effect.

For our purpose it will be quite satisfactory if we choose a choke of the first mentioned kind and fit a bleeder resistance to pass between 15 and 20 mA.

We have now to consider the amount of smoothing a filter of this kind will provide. Before doing so some idea must be formed of the degree of smoothness needed in the HT supply for different stages in the equipment. If the ripple content does not exceed 5 per cent. of the HT voltage it is usually satisfactory for the power amplifier of a CW telegraph transmitter. For the oscillator, frequency doublers and pre-amplifiers 1 per cent. of ripple is tolerable, while for telephony transmitters the ripple must be reduced to no more than 0.25 per cent.

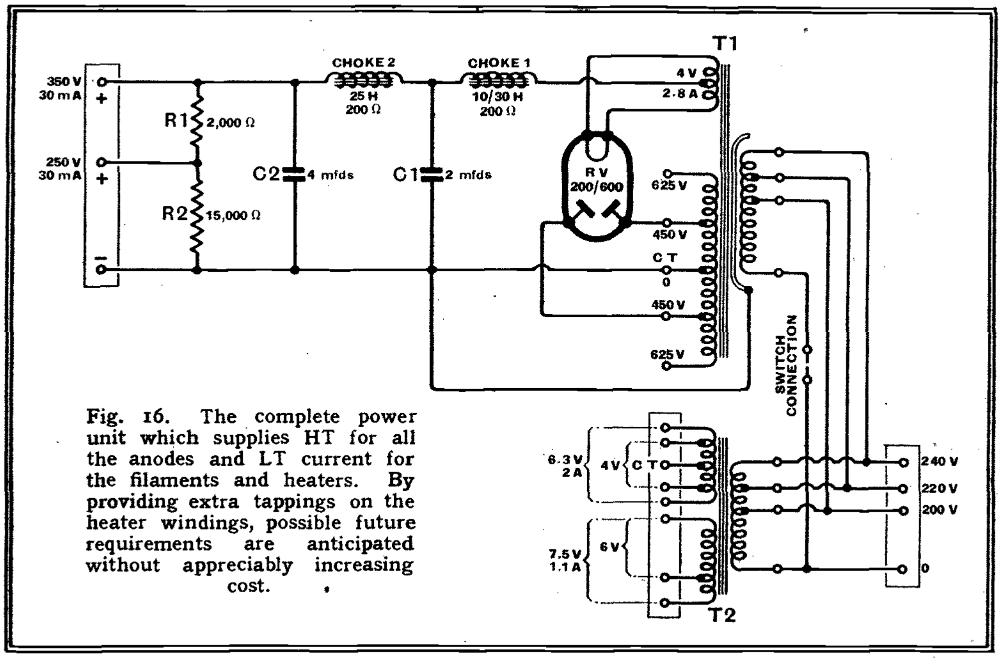
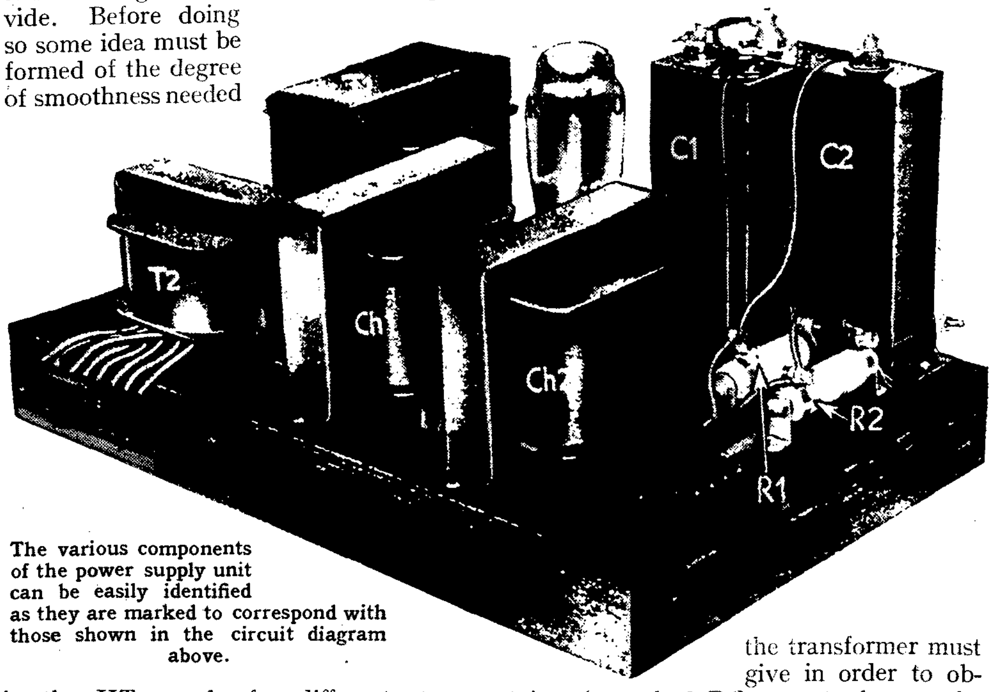


Fig. 16. The complete power unit which supplies HT for all the anodes and LT current for the filaments and heaters. By providing extra tappings on the heater windings, possible future requirements are anticipated without appreciably increasing cost.

A single-stage filter as shown in Fig. 15(a) will give a supply with a 5 per cent. ripple with an effective inductance of 10 henrys and a 2 mfd. condenser, but for 1 per cent. ripple or better a two-stage filter as Fig. 15(b) will be needed.

For example, a two-stage filter with L1, 10/30 henrys; C1, 2 mfds., L2, 25 henrys (constant inductance choke) and C2, 4 mfds. will have a ripple content below 0.2 per cent., and as this will satisfy all requirements it might be a good plan to build our supply unit on these lines.

We now have to find the RMS voltage the transformer must give in order to obtain a smoothed DC output of 350 volts at the probable current load of 100 mA.



The various components of the power supply unit can be easily identified as they are marked to correspond with those shown in the circuit diagram above.

This is slightly more current than will be wanted, but it allows for the addition of another stage, such as a frequency doubler, if we want to use one later.

The chokes it is proposed to employ have DC resistances of 200 ohms each, while the valve may be expected to drop about 20 volts or so at this load. For this supply unit it has been decided to use the Tungsram type RV 200/600 rectifying valve as it has a low impedance, having been designed to give good voltage regulation and to deliver a maximum current of 250 mA, when used as a full-wave rectifier. Also it will stand 600 volts RMS on each anode, which will be useful if we want to increase power to 25 watts or more later.

HT Secondary Voltage

Now we require 350 volts DC output. At 100 mA the smoothing chokes will drop 2 (200 x 0.1) = 40 volts, which, taking the valve drop as 20 volts, means we must add 60 to 350, giving 410 volts. DC values are average values and to convert to RMS this must be multiplied by 1.1 giving 451 volts, say, 450 volts RMS. In order to obtain 350 volts after smoothing the transformer secondary has to provide 450-0-450 volts RMS.

If now we decide to legislate for future requirements when, say, 500 volts DC may be needed, working out the voltage dropped with a current load of, say, 120 mA gives an RMS secondary voltage of 625-0-625. Though in excess of the stated maximum AC input to the rectifier it is permissible to exceed it by a small amount when a choke input filter is used, as the peak voltage and current are lower with this type of filter than with the orthodox condenser input circuit.

Therefore, we can decide on a transformer having a tapped secondary winding giving 625-0-625 volts RMS across the whole winding and 450-0-450 volts RMS at the tappings for the present 10-watt transmitter.

Now, so far as the smoothing conden-

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sers are concerned, we want one of 2 and one of 4 mfds., but as the output DC voltage is not likely to exceed 650 at the most with a bleeder resistance in circuit, condensers of 750 volts DC working would suffice. A 1,000-volt working type would give a better margin of safety and the oil-impregnated type are now obtainable at quite reasonable prices.

In addition to the high-voltage secondary we shall require some low tension

The high-voltage ends of the HT secondary windings on transformer T1 are anchored to the terminal saddle seen in the top left-hand corner in this underside view of the chassis.

windings for the filament supply of the valves. In a receiver power pack all the windings would be accommodated on a single transformer, but it is often more convenient in a transmitter supply unit to use a separate filament transformer. The LT winding for the HT rectifier can be on the transformer which supplies the HT, making this a self-contained unit, so that the HT can be switched off by fitting a switch in the primary circuit, but leaving the valves in the transmitter alight and ready for immediate operation after a period of listening.

The Tungsram RV 200/600 rectifier has a 4-volt filament and consumes 2.8 amps, and as it is a directly heated type there is no delay after switching on, so HT is available immediately.

The filament transformer has to supply the oscillator stage, which in our case has a 4-volt indirectly heated valve, the Tungsram APP4g, taking 2 amps, while the power amplifier if a TZ05/20, needs 6 volts at 1.1 amp. If a TZ08/20 is chosen, then 7.5 volts at 1.1 amp must be provided. Both these valves are of the directly heated kind.

Now, it is quite permissible to use a common filament supply for both kinds of valves, while the difference in voltage can easily be overcome by tapping the winding. However, if we are going to have tapped windings, the best policy is to arrange for alternative filament voltages, so that different valves can be tried in the various stages.

The suggestion put forward here is that one of the windings should give the choice of 4 or 6.3 volts, while another be included to give 6 or 7.5 volts. This combination will meet not only our immediate requirements, but it caters also for future needs, at least so far as we can legislate for at this juncture.

"Bleeder" Resistance Value

The complete circuit of the power supply unit thus works out as shown in Fig. 16. Resistances R1 and R2 not only serve as a bleeder resistance, but they also form a potential divider for obtaining the 250 volts required by the exciter unit. If R2 is made 15,000 ohms, which is a convenient value, it will pass 16.6 mA at 250 volts. R1, which is required to drop 100 volts, has to carry this current in addition to the 30 mA that will be taken from the 250-volt tapping. Its resistance is therefore 2,150 ohms; the nearest standard value being 2,000 ohms we will use it.

There is some advantage in fitting resistances that permit of easy adjustment, such as the wire-wound variety made by Bulgin and by Dubilier. Intermediate voltages can then be obtained by fitting an extra tapping band on one or both resistances. So far as rating is concerned, the 20-watt is quite large enough, and, indeed, provides a very big margin of safety.

The curve in Fig. 17 shows the measured DC output from the power supply unit illustrated. The sharp rise in voltage without the bleeder resistance in circuit and up to current loads of 12.5 mA is most marked. This resistance, passing about 16 mA, prevents this rise in voltage under working conditions.

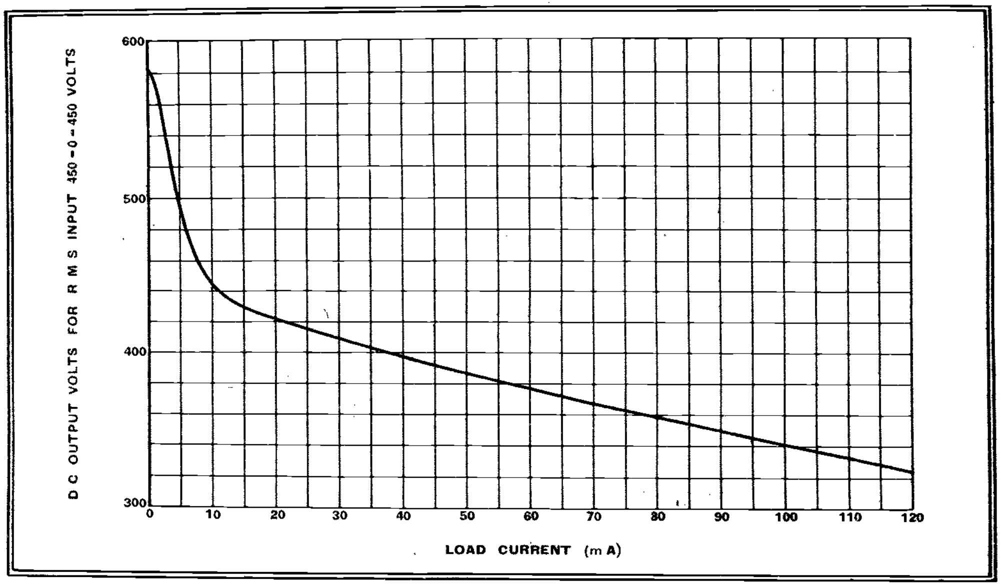


Fig. 17. Output voltage curve for the unit described.

In all the foregoing it has been assumed that an electric supply of the AC kind is available, but all who may be taking an interest in amateur transmitting will not be so fortunate as to have this facility. Some may have a DC supply, while others are forced to rely on batteries. It is hoped to deal with the particular problems associated with these matters later on in this series.

LIST OF PARTS

1 Mains Transformer, **(T1)**
 625-0-625 volts 100 mA, tapped 450-0-450 volts
 4 volts 2.8 amps, CT — Premier
1 Filament Transformer **(T2)**
 7.5 volts 1.1 amp, tapped 6 volts
 6.3 volts 2 amps, tapped 4 volts (CT) — Premier
1 Swinging Choke, 10/30 H., 150 mA **(Ch1)** — Premier, Type "A"
1 Smoothing Choke, 25 H., 150 mA **(Ch2)** — Premier
1 4-mfds. 1,000-volt working Condenser **(C2)** — T.C.C. Type 111
1 2-mfds. 1,000-volt working Condenser **(C1)** — T.C.C. Type 111
1 4-pin Chassis Valveholder — Clix
1 15,000-ohm 20-watt Resistance **(R2)** — Bulgin PR12
1 2,000-ohm 20-watt Resistance **(R1)** — Bulgin PR7
1 10-way Connector — Bryce 5C6
2 4-way Connectors — Bryce 5C2
1 Terminal Saddle — Eddystone No. 1046
1 Chassis ($\frac{3}{8}$in. plywood), $14 \times 9 \times 1\frac{1}{2}$in.
 Rectifying Valve, Tungsram RV 200/600

TUNGSRAM OS-12/500

THIS valve is essentially a pentode RF power amplifier designed for SW operation. Fitted with a 7-pin base and a top anode connection, it has a heater rated at 0.7 amp. at 12.6 volts. The maximum anode current is 40 mA. at 500 volts and the screen supply should be 200 volts. The maximum rated anode and screen dissipations are 12 watts and 8 watts respectively, and the mutual conductance is 3.4 mA/V.

In addition to its use as a transmitting valve, it is also suitable for use as a line output valve in an electromagnetic time-base. The valve will withstand 2,000 volts peak between anode and suppressor and 1,500 volts peak between screen and suppressor.

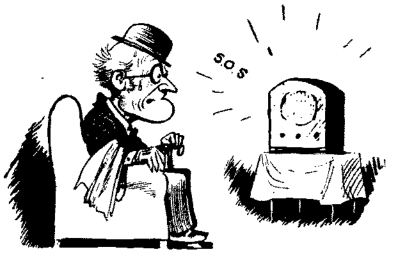
A similar valve—the OS-12/501—is available with a 6.3 volt 1.4 amp. heater. The price is 22s. 6d.

UNBIASED

By Free Grid

SOS or VTB?

I DON'T know whether it is a sign that I am getting old or that my liver needs decarbonising, but I must confess to a growing feeling of irritation at the way in which the myrmidons of the B.B.C. constantly use the phrase "SOS messages," although I would hasten to add that in this case I do not blame the B.B.C. as,



A feeling of irritation.

after all, they probably know no better and are merely following popular superstition in this respect.

The letters SOS in morse are not, of course, and never were, the international distress call used by ships. It would be just as true to label the distress call as VTB, VMS, EITGI or a host of other letter variations which the highly imaginative can evolve from the combination of morse symbols of which the international distress signal consists. Actually it represents no letters of the alphabet whatever and was never intended to. Consisting, as it does, of six morse characters, it could never represent even one letter because four symbols are the maximum used to form any letter of, at any rate, the English alphabet, although for aught I know there may be a dozen to represent letters in some alien lingoes.

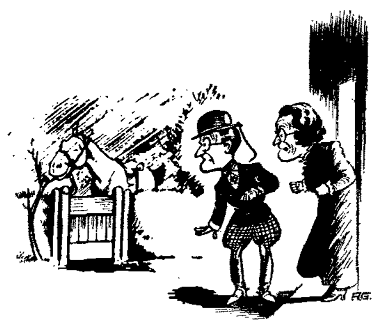
I think that the letters SOS were first evolved from the signal by some highly imaginative novelist who wanted to work in the rather dramatic phrase "Save our Souls." Prior to the adoption of the present distress signal, a combination of three letters actually was used, namely, CQD, this being made up of CQ, the general call for all stations, and the prefix D, used to denote an urgent "priority" message, and having nothing to do with the phrase "come quick, danger," which was, I believe, also evolved by the fertile imagination of a novelist—probably the same one.

Death-ray Wavelength Wanted

MANY of you will no doubt recollect the spate of death-ray inventions which made their appearance in the years immediately following the war. In his reminiscences published some time ago the erstwhile Air Ministry wireless chief told us, among many other things, that one inventor who gave a demonstration at the Air Ministry proved his ability to stop a petrol engine at the other end of the room by directing wireless waves at it, a feat with which the Air Ministry people had long been familiar. The irritating point about these reminiscences is that the wavelength and other vital technical data are not given, and not even *The Wireless World* Information Department with which I have been in communication seems willing to divulge them.

This latter point is particularly aggravating at the present moment, for I have been pestered during the past week or so by interference with my television reception, which I have definitely traced to a dilapidated car which seems perpetually parked outside my house, its owner being a fatuous young man who has recently been ensnared by my daughter Faradia. In reply to my expostulations he has explained that he is compelled to keep the engine running, as it is sometimes necessary to make a very quick getaway when Mrs. Free Grid comes into the room.

All I can say is that although in my young days we had no cars, I think that if we had had them we should have shown more consideration for others, and in any case we had more respect for parental authority; in fact, I can only recollect one unfortunate occasion when I came up against Mrs. Free Grid's mother. It so happened that I was accustomed to hitch my horse to the gatepost when I called, and one evening the future Mrs. Free Grid



"Had eaten a young sapling."

played one of Chopin's Nocturnes to me in such a realistic and touching manner that I fell asleep, and when I finally took my leave I found that my horse, enhungered by the long delay, had eaten the best part of a young sapling which had been planted by the front gate by Mrs. Free Grid's mother. However, I digress. What I wanted to say was that if any of you have any detailed technical data about these engine-stopping wireless waves and how to apply them, I should be heartily glad to learn of them, as it is high time that a stop was put to this philandering interference with television.

This Morse Business

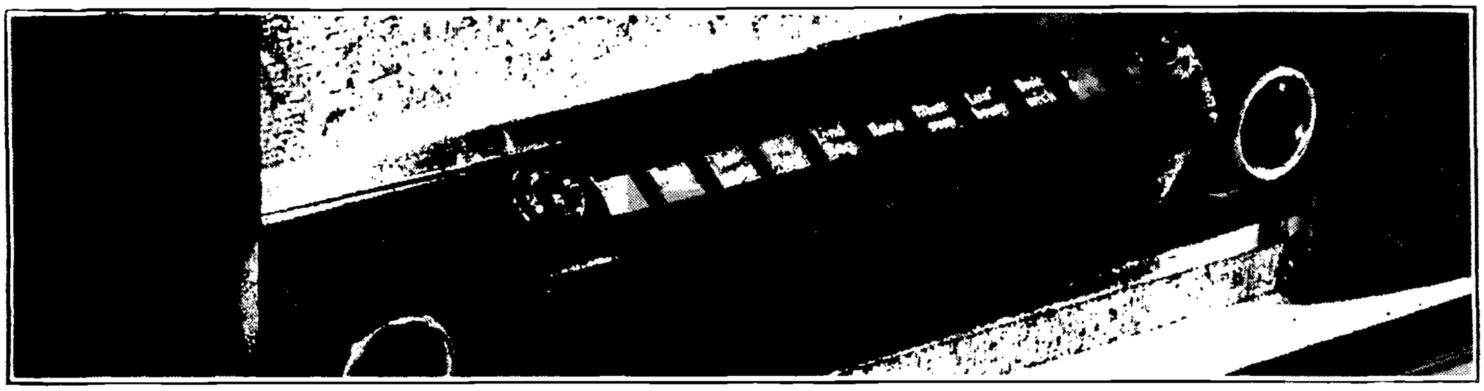
I SEEM to have raised a hornet's nest about my ears as the result of my recent attack on certain academic methods of learning morse, which start off by making the pupils memorise the code like a piece of poetry instead of learning to recognise the characteristic sound and rhythm of the various letters. To my mind such methods are just as bad as trying to teach a person to *speak* French by starting off with grammar. This latter method is all right if anybody merely wants to have an academic knowledge of the language, but as for its ability to teach a person to converse in the language, you

A haggard-looking individual.

have only got to watch a university-trained French scholar trying to buy himself a meal in a French restaurant in order to realise its futility. It is quite easy to do this in Paris and other places in France where foreigners forgather, since the waiters always understand English and also anglicised French, but it is far different in certain country districts.

I well recollect some years ago, when on a walking tour in a remote part of France, coming across a haggard-looking individual with a haunted look in his eyes, who turned out to be a man whose name was world-famous as a French scholar. He had bought a railway ticket for this place about a year before I encountered him, and having arrived there he found himself in a pitiable plight. Although he had sufficient money to pay his fare, he found that he was quite unable to make the booking clerk at the station understand his French. The result was that he was absolutely marooned in the village, and I do not know what would have happened had I not come along.

He had been able to get enough to eat by entering the village inn and rubbing his stomach, and he had, so the inn proprietor told me, acquired a reputation for being an unfortunate half-wit, as all they could understand from his speech was that he had a passionate and insane desire to know the whereabouts of the pen of his aunt, which apparently the gardener's boy had stolen. He wept tears of joy when I was able, with a few rough and uncouth phrases of French patois, to purchase a railway ticket for him and see him safely in the Paris train.



Push-Buttons

A SURVEY OF PRESENT-DAY TENDENCIES

By "CATHODE RAY"

A CERTAIN trade list of receivers now on the British market describes 665 models. Of these, 231 are found to be fitted with push-button tuning. Strictly speaking, I should say "automatic station selection," because I have included a few systems where switches or "telephone" dials are used instead of buttons. However, for the purpose in hand let's call them all buttons.

The previous season, push-buttoning was practically non-existent. So 231 out of 665 is a startling jump. Especially when the 665 include a number of "carry-forwards" from last season. Out of the 46 manufacturers listed, 40 offer push-buttons; the remaining 6 are all comparatively small firms dealing in more or less specialised types of set. Next season . . .? I can only judge of it from what I know, which is that a firm listing 3 of its 20 models with push-buttons this season has planned to appear with 10.

Is this "landslide" due to push-button tuning being invented just before the present season or to a sudden demand for it on behalf of the public, or both? As regards the date of invention; leaving out the inevitable Chinese and Egyptian claims to priority, and also some more recent ones, it can definitely be said that it was on the market at least as early as 1928, when the Zenith receivers sold in large numbers in America, and a year or two later appeared on this side under the name Zetavox. I brought one of the largest Zeniths home, where it was promptly christened "the speakeasy" on account of the rather furtive way in which the station selectors were concealed by a flap in the florid cabinetwork then in vogue in the U.S.A. They were more like typewriter keys than the modern press-buttons, and worked on what would now be described as the mechanical system. The inertia of the massive quintuple gang condenser was enormous, and a signalman's heave at the selector lever was required to move it, after which it went home with a resounding clang.

Although falling short of present-day standards in this respect, the Zenith was definitely in advance of many models now on the market as regards the ease with which the keys could be adjusted to select any station in the waveband. In the majority of models now available there is a restricted choice of stations that can be selected by any one button, and for changing the station there is hardly one that I could confidently entrust to most of the people I know.

Before going on discussing the merits and demerits of modern designs, just let me finish answering the question as to the cause of this sudden appearance of push-button tuning everywhere. Evidently it does not coincide with the date of invention. And as for public demand, those non-technical people I have heard expressing opinions seem to regard push-buttons as so many more things to go wrong, and apparently think designers are rather queer creatures for taking such a lot of trouble to "do it that way." Anyhow, neither recent invention nor public demand accounts for the meteoric rise of push-buttons. No doubt the driving motive was the usual commercial one of looking around for something to sell that makes all previous models look old-fashioned. That is not to say that there is no merit at all in the idea; personally I think it suits the needs of most people much better than turning a knob round and round, and I don't mind admitting that it suits me.

Presumably, the reason why it didn't "take on" years ago is that it is only within the last year or two that the type of set in common use has lent itself to a satisfactory and cheap push-button control. It was obviously asking for trouble to attempt it as long as receivers required a number of critical adjustments, such as reaction, to bring in a station. Then absence of AVC was a very noticeable drawback in the old Zenith. All this pointed to the superhet. But it is only quite recently that the usual type of superhet has had as few as two circuits to be tuned for each station, and anything more than two makes the pre-set type of control rather clumsy.

Why the motor-tuned type of station selector had to wait till now I have no idea, unless it had to be caught by infection from other sorts. It does not depend on the number of variable tuned circuits, and was accomplished somewhere about the same time as the Zenith, but never came to much.

I have mentioned two types of push-button system—pre-set (in which separate tuned circuits are brought into use by each button) and motor-operated. The third, in the usual classification, is mechanical, and has this much in common with the motor type that it makes use of the same variable condenser that serves for manual tuning. The pre-set type is divisible into three main sub-types, depending on whether the tuning is effected by capacity variation, inductance variation, or a mixture of both. In practice, inductance variation is usually done by moving a chunk of iron core inside the coil, and is called permeability tuning. In the mixed systems it is, I think, always the oscillator circuit that is permeability tuned, because that is by far the most critical, and permeability-tuned circuits are more likely to "stay put" than capacity-trimmed. A special development of the full-permeability system is the one in which the cores for the oscillator and preselector circuits are ganged, with the object of bringing the pre-setting adjustment within the ability of reasonably intelligent non-technical persons.

Most Popular Methods

Dividing the 231 push-button models I mentioned at the start into these classes they work out so:—

Mechanical	**66**
Capacity pre-set	**64**
Motor-driven	**38**
Permeability pre-set ..	**23**
Mixed, pre-set	**15**
Unspecified	**25**
	231

Taking a chance as a prophet, I should

Push-Buttons—
say that next season the motor and permeability (including mixed) types will gain ground at the expense of mechanical and capacity. Perhaps the wish is father to the thought. As the cheapest that can be done is mechanical, it may be that in a misguided effort to have all their models "up to date," manufacturers will bring out a lot of new mechanical models and offset the increase that is fairly certain to take place in the motor and permeability classes.

Disregarding cost, I place them in this order of merit—motor, permeability, capacity, mechanical. To intercept angry retorts, I emphasise that this is my personal opinion and only then in a general sort of way; naturally, a capacity-tuned pre-set system of particularly good design might be a lot better than a misbegotten permeability system. And a bad motor-driven system might perhaps be the worst of all. It is bound to be fairly expensive, because it must either be made phenomenally accurate or have a couple of extra valves for automatic frequency correction. And if it includes automatic waveband switching it is horribly complicated for servicing. But pending possible improvements in other types it is the best for station-changing, and—an important point, in my view—it gives a boost to remote control. Moreover, it employs the normal tuning means, instead of necessitating the addition of multiple tuned circuits, and does not restrict design to the simplest and worst type of superhet.

Mechanical systems appeal on the ground of cheapness, but when it is realised that the accuracy of location of the tuning condenser setting on the medium-wave band must be within about 2 parts in 1,000 to be satisfactory, and must stay there after the family has been playing with it for about a year, the thrift appeal is seen to enclose a possible snare. And it is not at all simple to devise a system in which the "feel" of the button pressing is the same for all stations, and which allows for easy station-changing and adjustment.

Abolish Wave-range Switching

Pre-set systems give the station at once, instead of a period of whirring wheels and things (which may or may not add to the pleasure of the process). There is generally more or less severe restriction on the stations that can be selected by any one button; station-changing is beyond the average person, and the chances of the tuning staying so accurate that no drift can be detected during, say, a year are not very large. In any case, it is generally admitted that the selectivity of push-button sets is fixed as low as the designer dares, to avoid making the inevitable slight drift too obvious. Up to the present, permeability tuning appears to be winning against capacity on points, not the least of which is the possibility of abolishing the need for waveband switching. There is not much sense in adopting push-button tuning with the laudable object of making things simple for poor Mr. and Mrs. Listener if they have to think of waveband switching, on/off switching, and a "Manual/Automatic" button as well as the station button. Let us hope that next season some of these superfluous processes will be eliminated.

Letters to the Editor

The Editor does not necessarily endorse the opinions of his correspondents

Non-Removable Valves

I MUST admit that in giving publicity to the rather drastic idea of soldering valves straight into the set I was not altogether unprepared for some dissent, and I am very glad to have Mr. C. Gordon's point of view, as expressed in last week's issue.

But I think he is overshooting the mark in saying that the article is "based *entirely* on misconceptions." Apart from the socket-abolition idea—which was only a sort of optional extra—it was based on actual experimental valves, American and European, together with actual valve makers' statistics. Mr. Gordon's complaint, however, seems itself to be based on a misconception, in that he judges the idea of fixed valves by his present experience of valves, whereas I definitely confined my tentative suggestion to a possible future state of affairs when the valves-to-be have proved themselves to be at least as reliable as volume controls, electrolytic condensers, and other components that are now fixed. So his remarks, based on the faults he experiences now, are really beside the point.

But I am indebted to him for reminding me of the set analysis angle, for it is quite true that the base-and-socket system serves a valuable purpose here, quite apart from valve faults. At the same time, Mr. Gordon will probably agree that the valve pin is not the ideal spot for connecting a meter, as it is impossible to obtain a reading in the RF leads without upsetting the working conditions—perhaps provoking oscillation in otherwise stable circuits, or stopping it where it is meant to be. It would be much better to insert the meter somewhere on the low potential side. Is it beyond the ingenuity of designers to make such provision in place of the numerous valve sockets they would save?

I hope I am not guilty of forgetting the service engineer, but I admit that if valves were as good as I think they ought to be he would run some risk of not finding enough work to keep him employed! However, no doubt some other complication would soon arise to keep him in demand!

"CATHODE RAY."

Demonstrating

AS one of the few firms in London handling communication receivers, may we be allowed to comment on "Diallist's" remarks in your issue of January 26th?

We carry a really wide range of these receivers at all times, with never less than a dozen different makes and types. It must inevitably happen occasionally, however, that we run out of a certain type for a short spell, due to American factory delays, etc., and no British agent can be blamed for either this, or if a new production is delayed. A 'phone call or postcard would, however, always save any distant visitor a wasted visit in this unlikely event.

There is, of course, little justification for a prospective client only hearing a set on London Regional, and we ourselves always offer to put any receiver "through its paces." It will be appreciated, however, that good short-wave reception cannot be obtained to order, and day-time reception in an interference-troubled district cannot be so good as in the client's home. That is why we find our special approval system very popular.

A. C. S. RADIO
London, W.C.1. H. MILES (G2NK).

Harmonic Interference on USW

ALTHOUGH it is admitted that motor car ignition systems cause serious interference with television and ultra-short-wave reception, we must not overlook other offenders; in particular, we should make sure that our wireless house is in order before asking outsiders to suppress interference voluntarily.

Take harmonics, for instance. In routine testing of television receivers in the Midlands the Daventry harmonic completely cuts up the picture if the set is correctly tuned to receive the sound and vision channels from A.P. To get good picture reception one must put up with a sound accompaniment from Daventry. Amateur transmitters, with a radiation of harmonics approaching the infinite, are even more to blame.

Occasional interference from a passing car is nothing compared with the continuous interference from harmonics produced by the transmissions of the very people commonly regarded as above suspicion.

Coventry. "TESTER."

[Presumably this refers to interference from the Empire stations; the third harmonics of GSP, GSI, GSO and GSF may be responsible.—ED.]

HENRY FARRAD'S SOLUTION

(See page 132)

IF the whistle is heard only when the neighbours are in, it seems likely that their set is causing the interference. As they usually listen to the long-wave National (Droitwich), with a frequency of 200 kc/s, the oscillator of their recent all-wave model, assuming the highly probable intermediate frequency of about 465 kc/s, would be tuned to 200+465, or 665 kc/s. Any frequency of about this figure would be capable of producing an audible beat-note with North Regional (668 kc/s), which is the nearest Regional station to Hull. On the other hand, Hull is sufficiently far away for reception of North Regional to be only moderately strong and therefore liable to interference by quite a weak signal. One might reasonably judge from his letter that Mr. Ironbotham and his neighbour are quite likely to be living in one of those rows of small houses where adjacent aerials are almost touching, and a very small amount of radiation from the neighbour's receiver would be enough to cause the trouble. Needless to say, Mr. Ironbotham has no cause to suspect his own set's age of being responsible, nor can he conscientiously be advised to follow his neighbour's choice and thereby add to the number of the potential disturbers of the ether.

NEWS OF THE WEEK

ARE EMPIRE TRANSMISSIONS JAMMED ?

Difficulties of Verification

UNSATISFACTORY rumours are continually filtering into Broadcasting House that the Daventry news bulletins are being deliberately jammed in different parts of the world.

Reports to this effect come from places as far apart as Natal and the Fiji Islands. In South Africa, apparently, no doubt exists that the news bulletins have been the subject of these unwelcome attentions, for the trouble is said to cease when the news finishes.

According to reports from Fiji, Daventry is jammed on all wavelengths, especially at night. Says a writer in the *Fiji Times*: "There is no doubt that the interference with Daventry is deliberate. The interference takes the form of continuous bubbling signals not connected with beam radio or commercial stations. At the same time, Russia and Germany, Holland and France are heard clearly and with maximum volume." Reports of this kind must, however, always be expected when political situations are obscure and listeners suspicious of interruptions."

POLICE RADIO

Mobile Transmitters and a Pocket Receiver

THE issuing of the annual reports of the police forces of Great Britain shows the increasing use made of wireless in the detection of crime. The West Riding County Police have just acquired a mobile transmitter which is sufficiently powerful to adequately cover the whole of the West Riding Police area. The Force is also being equipped with a further fifteen wireless patrol cars, bringing the total to ninety. These cars are fitted with compact ultra-short-wave receivers and a loud speaker.

A Lilliputian receiver measuring 4 × 2½ inches, including batteries, may soon be used by the Doncaster police. This pocket receiver has been designed by a member of the Force.

The Oldham Police Force is now equipped with two patrol cars which are fitted with transmitters and receivers. Each of the fifteen drivers and operators have passed post-office tests in morse. The police regional transmitting station, which is at Heaton Park, Lancashire, serves an area with a radius of some thirty miles. All communications are in morse, and these are prefixed by the number of the car for which the message is intended.

TELEVISION IS HERE—you can't shut your eyes to it. Now the farm is invaded. Last week, the television O.B. unit visited Bull's Cross Farm, Waltham Cross, Hertfordshire, where Mr. A. G. Street and the farmer piloted the Emitron cameras through the farmyard, fields and cowsheds. Contact with the Alexandra Palace transmitter was established by radio link and the quality of the finished transmission was unsurpassed.

A CENTRAL CONTROL ROOM at Alexandra Palace overlooks both studios and enables producers to utilise both for a single transmission or to conduct rehearsals in one while a broadcast is taking place from the other. Outside broadcasts also pass through the room, and the Farm transmission, pictured on this page, was co-ordinated on the sound and vision mixing desks shown here.

EMPIRE BROADCASTING

A Review of Progress

THE development of the B.B.C. short-wave broadcasting service since the experimental transmissions from G5SW at Chelmsford, which led to the inauguration of the Daventry Empire Service, was surveyed by Messrs. L. W. Hayes and B. N. MacLarty of the B.B.C. in their joint paper on the Empire Service Broadcasting Station, read before the I.E.E. on February 2nd.

It is impossible in the available space to deal adequately with the historic side of the development (much of which is already known by *Wireless World* readers) as portrayed by the authors, but the following observations of signal strengths made abroad will be of interest.

Signal-to-noise ratios measured by a private listener in Salisbury, Southern Rhodesia, during the period from April to August, last year, show that the lowest weekly average for the 50-kW transmissions from GSH on 21.47 Mc/s was 38 db., from GSG on 17.79 Mc/s 40 db., and from GSD on 11.75 Mc/s 35 db. The highest average for these transmissions was 53, 53 and 47 db. respectively.

The suitability of the Empire transmissions for rebroadcasting is exemplified by the results obtained at the Australian Post Office receiving station at Mont Park, Melbourne, of GSD (50 kW) on 11.75 Mc/s. These show that during April last year, for only 2.9 per cent. of the total time observed was the signal poor, 5.8 per cent. satisfactory, and the remainder good or excellent. During July no observed signal came under the category of poor.

RADIO CONFERENCE

Press and Industry Meet Radio Minister

A MEETING of representatives of the radio press and the wireless industry in France was summoned by M. Jules Julien, French Radio Minister, for the purpose of discussing questions concerning State broadcasting. The number of licensed listeners in the country increased by 550,000 during 1938, bringing the total to 4,705,859, and M. Julien, by examining diverse views on the subject and strengthening his grasp of the mechanism of broadcasting, hopes by the results of his work to increase the number to beyond the five million mark in the shortest possible time. His meeting with the Press and industry will, it is hoped, be the forerunner of a series of such conferences.

SAFER FLYING

Two New Radio Beacons

AT the exhibition, which was held in association with the Conference of the Aerodrome Owners' Association, in the Central Hall, Westminster, from February 1st to 3rd, several blind-landing systems were shown. Marconi's display included their new wireless beacon to be known as the Marconitrack. By using a series-phase aerial not only has the lateral radiation been greatly reduced, but the majority of the radiation is concentrated along the main approach line, with very little along the reciprocal bearing. The receiver has been designed to simplify the pilot's task of pre-setting the set's tuning.

An omni-directional 135-watt

News of the Week—
radio beacon, with a frequency range of 350-240 kc/s, was shown by Standard Telephones and Cables. A feature of this apparatus is the easily recognisable coded signals which are sent out at predetermined intervals. This equipment may be operated as a beacon or straightforward telephone/telegraph transmitter. The apparatus includes a fault indicator which indicates the section in which the fault occurs.

Features of the Standard-Adcock direction-finder, which was also on show, are freedom from "night effect" and "aeroplane error," and the fact that the separation of the aerial system and the receiving apparatus may be as great as 3,250 feet.

WORRIED WELSH LISTENERS

IN the corner of Wales bounded by Aberystwyth in the south and Pwllheli in the north, reception is notoriously bad.

Conditions are such that the Welsh schools broadcasts in the mornings have to be relayed by North Regional in addition to Washford and Penmon. This may be a sop to the Welsh, but it displeases Mancunians, who object to the inclusion of the Welsh language in their programme time.

With the opening of the Start Point transmitter, Washford will be able to concentrate on its Welsh service, and both this transmitter and Penmon might well be increased in power. An alternative suggestion is that the Penmon station should be moved farther south.

B.B.C. engineers, however, recognise that the beautiful Welsh mountains are mainly responsible for the trouble, but little difficulties of this kind were made to be overcome.

ELECTROLYTICS

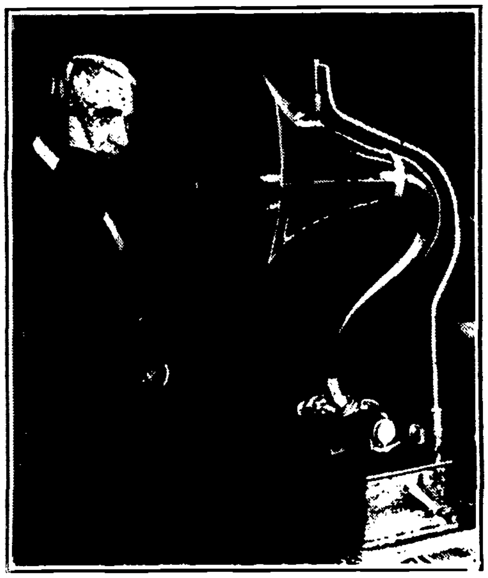
Development and Construction of Condensers

SOME of the problems that have confronted designers and manufacturers of electrolytic condensers were explained in a paper read before the Institution of Electrical Engineers on February 1st by Mr. Philip R. Coursey, Technical Director of the Dubilier Condenser Company, and Mr. S. N. Ray.

A brief survey of the development of the electrolytic condenser was followed by descriptions of the construction of the various types, such as the wet, dry and surge-proof varieties, and the particular characteristics of each were demonstrated.

One interesting point brought out by the demonstrations was that by roughening, or etching, the surface of the anode, a threefold increase in capacity is obtained for the same physical dimensions. This has resulted in a marked reduction in the size of modern condensers.

Demonstrations were also given showing the voltage regulating effect obtained with certain surge-proof condensers, and how they will withstand quite high voltages for short periods without damage.



THE FATHER OF SOUND REPRODUCTION. On February 11th will be commemorated the ninety-second anniversary of the birth of Thomas Alva Edison who died in 1931. He is here seen with his cylinder phonograph in his West Orange Laboratory, New Jersey, U.S.A. By his discovery of what is known as the Edison-effect (the fact that an electrode in the vicinity of an incandescent filament in a vacuum lamp draws current, provided its electric potential is positive with respect to some part of the filament) he provided the key to the thermionic valve.

FROM ALL QUARTERS

Television Entertainment in 1938

A TOTAL of 957.05 hours of television entertainment was broadcast from the B.B.C. transmitter at Alexandra Palace during 1938. The programmes included:

Drama, 246 hours; 25 per cent. of total.
Light Entertainment, 228 hours; 23 per cent. of total.
Outside Broadcasts, 113 hours; 11 per cent. of total.
Film transmissions represented 18 per cent. of total.

These figures are exclusive of 300 hours of film which was transmitted for demonstration purposes only.

Index and Binding Case

THE index for Volume XLIII of *The Wireless World*, July to December, 1938, is now ready, and may be obtained from the publishers at Dorset House, Stamford Street, London, S.E.1, price 4d. post free, or with binding case, 3s. 1d.

Radio Nations Transmissions

IN order to allow the Radio Nations transmitting station at Prangins to serve as a link between America and Eastern European capitals without interrupting the English transmissions, as has happened on two occasions recently, it has been decided to start the English programme at 7.30 p.m. G.M.T. (8.30 C.E.T.) instead of 6.45 p.m. as heretofore. The English programme will be transmitted on two wavelengths; HBO, 26.31 metres (11.402 Mc/s) and HBQ, 44.94 metres (6.675 Mc/s).

An I.E.E. Honour

SIR ARCHIBALD PAGE, Chairman of the Central Electricity Board, and President of the I.E.E. for 1927, has been elected an Honorary Member of the I.E.E. in recognition of his past services. Only one such appointment is made each year and the total number of Honorary Members at any one time is never permitted to exceed three.

"Let the Blind Hear"

NEARLY 45,000 blind people had been provided with wireless receivers or relay installations through the administration of the British "Wireless for the Blind" Fund at the close of its financial year on October 31st, 1938, the report for which has just been issued. The cumulative income of the Fund since its inception in December, 1929, amounted to £129,830. Of this sum over £117,000 had been spent on the actual provision of installations. With approximately 80,000 blind people in Great Britain there is still ample justification for the Fund's motto, "Let the Blind Hear." 50,937 listeners responded to Mr. Christopher Stone's Christmas Day, 1937, appeal.

TELEVISION PROGRAMMES

Sound 41.5 Mc/s. Vision 45 Mc/s.

An hour's special film transmission intended for demonstration purposes will be given from 11 a.m. till 12 noon each week-day. The National or Regional programme will be radiated on 41.5 Mc/s from approximately 7.45 to 9 p.m. every day.

THURSDAY, FEBRUARY 9th.

3, The Ambrose Octet. **3.30,** British Movietonews. **3.40,** 215th edition of Picture Page.

9, "Contrasts," a mixed programme including a sketch, songs and dances. **9.40,** Gaumont-British News. **9.50,** 216th edition of Picture Page. **10.20,** News.

FRIDAY, FEBRUARY 10th.

3, Vanity Fair—Spring fashions described by Bettie Cameron-Smaile. **3.10,** Cartoon Film. **3.20,** "A Tune to Take Away," a revue. **3.50,** Gaumont-British News.

9, Vanity Fair (as at 3 p.m.). **9.15,** "1066—and All That," the "historical" success by Reginald Arkell based on that Memorable History by Sellar and Yeatman. **10.15,** News.

SATURDAY, FEBRUARY 11th.

2.40, Rugby Football O.B. from Twickenham: England *v.* Ireland. **3.30,** "Contrasts."

9, Irène Prador in songs. **9.10,** Cartoon Film. **9.15,** "A Voice Said 'Goodnight,'" a one-act play by Roland Pertwee. **9.30,** Gaumont-British News. **9.40,** O.B. from Earl's Court of the last period of the Oxford *v.* Cambridge ice-hockey match. **10.10,** "The Conductor Speaks," Sir Henry J. Wood. **10.25,** News.

SUNDAY, FEBRUARY 12th.

3, Animal Cartoons by Arnrid Johnston. **3.10,** Film. **3.20-4.20,** "Arlecchino"—a theatrical capriccio in one act, by F. Busoni.

8.50, News. **9.5-10.35,** "Under Suspicion," a comedy thriller from the Playhouse Theatre.

MONDAY, FEBRUARY 13th.

3-4.30, "Theatre Royal," a play by Edna Ferber and George Kaufman.

9, Alfredo and his Gipsy Orchestra. **9.25,** O.B. of one of the regular Monday evening boxing tournaments from the Empress Hall, Earl's Court. **10.20,** News.

TUESDAY, FEBRUARY 14th.

3, "Eastern Cabaret," including Reine Paulet and Stone and Lee with Cyril Fletcher compère. **3.50,** Gaumont-British News.

9, "Theatre Royal" (as on Monday at 3 p.m.). **10.30,** News.

WEDNESDAY, FEBRUARY 15th.

3-4.30, "The Infinite Shoe-black," a play by Norman MacOwan.

9, "Grandfather's Follies." Cabaret from Grosvenor House. **9.40,** "Divertissement." **9.50,** Gaumont-British News. **10,** Rugger Demonstration. **10.10,** News.

Sounds—PLEASANT AND UNPLEASANT

THE DIFFERENCE BETWEEN MUSIC AND NOISE

By N. PARTRIDGE, B.Sc., A.M.I.E.E.

ALTHOUGH the subject of this article may seem to be outside the normal field of this journal, a knowledge of the matter discussed is of value to all concerned with sound reproduction.

THE niceties that elevate a musical masterpiece above the level of hot swing may be a little obscure; nevertheless, we radio engineers rather pride ourselves upon our ability to distinguish music from noise. We know a roll on the drum from a solo on the dust-bin lid. We can spot the difference between well-chosen chords struck on the piano and those indiscriminate fistfuls of notes so readily provoked from the very young. At least we could do so before the coming of "modern" music.

This natural division of sound into music and noise, concord and discord, pleasurable and annoying, is universally accepted but rarely explained. The sets we design, build, repair or experiment with are intended to reproduce music as opposed to noise. In view of this perhaps a few moments given to the contemplation of sounds, nice and nasty, might make an instructive break from our usual electrical worries.

The simplest continuous sound has a sine curve wave form as seen in Fig. 1. It is the tone emitted by tuning forks and also by a loud speaker connected to an audio-frequency oscillator. By the turn of a knob a beat oscillator will glide over the whole audible range of such tones. There is certainly nothing discordant about this performance, but the sound is uninteresting, boring and decidedly without emotional appeal.

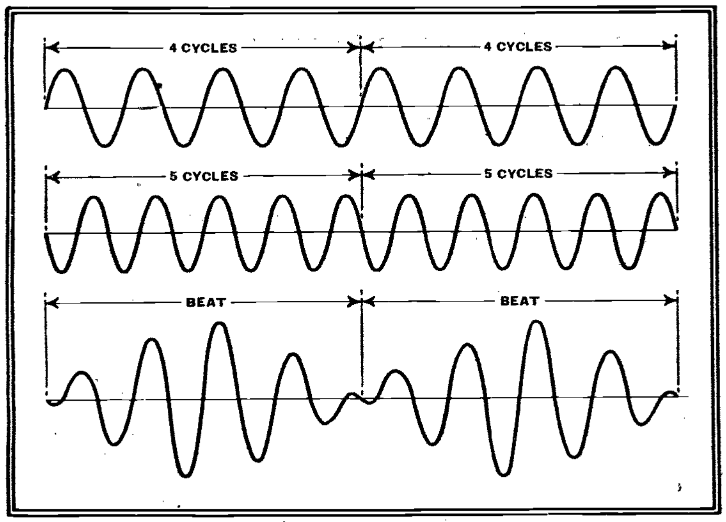


Fig. 1.—Production of a beat note between two oscillations of different frequency.

Apparently more than one pure tone is required in order to produce something aurally objectionable or pleasing. Our next imaginary experiment will therefore require two oscillators with associated amplifiers and speakers. Let them be accurately tuned to, say, C′=261 c/s (middle C), and then, leaving one at this setting, gradually raise the pitch of the other until it reaches the octave C″=522 c/s.

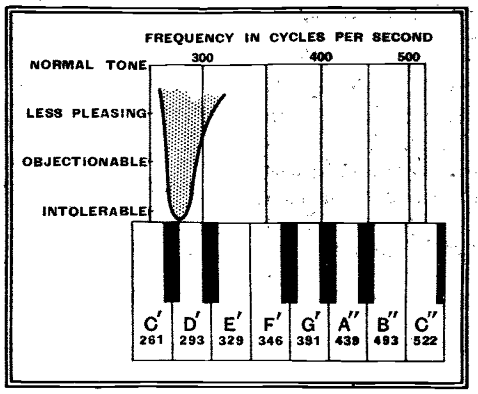


Fig. 2.—"Annoyance value" of a beat note.

When the oscillators are exactly in tune, the combined tone is little different from that of either of them separately. As they become a little off tune we do not hear the two individual notes, but the sound begins to pulse or beat. Fig. 1 shows how this comes about. When the two sound waves are in phase they reinforce one another, but as they approach phase opposition they cancel. Clearly a beat will be heard every time the lower oscillator slips a cycle behind that of higher pitch. Hence a difference of 5 c/s in the tuning of the oscillators will produce five beats per second.

The slow beats are rather fascinating, but as they get faster the effect is quite the reverse. The rapid throbbing becomes intolerable. Fortunately, the condition soon passes, and, by the time the variable oscillator reaches about 320 c/s, the beats are too fast to be followed by the ear, and the two separate notes become distinguishable. Just how pleasing these notes sound together is difficult to say, but, beyond all argument, they are preferable to the quick pulses. This state of debatable pleasure continues until the octave is reached. At this juncture a marked change occurs. The notes merge together, and the combined tone is clearer and brighter than either sounded separately.

Fig. 2 is an attempt to plot the relative "nastiness" of the combined sound against the pitch of the variable oscillator. Only a small portion of the curve can be drawn if general approval is to be won. Any attempt to indicate relative "niceness" of the more pleasing combinations would trespass upon the field of art, and it behoves one to be discreet.

The only region of discord shown on the curve of Fig. 2 is where the two notes are near together. This is rather odd, because anybody owning a keyboard instrument, be it a grand or a piano accordion, knows that middle C′ (261 c/s) sounded together with the B″ (493 c/s) above it (see Fig. 2) produces a howling discord. Why have we missed it?

Waveforms

The difference between the tone of our oscillators and that of musical instruments suggests itself as a possible explanation. The gliding tone experiment cannot be repeated using two pianos because the keyboard limits the frequencies obtainable to twelve definite

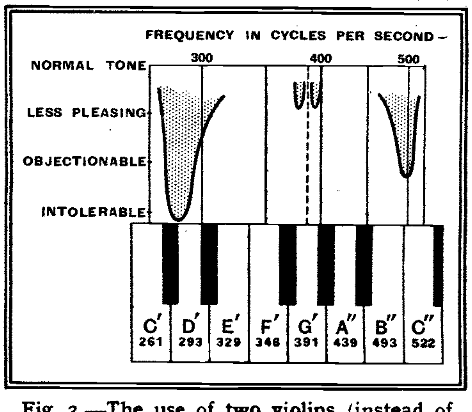


Fig. 3.—The use of two violins (instead of two oscillators) for the production of beat notes.

Sounds—

steps to the octave, but it can be repeated with two violins.

Fig. 3 corresponds to Fig. 2, the only

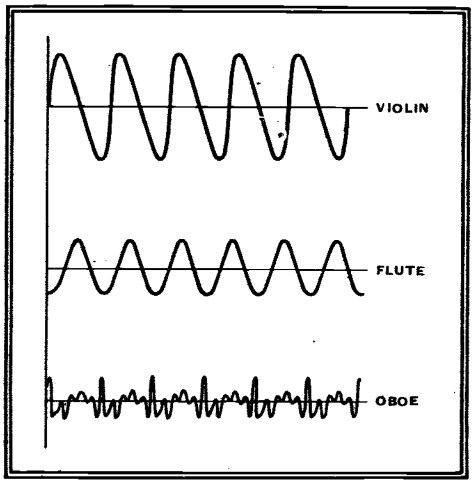


Fig. 4.—Type of waveform produced by various musical instruments.

change being that the two sine wave oscillators were replaced by two violins. The story is quite a different one. The missing discord of the seventh (C′ and B″) has made its appearance together with two other regions of lesser annoyance. It is very evident that tone quality has a bearing upon the matter apart from pitch, so that a brief study of waveforms becomes unavoidable.

Figs. 4 and 5 show the type of waveforms obtainable from various instruments. These curves must not be taken too literally, because both instruments and players differ in the tones they produce. Leon Goosens playing

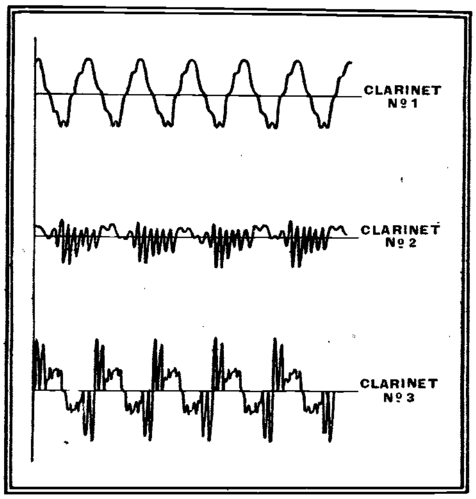


Fig. 5.—Showing the difference between the waveforms of three different clarinets.

the oboe sounds very different from the average orchestral player. Different again are the squeaks of the beginner. The only thing that gives identity to sounds of the same pitch is the waveform, and hence many waveforms must be possible from one instrument. Fig. 5 shows the waveforms of three different clarinets, each playing C′ = 261 c/s.

It is well known that however complicated a wave may appear, it can always be shown to be made up of a number of simple sine waves superimposed upon each other. In the case of musical instruments the frequencies of the component waves are simple multiples of the lowest or fundamental note and are referred to as harmonics. The first harmonic is the fundamental itself, that of double frequency is the second harmonic, and so on.

Table I sets out an approximate analysis of the tones of typical instruments. The figures given for the violin at once explain the presence of discord in our gliding tone experiment. The violin produces a strong second harmonic. The fixed pitch violin that was maintained playing a steady C′ = 261 c/s also gave out quite a lot of C″ = 522 c/s. As the variable pitch violin approached the octave unpleasant beats between it and the second harmonic will be sufficient to account for the disagreeable effect.

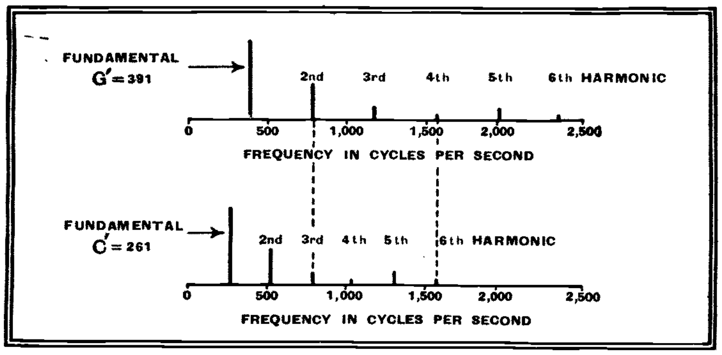


Fig. 6.—Fundamentals and harmonics of two violins; the frequencies are such that no beats are produced.

The interval of the fifth which is produced by sounding C′ and G′ together (see Figs. 2 and 3) has always been recognised from earliest times as particularly concordant. It will be noted that in Fig. 3 there is a region of discord on either side of G′ (391 c/s) with a gap between in which lies this especially favoured combination.

In Fig. 6 the spectrum of two violins playing C′ and G′ has been shown in rather a different way. The frequencies of the two fundamentals and of their harmonics are shown along the bottom, and the relative strengths or amplitudes of these are indicated by the height of the lines representing them. The third and sixth harmonics of the lower pitched instrument coincide with the second and fourth harmonics of the higher one. In addition to this the remaining harmonics fall well apart and are unable to produce beats. If the pitch of the instrument playing G′ were slightly raised or lowered, the harmonics now coincident would beat against each other. This explains Fig. 3 completely.

This theory of beats being the cause of discord is the basis of Helmholtz's Theory of Harmony. Its interest to the radio engineer lies in the fact that unpleasant sounds are not caused by harmonics as such, but by congestion of the upper frequencies causing beats between harmonics.

A pure sine wave note suffers no unpleasant change from a few per cent. harmonic distortion. The fact is that 50 or 100 per cent. addition of all audible harmonics will probably result in a much more musical sound. Any number of tone qualities can be coaxed from the organ in the name of middle C. This is all done by the drastic harmonic distortion, often beyond recognition, of the tone emitted by a tuning fork C′ = 261 c/s!

A complex sound consisting of several notes played simultaneously, together with the harmonics of each, is a different proposition. Harmonic distortion will produce numbers of new frequencies, including harmonics of the original harmonics. If some of the resulting frequencies fall near together, as they surely will, then discord, unpleasantness, or what the man in the street calls distortion, will be heard.

The most objectionable number of beats

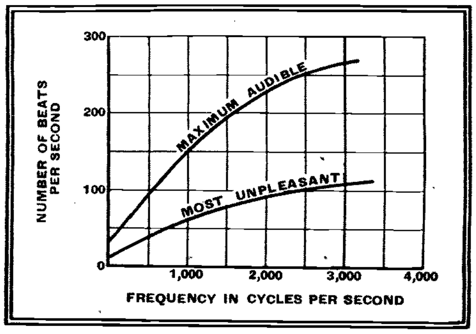


Fig. 7.—Audibility and unpleasantness of beats.

TABLE I.—Appropriate Analysis of the Tones of Typical Instruments.

Instrument.	Frequency of Fundamental.	Relative Amplitudes (%) of Harmonics.									
		1st.	2nd.	3rd.	4th.	5th.	6th.	7th.	8th.	9th.	.....
Piano ...	C = 130.5	100	65	30	35	15	55	15	30	20	and many higher.
Piano ...	C″ = 522	100	20	26	10	10					
Violin (Fig. 4)	G′ = 391	100	45	15	5	10	4				
Clarinet ... (No. 3 Fig. 5)	C′ = 261	100	60	10	5	10	35	40	50	15	and many higher.

Sounds—

per second depends upon the mean pitch of the beating notes. The same applies to the maximum number of beats that can be followed by the ear per second. This matter was investigated by Mayer and Stumpf and the results of their experiments are given graphically in Fig. 7.

In conclusion, the writer would like to make acknowledgment to two books from which he obtained valuable help in the preparation of this article. These works are "Speech and Hearing," by Harvey Fletcher, and "Science and Music," by Jeans.

Random Radiations

By "DIALLIST"

Some Hum, Some Don't

TRYING out considerable numbers of receiving sets, as I do, season by season, it's interesting to note how much they vary in the amount of hum produced. My mains supply is standard 50-cycle time-controlled AC, so that any well-designed set should be able to give a good account of itself in the matter of freedom from hum. Most of those of good quality are pretty well free from this unpleasant kind of noisiness, but I do come across examples, amongst models that are by no means in the cheap class, of pronounced and most annoying humming. It's a matter which should receive the very careful attention of manufacturers, for nothing is more annoying than a receiver which never stops making that monotonous purring noise. As often as not the nuisance seems to be due to lack of proper screening for certain of the valves. That, surely, is a matter which could and should be set right without much trouble or expense.

Another Mains-battery Receiver

AN officer of the Royal Corps of Signals who is stationed in the North very kindly sends me the circuit diagram of an ingenious power unit, designed for operating either of two different receivers, which works equally well from any 50-cycle AC supply with a voltage between 110 and 250, or a 12-volt motor car accumulator. As he marks his diagram "Copyright by Reuter, Press Association and Central News" I'm afraid that I can't reproduce it! What he has done is roughly this. The mains transformer primary is tapped at 110, 200, 220, 230, 240 and 250 volts. It is connected through a switch to the mains plug, with a simple arrangement for selecting the particular tapping required. Built into the unit is a 12-volt vibrator converter with an output voltage of 140. This is connected through a second switch to the 110-volt and 250-volt tappings. The smoothing arrangements are conventional but thorough, and my correspondent tells me that his apparatus works so well that on any wavelength (one of his sets is a communication receiver) you can switch over from mains to battery, or from battery to mains without noticing the slightest difference in performance. He is, I understand, considering the possibility of adapting the unit so that it will work off DC mains as well. If he succeeds in doing that he will have the ideal soldier's set—one that he can always be sure of bringing into operation in whatever part of the world he may be stationed. There is a sound idea for an Empire model here if any of our manufacturers care to put on their thinking caps.

Whiskrospherics

ONE electrical appliance that I haven't invested in yet is an electric razor. The main obstacle is the great oath that I swore some time ago not to allow any kind of apparatus capable of radiating interference to be fixed up in my home. I am not going to say that all electric razors radiate, for the very good reason that I don't know, because I can't claim to have tried them all. But so far I haven't come across one that doesn't produce a strong and highly unpleasant response from the wireless set when it is brought into use. It may be argued that that sort of thing doesn't matter very much because most people do their shaving in the early morning when the number of sets in use is insignificant. That's true enough, though some of the more hirsute have to undertake a second de-whiskering in the evening and there are always the lazy ones who don't go in for the shining morning face. Anyhow, the general principle holds: I maintain that at this time of day no manufacturer should turn out a domestic appliance that can radiate interference with wireless reception.

Always Something New

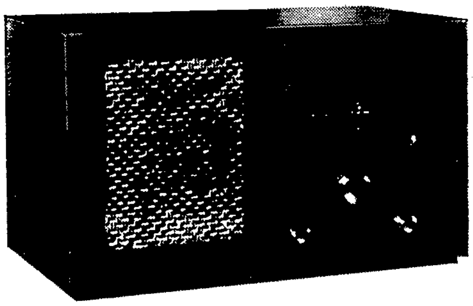
ONE of the great things about wireless as a hobby or as a profession is that there's always something new coming along. Sometimes the new things announced turn out to be not so useful as their enthusiastic inventors would have us believe; but, in any event, they always provide plenty of scope for both investigation and discussion. Do you remember the battle of the side-bands when Robinson first launched his stenode? He wasn't quite right in his one-time contention that there weren't no sich things; but his principle that the higher audio frequencies were only attenuated by super-selective circuits, and not completely lost, but could be boosted up again subsequently, is one that seems to find a pretty wide application to-day. Wireless is always advancing over the corpses of old beliefs killed stone-dead by subsequent discoveries. Time was when it was held that only the long-wave transmissions could span great distances and that the short waves were all but useless. Time was, again, when it was equally firmly held that ultra-short wave transmissions could not be received if the receiving aerial was much beyond visual range from that of the transmitter.

Snow and Wireless

ONE thing about snow is that the moisture from it really does soak deeply into the ground when the thaw comes and doesn't run off the mere surface as rain water so often does. A snowy winter should mean months of thoroughly damp subsoil, and I shouldn't be at all surprised to see reports during the coming summer from many people about phenomenally good wireless reception. Heaps of folk don't get their earth connections deep enough down to cope properly with the conditions that follow a dry or a snowless winter. The subsoil then may become dried up for many inches down and, if the earth connection is shallow, reception can be badly affected.

A Case in Point

Once I remember being called in by a puzzled friend who had installed a first-rate receiver one summer and was getting the poorest of results with it. It was in the days before the superhet. This set, though it had a useful RF stage and two AF, needed the reaction coupling to be screwed well up to bring in even the local station at respectable strength. The trouble was traced to the earth connection, which was buried about a foot and a half below the surface in lightish soil. It had done well enough during the winter, but now it was useless. Deepening its hole by another foot until good, heavy soil was reached made all the difference. Next time you want a little healthy exercise, I can strongly recommend a little spade-work for the benefit of the "earth."



COSSOR MODEL 70. A two wave-band AC superheterodyne with five valves including rectifier. The output valve is a triode and an 8-inch loud speaker is incorporated in the horizontal-type cabinet. Station names are printed on a black background and the price is 8½ guineas.

News from the Clubs

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

On January 31st Mr. P. G. A. H. Voigt gave a lecture and a demonstration, his subject being "Reproduction," and at the following meeting Mr. H. Bevan Swift, Past-President of the R.S.G.B., talked on "Radio Reminiscences." At the next meeting, on February 14th, Mr. A. W. Graham will discuss "Push-Pull Balancing Problems."

Cardiff and District Short-wave Club

Headquarters: Toc H. Rooms, Crown Court, Duke Street, Cardiff.
Meetings: Thursdays at 8 p.m.
Hon. Sec.: Mr. H. H. Phillips, 132, Clare Road, Cardiff.

At the meeting this evening (February 9th) Mr. H. H. Phillips will talk on the subject of "Research Problems." The R.S.G.B. meeting will be held on February 16th.

Mersey-side Transmitting Society

Headquarters: 368, Stanley Road, Bootle, Liverpool, 20.
Meetings: Tuesday evenings.
Hon. Sec.: Mr. C. E. Cunliffe, 368, Stanley Road, Bootle, Liverpool, 20.

A discussion night will be held on February 14th, and at the following meeting, on February 21st, a talk will be given on "The Theory and Design of Power Amplifiers and Coupling Systems." A practical demonstration of power amplifiers will be given on February 28th.

Maidstone Amateur Radio Society

Headquarters: 244, Upper Fant Road, Maidstone.
Meetings: Tuesdays at 7.45 p.m.
Hon. Sec.: Mr. P. M. S. Hedgeland, 8, Hayle Road, Maidstone.

A lecture on "56-Megacycle Operation" will be given at the next meeting on February 14th. On February 21st a representative of the Mullard Co. will lecture on "Cathode Ray Tubes."

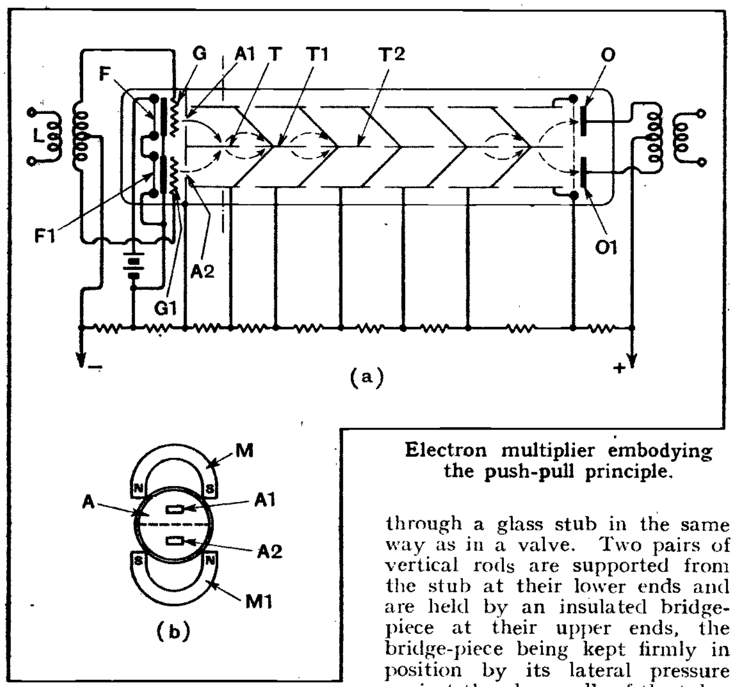
Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section

ELECTRON MULTIPLIERS

THE electron multiplier is most efficient when amplifying small currents, such as those produced by a photo-electric cathode. If one starts with the heavier emission given by a thermionic cathode, it becomes difficult to modulate the electron stream to any great depth, so that the output contains an unduly large direct-current component.

The object of the invention is to overcome this difficulty by applying the principle of push-pull amplification to the multiplier. As shown in the drawing, the indirectly heated cathode is made in two sections, F, F1, the co-operating grids G, G1 being fed in push-pull with signal voltage from an input coil L. As the grid-voltages vary, the electron stream passes first through an aperture A1 (shown separately in diagram (b)), and then through an aperture A2 in the common anode A. Magnets M, M1 apply fields in opposite directions to the electrons, so that as the latter pass in separate streams through the tube, they strike against the upper and lower faces respectively of the common "target" electrodes T, T1, etc., as shown in dotted lines. The amplified currents are finally collected by the two separate electrodes, O, O1.



Electron multiplier embodying the push-pull principle.

Standard Telephones and Cables, Ltd. (Assignees of A. M. Skellett.) Convention date (U.S.A.), July 31st, 1936. No. 493217.

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STRAYING ELECTRONS

IN an electron-multiplier it is found that the noise-to-signal ratio is usually higher than that to be expected from the theory of the so-called "shot" effect, particularly when the multiplier is amplifying the current produced by a relatively weak ray of light. It is thought that the trouble is due to stray electrons, which are deflected from the main discharge path and build up harmful charges on the insulating supports and other parts of the electrode system.

According to the invention this is prevented by the provision of two "strip" electrodes, which are located on both sides of the main accelerating and target electrodes, and are so biased that they serve to repel any swerving electrons and restore them to their proper path. The two auxiliary strips may be replaced by a single cylindrical "guard," which is biased to a voltage equal to, or less than, that of the photo-sensitive cathode.

Cie. pour la Fabrication des Compteurs et Materiel des Usines à Gaz. Convention date (France), August 28th, 1936. No. 493968.

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PIEZO-ELECTRIC OSCILLATORS

A QUARTZ crystal is mounted inside an evacuated glass bulb, the electrodes being brought out through a glass stub in the same way as in a valve. Two pairs of vertical rods are supported from the stub at their lower ends and are held by an insulated bridge-piece at their upper ends, the bridge-piece being kept firmly in position by its lateral pressure against the glass walls of the tube.

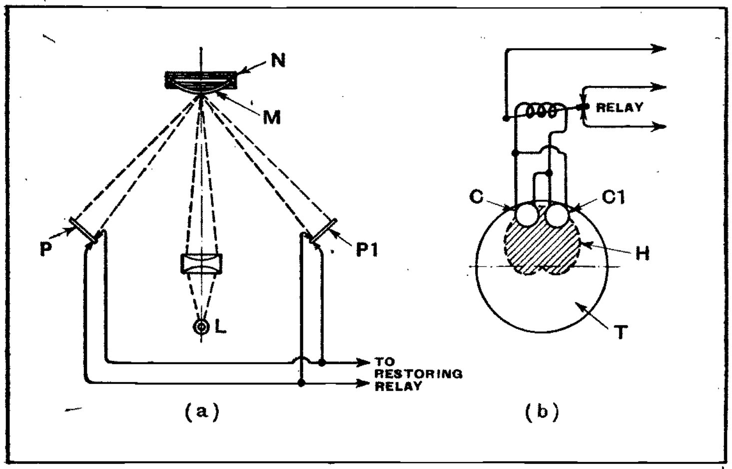
Two of the rods are bent outwards from the vertical for part of their length and are then bent inwards again, so as to form a centre "loop" or mounting for the crystal, which is thus held in position with a resilient pressure of the electrodes against its surface.

Fabrica Italiana Magneti Marelli. Convention date (Italy), March 22nd, 1937. No. 495009.

"ROBOT" STEERING

A "RADIO-COMPASS" which gives a visual or direct indication of the direction of a distant transmitting beacon is used to steer an unmanned aeroplane or submarine.

As shown in Diagram (a), the needle N of the radio compass normally points along the fore-and-aft line of the craft, but swings to one side or other if the craft yaws away from the straight course. The needle, which carries a small mirror M, is set between a pair of photo-electric cells P, P1, so that any movement causes a lamp L to illuminate one cell more than the other. The resulting current is then amplified and applied to a relay, which "corrects" the steering until the original light-balance between the cells is restored. Alternatively, the movement of the needle N may be applied to upset the balance of a capacity bridge which then brings the restoring relay into action.



Radio-controlled steering system for boats, aircraft, etc.

In the arrangement shown in diagram (b) the radio-compass needle is replaced by a cathode-ray tube T, on which the direction of the distant beacon is indicated by a fluorescent trace, in the form of a heart-shaped curve H. Any shift in the curve, due to the craft moving off its course, will then illuminate one of the PE cells, C, C1 more than the other, and so operate the steering controls to bring the craft back into line.

Standard Telephones and Cables, Ltd. (assignees of Le Materiel Telephonique Soc. Anon.). Convention date (France), November 4th, 1936. No. 492927.

o o o o

VIEWING SCREENS

OWING to the curvature of the bulb end of a cathode-ray tube, the picture details which fall on the outer edges of the fluorescent screen may be considerably distorted. The effect is most noticeable at the four corners of the "mask" within which the picture is usually centred.

In order to minimise this defect, a small strip of ground glass is placed at each corner of the mask, where it cuts off a part of the angle, and so prevents the worst of the distortion from being seen. This necessarily diminishes the total field of view to a small extent, but since the screening strips are made of translucent or ground glass, diffused light from the screened corners of the fluorescent screen is allowed to pass through. The general illumination of the received picture is, therefore, not noticeably diminished.

Baird Television, Ltd., and A. H. Gilbert. Application date, March 12th, 1937. No. 491886.

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DIRECTION-FINDING

A KNOWN method for avoiding "night effect" in direction-finding is to use three or more vertical frame aerials which are rotated simultaneously about a common centre. In such an arrangement any horizontally polarised waves are balanced out, when the frames are set parallel with the direction of the incoming signal.

According to the invention, in order to avoid the mechanical difficulties associated with the bodily rotation of the aerial system as a whole, each frame aerial is replaced by a pair of fixed frames mounted at right angles to each other. Each pair of frames is then coupled to a pair of field coils and a search coil, forming a radio-goniometer. All the goniometers are arranged at the centre of the aerial system, and the various search coils are ganged together on a common shaft, so that only one adjustment is necessary.

Telefunken Ges fur drahtlose Telegraphie m.b.h. (addition to 467785). Convention date (Germany), April 7th, 1937. No. 493027.

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

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NEW RECEIVERS AND AMPLIFIERS

DEGALLIERS, Ltd.—See our advertisement on Page 7.

NOTE New Address.—31, Craven Terrace, Lancaster Gate, W.2. Paddington 2745. [7934

BAKER'S New Quality Receiver and Corner Horn Speaker for Realistic Reproduction.—Details from Baker's Selhurst Radio, South Croydon. [7965

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ARMSTRONG Announce Model A46/FC Amplifier.—This new unit is a 6-watt push-pull amplifier having in addition to the normal flat frequency response, both a bass and treble boost circuit giving control of the frequency response at both ends of the audio spectrum; the price of model A46/FC is 11 gns.

ADVANCE Details of the New Amplifier, together with particulars of our standard 6-watt amplifier model A46/7 at 9 gns., the 12-watt amplifier model 127/PX at 12 gns. and the local station feeder unit RF2/4 at 3 gns., are available on request.

ARMSTRONG Co., 100, St. Pancras Way, Camden Town, London, N.W.1. [7974

ALBA, Ferguson, Ever-Ready, Halcyon, Portadyne, Sparton, Spencer and other first class makes always in stock; wholesale only.—Trade enquiries to Leonard Heys, 36, Henry St., Blackpool. [0610

GENUINE Bargain.—Quality amplifiers, 8 watts undistorted push-pull output, latest British octal base valves (6.3v. heaters), tone control, matched energised speaker, wired and tested; £6; c.o.d.; carriage paid; 7 days' approval.—Radio Chassis Supplies, Balmoral, Pavilion Drive, Leigh-on-Sea. [8004

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WANTED for Cash, Challenger M.S.K. 505.—Lownds, The Cottage, Old Lenton, Nottingham. [8013

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10-WATT Marconi Speaker Model P.S.51, 7ft. horn, £11/10; 12-watt Marconiphone Model E.M.5, amplifier, turntable, mike, etc., oak transportable, £12; Bayliss convertor, 12 D.C.-230 A.C., 150 watt, £3.—K. Sayer, Kirkby Stephen. [8000

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NEW VARIABLE SELECTIVITY

MODEL AW125PP

12-V. 5-BAND ALL-WAVE RADIOGRAM CHASSIS

(12—550 continuous, 1000—2000 m.)

with R.F. Pre-Amplifier, 2 I.F. stages with Variable Selectivity. Manual R.F. gain control and 10 watts R.C. coupled Triode P.P. Output. **£17.17**

Further extracts from The **Wireless World**

TEST REPORT, Jan. 5th, 1939

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Every detail of the assembly and wiring is neat and workmanlike, the controls are smooth and well graded.

The oscillator tracking is good and the sensitivity is unusually well maintained throughout the whole range of the receiver. Wherever one decides to search for stations, whether it be the 13-metre band at the lower extremity of the range, the so-called 'trawler' band or the long waves, one finds the same characteristic vitality which betokens an RF stage and two good IF amplifiers pulling their whole weight.

The three degrees of selectivity give clearly defined increases in band width. They have been well chosen. . .

The volume control is smooth and the output stage accepts all that the set will give it without showing distress."

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VENTILATED Steel Cases for Above; 12/6.

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MISCELLANEOUS

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ALL Models Super Shrouded, primaries screened and tapped, 200-250v., filaments C.T.

ANY Model Fitted 5v. or 6.3v. Filaments, if Required.

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AUTO Transformers, 100-120 to 200-240v.; 80 watts, 11/-; 120 watts, 14/6; 200 watts, 21/-; 250 watts, 25/-; 300 watts, 28/-; 500 watts, 47/6.

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TANTALUM for A.C. Chargers, H.T. and L.T.—Blackwell's Metallurgical Works, Ltd., Garston, Liverpool. [7263

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CONVERT Your Set into a Radiogram at Minimum Cost; surplus cabinets from noted makers under cost of manufacture (undrilled), 30/- upwards; motors at wholesale price.

"FIT-A-GRAM" Cabinet, 31x17x15, 21/-.

UNDRILLED Table, console and loud-speaker cabinets from 3/6.

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E.D.C. Convertor, 220 D.C., 230 A.C., 180 watts; what offers?—McKay, 60, Whitehall Rd., Aberdeen. [8002

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A.C.-D.C. Conversion Units for Operating D.C. Receivers from A.C. Mains, 100 watts output, £2/10; 150 watts output, £3/10.

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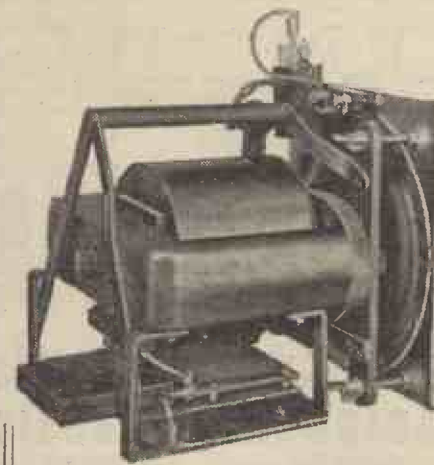
BAKER'S New Corner Horn Speakers set a New High Standard in the Realistic Re-creation of Speech and Music Which Will Appeal to All Music Lovers; your present receiver or speaker taken in part exchange.—Details from the Pioneer Manufacturers of Moving Coil Speakers, Baker's Selhurst Radio, 75, Sussex Rd., South Croydon. [7967



DEMONSTRATION WEEK

We cannot tell you in an advertisement what the Voigt Loud Speakers sound like. You must hear them for yourself. They can be heard at the following places by appointment during the week from 13th to 18th February.

Where the demonstration takes place in the London Area, or close to a local station, the light coil twin diaphragm will be used.

"The Wireless Trader" in a recent review of the Light Coil Twin stated, "That where the input is free from interference and other defects, the results obtained can be described as THRILLING."

Those interested are advised to consult the programmes prior to making an appointment, since transmissions (or amplifiers) which are in any way inferior cannot do justice to our instruments.

BERKSHIRE, Maidenhead
Dynatron Radio Ltd. — *Maidenhead 1211*
CHESHIRE, Nantwich
George Berry, Churchyard Side
CORNWALL, Falmouth (Also Penzance)
F. B. Grose — *Falmouth 372*
DORSET, Parkstone (Nr. Bournemouth)
Harold Taylor, at Lilliput Square, Sandbanks Road — *Canford Cliffs 430*
DERBYSHIRE, Derby
Victor Buckland Ltd. — *Derby 45922*
ESSEX, Clacton
H. T. Greenfield — *Clacton 1129*
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A. H. Silcocks & Son Ltd. — *Romford 710*
HANTS, Bournemouth
Radiocraft Ltd. — *Bournemouth 2023*
HANTS, Southsea
F. Gleed — *Enquiries to Portsmouth 4340*
KENT, Bromley
Lowther Manufacturing Co. Ltd. — *Ravensbourne 5225*
LANCASHIRE, Manchester 3
Holiday & Hemmerdinger Ltd. — *Blackfriars 4096*
LANCASHIRE, Haslingden
Arthur Coulton — *Rossendale 663*
LEICESTERSHIRE, Leicester
W. Winder — *Leicester 89787*
LONDON, S.E.26
Voigt Patents Ltd. (Demonstration address not yet settled. 'Phone for details.) — *Sydenham 6666*
MONMOUTHSHIRE, Ebbw Vale
S. Brewer & Son — *Ebbw Vale 141*
NORTHANTS, Northampton
Fraser Son & McKenzie Ltd. — *Northampton 618*
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LOUD-SPEAKERS

SECOND-HAND, CLEARANCE, SURPLUS, ETC.

G.12 Rolas, brand new; P.M., 59/6; energised, 47/6; Rola 8in., energised, 6/11.—Shippers, 18, Corporation St., Manchester. [0606

3,000 Speakers from 5/6 each, P.M. and energised, 4in. to 14in., including several Epoch 18in. —Sinclair Speakers, Alma Grove, Copenhagen St., N.1. [0590

BAKER'S New Corner Horn Speakers Take the Place of all Previous Models; limited number of new surplus super power speakers, electro and permanent magnet, available at half price.—Details from Baker's Selhurst Radio, South Croydon. [7969

Wanted

WANTED, Voigt twin diaphragm unit; price, particulars.—G. E. Tonge, 29, Dean Lane, Manchester, 10. [8015

LOUD-SPEAKER CONVERSIONS

SINCLAIR SPEAKERS.—For conversions of all makes and types; advice given.—Alma Grove, Copenhagen St., N.1. [0593

BAKER'S New Triple Cone and Corner Horn Conversions Will Considerably Improve Reproduction from Your Present Speaker, whatever make, British or American.—Details from Baker's Selhurst Radio, South Croydon. [7968

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Wanted

WANTED, Baird Televisor Model T5C, second-hand; cash for best offer.—Box 8622, c/o *The Wireless World*. [8005

TRANSMITTING APPARATUS

G5NI.—The recognised distributors for amateur equipment, National R.M.E., Thordarson, Hammarlund, McMurdo, Hallicrafters, etc.; send 1½d. stamp for catalogue.—G5NI (Birmingham), Ltd., 44, Holloway Head, Birmingham. [0531

A.C.S. RADIO, specialists in short-wave apparatus, communication receivers, including Hallicrafters, National and R.M.E. transmitting equipment, valves and components.—Send for free catalogue to A.C.S. Radio, 16, Gray's Inn Rd., W.C.1. Holborn 9894-5. G2NK, Technical Manager. [0550

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ALL Types of American Valves, first grade only, Ken. Rad, Philco, Hytron, Raytheon, all tubes fully guaranteed, 5/- each; also line cords, resistances and electrolytic condensers for replacements. Stamp with all enquiries.

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ALL Types of American Tubes in Stock of Impex and Arcturus makes, at competitive prices.

WE Can Also Supply a Full Range of Guaranteed Replacement Valves for Any British, non-ring, American or Continental type at an appreciably lower price.

SEND for Lists of These, and also electrolytic condensers, line cords, resistances, etc.

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RADIOGRAPHIC, Ltd., 66, Osborne St., Glasgow, C.1. [8006

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AMERICAN Valves, first grade, in all types; trade supplied.—Metropolitan Radio Service Co., 1021, Finchley Rd., N.W.11. Speedwell 3000. [0436

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EUROPA Mains Valves, AC-HL, AC-P, 3/6; AC-SG, AC-HP, AC-VMHP, DH Pentode, 4/-; AC-Pen., AC-DDT, 5/-; Octodes, Hexodes; rectifiers UU120-350, 4/-; 500v., 5/-; 13v. A.C.-D.C. range, 5/-; American tubes, 80, 6A7, 42, 2/-; other numbers, 2/8; 6A8G, 6K7G, 6Q7G, 2/8; Kenrad, Triad, Acturus, from 3/6; trade discounts Hivac, Tungsram, Triotron.—Superadio, Dantzic St., Manchester. [8011

METERS, ETC.

AVO, Weston, Taylor, Hunts, Triplett, Wearite, etc.; trade enquiries only.—Leonard Heys, 36, Henry St., Blackpool. [0608

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RADIOMETER £8/8 Valve Tester, A.C. 200-250; £3/19/6; guaranteed perfect.—Jacobs, Hope St., Hanley. [8008

FERRANTI A.C.-D.C. Tester in Case, £3/12/6; A.C. test set (two instruments in bakelite case), £3/15; or with miniature current transformer, £5/10; similar D.C. set, mirror scales, £3/12/6.

FERRANTI Flush Type Meters, 1 m.a., 27/-; 500 microamps, 30/-; 250 microamps, 33/6; several 200 o.p.v. portables, 3-range.

ALL Above in Brand-new Condition and Guaranteed First Grade Accuracy.—MacLachlan and Co., Strathyre. [8014

Wanted

BEST Prices Paid for All Kinds of Measuring Instruments.—Box 8628, c/o *The Wireless World*. [8019

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MEISSNER 1939 Products.

JUST Arrived.

47/6.—New 8-button push-button tuner, can be affixed to any superhet or T.R.F. receiver, any make, 2 or 3-gang mains or battery, only three wires to connect to top of gang condensers; the best push-button tuner the United States has produced; order now for immediate delivery; full instructions in each carton; ten minutes to fix.

£12/10.—Meissner signal shifter is completely assembled, wired and adjusted with one set of coils and has its own power supply, three provision switch providing "automatic stand-by," "continuous operation," and "manual stand-by"; in fact, makes your QSO's 100%.

£10/17/6.—All-wave tuning unit.

THE Meissner All-wave Tuning Assembly is the Complete Heart of the Receiver, consisting of 5 band coil and switch assembly, 6.8 to 2,140 metres, individual coils for each band, low loss bakelite forms, align-aire trimmers, 6-gang shorting switch, Meissner quality precision 3-gang variable tuning condenser, illuminated oblong dial, fully calibrated 5-band scale, completely mounted on rigid crackled steel chassis, all components carefully mounted and including all resistors, by-pass condensers, coupling condensers and A.V.C. network associated with the R.F. mixer and oscillator circuits; every unit completely aligned and padded and laboratory tested; 2d. stamp brings complete illustrated lists of Meissner products by return post from sole distributing agents of Meissner Manufacturing Company of U.S.A.

ANGLO-AMERICAN RADIO (and MOTORS), Ltd. (Dept. F/6), Albion House, New Oxford St., London, W.C.1. [7643

COMPONENTS

SECOND-HAND, CLEARANCE, SURPLUS, ETC.

PREMIER SUPPLY STORES.

PLEASE See Our Displayed Advertisement on this page. [0488

SOUTHERN RADIO'S Bargains.

50/-.—Sunbeam 4-valve A.C./D.C. superhet receivers, full size set, brand new, complete in attractive cabinet, moving coil speaker; 50/-.

22/6.—5-band pentode battery kits. Complete 1939 all-wave kits, metal chassis and all accessories, 10-2,000 metres, world-wide reception; complete, less valves, 22/6; with 3 valves, 34/6.

35/-.—8-button push-button tuners, complete, new and boxed with all accessories and station tabs, with full instructions for attachment to any set, mains or battery, simple to attach; 35/-.

10/-.—A.R.P. radio outfit, comprising finest crystal set, headphones, aerial and earth equipment, a complete emergency installation, 10/-; crystal set only, 3/11.

5/-.—Bargain parcels of useful radio components, coils, transformer resistances, condensers, wire, circuits, etc., value over 20/-; 5/- per parcel.

TELSEN W349 Midget Iron Core Coils, 3/6; dual range coils, 2/6; with aerial series condenser W76, 3/3.

A.C./D.C. Multi-metres, 5-range, 8/6; Ace "P.O." microphones, 4/-.

2/6.—Ormond loud speaker units, new and boxed; 2/6 each.

VALVES for American Receivers, all types; 5/3 each.

MISCELLANEOUS Lines of Special Interest to Service Men and Experimenters.

36 Assorted 1-watt Wire-ended Resistances, 5/6; 24 tubular condensers, assorted capacities up to 0.5 mfd., 6/-; volume controls, assorted capacities (less switch), 7/6 dozen; with switch, 11/6 dozen; mica condensers, assorted, 1/9 dozen; Mainsbridge type condensers, 1 mfd., 2 mfd., 4 mfd., 8 mfd., 8/- dozen; valve holders, 5-pin, 7-pin, 9-pin, 2/6 dozen; battery leads, multi-way, 6/6 dozen; parcel of assorted servicing components comprising resistances; tubular, mica, variable, electrolytic and block condensers; wire; sleeving; volume controls; valve holders, etc., etc., 10/- each; parcel containing at least 100 articles.

THOUSANDS of Bargains in Sets, potentiometers, electrolytics, gramophone motors, crystals, headphones, etc., etc.; 2d. stamp brings list of further bargains.

SOUTHERN RADIO, 46, Lisle Street, London, W.C. Gerrard 6653. [7872

FREQUENTITE Trimmers, 30 mmfd., 3d.; 2×100, 2×140, 2×250, 6d.

PAXOLIN Trimmers, 30 mmfd., 2d.; 100 mmfd., 3d.; 20 mmfd., 3d.

TUBULARS, non-inductive, 300-400 working volts: 0.5 mfd., 4d.; 0.1, 0.05, 3d.; 0.02, 0.006, 0.005, 0.001, 2d.; 25 mfd., 25 volt working, 4d.

SINGLE Screened Wire, high insulation, 2d. per yard; satisfaction guaranteed; post paid over 2/6.

BROWN and WELCH, 371a, Green Lanes, Palmer's Green, N.13. [8001

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ELECTRIC Dry Shaver, A.C./D.C., 200-250, "Minute Man," list price £2/10; our price £1/10, complete with leatherette case, one year's guarantee; send for details; trade supplied.

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HENRY'S, 72, Wellington Av., London, N.15. Stamford Hill 2097 [7983

VAUXHALL.—All lines previously advertised are still available; send now for latest price list, free.—Vauxhall Utilities, 163a, Strand, W.C.2. [7980

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1939 RADIO

—Specified **PREMIER COMPONENTS** for the—

AMATEUR TRANSMITTING STATION "POWER SUPPLY UNIT"

All to exact specification.

PREMIER MAINS TRANSFORMER	27/6
PREMIER L.T. TRANSFORMER	16/6
PREMIER TYPE "A" SWINGING CHOKE	10/6
PREMIER 150 m.a. SMOOTHING CHOKE	11/6

PREMIER BATTERY CHARGERS. Westinghouse Rectification. Complete. Ready for use. To charge 2 volts at ½ amp., 10/-; 6 volts at ½ amp., 16/6; 6 volts at 1 amp., 19/6; 12 volts at 1 amp., 21/-; 6 volts at 2 amps., 32/6.
AUTO TRANSFORMERS. Step up or down A.C. mains between 100—250 volts. 60 watts, 9/-; 100 watts, 11/6.
Premier Transverse Current Microphone, 20/-. Microphone Transformer, 6/-. Table Mike Stand, 7/6.
BRAIDED METAL SCREENED WIRE for mikes, pick-ups, etc. Single, 4d. yd.; Twin, 6d. yd.
PREMIER U.S.A. QUARTZ TRANSMITTING CRYSTALS, 7 mc. and 3.5 mc., 10/- each. Enclosed holder and base, 3/-.
TUBULAR CONDENSERS, all values from .0001 to .5 mf., 6d. each.
U.S.A. VALVE HOLDERS, 4, 5, 6-and 7 pin., 6d. each. Octals, 9d.
CERAMIC U.S.A. VALVE HOLDERS, all fittings, 1/- each.
PREMIER S.W. H.F. Chokes, 10-100 metres, 9d. each. Pie-wound, 1/6 each. Screened, 1/6 each.
SHORT-WAVE COILS, 4- and 6-pin types, 13-26, 22-47, 41-94, 78-170 metres, 1/9 each, with circuit. Special set of S.W. Coils, 14-150 metres, 4/- set, with circuit. Premier 3-band S.W. coil, 11-25, 19-43, 38-86 metres. Suitable any type circuit, 2/6.
UTILITY Micro Cursor Dials, Direct and 100:1 Ratios, 3/9.
PREMIER Short-Wave Condensers, all-brass construction, with Trolitul insulation: 15 mmf., 1/6; 25 mmf., 1/7; 40 mmf., 1/9; 100 mmf., 2/-; 160 mmf., 2/3; 250 mmf., 2/6.
TROLITUL DOUBLE SPACED TRANSMITTING CONDENSERS. 15 mmf., 2/9; 40 mmf., 3/6; 160 mmf., 4/6.
COIL FORMERS, 4- or 6-pin low-loss, 1/- each.
LISSEN Power Packs in aluminium cases, 150 v., 25 m.a., with 6.3 v. L.T., 100-250 v. mains, 10/6, with Rectifier.
METAL RECTIFIERS, 250 v., 60 m.a. output, 4/6 each.
AMERICAN VALVES. We hold the largest stocks of U.S.A. tubes in this country and are sole British Distributors for **TRIAD** High-grade American Valves. All types in stock. Standard types, 5/6 each. All the new Octal Base tubes at 6/6 each, 210 and 250, 8/6 each.
EUROPA MAINS VALVES, 4 v. A.C. Types, A.C./HL., A.C./L., A.C./S.G., A.C./V.M.S.G., A.C./H.P., A.C./V.H.P., A.C./P., and 1 watt D.H. Pentodes, all 4/6 each. A.C./Pens., I.H., 5/6; A.C./P.X.4, 6/6; Oct. Freq. Changers, 8/6; Double Diode Triodes, 7/6; Triode H. ex. Freq. Ch., 8/6; Tri. Grid Pen., 10/6; 3½-watt D.H. Triode, 7/6. 350 v. and 500 v. F.W. Rect., 5/6. 13 v. 2 amps. Gen. Purpose Triodes, 5/6; H.F. Pens. and Var.-Mu. H.F. Pens., Double Diode Triodes, Oct. Freq. Changers, 7/6 each. Full-wave and Half-wave Rectifiers, 5/9 each.

Premier Short-Wave Kits

Complete to the last detail including all Valves and coils, as well as theoretical and wiring diagrams and lucid instructions for building and working. Each kit is supplied with a steel Chassis and Panel and uses plug-in coils to tune from 13 to 170 metres.

1 Valve Short-Wave Receiver or Adapter Kit	17/6
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Will match any modulator to any R.F. Secondary Load, Triodes, Tetrodes, and Pentodes Class A Single or Push-Pull Class "ABI" and "B" in Push-Pull or 500 ohms line input, can easily be matched to any of the following Radio Frequency final stages requiring modulation. Triodes, Tetrodes or Pentodes operating under Class "A," "B," "BC" and "C" conditions either Single or Push-Pull. Totally enclosed in cast cases with engraved Panel, and full instructions. Ratings are based on R.F. inputs. 50 Watt, 17/6. 150 Watt, 29/6. 300 Watt, 49/6.
A new range of "Matchmaker" Universal Output Transformers which are designed to match any output valves to any speaker Impedance, are now ready.
11 ratios, from 13:1 to 80:1.
5-7 Watt, 13/6. 10-15 Watt, 17/6. 20-30 Watt, 29/6.

Our City Branch is moving from 165 to 169, Fleet Street. You are invited to inspect the many BARGAINS at our CLEARANCE SALE—NOW ON at 165, Fleet Street, E.C.4. *Callers only.*

Have you had our 1939 Catalogue, Handbook and Valve Manual? 90 pages of Radio Bargains and Interesting Data. Price 6d.

ALL POST ORDERS TO: Jubilee Works, 167, Lower Clapton Road, London, E.5. *Amherst* 4723.
CALLERS to:—Jubilee Works, or 165, Fleet Street, E.C.4. *Central* 2833, or 50, High Street, Clapham, S.W.4. *Macaulay* 2381.

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MAINS RADIO DEVELOPMENT COMPANY.

MAINS RADIO DEVELOPMENT COMPANY Offer Outstanding Bargains, carriage paid, delivery by return. Telephone Tudor 4046, or call mornings. Stamp for List 221.

TRANSATLANTIC 1939 4 Waveband Superhet Tuning Packs, covering 10-30, 30-82, 198-560, 800-2,200 metres, comprising all coils, J.B. bar-gang condenser, full vision coloured 2-speed drive, Yaxley switching, two 465 k/c. I.F. transformers, etc., completely wired, with A.V.C. line, aligned, tested, ready to connect, 3-gang, H.F., F.C. and I.F., 65/-; 2-gang F.C. and I.F., 47/6.

AMPLIFIERS, six-watt push-pull, for MH4 and two PX4's or equivalents. Absolute complete kit of parts, best tested components, with circuit; 52/6, less valves.

ERIE 1-watt Colour Coded Unused Resistors, wire ends, any size 50 ohms to 5 megohms, your selection, 3d. each, 2/6 dozen; 2-watt, 6d. each.

CENTRALAB Latest Potentiometers, unused, long spindle, all sizes, 5,000 ohms-1 megohm, 2/-; with mains switch, 2/3.

T.C.C. Midget Card 8 mfd. 600-volt Peak Electrolytics, 1/6; T.C.C., metal, 8 mfd., 600-volt peak, 2/3; Dubilier 4 mfd. 250-volt, 10d.

4/-.—Famous make fully guaranteed American tubes, coloured boxes, first grade, all popular types, 4/-; popular glass Octals, 4/6.

CLIX Unused Chassis v.-holders, 5-, 7-, 9-pin, 3d. each; all American sizes, 6d.; best sleeving, 1½d. yard.

TUBULAR Condensers, 400-volt working, wire ends, best make, 0.0001-0.05 mfd., 4d.; 0.1 mfd., 4d.; 0.25, 0.5 mfd., 6d.

FIFTY N.S.F. ½-, 1- and 2-watt Resistors, wire ends, marked and colour coded, over 20 good sizes in each parcel; 2/6 per 50 only.

FERRANTI Twin H.F. Choke Mains Interference Filters, extraordinarily effective; to clear, 1/-.

MAINS RADIO DEVELOPMENT COMPANY, 4-6, Muswell Hill Rd., London, N.6. Tudor 4046. [7853

RYALL'S RADIO, 280, High Holborn, London, W.C.1, offer new goods at knock-out prices. Note.—All post free.

VARIABLE Condensers.—Plessey small two- and three-gangs screened with trimmers, Midget twin semi screened; all 2/9 each.

SATOR Volume Controls, ½ meg. with switch, 10,000 with switch, 5,000 with switch, 5,000 wire wound less switch; 1/3 each or 6/6 dozen.

SCREENING Plates for Yaxley Type Switches, 3¾×3½ or 7×2¾ drilled, five for 1/6; Ryalls 1 mf. 400v. wkg., 1/3 per dozen; B.I. 1 mf., 3 1/4.

B.I. Electrolytics, 12×8×50, 350v.12v. peak, 1/3; Ferranti midget 4×4, 1/3; Ferranti 8×8 500v., 1/6; Plessey 30×8×2 350v., 1/6.

POLAR/NSF Low Loss Air Spaced Rex Type Switches, eight 4-way switches, length 9in., 2/9 each; Zenith A.C./D.C. 3 amp. resistances, ex Ferranti 550 ohms, tapped 330/70/100, 1/4 each, 9/6 dozen.

A.C./D.C. Insulated Resistances, .3 amp., 670 ohms or 150 ohms, tapped, 2/- each; Polar VP drives, less escutcheons, 2/-.

SALE.—Last few sets iron core superhet coils, R.F. or band pass with coil details, padder values, 5 coils, including 2 I.F.s, 5/9. Note.—465K.C. 2-baud.

AMERICAN Type Valves, 80 42, 43, 6a7, 6d6, 6c6, 12z3, 46, 57, 2/3 each; 6B8g, 6G5, 6K7g, 5Y4g, 25L6, 3/3 each; sockets, 4-, 5-, 6-, 7-pin, 4d. each, 3/- dozen.

ALL-WAVE Aerial Kits, complete with two transformers, wire and lead in, insulators and full instructions, U.S.A. make; 13/9 each.

B.I. Tubular Condensers, new stock, 4 mfd. electrolytic, 200v. peak, 6d. each; B.I. 0.05 tubulars, 350v. wkg., 1/3 dozen or 4/5 half gross, 6/6 gross; B.I. 0.25 tubulars, 2/- dozen.

SATOR Silver Mica Type Condensers, .0001, .0002, .0005, 1/3 dozen; Sator tubulars, 1,500v. test, .001, .002, .003, .005, 1/3 dozen; .01, .05, 1/3 dozen or 4/6 half gross, 7/6 gross.

HAMMARLUND Midget 30 mm. Trimmers, Paxolin, 1/9 dozen; top cap thimbles, 18 for 1/3, 3/9 half gross; clip on bulb holders, 1/3 dozen, 4/6 half gross, 6/9 gross.

TUNING Eyes, 4v. ½ amp. heater, octal base, 3/6; K.B. iron core wave traps, very effective on medium and long, 1/3 each.

RYALL'S RADIO, see above. [8017

TWO Rola G12, new, 36/- each; W.W. Quality Receiver, power pack and speaker, complete, £2/5.—92, Bassett Gardens, Osterley, Middlesex. [8010

HEADPHONES, reconditioned, guaranteed, brown type "A," adjustable reed, 4,000 ohms, 20/- pair; Telefunken, adjustable, 4,000 ohms, 7/6 pair; postage 6d.; other makes from 2/6.

BROWN Type "A" Single Earpiece, 2,000 ohms, on handle with volume control, made for "Ardente"; 12/6.—Post Radio, 2, Copenhagen St., London, N.1. [7954

SOMETHING New.—Fourteen stations at the flip of the finger, with the new American automatic teledial tuning unit; later and better than push-button tuning, genuine surplus stock of a well known manufacturer.

THIS is Not an Advertising Stunt, but a genuine brand new article genuinely worth £3/15 which we are able to offer at the remarkable price of 17/6 only, postage 1/-. Call for demonstration or write to

SAMSON'S SURPLUS STORES, 4, Praed St., W.2; or 250, Pentonville Rd., King's Cross. [8024

COMPONENTS—SECOND-HAND, CLEARANCE, SURPLUS, ETC.

R

TELEPHONE: Holborn 4631.

RADIO CLEARANCE, Ltd., 63, High Holborn, W.C.1, open the New Year with special offers of brand new receivers and components, etc., maintaining their reputation as the leading Mail Order House for surplus radio.

***

BRITISH Belmont 8-valve Plus Magic Eye All-wave A.C. Superhet Chassis, 4 wave-bands, two short, medium and long, fitted latest Mullard octal base American type valves. Brief specification: Short wave 6-18 metres (covers television sound), short wave 2, 18-50 metres, medium band 200-550 metres, long 900-2,000 metres. Valve combination 6K7, Pre H.F., 6J7 oscillator, 6J7 mixer, 6K7 I.F., 6Q7 (DDT) detection, A.V.C. and first L.F. two 6F6s parallel output, 5Y3 rectifier, plus 6G5 Magic Eye visual tuning, handsome dial, station names etched on glass; controls 2-speed tuning, volume and on/off, combined variable tone control and selectivity switch wave change plus gramo. switch. Size of chassis, 13½in.×10in.×3in. Supplied complete with valves, escutcheon, knobs and chassis bolts, but less speaker; £5/19/6 each.

COMPLETE Receiver in Handsome Walnut Cabinet, details as above, complete with speaker; £7/7 each.

***

DECCA 6-valve 3 Wave-band Battery Chassis, fitted complete with Mazda and Osram valves, QPP output; these chassis give a sparkling performance on all wave-bands, and are the product of a well-known manufacturer; complete with valves. £3/3 each.

***

AMERICAN Valves, special offer, Majestic 6Z5 full wave rectifier, 6.3 v. 250 volts, 60 m.a., 9d. each; also 55 and 6D7, 9d. each.

***

HUGE Purchase Plessey Mallory Electrolytics, at the following special prices.

8+4+4+4 Mfd., 570v. working, +4 mfd. 300v. working, metal case, size 2½in.×1½in.×4½in., common negative; for E.M.I. replacements, etc.; 3/6 each.

16+8 mfd., 470v. working, can neutral, common negative; 2/2 each.

8+12+2 Mfd., 500v. working, +2 mfd., 250v. working, cardboard type, wire ends, common negative; 2/6 each.

24 Mfd., 450v. working, can type, can negative; 2/- each.

32 Mfd., ditto; 2/- each.

16 Mfd., 475v. working, ditto; 1/6 each.

16 Mfd., 475v. working, can neutral, separate negative; 1/6 each.

8+8 Mfd., 475v. working, can negative; 2/- each.

8+8+2+1 Mfd., 450v. working, cardboard type, wire ends, common negative; 2/8 each.

8 Mfd., 450v. working, +16 mfd., 350v. working, can type, common negative; 1/6 each.

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8 Mfd., 250v. working, cardboard; 10d. each.

6 Mfd., 450v. working, +4 mfd., 450v working, common negative, cardboard; 1/2 each.

6 Mfd., 450v. working, can type; 1/- each.

8 Mfd., 350v. working, can type; 1/5 each.

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50 Mfd., 12v., wire end tubulars; 9d. each.

25 Mfd., 3-volt working, tubular, wire ends; 6d. each.

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TYPE No. 1575, 4 pole, 4-way, 3 bank, 6½in. overall length, 1¼in. shaft, 2/- each.

TYPE No. 3077, 2 pole, 2 bank, W/C and R.G switch, 4in. overall length, 1in. shaft; 1/6 each.

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PATENTS

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NOTICE is Hereby Given that Marconi's Wireless Telegraph Co., Ltd., of Marconi Offices, Electra House, Victoria Embankment, London, W.C.2, Noel Meyer Rust, of "The Glen," Danbury Common, Chelmsford, Essex, and John Forrest Ramsay, of 55, New St., Chelmsford, Essex, seek leave to amend the specification (including the drawings) of Letters Patent No. 493,860 granted to them for an invention, entitled "Improvements in or relating to aerial feed and aerial tuning circuit arrangements."

PARTICULARS of the Proposed Amendment were set forth in No. 2611 of the Official Journal (Patents), published on February 1st, 1939.

ANY Person, or persons, may give Notice of Opposition to the amendment by leaving Patents Form No. 19 at the Patent Office, 25, Southampton Buildings, London, W.C.2, within one calendar month from the date of the publication of the said Journal.—M. F. Lindley, Comptroller-General. [7993

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SITUATIONS VACANT

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APPLICATIONS are Invited for an Appointment as Senior Technical Officer (Ref. A.282) at the Royal Aircraft Establishment, South Farnborough, Hants, to direct experimental and development work in a division of the Radio Department.

CANDIDATES Should Have Had Training to Degree Standard and lengthy experience in radio development and experimental work. Experience in aircraft radio work, direction finding, or small transmitters would be an advantage.

CANDIDATES Must be Physically Fit for Flying, and willing to fly as observers.

SALARY Scale: £680 by annual increments of £25 to £800 (women £580 by £25 to £680).

THE Appointment will be Non-pensionable, but the entrant will be eligible for consideration for appointment to a pensionable post in the event of vacancies arising on the permanent establishment. Promotion from Senior Technical Officer to Principal Technical Officer (£850 by £30 to £1,050 a year), (women £700 by £30 to £890 a year) is governed by merit as and when vacancies arise.

APPLICATION Should be Made on a Form to be Obtained (quoting Ref. No. 282I) from the Chief Superintendent, Royal Aircraft Establishment, South Farnborough, Hants, to whom it should be returned not later than 25th February, 1939. [7998

AIR MINISTRY.

AERONAUTICAL Inspection Directorate.

VACANCIES Exist in the W./T. and Instrument Branches of the A.I.D. for Unestablished Appointments as:—

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CANDIDATES Suitably Qualified for Examiner Posts will on Appointment be Required to Undergo a Course of Training in Aeronautical Inspection of up to a Period of Three Months. Until satisfactory completion of training course, they will be graded and paid as Assistant Examiner (see below), but during the training course a subsistence allowance will be payable to married men who normally reside outside the area of the training centre. Examiners are required to accept liability to serve at any A.I.D. station in the United Kingdom.

CANDIDATES who, on interview, fail to qualify for the Examiner Grade, may be considered for:—

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QUALIFICATIONS Required of Examiners.

APPLICANTS for Vacancies in Instrument Branch must have good General Education, theoretical knowledge in physics, optics, mathematics, training in light engineering or instrument making. Candidates must be able to read working drawings and specifications, and use micrometers and other types of measuring instruments. Preference will be given to candidates having a good knowledge of thermometry, precision pressure measuring instruments as used on an aircraft, and of materials from which they are manufactured.

APPLICANTS for Vacancies in W./T. Branch having the Following Qualifications will receive preference: good general education, sound technical knowledge of high frequency engineering equal to City and Guilds final examination in Radio Communications, practical knowledge of modern methods of production and testing of W./T. transmitters, receivers, wavemeters and associated equipment; also electrical equipment, such as generators, transformers, and of materials from which they are manufactured. Candidates must be able to read working drawings and specifications and to use micrometers and other measuring instruments.

NORMAL Age Limits 21-50 Years. Candidates between 50-55 years will be considered if they have had inspection experience.

APPLICATION must be made on Form 786, copies of which can be obtained only on application by postcard to The Under Secretary of State, Air Ministry, I.G., 29, Berkeley Square House, Berkeley Sq., W.1.

INDIVIDUALS who do not Possess All the Qualifications set out above, or who have been previously rejected, should not apply. [8022

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APPLICATIONS Should be Addressed to the Commanding Officer, No. 1 Electrical and Wireless School, Royal Air Force, Cranwell, Lincs, giving full particulars as to previous experience, age, etc. Candidates will be required to appear before a Selection Board for interview and test. The test will include the giving of a lecture on any subject, which may be chosen by the candidate, involving electrical principles. Lecturing sequence and style are most important. [0616

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CANDIDATES Should Preferably be Under 45; must be first class wireless mechanics with thorough knowledge of testing and servicing short wage wireless transmitters or receivers and television receiving apparatus; should possess sound practical and theoretical knowledge of commercial short wave transmitters and preferably hold Final (Grade III) Certificate of City and Guilds of London Institute Examination in Radio Communication.

SUITABLE Candidates may be set a Short Trade Test, after an interview in London; those selected will undergo a course of instruction and will be required to give an undertaking to enlist into the Territorial Army (with rank of Staff Sergeant).

PREFERENCE Given to Ex-Service Men, other things being equal.

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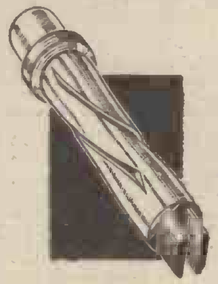

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Higher National Certificate in Electrical Engineering;
Certificate of City and Guilds of London Institute in Radio Service work;
Or similar qualification; or

(B) Be able to pass an examination on the following Syllabus:—
Current Electricity.—Properties of an electric current. Ohm's Law and its applications. Galvanometers and Measuring Instruments. Electro-magnetism. Magnetic materials.
Alternating Currents.—General principles. Effects of Resistance, Inductance and Capacity. Resonance.
Radio.—General character of a radio signal. Elementary knowledge of valves and their simple applications.

SUITABLE Candidates will Undergo a Short Trade Test after Interview in London, and those selected will enter a course of instruction at the Military College of Science, Woolwich. On final acceptance, to depend upon an examination after three weeks' instruction, successful candidates will be required to give an undertaking to enlist into the Territorial Army (with rank of Sergeant) and will receive a further three weeks' instruction before transfer to their permanent stations. Regulated travelling expenses on transfer will be payable.

PREFERENCE Given to Ex-members of His Majesty's Forces, other things being equal.

APPLICATION Forms, obtainable by post card from Under Secretary of State (C.5), War Office, S.W.1, to be lodged by 18th February, 1939.

QUOTE Appts. No. 118. [8007

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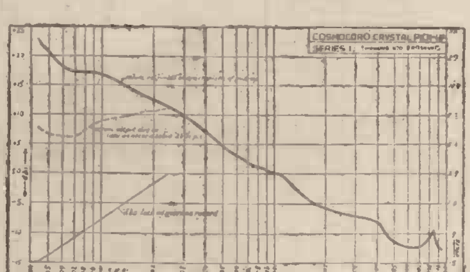

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The Wireless World

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THE PRACTICAL RADIO & TELEVISION JOURNAL

Thursday, February 16th, 1939.

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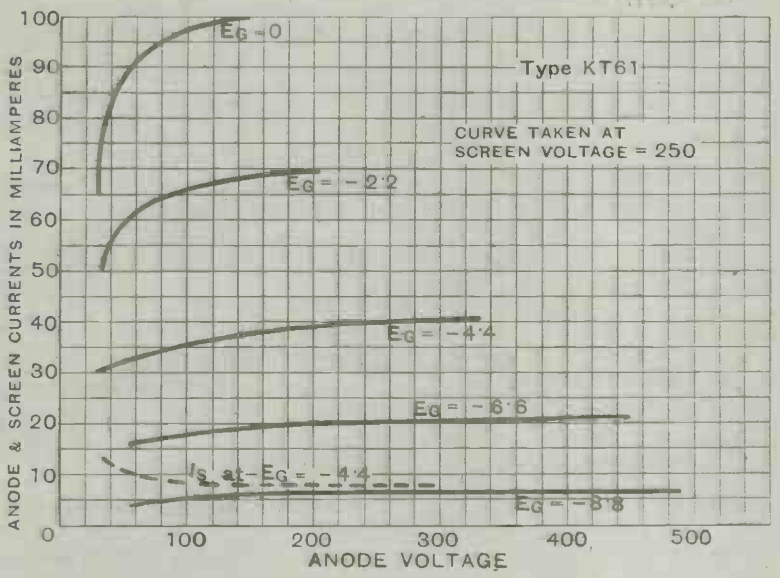

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Heater Voltage	6.3
Heater Current	0.95 amp. approx.
Anode Voltage	250 max.
Screen Voltage	250 max.
Anode Current average	40 mA
Screen Current average	7.5 mA
Grid Voltage	−4.4 volts
Anode Dissipation (watts)	10 max.
Bias Resistance	90 ohms
Optimum Load Resistance	6,000 ohms
Mutual Conductance .. .. (Measured at Ea = Es = 250, Ia = 40 mA)	10.0 mA/volt
Estimated Power Output (watts)	4.6

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The Wireless World
THE PRACTICAL RADIO JOURNAL
28th Year of Publication

No. 1016. THURSDAY, FEBRUARY 16TH, 1939. VOL. XLIV. No 7.

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

CONTENTS

EDITORIAL COMMENT

Electric Shock

Familiarity Breeds Contempt

In drawing attention to what is described as "the increasing danger of electrical death or maiming which exists in present-day amateur transmitters" the journal *QST*, official organ of the American Radio Relay League, raises a matter to which we should certainly not close our eyes. But any alarmist tendency to exaggerate the danger would be equally out of place.

Not only transmitters, but wireless apparatus of every kind should be handled with the greatest respect. Indeed, one of the recent casualties that is taken by our American contemporary to point its moral was due to a small speech amplifier in which the maximum voltage probably did not exceed 500. We are all inclined to forget that an RMS voltage of 700 across the extreme ends of the HT secondary is a commonplace in everyday broadcast receivers, and that a peak inverse voltage of 1,000 between anode and cathode of the rectifier is by no means uncommon in such receivers. Much lower pressures than any of these can cause fatal shocks.

Television, Too

In television receivers voltages are higher and the risk is consequently greater, though where potentials of thousands of volts exist a certain measure of automatic protection is sometimes (but not always) afforded by the presence of resistances which limit the current that can flow to something below the value that normally causes death or serious injury.

It seems that the two greatest sources of danger are the over-confidence engendered by familiarity and failure to provide proper screening for high-voltage apparatus. Of these the first is by far the greater, and nowhere is the saying that familiarity breeds contempt better exemplified than among those wireless workers, both professional and amateur, who think nothing of trusting their lives to a few mils of insulating material or even to something far less substantial.

Happily, fatalities have so far been few in this country, but there have probably been a number of unreported accidents causing permanent disability. We do not propose to make our readers' flesh creep by describing some of the more gruesome effects of electric shock, but the warning that familiarity should in this case breed respect instead of contempt is certainly not out of place.

Code Abbreviations

An Annoying Affectation

AMATEUR transmitting is on the whole extremely well conducted in this country, but a complaint must be registered against the growing habit of the fraternity to use "Q" code abbreviations in telephony in cases where plain language would meet the case much better. It should hardly be necessary to point out that the code was devised for telegraphy, not telephony.

The essence of smart operating is speed and clarity. Why say "QRM" (three words, when spoken) or, more clumsily still, "Quebec, Radio, Montreal" when "jamming" would be shorter and more intelligible? A still worse piece of clumsy verbiage is the spoken morse signal "dit-dit-dit-dah-de-dah" when "over" or "closing down" is meant.

Ganged Permeability Tuner

DESIGN OF A PRESS BUTTON UNIT

By A. J. TURNER
Chief Engineer, Wright and Weaire, Ltd.

DESCRIBING a press button tuning unit in which preliminary adjustments to signal-frequency and oscillator circuits are affected by simultaneous movement of a pair of iron cores mounted on a common spindle.

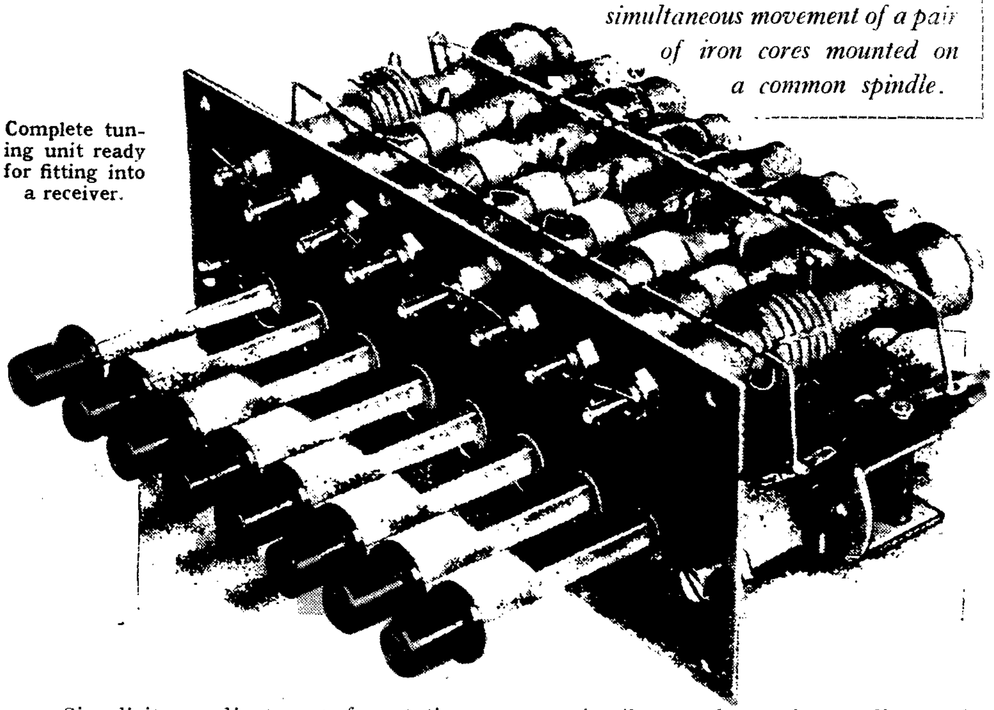
PRESS button tuning for radio receivers has gained in popularity to such an extent that practically every set maker now features a receiver fitted with this interesting accessory.

Whether press buttons will remain an accessory to the "manual" tuning control, or will eventually displace it by some ingenious scheme giving an unlimited choice of stations upon a limited number of buttons, remains to be seen. In any case it cannot be denied that press button tuning and the various methods of accomplishing it still occupy the minds of many people connected with the industry and, therefore, a description of a permeability tuner designed for press button control may be of interest.

Various systems of permeability tuning have, of course, been in use for some time in connection with automatic tuning, but they are generally of the type using separate iron-core adjustments for the aerial and oscillator circuits. A distinction is claimed for the unit about to be described, inasmuch as the iron cores controlling the inductance of aerial and oscillator circuits are "ganged" to a common operating spindle and, therefore, tuning is accomplished by a single adjustment.

The writer does not claim credit for this idea, which, he believes originated in America, but after some months of development a number of snags were overcome, and a satisfactory tuner was evolved suitable for English valves and conditions.

Briefly, the advantages that can be claimed for a tuner of this type are:—



Complete tuning unit ready for fitting into a receiver.

1. Frequency stability. The circuit is tuned by the movement of iron dust cores having a low ratio of inductance change to core movement, and stable fixed silvered mica tuning condensers.

2. Simplicity; adjustment for stations are effected by means of a single tuning control.

3. Medium- or long-wave stations directly obtained on the press buttons irrespective of the position of the normal wave-change switch.

4. Ease of installation into any standard superhet chassis.

A first consideration in the development of this tuner was to obtain the maximum tuning range with each coil in order to restrict the number of different coils necessary to cover the medium and long wavebands. In the present design, complete coverage of the medium waveband with sufficient overlap is obtained with three coils, and to cover the useful portion of the long waveband one coil only is required.

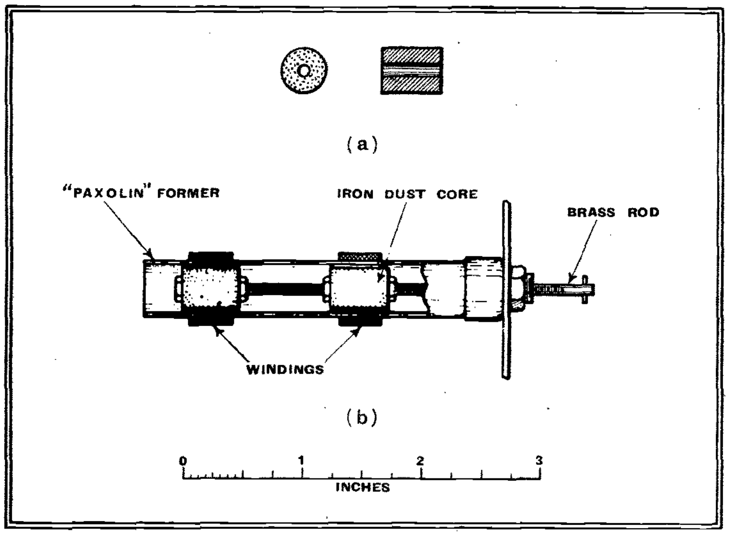


Fig. 1.—(a) The simple iron-dust core used in the tuner and (b) a complete coil unit assembly.

By using more complicated and consequently more expensive iron cores, it is possible to improve upon these results, in fact, the entire medium waveband can be covered with one coil. Since, however, several coils must be used according to the number of press buttons desired, the cost of these special cores in duplication would increase production costs considerably.

Fig. 1 (a) illustrates the simple iron cores used in the tuner and by employing thin coil formers and winding shape shown in Fig. 1 (b), a maximum effective permeability of 2.45 is obtained. This figure gives a tuning ratio of 1.57 and, therefore, a tuning range in this particular example of from 1,500 kc/s to 955 kc/s.

Coil Unit Construction

The arrangement of a single coil assembly is shown in Fig. 1 (b), coil A representing the signal-frequency winding and coil O the oscillator winding.

Single windings are employed to avoid additional switching that would be necessary with inductive coupling windings. Reference to Fig. 2 will indicate how these single windings are used in the signal-frequency and oscillator circuits.

In fixing the values of signal-frequency coil inductances, two considerations recommend the choice of a low L/C ratio. First, low inductances mean fewer turns, and, therefore, a higher tuning ratio, because the iron cores have more effect upon compact windings. Secondly, the fixed tuning capacity will be relatively larger and will help to swamp variations in stray capacities found in production receivers, thus helping the final alignment problem.

The requirements of the oscillator sec-

Ganged Permeability Tuner—

tion of the coils are not so easily fulfilled. To ensure correct tracking it is necessary for the oscillator circuit to maintain a constant frequency difference (the intermediate frequency) above the signal-frequency circuit throughout the tuning range.

Satisfactory results may be obtained by using similar form factors for aerial and oscillator windings and iron cores of different permeabilities, or by using cores of similar permeabilities and different form factor windings. In the present design the medium-wave coils are wound with similar form factors, and have cores of different permeability, while for the long waveband both form factor and iron core permeability differ from the input circuit in order to achieve satisfactory tracking.

The accuracy of tracking finally obtained when the tuner is wired into a receiver, depends upon how closely the values of the circuit constants adhere to the values assumed when the initial calculations were made. There are several factors which combine to cause tracking errors; these are:—

(a) Slight errors in the inductances of the coils.

(b) Errors in setting the distance of the coils relative to the associated iron cores.

(c) Variations in circuit capacities from the given values for which the coils were designed.

The last variation may be obvious, such as excessive strays, or it may be caused by the use of an incorrect frequency - changer valve with high-slope oscillator, causing excessive coupling and a high reflected capacity across the grid circuit, in which case the remedy is obvious.

Fortunately, there exists an expedient which compensates for most of the unavoidable errors and, therefore, in practice mistracking is not nearly so serious as might be imagined. This expedient requires that the input coils be wound in such a manner as to be initially free to slide along the former. The procedure for adjusting and compensating the coils is then carried out in the following manner:—

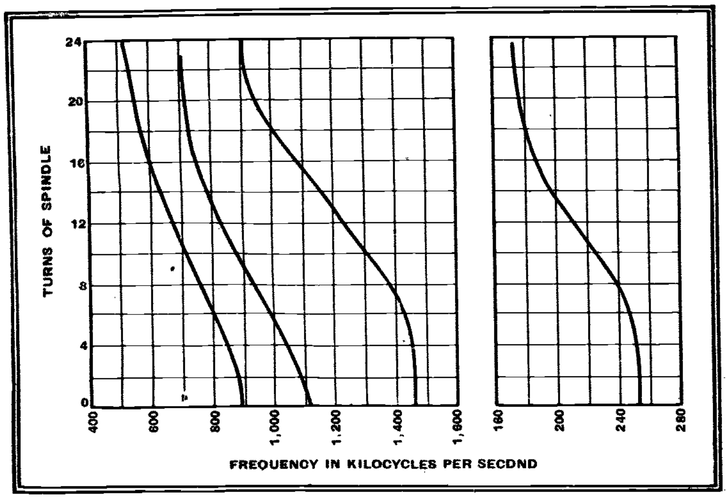


Fig. 3.—Frequency calibration curves for each type of coil used in the tuner.

When the tuner is wired into the receiver and ready for operation, a signal generator is connected to the aerial and earth input. A modulated signal having a frequency approximately midway in the range covered by the particular coil under adjustment is fed into the receiver. The iron core operating spindle is then turned until a response is obtained in the speaker. The signal-frequency coil is next moved over the former until maximum output is obtained, after which it is fixed to the former in this position, either by means of a strip of adhesive tape or by the application of a suitable wax.

The tuners may, of course, be adjusted in this manner when temporarily connected to a test receiver having characteristics as near as possible to the production receiver, so that when the tuner is finally installed no further alignment procedure is necessary.

Curves showing frequency in kilocycles against turns of the iron core adjusting spindles for each coil are given in Fig. 3.

A comparison between the performance of the permeability tuner and an efficient set of conventional variable - capacity - tuned iron-cored coils is of interest. Measurements were made on a receiver having a circuit shown in part by Fig. 2. The change-over

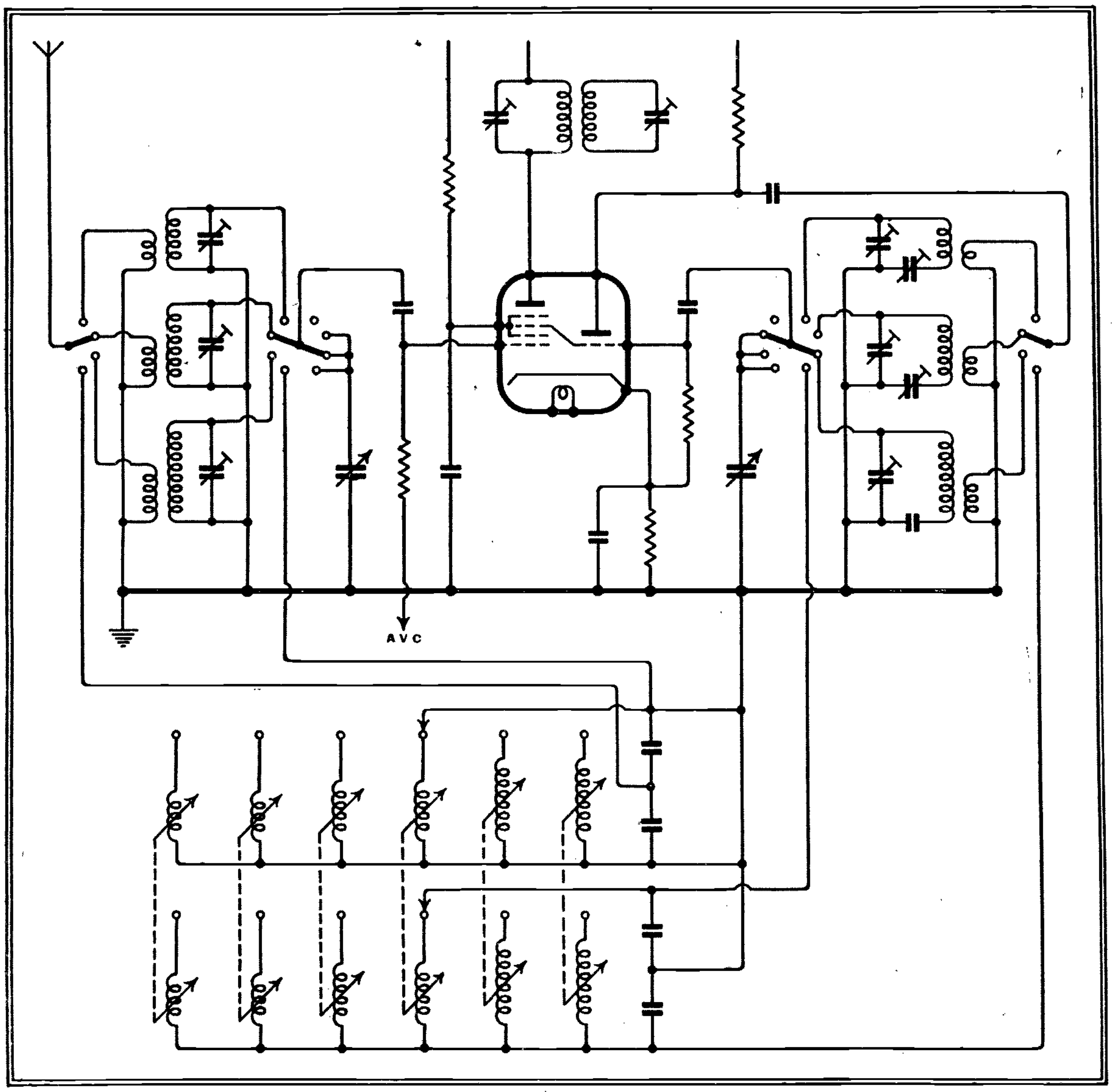
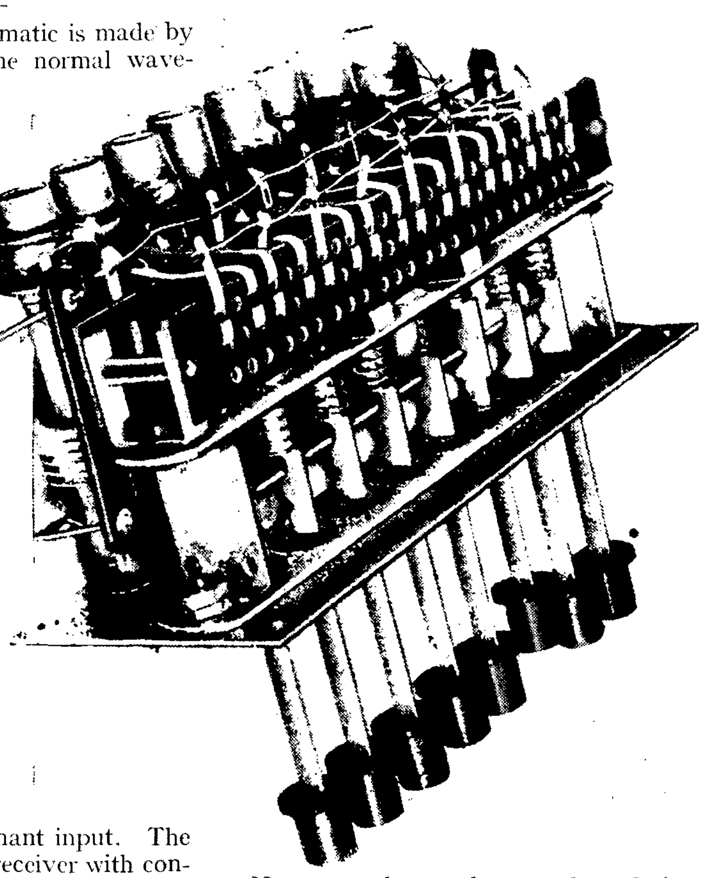


Fig. 2.—Arrangement of manual and press button circuits of a three-band superheterodyne receiver.

Ganged Permeability Tuner—
from "manual" to automatic is made by an extra position on the normal wave-change switch as shown.

Sensitivity curves of the two tuning systems are given in Fig. 4. A certain loss in sensitivity in the permeability tuned coils is unavoidable, although the difference is not detected aurally because of the action of the AVC system.

The selectivity of the 465-kc/s intermediate frequency amplifier of the test receiver was 25 kc/s at 100 times, and 30.5 kc/s at 1,000 times resonant input. The overall selectivity of the receiver with conventional coils was 35 kc/s at 1,400 kc/s and 16.5 kc/s at 200 kc/s at 1,000 times.



View of the underside of the tuner, showing switching mechanism.

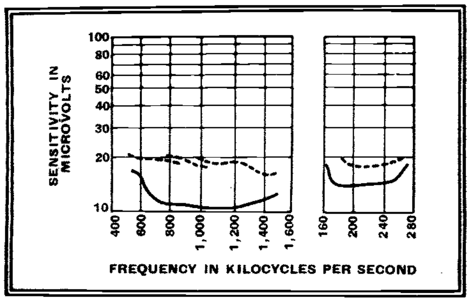


Fig. 4.—Sensitivity of manually tuned circuits, shown in full lines, compared with that of press button circuits (dotted lines).

With press-button coils the figures were 36 kc/s at 1,400 kc/s and 22 kc/s at 200 kc/s at 1,000 times.

No attempt has yet been made to design 3-circuit (i.e., signal-frequency input, RF amplifier and oscillator) permeability tuners. This is partly due to the substantial increase in production cost, and also to the fact that 2-circuit press-button tuners are being successfully used in superhets having three manually controlled circuits. The difference in sensitivity, however, due to the RF stage when switching from manual to automatic is very noticeable.

The progress of permeability press-button tuning depends more at the moment upon the production of switches with increased switching combinations. Later types of permeability tuners in preparation will include press buttons for selecting the "manual" short-, medium- and long-wave coils, in place of the separate rotary wave-change switch in addition to press buttons for pretuned stations.

The Radio Research Board

ASPECTS OF THE YEAR'S WORK

THE Annual Report of the Department of Scientific and Industrial Research, which has just been published (H.M. Stationery Office 3s.), contains an interesting summary of the investigations carried out on behalf of the Radio Research Board. This work has been done mainly by the Radio Department of the National Physical Laboratory at its research stations at Slough and Leuchars, although a certain part of the work on the study of the ionosphere has been accomplished at Cambridge University under the direction of Prof. Appleton.

The properties of the upper atmosphere, more commonly referred to as the ionosphere, have been further investigated by projecting wave-trains of short duration from a transmitting station, and studying the echos received. By observing the critical frequencies of the waves at which the various regions are just penetrated, and so cease to supply an echo, much useful information concerning their effective height and the maximum ionisation density has been gathered. At the same time, a considerable amount of work has been carried out regarding the propagation of ultra-short waves along the ground and through the lower atmosphere. Investigations have been undertaken from 410 to 34 Mc/s (0.73 to 8.8 metres).

Direction-finding has been another of the major subjects of research during the year, more especially at comparatively long distances. Observations have been made up to 3,000 miles, the wavelengths used being between 30 and 45 metres. The utility of direction finders designed to work on ultra-short wavelengths between 6 and 10 metres has also been investigated and some very encouraging results obtained. A special form of direction-finding apparatus, operating on this band, has been developed for the Meteorological Office for the location of its radio-sounding balloons.

Field strength measurements have also been investigated, and here again, ultra-short waves have received a large measure of attention. Researches have also been carried out on the source and waveform of various types of atmospherics, and preliminary investigations indicate that there are three distinct types of oscillatory patterns in the atmospheric waveform.

A subject that is of more immediate practical application is an investigation into the effects of temperature on components used in oscillatory circuits, and various methods of compensating for temperature variation in condensers and tuning coils have been gone into. The possibility has also been examined of using the deflection of a focused beam of electrons as a basis for the construction of amplifying valves for use on microwaves below one metre.

PROBLEM CORNER—7

Henry Farrad as Adjudicator

ANOTHER letter to Henry Farrad is published for readers to test their powers of observation and deduction. The answer is given on p. 170.

4, Weir Avenue,
Watchet.

My Dear Henry,

I should be very much obliged if you would give me some advice about my wireless. Last week it suddenly broke down, and I cannot get a sound from any station I tune to, nor does the green light in the "magic eye" move at all, as it used to, when I turn the knob. I asked the man who sold it to me to come round and see what was wrong, which he did, and now I have got a letter from him saying it will cost £2 3s. 6d. to put it right. He said it was the transformer or something—I had better quote his letter to make sure I get the technical terms right:—

"From tests applied to your receiver I have ascertained that a filter condenser has broken down causing damage to the rectifier valve and the HT winding of the mains transformer. These three items will therefore have to be replaced, and I have pleasure in quoting you £2 3s. 6d. for the renewals, inclusive of fitting and testing."

It seems quite a lot of money, and as I have a feeling that this man is not altogether reliable in his dealings I wish you would tell me first whether you think the estimate is reasonable.

Yours very sincerely,
Emily Simple.

Was the proposed charge reasonable?

Cathode Bias and Feed-back

HOW AUTOMATIC BIAS WORKS

WITH the usual system of obtaining grid bias negative feed-back occurs along the cathode resistance and reduces the amplification. It is well known that the use of a large-capacity by-pass condenser enables this effect to be avoided, and the mechanism involved in the feed-back is discussed in this article.

IT is now the usual practice whenever indirectly heated cathode valves are used to obtain grid bias by inserting resistances in the cathode leads. Each valve is then independently biased and a change in the bias of one valve has no direct effect on that of the others.

The basic circuit is shown in Fig. 1, where R3 is the cathode bias resistance and R1 and R2 are parts of the input and output couplings. Actually these couplings need not be resistances, and in practice they often are not.

The anode current i of the valve flows in the direction shown by the arrows, since it flows from cathode to anode inside the valve. This current flows through R3 and sets up a voltage drop across it which is equal to iR_3, current being expressed in amperes and resistance in ohms.

Now this voltage drop makes the cathode positive with respect to negative HT, to which the grid is returned through R1. There is normally no grid current, so the grid is at the same potential as negative HT. The cathode is thus positive with respect to grid by the same amount that it is positive with respect to negative HT. Consequently, the grid is negative with respect to cathode.

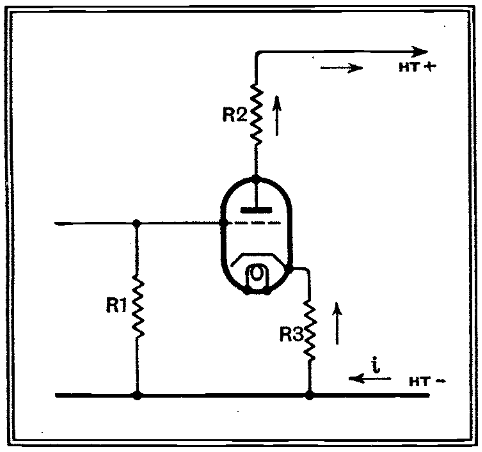


Fig. 1.—This diagram shows the basic cathode-bias circuit.

The input signal is applied across R1 and swings the grid potential positive and negative relative to negative HT. The grid is always negative relative to the cathode, however, because of the voltage drop across R3; that is, provided that the signal is not larger than the grid bias.

When the grid swings positive the grid potential is less negative than before with respect to cathode, so that the anode current increases. The voltage drops across R2 and R3, therefore, increase as well. With respect to negative HT the anode is less positive than it was and the cathode is more positive.

When the grid swings negative exactly the reverse happens, the anode current falls and the voltage drops across R2 and R3 are decreased. Consequently, the anode becomes more positive, and the cathode less positive relative to negative HT.

It is therefore clear that when a signal is applied both anode and cathode potentials fluctuate, and that the change of anode potential is in the opposite direction, and the change of cathode potential is in the same direction as the grid voltage change. All potentials are reckoned with respect to negative HT. The output voltage at the cathode is thus in the same phase as the input and the output voltage at the anode is in the opposite phase.

Negative Feed-back

Now the voltage which is effective in operating the valve is not the signal voltage across R1, but that which appears between grid and *cathode*. As the grid potential changes, the cathode potential changes also in the same direction; therefore the voltage between grid and cathode is less than the input across R1 by that developed across R3. If the input voltage is E1 and the cathode voltage is E3, the grid-cathode voltage Eg is E_1-E_3: alternating voltages or *changes* of steady voltage are here referred to.

This is a form of negative feed-back, and the gain of the stage is reduced because the full input to the stage is not effective in operating the valve, being offset by the voltage across R3. The gain obtained is the same as if there were no feed-back but the AC resistance Ra of the valve were increased to $R_a + R_3\ (1+\mu)$ where μ is the amplification factor. Viewed from the anode circuit the valve also behaves as though its AC resistance were this high value.

In most cases this feed-back is disadvantageous, and it can be avoided by shunting R3 by a condenser as in Fig. 2. As a condenser does not pass direct current the steady conditions are clearly unaffected and the bias remains unchanged. Rapid changes of voltage, however, are largely absorbed by the condenser.

Suppose the grid potential is changed rapidly in a positive direction. The anode current rises but the potential across R3 does not rise at once. The increase of current does not flow through R3 but is supplied by a loss of electrons from the upper plate of C. If the grid is maintained at its new potential, of course, C cannot continue to supply electrons and the current is diverted to R3. The process is gradual; C supplies the initial electrons for the current, but there is a continual and gradual change over to R3. As time progresses, the electrons supplied by C fall off and the current through R3 increases.

Now instead of keeping the grid potential at its new value, we can apply an input which swings the grid rapidly in a positive direction, then falls back to normal, swings an equal amount in a negative direction, and finally returns to normal. The anode current will at first rise for the positive grid voltage change, then fall to its normal value, and then fall below it to correspond with the negative grid voltage change, finally returning to normal.

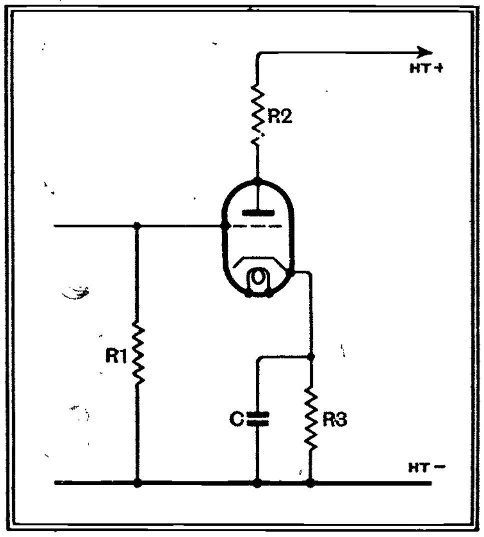


Fig. 2.—Feed-back along R3 can be avoided by using a large-capacity by-pass condenser C.

The condenser C will supply the initial current by losing electrons from its upper plate, but before the potential across it has had time to rise appreciably, the total current will have fallen again and gone below the normal value. The condenser will now gain electrons through R3. Although the anode current is lower, the current through R3 is hardly changed, for the condenser C takes the surplus current.

It will thus be seen that although the anode current fluctuates to follow the changes of grid voltage the current through R3 does not, for the condenser C

Cathode Bias and Feed-back—

absorbs the difference. When the anode current swings below normal, electrons flow into the upper plate of C and represent the difference between the normal and instantaneous currents. When the anode current swings above normal, electrons leave the upper plate of C.

Another way of considering the matter is on the basis of impedance. The condenser C has a reactance which is in parallel with R3 so that the impedance of the combination is lower than that of either. If the condenser is large enough its reactance will be very small, so that a given alternating anode current will develop a correspondingly small voltage across it. Therefore there will be little voltage to oppose the input voltage, and the negative feed-back effect will be small.

The reactance of a condenser is inversely proportional to its capacity and to the frequency of the alternating current. If even amplification of all audio frequencies is wanted, therefore, it is necessary to make the condenser large enough for its reactance to be very small at the lowest frequency required.

In practice, it is usual to use a capacity of 25-50 μF. in AF amplifiers and this is large enough for most purposes. When valves of unusually high mutual conductance are used, a larger capacity is sometimes needed. For IF and RF amplifiers the capacity is usually 0.1 μF. and in short-wave equipment it is often 0.01 μF. or even smaller.

Problems

THOUGHTS ON HENRY FARRAD'S DIFFICULTIES

By

"CATHODE RAY"

THE appearance of "Problem Corner" is not, I hope, intended to suggest that problems can be tucked away into a corner of the field of radio. The said field of radio seems to me to be about ninety-nine per cent. problems—and don't ask me too suddenly what the other one per cent. consists of, because I would need time to think. The serviceman obviously has a full-time job solving problems; so has the designer. Even the listener is constantly faced with the problem of deciding whether the noise he is hearing is due to the neighbour's new ultra-violet-ray apparatus or a leak in his own wiring, or whether his amplifier is deteriorating or if it is a bad OB line "beyond our control."

In solving problems it is obviously an advantage to know as much as possible about the subject. But this is not everything. In my exam. days I often managed to do less badly than some who really knew their stuff. This was not due to what you probably suspect, but to the fact that I had sufficient self-control to refrain from writing anything at all for fully 15 minutes after being presented with the paper; while the brainy people were busily dashing off pages of perfectly correct answers to questions which were not exactly the ones asked. I throw this out as a hint to any readers who may suffer from examination-fright.

Following False Scents

In practical problems, too, it pays to study the data carefully and not waste time following up scents that could be seen to be false. Henry Farrad and his followers have the advantage—unfortunately denied in real life—that the information supplied is sufficient to enable a logical conclusion to be drawn, and can either be assumed to be correct or else implies the correct data. In earning our living we are usually faced with the difficulty that the data may be insufficient and its accuracy unknown, as that we may have to set about collecting our own data.

If somebody for whom you fixed up a receiver some time ago complains that "it is making a funny noise, what is wrong?" the information certainly seems absurdly inadequate. It must not be forgotten, either, that the person concerned is probably quite incompetent to pick out the symptoms that would be helpful in drawing a conclusion; and one has to be prepared for terms to be used in ways that are misleading to a technical person. "Distortion" may be used to describe hum, and "hum" to describe microphonic howl. It is no use getting angry with the informer; he (or she) has not been through a technical college. I had a complaint from a semi-technical quarter that a certain battery superhet didn't give enough output. As the perpetual difficulty with battery superhets is to obtain sufficient undistorted output without excessive battery consumption, I wasted quite a lot of time in finding the receiver to be up to standard in this respect and reporting it so. Whereas the real complaint was that (due to a lower value of AVC delay voltage) it was not possible to get a feeling of "punch" by grossly overloading the output stage at maximum setting of the volume control. In fact it had been designed to avoid this cause of distortion!

So when getting information second-hand it is more important to know what the informer means by his words than what you would mean by them. This is especially so when asking him for further clues. Then he may not be very helpful when pressed for details; like the patient who, when the doctor said "Well, now, what's the matter?" replied "That's what I pay you to tell me!" But incidental knowledge may eke out apparently scanty information. In a Henry Farrad problem the usual conventional weather remark turned out to be a valuable clue. The locality of the receiver, in relation to broadcasting stations or possible sources of interference, is often important. Knowledge of the type of person using it, or making the complaint, helps in the interpretation to be put on the information given. Some people are hyper-critical, whereas others refer quite mildly to distortion that is dreadful beyond words. If they are known to be of the type that switch on every morning and switch off at bedtime, a worn-out valve is more reasonably suspected than if they listen to nothing but the News.

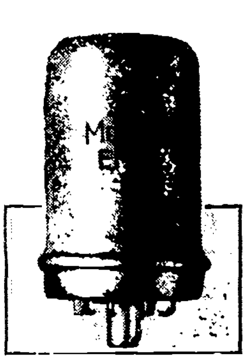
When the problem can be examined direct, one possible source of confusion is eliminated. The speed and certainty of solution then depend mainly on one's mental and instrumental resources. I suppose most people in this game have come across cases that seem to run contrary to the laws of nature, and tempt one to give up striving against a thing that seems to have the supernatural on its side. The trouble may be due to one's own incomplete knowledge of the laws of nature, which are many. A resistor may indicate 1,000 ohms on an ohmmeter, and yet with 10 mA. through it the voltage across its terminals may not be the 10 volts that one would expect on the ground of Ohm's Law. The resistance value might happen to depend on the current passed.

Take Nothing for Granted

Then apparently conflicting and absurd results may be due to unsuspected faults in the parts that are being assumed to be dependable. The 50,000-ohm coupling resistor in an amplifier may be passing 2 mA, and yet show no voltage across it when measured by the same multi-range instrument. But it is possible for the meter to develop a fault on one range! Or current may fail to pass between two points that are joined by a short piece of thick flex that gives a satisfactory zero resistance test. But flex does sometimes develop a break that is concealed by the covering, and which makes contact when brought into the testing position and opens in the working position.

It is well to remember that nothing can be really "impossible," and the apparently conflicting results can be reconciled by close enough examination.

The usual retort to the advice about patiently following a systematic sequence of tests that (in the words of the adviser) yields the correct result by the inexorable force of logic, is that life is too short and a serviceman who followed this method would get the sack. Certainly there must be a happy medium between rigid system on the one hand and random shots on the other. The only way to reach it is by experience and common sense.



All-Glass Valves

NEW METHOD OF VALVE CONSTRUCTION

VALVE development continues rapidly and concerns both the characteristics and method of construction. A new Mullard type of valve of exceedingly unorthodox construction is described in this article.

THE development of the technique of radio valve manufacture was assisted in the early stages by the experience gained in the production of incandescent lamps. Although originally developed for the lamp, the glass bulb and foot, with its pinch, were adopted for the vacuum-tight envelope of the valve. Recent receiver development, however, has raised problems which are difficult of solution with the existing valve technique. This is especially so in the case of short-wave and television apparatus.

Some of the difficulties encountered in the original method of construction, as developed from incandescent-lamp manufacture, can be summarised as follows:—

(1) In certain valves of the old construction it was found necessary to connect anode and control grid to the opposite ends of the valve, which sometimes complicates receiver design.

(2) Long internal connections from the electrodes to the external contacts considerably increase the actual capacities and inductances of the electrodes. This gives rise to serious difficulties when dealing with short waves.

(3) Long connecting leads from the electrodes to the contacts also cause appreciable variation in the effective inter-electrode capacities. This effect is made worse by the presence of the "getter" deposit in the neighbourhood of the pinch.

(4) The bakelite used in the manufacture of the base of the valve is rather unsatisfactory, partly because its dielectric constant varies with temperature, and this causes some change in the effective valve capacities during the warming-up period after switching on.

In an attempt to solve these problems the Mullard "All-glass" valves have been introduced, and in most respects they prove to be a satisfactory solution, readily adaptable to mass production. The photograph shows the external appearance of one of these valves, the EF50, and Fig. 1 shows the constructional details.

The bakelite base and the foot with its usual pinch have been eliminated and replaced by a machine-made pressed-glass base (A). This glass base includes the chrome-iron leading-out wires. Chrome-iron is chosen for this purpose because it has a coefficient of expansion similar to that of certain qualities of glass, and in other respects it proves to be very suitable for making vacuum-tight seals.

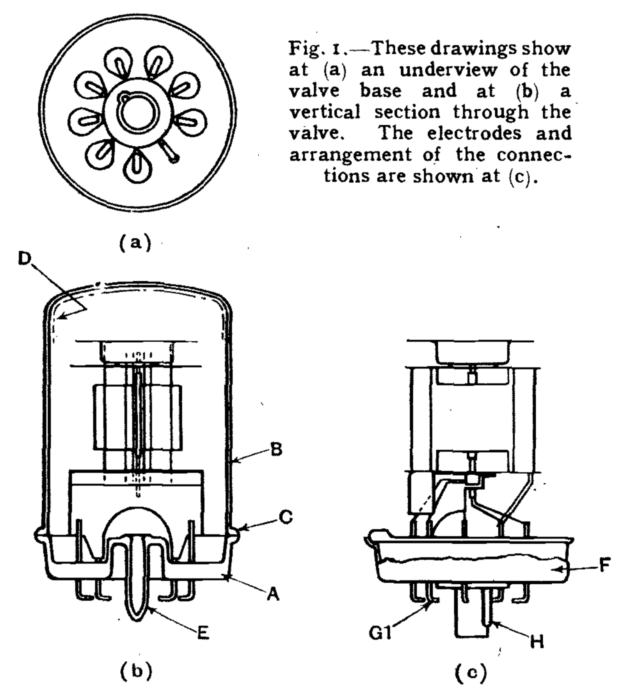


Fig. 1.—These drawings show at (a) an underview of the valve base and at (b) a vertical section through the valve. The electrodes and arrangement of the connections are shown at (c).

The seal between the bulb (B) and the glass base forms the flange (C). The "getter" deposit (D) is located exclusively at the top of the bulb. The exhaust tube (E) is part of the glass base, and both the exhaust tube and the base are covered with a metal screen (F), which is provided partly to give mechanical protection of the exhaust tube and partly to allow of external electrical screening between the control grid contact (G1) and the anode and heater contacts.

The provision of a locating spigot (H) facilitates the correct insertion of the valve into the socket. This is similar to the method employed in the octal base.

The External Contacts

When inserted in the specially designed socket the silver-plated chrome-iron contacts at the base of the valve have a contact resistance of 5 to 8 milli-ohms, which compares favourably with other existing bases.

This method of making the connections has the advantages that there are no soldered joints on the valve, and there is no base which can become loose. More important, the connections between each electrode and the point where the external circuit wiring is soldered to the contact springs on the valveholder are very short.

The Internal Leads

The arrangement of the leading-out wires in a typical small valve—the EF9—with a pinch construction is shown in Fig. 2. The wires run more or less parallel with each other inside the foot for a length of approximately 35 mm., compared with 15 mm. in the all-glass construction.

In Fig. 3 the total length of the connection from the cathode A to the cathode contact soldering tag B on the valveholder is compared for the EF9 and EF50. This length is of importance in short-wave work, particularly at the wavelengths used for television, and the diagram shows that it can be reduced from 65 mm. to 45 mm., a decrease of more than 35 per cent.

Further advantages are obtained by the elimination of the bakelite base, since bakelite has comparatively high dielectric losses and a dielectric constant which varies to some extent with temperature change. As a result of this and other causes the capacity variations of valves during the warming-up period give rise to considerable frequency drift; eliminating the bakelite base assists appreciably in the improvement of this defect.

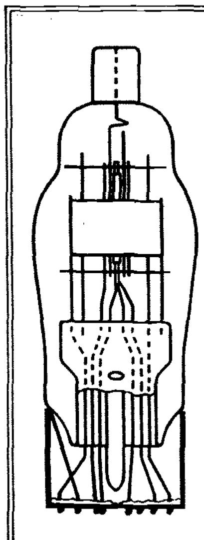


Fig. 2.—The greater length of the internal leads is clearly shown in this drawing of an ordinary valve.

The effect described is well brought out

All-Glass Valves—

by the figures of Table I. These measurements were made at a frequency of 15 Mc/s and an ambient temperature of 25° C.

As shown in Fig. 1, the control grid connection of the EF50 has been taken to the base. In the pinch construction this would not be permissible, because it would give rise to insufficient screening between the control grid and the anode and heater. The external screen (F) and the internal screen ensure very small anode-to-grid and heater-to-grid capacities in the EF50. The anode-grid capacity is less than 0.002 mmfds, and the grid-heater capacity is less than 0.003 mmfds.

These values, which include the capacities of the socket, are quite as small as those measured on the EF9 with the control grid lead taken out to the top cap.

It has been found in practice that the input and output capacity tolerance of the EF9 cannot be reduced below $\pm$ 0.6 mmfds, the input capacity being

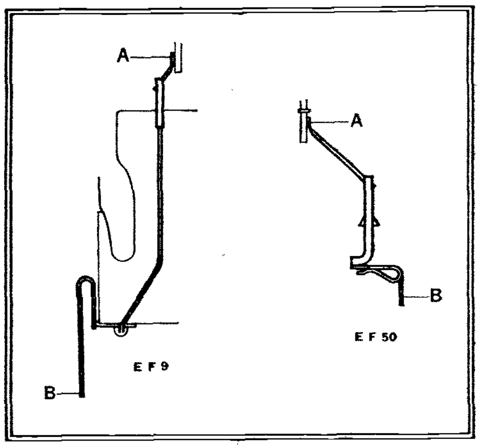


Fig. 3.—The lengths of the internal cathode leads for the EF9 and the new EF50 are well brought out in these sketches.

5.0 $\pm$ 0.6 mmfds, and the output capacity 7.0 $\pm$ 0.6 mmfds. On the other hand, the all-glass type EF50 can be made with input and output capacity tolerances of only $\pm$ 0.2 mmfds. In some applications this is an important advantage.

It is possible to work to these reduced tolerances because the lead-out wires in the pressed-glass base are always the same distance from each other, and these distances are greater than in the normal pinch construction. Further, the "getter" deposit is at the top of the bulb and no longer influences the capacities between leads, and the mechanical stability of the electrode system is greater in the new construction.

An additional advantage of limiting the "getter" deposit to the top of the bulb is the reduced risk of bad insulation between the support wires, thus obviating the necessity for the well-known white insulation material on the pinch, which can give rise to crackling noises.

In the conventional pinch construction all lead-out and supporting wires in the pinch are in one plane. This necessitates the well-known dome mica construction. In the all-glass valves the supporting wires are arranged in a circle (see Fig. 4). This increases the mechanical stability of the system to such an extent that the additional support of the dome mica construction is not required.

The dimensions are of the same order as those of other types of small valves as shown in Table 2.

TABLE 2.
VALVE TYPES.

	EF9.	EF50.	EF11.
Length in mm. ..	86	60	55
Diameter in mm. ..	30	32.5	42.5
Weight in grammes.	24	28	46

A point of special importance to set-makers is the possibility of transporting sets with the valves in position without risk of the valves shaking out. With this object in view the socket for the all-glass valve has been designed on the bayonet-lock principle. This has the advantage that the valve can be firmly secured in its socket by applying comparatively light pressure, followed by a twist, after which the valve cannot be removed unless a twist is applied in the opposite direction.

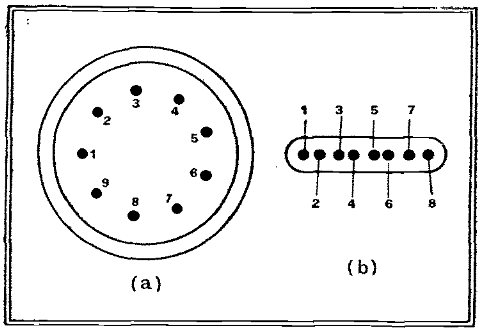


Fig. 4.—This diagram shows at (a) the base arrangement of the new valves and at (b) the pinch of a conventional type.

This socket has proved entirely satisfactory for use in apparatus designed for aircraft.

TABLE 1.
FREQUENCY DRIFT.

Valve type.	Time after which 80% of the total drift is reached.	Total drift.
EK2—bakelite base.	12.0 minutes	4.4 kc/s.
EK2—all-glass ..	9.5 minutes	2.7 kc/s.
ECH11—an all-metal valve with bakelite base.	11.8 minutes	5.5 kc/s.

The Wireless Industry

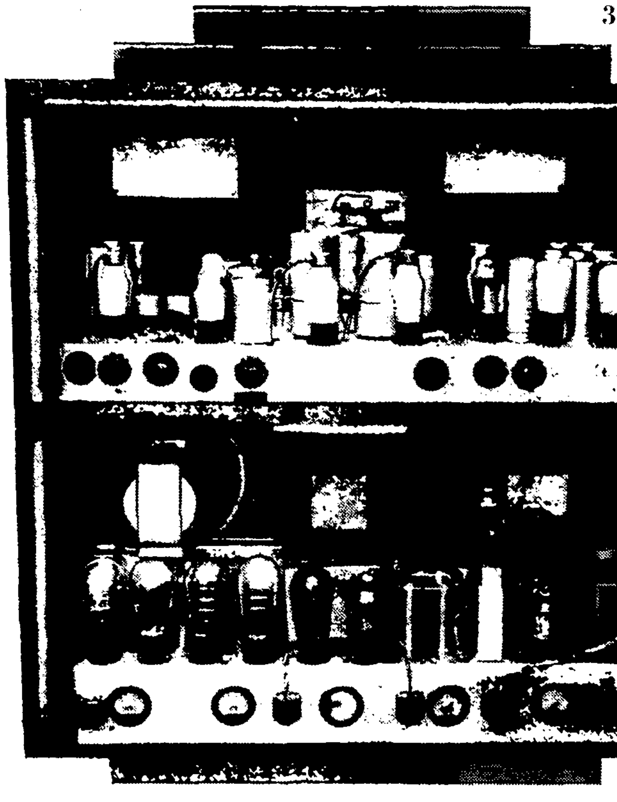
LESLIE DIXON AND COMPANY, of Electradix House, 218, Upper Thames Street, London, E.C.4, have just issued a Sale List dealing with components and accessories of various kinds, as well as testing apparatus, meters, generators, recorders, chargers, etc.

Leaflets describing console and radio-gramophone cabinets and extension speaker cases are available from Lockwood and Company, Lowlands Road, Harrow.

A firm of importers in India wishes to get into touch with manufacturers of receivers suitable for Indian conditions who are not already represented in that country. Letters addressed to this office will be forwarded.

The footnote to the Film Industries advertisement last week suggested that the F.I. 15-watt amplifier is for the trade only; actually, the instrument is available to the general public at the price given.

Marconi-Ekco Instruments, Ltd., Electra House, Victoria Embankment, London, W.C.2, have issued a pamphlet on "Noise-Measuring Apparatus."



31-VALVE AMATEUR-BUILT RECEIVER

COMPREHENSIVE EQUIPMENT.—Including features taken from a number of *Wireless World* receivers and units, this ambitious receiver has just been built by Mr. W. R. Palmer to his own design. The superheterodyne unit is that of the Quality Receiver, while a Colebrook amplifier is used for local-station work. Volume expansion is employed, and the AF section includes both the Quality Amplifier and the PA Amplifier. The total number of valves, including rectifiers, is 31, and 5 wavebands are covered.

Constant Slope Voltage Control

Variable Output with Uniform Regulation

A METHOD, suitable for low power work, of controlling the voltage output of an HT rectifier.

By R. H. TANNER, B.Sc., A.C.G.I., and P. H. WALKER, B.Sc. (Eng.)

IN experimental work it is frequently desired to arrange that the voltage output of a power unit shall be variable over a limited range. The normal methods of effecting this control employ either a variable series resistance or a potentiometer, but both of these have serious disadvantages. The introduction of series resistance does give satisfactory control of output voltage provided the load is constant, but it results in poor voltage regulation, the output voltage falling rapidly with increase of load.

With the potentiometer method regulation may be made as good as desired, provided that the power output required is but a small fraction of that available from the rectifier, for it is essential to the working of this system that the potentiometer shall take considerably more current than the external circuit; otherwise its action becomes almost identical with that of the series resistance.

In the system to be described these disadvantages are largely overcome, and the effect of the control is to shift the regulation curve bodily up and down without materially altering its slope over the normal working range. The circuit used is shown in Fig. 1 and its simplicity will at once be apparent. It is applicable to all circuits having a condenser input to the smoothing filter, and the control of voltage is carried out by varying the reservoir impedance. It is well known that changes in the capacity of the condenser C cause changes in the terminal voltage, but since an 8-mfd. variable condenser is scarcely a practicable proposition, control by this method can only be made in steps.

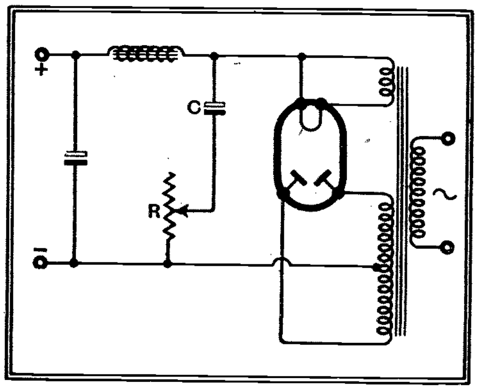


Fig. 1.—With this circuit, which differs from the standard arrangement only in the introduction of a variable resistance R, the output voltage can be controlled without affecting the regulation.

The inclusion of the resistance R, however, makes continuous variation possible. The results are very satisfactory, although the effect is not identical with that produced by changing the capacity, since the introduction of resistance into the filter input impedance brings into play certain factors too complicated to be dealt with here. It may be said, however, that the voltage and current stresses upon the rectifier, transformer and condenser are all somewhat reduced by the insertion of R, and that when the resistance is made very large the circuit becomes, in effect, a choke input filter.

Value of Resistance R (ohms)	Nominal Output Voltage					
	450		350		250	
	Current (mA)	Power (watts)	Current (mA)	Power (watts)	Current (mA)	Power (watts)
50	250	3.1	195	1.8	140	1.0
500	160	12.8	125	7.9	90	4.0
1000	120	14.4	94	8.9	67	4.5
2500	70	12.3	55	7.5	39	3.8

The above table shows the measured and calculated currents and powers in the resistance for various values of R (Fig. 1) and output voltage. These figures are used in the choice of a suitable component.

Fig. 2 indicates the results that may be obtained when using perfectly standard equipment. The transformer was designed to give an output of 450-0-450 volts and the rectifier was an American type 5Z3 valve, which is practically the equivalent of the British U.18 and U.52. The choke had a nominal inductance of 20 henrys and a resistance of 250 ohms, being a component intended for use with a condenser input. It is very probable that with a choke designed for use without a reservoir condenser the regulation at lower voltages would have been still further improved over that shown by the curves.

The curves given in Fig. 2 show the output voltages obtained when R is given the values of 0 and 2,500 ohms, with two additional curves, shown dotted, indicating intermediate positions when R is 500 and 1,000 ohms. It will be seen that a voltage range of over 100 volts is available; even when the maximum value of R is limited to 1,000 ohms the range at 150 mA is 90 volts, or 20 per cent. of the nominal output of 450 volts. All these figures relate to the use of an 8-mfd. reservoir condenser, and it should be borne in mind that a reduction of this capacity will reduce the control range available.

It is evident that the resistance R does not dissipate any DC power, but there is, however, a considerable alternating current flowing through it and the component must be chosen accordingly. The accompanying table gives the measured values of this current for various resistances, together with the corresponding calculated powers, and it is obvious that a high-wattage component is needed, particularly where high transformer output voltages are used. It will be seen that the AC power absorbed by the control circuit is an appreciable percentage of the total output power, which, though negligible in amateur receiver and transmitter experiments, makes the method uneconomical for controlling the voltage of high-power rectifiers. For lower transformer voltages the power dissipated in the resistance is reduced in proportion to the square of the voltage ratio. To illustrate this point, extra columns have been added to the table giving the estimated powers and currents for other values of nominal power-unit output voltage.

The most suitable of several different kinds of resistance that have been used appear to be either the Claude Lyons Standard Clarostat or the Bulgin range of 60-watt variable resistors. The former, owing to its unusual construction, has a power rating almost independent of its resistance value, and thus can carry the heavy currents which flow at the low resistance end of the range, although its power rating is only 15 watts. It has, however, a minimum value of about 100 ohms, which will slightly reduce the maximum voltage output of the unit. The Bulgin resistances must be chosen to carry the heaviest current to be expected, as they are essentially current rated. For voltages in excess of 500 the Power Clarostat with a range of 50-2,500 ohms would be suitable.

In conclusion, it should be pointed out that the use of this principle will reduce to a certain extent—depending on the value of resistance in circuit—the smoothing effect of the reservoir condenser. The filter circuits should, therefore, be designed rather more generously than would otherwise have been the case. Where there is any doubt the safest plan would be to follow a design for a filter employing a choke input, as the added condenser and resistance will then no longer be essential to the smoothing.

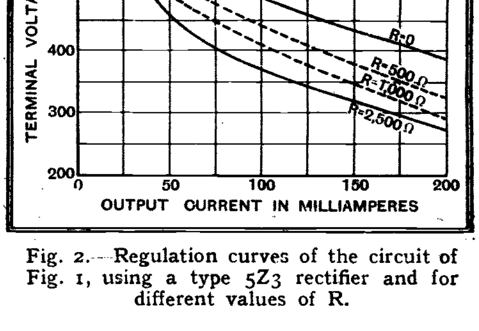


Fig. 2.—Regulation curves of the circuit of Fig. 1, using a type 5Z3 rectifier and for different values of R.

Television Topics

INTERFERENCE FROM HARMONICS OF SW STATIONS

A READER living in Coventry[1] experiences interference on the Alexandra Palace vision signal from the Daventry short-wave stations which he attributes to harmonics radiated by these stations. Such interference is quite possible when the receiver is at a fairly short distance from the transmitter, because it is extremely difficult completely to prevent the radiation of such harmonics.

When a receiver is near a transmitter operating on certain frequencies, and especially when it is a long way from the vision transmitter and the receiver is consequently operated at high gain, a certain amount of interference is likely. If the receiver is in a suitable location the easiest remedy lies in the use of a suitable aerial system.

The use of a highly directional receiving aerial is not necessarily advisable; it is more important that it should possess the property of giving no response to signals from one particular direction. The familiar dipole with reflector is of this type. As usually erected, the reflector is placed behind the dipole so that reflector, dipole, and transmitter all lie on the same straight line. This gives the maximum signal strength and it also gives the minimum pick-up from an interfering signal if this is located on the same straight line projected backwards.

In general, however, the interfering station is not so conveniently placed, and the best results are then obtained by poling the aerial to give not maximum signal pick-up from the vision transmitter but minimum interference. This is illustrated in Fig. 1, where (a) indicates the usual way of erecting the aerial and reflector and shows also its polar curve. At (b) the aerial is depicted poled for minimum interference, and it is clear that there is a big reduction in interference for only a small reduction in the wanted signal.

The setting of the aerial for minimum pick-up is much more critical than for maximum and must be carried out experimentally by rotating the aerial system and observing the effect of each change. This method of avoiding interference naturally fails if the interfering station is situated on the same side of the receiver as the vision transmitter. It may also fail in the case shown in Fig. 1 if there is any appreciable degree of reflection of the interfering signal.

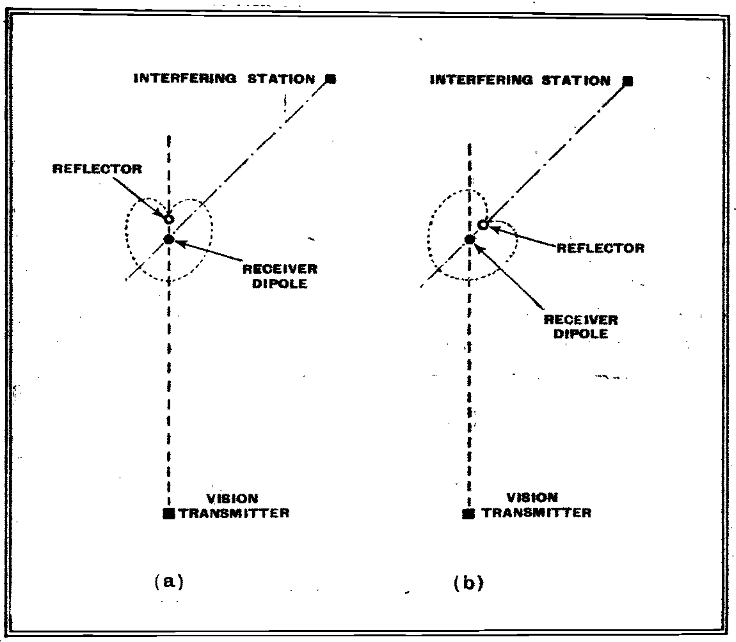


Fig. 1.—These diagrams show at (a) the usual method of erecting a dipole aerial and reflector poled on the transmitter for maximum response and at (b) adjusted to give minimum interference.

In the case of interference from harmonics of the Daventry stations, however, this is not the only way of tackling the problem. Interference can be avoided by designing the receiver appropriately.

With double sideband working and a frequency response up to 2 Mc/s, the band-width extends from 43 Mc/s to 47 Mc/s; with single sideband operation it can be 43-45 Mc/s or 45-47 Mc/s. To cause interference the harmonic of a signal must fall within one of these bands. The table shows the frequencies within which the interfering signal's fundamental frequency must lie if interference is to be experienced, for harmonics up to the fifth.

With both sidebands retained trouble may be found from the following: 2nd harmonic of GST, GSG on 21.55 and 21.53 Mc/s; 3rd harmonic of GSP, GSI, GSO, GSF, on 15.31, 15.26, 15.18 and 15.14 Mc/s, and 4th harmonic of GSD on 11.75 Mc/s. With single sideband working using the band of 45-47 Mc/s, all these possibilities remain, except GST and GSG, but if the band of 43-45 Mc/s is chosen none of them is present except GST and GSG.

Under these circumstances, therefore, the use of single sideband reception will be decidedly advantageous. If the IF amplifier is provided with a response cutting off sharply outside its pass-band of 2 Mc/s, the possibilities of interference from this source are greatly reduced, even in close proximity to the transmitters. If the band-width is slightly reduced, say to 1.8 Mc/s, and the accepted band is 45-43.2 Mc/s, all interference can be avoided.

It is necessary, however, to make sure that interference is really due to harmonics of the transmitter, for it is quite possible for it to occur through second-channel interference. If the intermediate frequency is f_i and the band-width is 43-47 Mc/s, then if the oscillator frequency is lower than the signal frequency second-channel interference may be found from signals in the band $43\text{-}2f_i$ to $47\text{-}2f_i$ Mc/s.

A common value for f_i is 13 Mc/s, giving an interference band of 17-21 Mc/s. Within this band are GSG and GSV. For single sideband reception the bands are approximately 17-19 Mc/s and 19-21 Mc/s. The former contains GSG and GSV and is the band effective if conditions are chosen to avoid harmonic interference.

By working with the oscillator at a higher frequency than the signal, however, the interference band is $43+2f_i$ to $47+2f_i$ Mc/s, or with $f_i=13$ Mc/s, 69–73 Mc/s. This is a vacant band at present and the use of the higher oscillator frequency effectually prevents the possibility of second-channel interference.

By adopting single sideband reception of the band 43.2-45 Mc/s and operating with the oscillator at a higher frequency than the signal no interference from the Daventry short-wave stations should be experienced in any locality. The oscillator will of course be set at 58 Mc/s, and the IF band should be 13-14.8 Mc/s. The sound intermediate frequency is 16.5 Mc/s.

It should be emphasised that in the vast majority of cases no interference is experienced, but there is the possibility which a correspondent has pointed out of such interference in certain localities. Fortunately a remedy is possible at the receiving end.

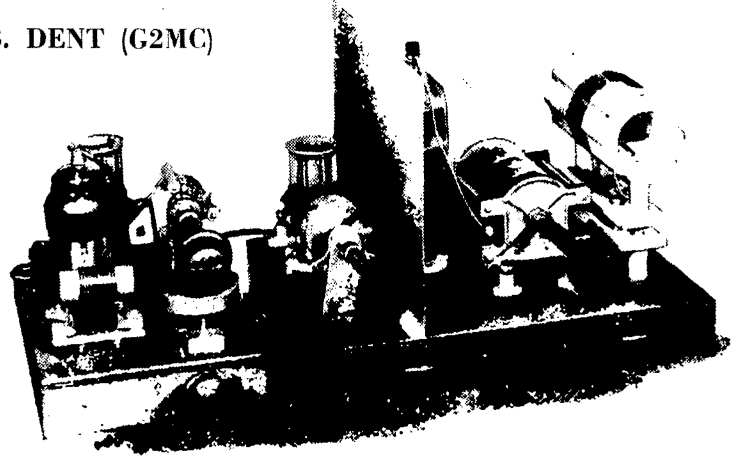
	Double-Sideband	Single-Sideband	
Input Band-width (Mc/s).	43—47	43—45	45—47
Harmonic :	Signal Frequencies (Mc/s).		
2nd	21.5 —23.5	21.5 —22.5	22.5 —23.5
3rd	14.3 —15.7	14.3 —15	15 —15.7
4th	10.75—11.75	10.75—11.25	11.25—11.75
5th	8.6 — 9.4	8.6 — 9	9 — 9.4

[1] *The Wireless World*, February 9th, 1939, Letter to the Editor.

The Amateur Transmitting Station

By H. B. DENT (G2MC)

Part VII.—Methods of Keying: Modulating for Telephony Transmissions



THE connection of a morse key to a transmitter is not such a simple matter as would appear at first sight. The pros and cons of the various available methods are discussed in this instalment, which also deals with the question of modulation for speech transmission.

WE have now reached the point where a decision must be made as to whether the transmitter that has been described is to be keyed for telegraphic communication or modulated for telephony. Telegraphy obviously requires the least amount of apparatus, for it is only necessary to devise some simple way of breaking up the radiated waves into dots and dashes to achieve this object, whereas for telephony transmission equipment must be provided for amplifying sounds, such as speech or music, in order that a sufficient amount of audio power shall be available to modulate the radiated waves, or the carrier, as it is usually called.

A telegraph key inserted in the HT lead would serve to make and break the supply to the valves, but it is not good practice to key in the main supply in any but very low-power transmitters. Where there is appreciable power in the circuit, arcing will take place at the key contacts, and often when the key is "open" an arc forms and allows current to flow to the valves. The formation of intelligible morse characters will be almost impossible under these conditions.

There are, of course, ways and means of preventing arcing at the contacts, but before applying remedies it would be advisable to see if the arcing cannot be minimised by choosing a better place for the key. Arcing will be greatest where the largest current flows, so that the logical place to key is where the power is lowest.

Another effect produced is that interruption of a circuit of moderately high power causes energy to surge to and fro in the circuit in much the same way as the discharge of a condenser through a path of low resistance produces a train of damped oscillations. These oscillations will be radiated either by the aerial or by the mains wiring, and possibly by both, with the result that interference may be produced in nearby receivers. These damped oscillations cover a very wide band of radio frequencies, so that such interference can extend into the ordinary broadcast wavebands.

The possession of a transmitting licence does not absolve the amateur from the responsibility for any interference caused to broadcast listeners, so that every possible precaution must be taken to suppress and remedy it. This shock-excitation form of interference can be identified by quite loud thumps and clicks being heard in a nearby receiver, and thus it has been

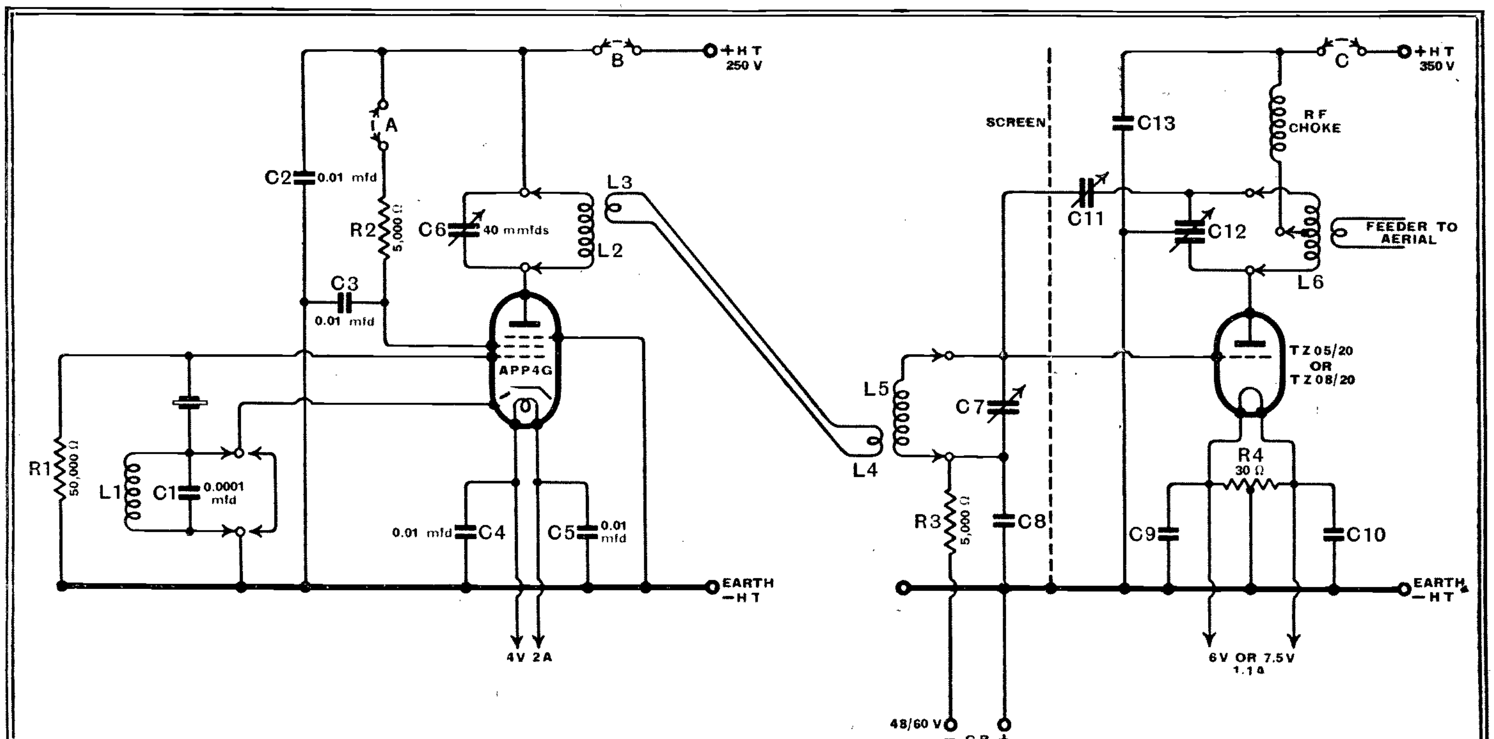


Fig. 18.—In this circuit are three points, A, B and C, where a key for telegraph transmission can be inserted; the merits of the various keying positions are discussed in the text.

The Amateur Transmitting Station—

described as key thumps or key clicks.

The amount of interference produced will be governed by the power in the circuit interrupted by the key, and if it is included in a high-power circuit their elimination will be more difficult than would be the case were only very little power being keyed. Accordingly, then, we must look for a place in the transmitter where the power is low and where keying can effectively be undertaken.

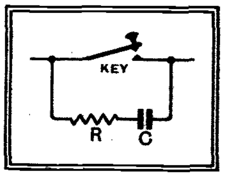


Fig. 19.—A simple filter for suppressing key clicks.

Referring to Fig. 18, there are three points in the circuit, marked A, B, and C, where a key can be inserted; these points indicate where terminals or jacks have been included for one purpose or another.

Point A is in the screen grid lead to the APP4G oscillator valve, and the current flowing is about 5 to 7 mA. In the line where B is included, the current is about 30 mA, while at C, in the power amplifier HT supply, about the same current will be flowing. It is obvious that A is the best place for the key, as the lowest current flows in the screen circuit of the valve.

Even choosing this point for keying will not necessarily remove all trace of interference, and if a close inspection of the key contacts is made when the key is closed and opened, bright bluish sparks will often be seen. These are quite sufficient to cause interference, even though they may not be serious enough to give rise to actual arcing across the contacts.

Key Filters

A simple form of key click filter will suffice to suppress any interference due to this sparking. The filter consists of a resistance and condenser joined across the contacts as shown at R and C in Fig. 19. A capacity of one or two microfarads is required, while the resistance should be of the order of 1,000 ohms. Where the current in the keyed circuit exceeds about 10 mA, the remedy must take the form of slowing down the surges in the circuit, and this can be done by including a high-inductance choke in the HT lead. If the inductance is too large, the current will not be able to rise to its maximum during the short time the key is closed to form a dot, so that the "lag," as it is called, becomes too great, and either a slower sending speed must be adopted or the choke inductance lowered. A variable resistance joined across the choke provides a means for varying the time lag of the circuit. A complete key filter of this kind is shown in Fig. 20.

It may sometimes be found that, having taken these precautions, traces of interference are still noticeable in nearby receivers, or possibly in one's own domestic receiver. This is most likely caused by conduction along the supply mains. A mains filter consisting of two RF chokes with condensers arranged as in Fig. 21 will usually effect a cure. The condenser should be the kind recommended for use in interference suppression circuits and have a rating of 1,500 volts AC test.

The chokes are connected in the primary circuit of the mains transformer supplying HT and LT for the oscillator and power amplifier stages in the transmitter, and they must, of course, be wound with sufficiently heavy gauge of wire to carry the primary current without appreciable drop in voltage. They must be effective at the lowest frequency on which the transmitter will operate, but not necessarily on the lowest frequency generated. For example, if a 7-Mc/s crystal oscillator is used, but with the output taken at the second harmonic and the fundamental not amplified at all, chokes effective at 20 metres can be fitted, as the power in the fundamental will be too low to be troublesome.

One does not want to use chokes larger than necessary, as they will have to be wound with a very heavy gauge of wire. Of course, it is possible to compensate for voltage drop in the chokes by connecting the mains to the primary tapping next below that of the mains voltage, and the only disadvantage of this is that there will be a slight rise in filaments volts when the HT load is removed, such as during intervals between keying.

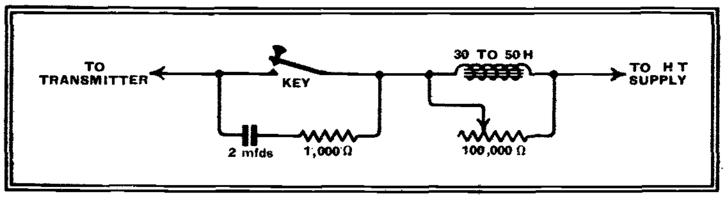


Fig. 20.—An AF choke shunted by a variable resistance is sometimes needed in the HT line to suppress key clicks.

Throughout this series of articles we have assumed the transmitter will be used for telegraphy work, and mention of telephony has been intentionally avoided, as the beginner would be well advised to concentrate on getting a CW telegraph transmitter to work efficiently before attempting to apply modulation.

A brief discussion of telephonic transmission will not, however, be out of place at this juncture. It is not proposed to deal with the theory of modulation, but merely to explain the basic principles and how they are applied to a transmitter of the kind described here.

The usual system adopted is that known as amplitude modulation. In this system the amplitude of the radio frequency wave is made to vary in accordance with the sounds reaching the microphone. The amount by which the RF oscillations, or the carrier, is varied is generally expressed as a percentage, being the maximum modulated amplitude minus the unmodulated carrier amplitude, divided by the unmodulated carrier amplitude and multiplied by 100. Thus if the carrier is increased to one and a half times its normal value, the modulation can be expressed as 50 per cent., while if the change is to twice the steady value the modulation would be 100 per cent. This is the maximum depth of modulation possible without distortion. Any excess of 100 per cent. is described as over-modulation and can cause serious interference to broadcast listeners.

As the process of modulation is to increase the amplitude of the carrier, 100 per cent. modulation represents a fourfold increase in peak output power, as the peak current and voltage are doubled. Thus the power amplifier must be capable of handling these peaks without damage to the valve and when operated at maximum input, voltages must be adjusted accordingly.

The advantages of fully modulating a transmitter will be apparent when it is realised that at the receiving end it is only the changes in carrier amplitude that produce the signals; thus a low-power telephony transmitter modulated 100 per cent. will appear to be as loud as one with several times more carrier power but with a much lower level of modulation.

Anode Modulation

Modulation can be effected in the anode circuit or in any amplifying stage preceding the final amplifier. If the last-mentioned scheme is adopted, the final amplifier must be a linear amplifier, such as a Class A or a Class B stage, and any system that would distort the modulated input to the valve cannot be used.

As it is desirable to operate the RF power amplifier at the highest possible efficiency (i.e., Class C) modulation is generally effected in the anode circuit of the last valve in most amateur transmitters. If pentode or tetrode valves are used in the RF power amplifier, modulation can be applied to the suppressor electrode, or a combination of anode and suppressor grid modulation may be employed.

The advantages of modulating in an early stage, in the grid circuit, or in the suppressor grid circuit of valves is that only a few watts of audio power are required, whereas modulating in the anode circuit of the final valve demands a relatively large audio frequency power. However, as for a 10- or 25-watt transmitter, the AF power required for the modulator is 50 per cent. the power input to the

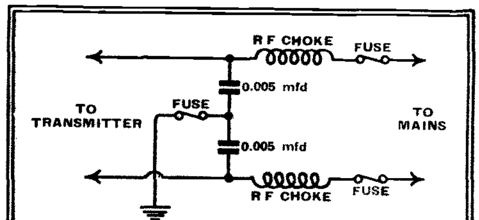


Fig. 21.—An RF filter in the mains leads to the transmitter may be needed to prevent interference with broadcast sets.

The Amateur Transmitting Station—
modulated stage, assuming anode modulation, a small public-address-type amplifier will suffice.

Audio frequency power amplifiers require to work into a definite load, and in the case of anode modulation with a triode valve, this load is provided by the DC resistance of the anode-filament path in the RF amplifier.

It is hardly to be expected that this will in all cases be just right for the modulator employed, and an impedance match will have to be effected. If a common HT supply is used for the AF and RF amplifiers, modulation can be effected by means of an AF choke in the HT supply as shown in Fig. 22 (a). When it is necessary to match dissimilar impedances with choke coupling, the circuit of Fig. 22 (b) could be employed; here an impedance step-up is shown, the modulator requiring a lower load than the DC resistance of the RF valve, but if a step-down has to be used, one end of the AF choke would be joined to the anode of the modulator, while the RF amplifier supply would be taken from a tapping on the choke.

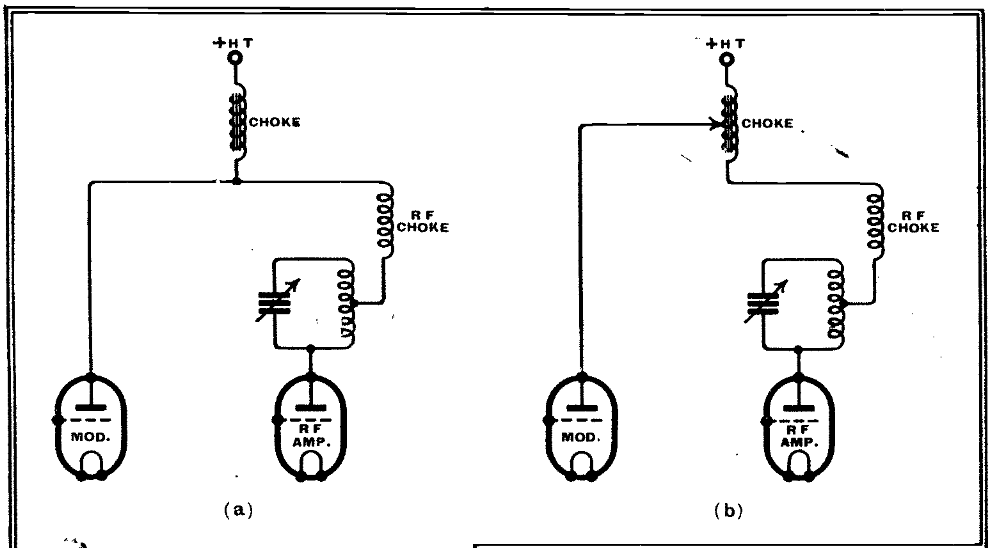
Another method is to use a transformer with or without separate HT supplies, while if a push-pull modulator stage be employed, then it can be arranged as shown in Fig. 22 (c). Where a modulation transformer is used with a single output valve in the AF amplifier, the primary and secondary connections can be arranged so that the flux in the core is cancelled, or at least reduced to a value depending on the difference between the larger and the smaller currents.

If they were not opposed, a core of sufficiently large size to carry the flux without saturation would have to be used. This does not apply in the case of the push-pull stage, as in Fig. 22 (c), since the primary flux is already balanced out, but the core has to carry the flux produced by the secondary or RF amplifier anode current.

As several audio frequency amplifiers, ranging from a 3½-watt model to one giving 30 watts output, have been described in *The Wireless World*, there is no need to discuss the design and construction of a modulation amplifier here.

A selection of those that would be suitable for the purpose is given below, though in some cases a few modifications, such as fitting an output transformer of the correct ratio, and possibly the addition of a one- or two-stage pre-amplifier for microphones of small output, may be needed.

Attention should be drawn to a regrettable error in the inscription to Fig. 14 of the last instalment. The inscription should read: The output voltage of a condenser filter (A) is *higher* but *worse* regulated than that of a choke input filter (B).



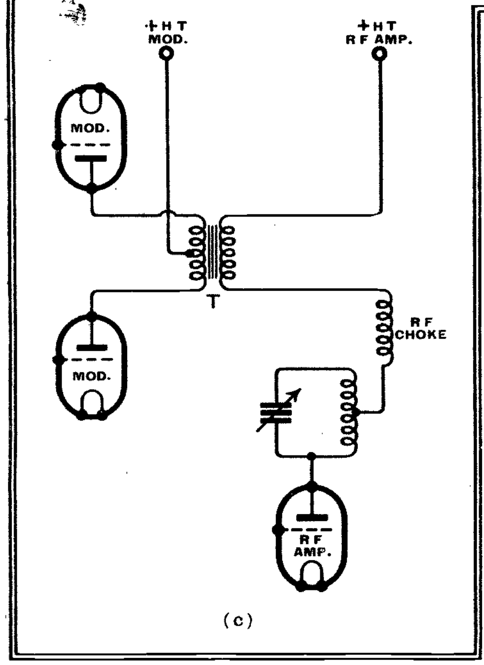


Fig. 22.—If the RF amplifier provides the correct load for the modulator circuit, method (a) can be used, otherwise matching can be effected as shown in (b) or (c).

AF Amplifiers previously described in "The Wireless World"

Small Quality Amplifier (3½ watts)
Nov. 4th, 1937.
Recording Amplifier (4-6 watts)
March 19th, 1937.
Push-pull Quality Amplifier (7-9 watts)
Reprint of May 11th and 18th, 1934, and December 23rd, 1937.
AC/DC Negative Feed-back Amplifier (5-6 watts)
November 6th and 13th, 1936.
12-watt Amplifier
April 3rd and 10th, 1936.
30-watt Amplifier
September 10th and 17th, 1937.
Battery Quality Amplifier
May 19th and 26th, 1938.

NEWS FROM THE CLUBS

Slough and District Short-wave Club

Headquarters: 35, High Street, Slough.
Meetings: Alternate Thursdays at 7.30 p.m.
Hon. Sec.: Mr. R. J. Sly, 16, Buckland Avenue, Slough.

At the last meeting 2FAU gave a very interesting talk on "Oscillators." It has been decided to build a short-wave receiver for the use of the Society, and also to apply at a later date for an AA licence. The next meeting will be held this evening (February 16th), when Mr. Gilbert will talk about "Microphones and Amplifiers." There will also be a demonstration of a "Sky Champion" receiver and an "R" meter.

Bradford Experimental Radio Society

Headquarters: 66, Little Horton Lane, Bradford.
Hon. Sec.: Mr. S. Hartley, 7, Blakehill Avenue, Fagley, Bradford.

A very unusual lecture was given on February 15th by Mr. W. J. James, the subject being "Psychic Television in Relation to Science." The lecturer gave theories regarding sound and thought waves as applied to clairvoyance and kindred sciences. At the meeting on February 28th Mr. Milnes, of the Milnes Electrical Co., will demonstrate a receiver operating from the gas mains.

Thorne Amateur Radio Society

Headquarters: 51, King Street, Thorne, near Doncaster.
Meetings: Sundays at 2 p.m.
Hon. Sec.: Mr. G. Beaumont, 15, Marshland Road, Moor-Ends, near Doncaster.

The above Society was formed on January 25th, 1939, and it will devote all its time to short-wave reception and transmission. A charge of 6d. will be made at every meeting.

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

At the next meeting, to be held on February 21st, Mr. H. L. Bowen, of the Mullard Wireless Service Co., will give a lecture entitled "The Latest Valve and Television Developments." On the following Tuesday (February 28th) a representative of Everett Edgcumbe, Ltd., will lecture on "Radio Servicing Instruments."

Southall Radio Society

Headquarters: Southall Library, Osterley Park Road, Southall.
Meetings: Tuesdays at 8.15 p.m.
Hon. Sec.: Mr. H. F. Reeve, 26, Green Drive, Southall.

At the meeting held on January 31st Mr. H. D. Cullen gave an interesting talk on "The Use of Measuring and Testing Instruments" and demonstrated, among other things, a cathode-ray oscillograph, a valve-testing panel, and a Wheatstone Bridge employing a neon type of indicator in place of the more usual galvanometer.

Ashton and District Amateur Radio Society

Headquarters: Commercial Hotel, 86, Old Street, Ashton-under-Lyne.
Meetings: Alternate Wednesdays at 8 p.m.
Hon. Sec.: Mr. K. Gooding, 7, Broadbent Avenue, Ashton-under-Lyne.

No fewer than thirty-five members attended the meeting at which Mr. J. Collinge, of Ferranti, Ltd., gave a lantern lecture entitled "Electrical Measuring Instruments." It is proposed to hold a "hamfest" during this month but nothing definite has yet been fixed.

Radio, Physical and Television Society

Headquarters: 72a, North End Road, London, W.14.
Meetings: Fridays at 8.15 p.m.
Hon. Sec.: Mr. C. W. Edmans, 15, Cambridge Road, North Harrow.

The following programme has been arranged:—

February 17th.—Lecture and Demonstration by Mr. B. R. Bettridge, of the Marconiphone Co., on "Small Television Cathode-Ray Tubes and their use by the Home Constructor."

February 24th.—Lantern lecture by Mr. Greaves, of the Mullard Wireless Service Co., entitled "Valve Design."

March 11th.—Visit to the printing works and wire-room of the "Sunday Graphic."

March 24th.—Lecture by a representative of the British Thermostat Co.

March 31st.—Lecture by a representative of H. Tinsley & Co., entitled "The Radio Frequency Dielectric Test Set Designed by the National Physical Laboratory."

GREAT BRITAIN'S NEW WAVELENGTHS ?

Proposed Changes to be Discussed at Montreux

MUCH speculation has been made in the Press on the subject of the changes in wavelengths which might be expected as a result of the Conference to be held at Montreux beginning on March 1st. From a reliable and authoritative source, *The Wireless World* learns that many changes, some quite drastic as far as English stations are concerned, are included in the proposed reshuffle of wavelengths which will be presented at the Conference by the International Broadcasting Union, whose task it has been to prepare a plan.

All the proposed changes to English wavelengths entail a shortening of from 85 to 14 metres, and stations would, therefore, tend to lose effective coverage by the use of shorter wavelengths which are more susceptible to fading and attenuation.

We will retain our one exclusive long wavelength, which it is proposed to lower from 1,500 to 1,415 metres. Slaithwaite, the North Regional, would drop to 435 metres (690 kc/s) which it would share with the 20-kW Jerusalem station, as it does its present 449.1-metre wavelength.

It is proposed that the Scottish stations at Burghead and Westerglen, which at present share 391.1 metres with Ijevsk, a 4-kW Russian, should share 372 metres (806 kc/s) with the Egyptian 20-kW Cairo I station. It is known that this station will shortly be replaced by one of 50 kW.

Penmon and Washford, the Welsh Regionals, would drop to 341.3 metres (879 kc/s) which wavelength they will share, as at present, with Greece. The station at Thessalonica which will share this wavelength is under construction and will have a power of 15 kW.

Exclusive Wavelengths

One of Great Britain's two exclusive medium wavelengths would be retained by London Regional—315.5 metres (951 kc/s). Lisnagarvey, the N. Ireland Regional transmitter, has virtually had an exclusive wavelength so far, for the Palestinian station, with which it was to have shared its present frequency, is not yet built. In the proposed plan they are to share 285.4 metres (1,051 kc/s).

Midland Regional has so far shared its wavelength with Chernigov, a 4-kW Russian station. This arrangement is proposed to continue on 276 metres (1,087 kc/s). The proposed East Anglian station, about which much has been written, receives its first official recognition in the new plan—Norwich is to share the Midland Regional wavelength.

The West of England Regional (Washford) will again share with Krasnodar, a 1-kW Russian station, its proposed wavelength of 265 metres (1,132 kc/s). As in the Lucerne plan, Stagshaw (North East Regional) and Alexandria I (1-kW) would share 249.2 metres (1,204 kc/s). Hungary, a non-signatory to Lucerne, also transmits from its 6.25-kW station at Nyiregyhaza on Stagshaw's present wavelength.

The "Little Nationals," London, North and Scottish, it is planned to drop to 243.7 metres (1,231 kc/s) which wavelength they would share with a Turkish station. That is the present arrangement, but Turkey not having utilised the wavelength it is virtually exclusive.

Aberdeen, which at present shares 233.5 metres with Greece, Germany and Belgium, is planned to share 214 metres (1,402 kc/s) with Danzig (0.5 kW) and the 10-kW Yugo-Slavian station now under construction at Split.

For Great Britain's second exclusive wavelength it is proposed to allocate 203.5 metres (1,474 kc/s), which is at present shared by Plymouth and Bournemouth with eight Belgian very low-powered stations. This wavelength, it is suggested, will be given to the new 100-kW transmitter now nearing completion at Start Point, Devon.

We understand that the proposed exclusive medium wavelengths for France are: 221, 217, 211, 207 and 204 metres.

NEWS OF

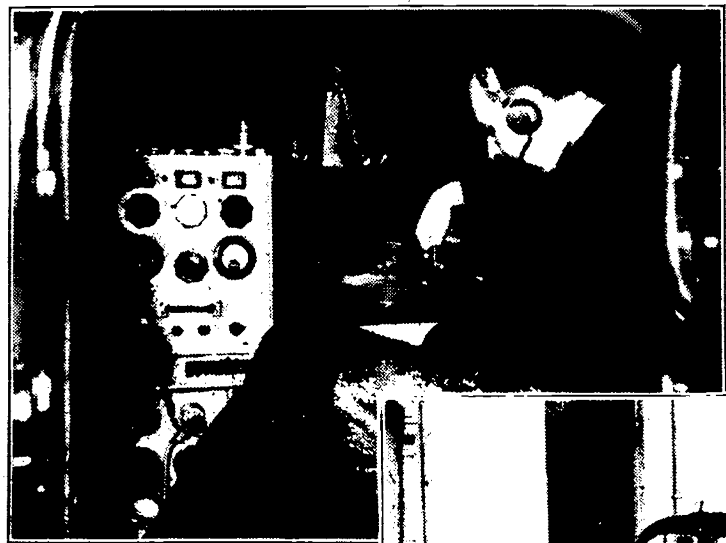
SALOON RECORDING CAR

Press Methods Invade Broadcasting

SPEED is essential for the B.B.C. News Department. The need for a fast car that could go anywhere at a moment's notice to collect actuality material for home and overseas bulletins has been met. This motor car, unfettered by the speed limitations imposed upon vans of the Recording Unit, has already brought into the homes of listeners impressions of such diverse, momentous events as Mr. Chamberlain's journeys to and from Germany, the relief of the Longships Lighthouse off Land's End, the sinking of the Spanish vessels off Cromer, the Fen floods, and the departure of the Coronation Scot for America.

Manned by a crew of three, the car is equipped with portable recording apparatus comprising a motor generator and switch gear, an amplifier and five-way mixer, and a turntable and tracking mechanism. A hundred yards of cable for telephone communication and a similar length of cable for the microphones are also carried.

The car is always ready for action. Even to-night its latest job of work may be broadcast in the Third News and ten o'clock news bulletin.



The engineer has everything at his finger-tips as he records an item for to-night's news on a cellulose-coated metal disc.

TELEVISION FROM THE THEATRE

Monthly Transmissions from London Coliseum

FOLLOWING upon the success of the recent inaugural television transmission from the Coliseum stage, an arrangement has been made with Sir Oswald Stoll whereby the B.B.C. will broadcast a series of monthly television transmissions from the Coliseum, beginning on Tuesday, February 21st.

It is emphasised that the new feature, "Coliseum Night," will be the straightforward televising of an ordinary performance. Television cameras will be inconspicuously placed at the side of the dress circle and the transmission will be produced for television by Mr. Philip Dorté in the mobile control room parked outside the theatre. From here the vision signals will be conveyed by cable to Alexandra Palace for retransmission.

The Coliseum has been specially wired for television, and is thus the first theatre in the world to be so equipped permanently.

TELEVISION AND THE CINEMA

AS the result of an arrangement between R.K.O. Radio Pictures and the National Broadcasting Company of America, a ten-minute version of the new Kipling film, "Gunga Din," is being shot for television.

The presentation of "super trailers" by means of television will, it is thought, provide an amusing feature for viewers, allow them to see their favourite artistes on their own screens and, incidentally, publicise the film. The arrangement introduces co-operation instead of competition between the television and cinema industries.

THE WEEK

HOME FACSIMILE SERVICE

Plan for Radio Newspapers

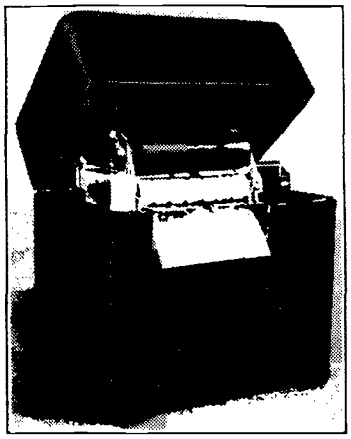
SIMPLICITY is a salient feature of the R.C.A. home facsimile receiver which is now in production. The receiver, which is no bigger than a radio-gramophone, when once adjusted needs no further attention, an automatic time switch setting the receiver in motion when the transmission of the radio newspaper begins and switching off again when it is completed.

It is announced that more than half a dozen stations in various American States have ordered facsimile transmitting equipment, and the Federal Communications Commission is issuing licences provided that the station undertakes to place at least fifty receivers in home service. When the services begin in the Spring or early Summer, most of the stations will transmit between midnight and dawn so that the newspaper will be completed before breakfast.

The method of transmission briefly is, that the text having been placed on the transmitting cylinder, it is horizontally scanned by a beam of light as the cylinder slowly revolves. The light is reflected and focused on a photo-electric cell which transforms the varying intensity of light into electrical impulses.

In the receiver rolls of white paper, 8½ inches wide, and ordinary carbon paper are fed past a metal cylinder, which is synchronised with the transmitter. On the cylinder is a single spiral of wire which projects only a fraction of an inch above the surface. The fluctuations in the intensity of the incoming signals press the paper and carbon together against the spiral, thereby making marks corresponding to the light and shade of the original text.

The facsimile signals can be heard on an ordinary receiver as high-pitched tones of varying intensity.



RADIO NEWSPAPERS. The R.C.A. facsimile receiver which is no larger than a radio-gramophone.

NEW TRANSATLANTIC AIR SERVICE

Running Commentary on Initial Flight

AMERICA is soon to inaugurate the transatlantic air service with Pan American Airways' Yankee Clipper No. 17. Installation of wireless equipment which will keep the 'plane in touch with the networks of Columbia Broadcasting System during its initial trip across the Atlantic has been completed by Mr. Clyde Houldson, short-wave field technician of WABC.

The equipment was built to the specifications of the C.B.S. engineering department, and Mr. Houldson, as well as operating it, will act as announcer.

The 100-watt transmitter has been assigned the call letters WCBN, and has been licensed by the Federal Communications Commission to use eight special frequencies within the 1,600-kc/s to 23-megacycle range. It has been installed in the lower compartment of the 'plane's nose and will be remotely controlled from the radio room on the upper deck. It is amusing to record that by an agreement between C.B.S. and Pan American the weight of the equipment, "plus Mr. Houldson," must not exceed 1,000 lb.

BRITISH TRANSMITTER FOR SIAM

THE Siamese Administration, which has for some time been planning an important extension of its broadcasting system, has placed the order for its new 100-kW national broadcasting station, to be erected at Bangkok, with Standard Telephones and Cables, of London. The Administration has thus followed the lead given by the B.B.C., whose two most recent stations, Stagshaw and Aberdeen, and those under construction at Start Point and Clevedon, are "Standard" equipments.

The order, which will amount to approximately £60,000, includes studio equipment and a "Standard-Blaw-Knox" vertical mast anti-fading aerial, and is the first of this type to be used. It has an extending top-mast which varies the constants of the radiating system.

STANDARD FREQUENCY BROADCASTS

A Tuning Note for Musicians

THE bane of musicians is the matching of instruments of various makes. This difficulty has frequently arisen with international exchange programmes when the two orchestras taking part are tuned with slightly different frequencies. The German broadcasting authorities have now introduced an excellent scheme to overcome this.

Each morning from 10 G.M.T. will be broadcast from Deutschlandsender a fourteen-minute standard frequency transmission. A tuning note, the international 440-cycle *a'*, will be broadcast during part of the transmission. The remainder of the time will be occupied by the transmission of a 1,000-c/s note, which will also be generated at the Electrical and Physical Institute of Berlin, with an accuracy of 10^{-8}.

THOSE "MYSTERY" STATIONS

AT this time of the year the B.B.C. receives a crop of reports that the long-wave National suffers from fading, and 1939 is no exception. Cornwall and Devon are the worst sufferers, but complaints also come from the Newcastle district. Fortunately, the trouble is seasonal.

An epidemic of "mystery" transmitters is also reported. These unknown stations are said to be deliberately jamming either the local station or Droitwich. Fading is considered to be the probable explanation. When signal strength is lost, distant transmitters on adjacent wavelengths make themselves heard, and the non-technical listener concludes that some malign influence is at work.

SELFRIDGE'S TELEVISION EXHIBITION

Programmes from Model Studio

"TELEVISION is going to be the salvation of radio—in five years' time," said Mr. Gordon Selfridge, jnr., after a recent visit to Alexandra Palace. On Monday he presided at the opening by Mr. Jack Hulbert at Selfridge's Oxford Street Store, of what is the largest television exhibition to be held in a department store.

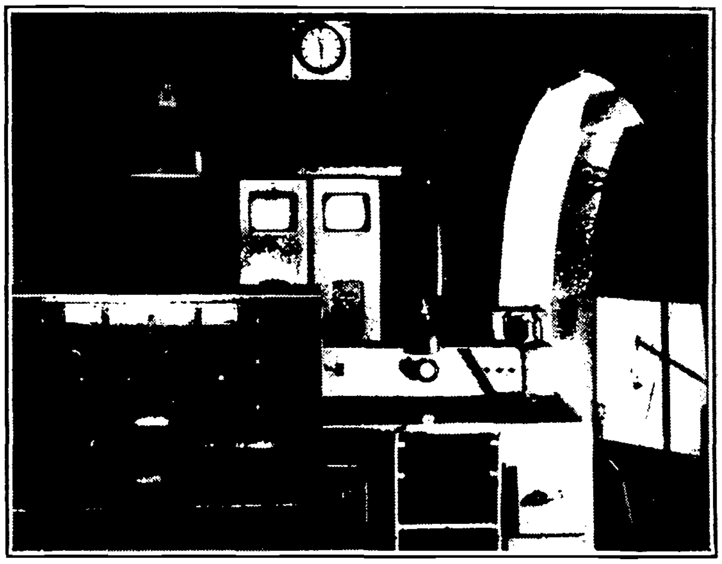
This exhibition, which has been arranged by H.M.V. with the co-operation of the B.B.C. and E.M.I., and includes a large television studio and a complete Marconi-E.M.I. transmitter, will remain open for seven weeks.

Every available make of televisor will be linked to the transmitter from which they will be fed with the normal B.B.C. programmes as well as those emanating from the model studio. In this way, a continuous programme will be available from 10.30 a.m. until 7 p.m.

The thirty-eight receivers in the exhibition hall have been arranged in separate low three-sided booths from which visitors can also see the actual performance in the glass-fronted studio. A further 15 televisors are scattered throughout the store.

TELEVISION BANS LIFTED

TWO television bans have been lifted by the announcement that the B.B.C. is to televise the Boon-Danahar fight for the British Lightweight championship at Harringay on February 23rd. The B.B.C. is not paying for the right to transmit the fight because it has agreed to the promoter arranging for the Gaumont-British Picture Corporation to project the transmission on the Baird large-



STUDIO B CONTROL GALLERY at Alexandra Palace. On the left is the vision mixing desk for combining the outputs of three cameras and the telecine channel. The producer's desk, with microphone for passing instructions to the cameramen, is on the right with the monitor receivers in the background. Through the window on the right can be seen the microphone boom in the studio.

News of the Week—

screen systems at the Tatler Theatre and Marble Arch Pavilion to their paying audiences.

Previously the B.B.C. has not allowed the projection of its transmissions to paying audiences at cinemas and boxing promoters have so far banned the televising of big fights.

B.B.C. STAFF ON LISTENER RESEARCH

THE B.B.C. Listener Research Section is calling upon their colleagues of the general staff to help in a questionnaire based on the Sunday morning programme, "This Symphony Business." Hitherto only the engineers on the B.B.C. staff have been asked to co-operate in this way in their spare time.

Engineers do a considerable amount of listening at home for test purposes. At times they are asked to report on signal strength, modulation, etc., and to report on the results of aerial adjustments, new microphones and other changes. Many of them are keen "amateurs" in their off-time, and quite a few who have been on duty in the control room all day will admit that, on reaching home, they sit up through the small hours listening on the short waves.

B.B.C. AND THE I.R.A.

BROADCASTING HOUSE, guarded like a fortress during the crisis, is once again on the defensive, following the bomb disturbances in London. Porters and commissionaires have been warned to be doubly vigilant, and a watch is kept for any strangers who might wander in the direction of the control room.

Officials are also asked to see that their guests are escorted to the entrance when interviews are terminated, though this delicate duty is carried out under an engaging mask of politeness.

SALVAGED from the gutted ruins of a house which was recently destroyed by fire at Cinderford, Gloucester, this Marconiphone 577 was found to be in excellent working order apart from a charred speaker cone and misalignment of the IF's.

AMERICA'S FIRST "PRODUCTION-LINE" TELEVISOR

MORE than one hundred of America's first "production-line" television sets, made by Allen B. Dumont Laboratories, Inc., have already been distributed in the New York metropolitan area in readiness for the opening of the New York television service in a few weeks time. The receiver, which incorporates a 14-inch diameter electrostatically controlled cathode-ray tube, gives a black-and-white picture measuring 8in. × 10in. Six operating controls are fitted in the front of the cabinet, four of which are for vision adjustments.

DUMONT'S table model, which costs $395, is claimed to be America's first production-line televisor. The console edition, the chassis of which is identical with that of the table model, costs $50 more.

The receiver, which handles either single- or double-sideband modulation, is built on several "decks" for easy assembly and servicing.

FROM ALL QUARTERS

Television Probe

WITH the object of compiling a list of television set owners for the purpose of obtaining information regarding the number of viewers and their location, as well as providing a means for testing programme response, the B.B.C. last Sunday invited viewers to send their names and addresses to the Director of Television. Known viewers received a questionnaire by post.

Inside Aerials

AT the monthly meeting of the Flaxstone Rural Council in York it was decided that all houses coming within their jurisdiction should have properly constructed inside aerials.

R. E. Wireless Signals Reunion

THE sixth reunion dinner of the R.E. Wireless Signals (1914-1919) Association will be held at the Guildhall, Worcester, on Saturday, February 18th. Details may be obtained from the Hon. Sec., Mr. C. R. Johnson, 288, St. Paul's Road, Smethwick, Staffs.

Scandinavian Licences

FOLLOWING an increase of almost 6,000 during December, the Norwegian receiving licence returns on January 1st totalled 364,548, of which some 6,500 were free. In Denmark the total reached 762,213 (including 57,759 free licences), which is an increase of approximately 52,000 during the year. The broadcasting density of Denmark has thus risen to 20.6 licences per 100 inhabitants, so that Denmark should retain her world position of second in this respect.

Philips' Factory Extension

PLANS to double the size of the Philips factory at Blackburn and to transfer some of the important manufacturing processes from other factories were announced last Thursday by Mr. J. Visman, managing director of Philips Blackburn Works, Ltd., during an official visit of the Mayor of Blackburn to the factory.

Sunday Stunts

BY means of a short-wave portable wireless transmitter Miss Jasmine Bligh, B.B.C. television announcer, will speak to viewers from an autogiro during the O.B. from Hanworth Aerodrome on Sunday, February 19th.

Mass Listening in Tripoli

LOUD speakers have been erected in the streets and bazaars of Tripoli so that the local Arab population shall hear the Italian Arabic programmes.

Norway's New Stations Testing

THE new R.C.A. 100-kW transmitter at Vigra has commenced testing on 476 metres (629 kc/s). This wavelength has so far been used by the 20-kW Trondheim transmitter, which is now moving to 360 metres (832 kc/s). Tests commenced on February 12th from the new 5-kW short-wave transmitter at Jeloy. This station will be equipped with an aerial directional on the U.S.A., and although designed chiefly for commercial use, it will also be used for broadcasting purposes.

Electrical Interference

THE Town Council of Zara, the small Italian town on the Adriatic coast, has allocated a sum of money to be spent each month to combat and reduce electrical interference in the district.

Inventions Exhibition

THE annual Inventions Exhibition organised by the Institute of Patentees, which is being held in the Royal Horticultural Hall, Vincent Square, London, S.W.1, opened yesterday, February 15th, and will remain open until February 25th.

Milan's New Studios

E.I.A.R. have started a competition, which is open to all members of the Fascist party, for the design of new studios to be erected in Milan. The total cost of the new building is not to exceed more than eight million lire (approx. £90,000), and the first prize will be fifty thousand lire.

TELEVISION PROGRAMMES

Sound 41.5 Mc/s Vision 45 Mc/s

An hour's special film transmission intended for demonstration purposes will be given from 11 a.m. till 12 noon each weekday. The National or Regional programme will be radiated on 41.5 Mc/s from approximately 7.45 to 9 p.m. every day.

THURSDAY, FEBRUARY 16th.

3, Alfredo and his Orchestra. **3.25,** Gaumont-British News. **3.35,** 217th edition of Picture Page.

9, "A Tune to Take Away" (2nd edition), a revue. **9.30,** British Movietonews. **9.40,** 218th edition of Picture Page. **10.15,** News.

FRIDAY, FEBRUARY 17th.

3, "Grandfather's Follies." Cabaret from Grosvenor House. **3.35,** Schoolboy Howlers. **3.40,** British Movietonews. **3.50,** Music Makers, Eunice Gardiner (pianoforte).

9, News Map No. 11—Italy. **9.20,** Gaumont-British News. **9.30,** Jack Melford in the comedy "Youth at the Helm." **10.40,** News.

SATURDAY, FEBRUARY 18th.

3, The Jacquard Puppets. **3.10,** Gaumont-British News. **3.20,** "Fat King Melon," a children's play by A. P. Herbert.

9, Eastern Cabaret. **9.50,** British Movietonews. **10,** A Jumble Bee—Newspaper Columnists v. Their Victims. **10.30,** News.

SUNDAY, FEBRUARY 19th.

3, "Autogiros," O.B. from the London Air Park, Hanworth. **3.20,** Cartoon Film. **3.40,** Sports Film, "Pinehurst."

8.50, News. **9.5,** Talk: Low, the cartoonist, on Col. Blimp. **9.15,** Cartoon Film. **9.20,** The Vic-Wells Ballet Company in "Checkmate."

MONDAY, FEBRUARY 20th.

3-4.10, "Youth at the Helm" (as on Friday at 9.30 p.m.).

9, "The Infinite Shoe-Black," a dramatic interpretation of a Carlyleian philosophy. **10.30,** News.

TUESDAY, FEBRUARY 21st.

3, Corliss and Palmer, American duettists in "Intimate Cabaret." **3.20,** Gaumont-British News. **3.30,** "Fantastic Garden" (2nd edition), a programme of song, dance and orchestral music.

9, "Coliseum Night," first of monthly series of O.Bs. from the London Coliseum. **10,** British Movietonews. **10.10,** Friends from the Zoo. **10.25,** News.

WEDNESDAY, FEBRUARY 22nd.

3, Foundations of Cookery, No. 3, Marcel Boulestin. **3.15,** Cartoon Film. **3.20,** "Checkmate" (as on Sunday at 9.20 p.m.).

9, "Ladies in Waiting," an all-women detective play by Cyril Campion. **10.40,** News.

Simplified Variable Selectivity

By R. E. SPENCER

USE OF "STAGGERED" CIRCUITS

THE problem of varying the selectivity of a receiver, especially by methods involving variation of the response curve of the intermediate-frequency section of a superhet receiver, is one which has called forth a great variety of solutions, all more or less satisfactory. These solutions can be divided, broadly speaking, into two categories; those in which the shape of a band-pass curve is modified by variation of coupling, and those in which the detuning of the circuits in opposite directions provides the major control.

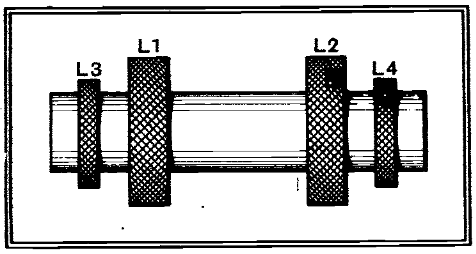


Fig. 1.—Arrangement of coupling transformer providing variable selectivity by means of staggered tuning.

The methods which may be included in the former class involve the control of an actual coupling reactance or of the mutual coupling between the two inductances. Any variation but that of "mutual" alone inevitably varies the effective tuning frequency of the circuits, and necessitates a further subsidiary control, albeit automatically connected, to maintain the mid-point of the new resonance curve at its old position. The same disadvantage, though to a lesser extent, is also inherent in variation of mutual, since, even if the stray capacity between the coils and the smaller effect of the copper of one coil in the field of the other are eliminated by means of a static screen between the coils, the self-inductance and stray capacities are affected by variation in the proximity of external screens and the static screen.

It is therefore desirable in the case of control by mutual, and essential in all other cases, to provide small additional circuit elements for the correction of the mean frequency. If these balancing elements are to be used to best advantage, ganging of the circuit is necessary not only in the under-coupled condition, but also when the over-coupled condition is being used; and it is in practice extremely difficult to obtain the ideal adjustment of a band-pass circuit in the hypercritical condition.

Because of these difficulties it is interesting to consider the alternative method already mentioned, namely, control by detuning circuits in opposite directions. As is well known, it is clear in mathematical analysis that the effect of detuning the circuits equally in opposite directions is identical, except in gain, with that obtained by over-coupling; and since the greater band-width is normally only required when receiving stations of adequate field strength, the small loss of gain is not a serious consideration.

Short-circuited Auxiliary Windings

It has in the past been suggested that this method can be carried out by using a differential condenser to transfer capacity from one circuit to the other. When, however, it is only necessary to provide a simple two-position band-width control, it is possible to use a method in which the inductances of the primary and secondary coils are altered by the short-circuiting of auxiliary windings, which are placed near to the tuned windings. One such coil would be associated with each winding on the outer ends of the common former, and connected to a switch so as to be opened or closed alternatively. The circuits will inherently be tuned to different frequencies, and the coupling will be below the critical value; adjustment of the circuit will be made so that the coils are tuned to the same frequency when one short-circuit coil is closed. When the switch position is reversed the one coil will tune to a lower and the other to a higher frequency than before, and a band-pass response will be obtained. Preservation of the correct centre frequency is achieved by spacing the shorting coils so that both frequencies are changed by the same amount. The heights of the two peaks will be equal if the two circuits, in the "broad" condition, have the same magnification factors; to enable this to happen without extra damping it is an advantage to connect the transformer in circuit so that the coil which is controlled by the shorting coil in the broad condition is the one which is naturally less damped by its other circuit conditions.

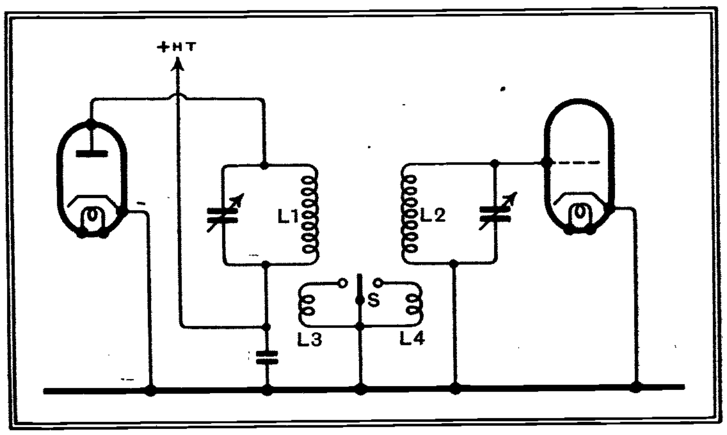


Fig. 2.—How the windings of the transformer of Fig. 1 are connected.

The physical arrangement of a unit of this type is shown in Fig. 1. The functions of the various coils are indicated by the circuit diagram of Fig. 2, while Fig. 3 shows the response of the unit (a) with neither coil shorted, (b) with the switch in the selective position, and (c) in the broad position. In practice, good results are obtained by making L3 and L4 coils of about 80 turns on a former ⅜in. in diameter, while the remainder of the components shown in the circuit diagram are quite orthodox.

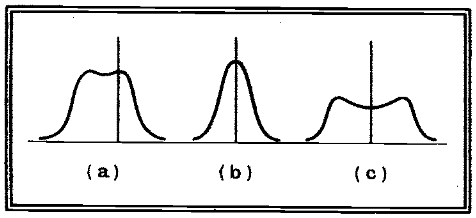


Fig. 3.—Selectivity curves obtained with the shorting switch in various positions.

BOOKS RECEIVED

Processes and Machinery in the Plastics Industry. By Kurt Brandenburger. Pp. 243; 164 illustrations. Sir Isaac Pitman and Sons, Ltd., Parker Street, Kingsway, London, W.C.2; price 25s. Dealing with the moulding of synthetic resins and resinoid compounds; the nature of the materials and processes are fully described.

Trade Marks. By Reginald Haddan. Pp. 128. Sir Isaac Pitman and Sons (address above); price 5s. Written with special reference to the Trade Marks Act of 1938, this book deals with the nature of trade marks, their ownership, registration and protection. Notes on protection abroad are included.

Practical Wireless Service Manual. By F. J. Camm, F.R.S.A. Pp. 288; over 220 illustrations. George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2; price 5s. Dealing with the testing of all types of broadcast wireless receivers and the tracing and remedying of faults in them.

Radio Facsimile. By various authors. Pp. 354, with numerous illustrations. R.C.A. Institutes Technical Press, 75, Varick Street, New York, U.S.A. A collection of papers by R.C.A. engineers relating to the transmission and reception of "still" images. The history and development of "photo-radiogram" services are covered as well as the more recent methods of radio facsimile broadcasting.

UNBIASED

By FREE GRID

Television and the Cinema

I WAS very gratified to hear, in the course of the B.B.C. broadcast debate on good manners the other evening, that somebody had the courage to get up and protest against the increasingly bad behaviour of the modern theatre- and cinema-goer. It was stated, quite rightly in my opinion, that, whereas at one time the theatre-goer was as dignified and decorous in his behaviour as the old-time Victorian concert enthusiast, all this has now vanished.

Most people seem to attend places of entertainment nowadays for no other reason than to indulge in an orgy of eating and conversation. Not so very long ago, when I was attending a concert in the West End of London, the young lady sitting next to me not only insisted upon talking loudly to her companion and noisily masticating chocolates all the time, but finally upset a cup of tea down my shirtfront. She did not offer me one word of apology, but merely made a ribald remark to her companion about "taking the starch out of him," alluding, I presume, to my ruined shirtfront.

In cinemas things are a good deal worse, and even the practice of bringing small portable receivers into the cinema is rapidly growing, the reason being that the person bringing it only wants to see one particular film on the programme, and turns the set on to while away the time when the other films are being shown,

A diverting damsel.

quite regardless of the fact that other people are thereby prevented from following the dialogue.

In view of the foregoing facts, I was very pleased to read in my newspaper the other day that an old idea which I put forward in these columns some years ago is now being hailed in America as a new and revolutionary invention. I am sufficiently devoid of selfish motives to be glad that the idea is being discussed and that there is a possibility of it being put into practice; it does not matter in the least to me who gets the fleeting and tinsel glory of being acclaimed as its originator.

Briefly the idea is that, instead of our being compelled to attend cinemas and to sit through hours of discomfort, the programme should all be televised from a station set up in each district by the cinema industry so that we could see the pictures in the comfort of our own homes. Faradia tells me that the scheme would be foredoomed to failure, since it is only old-fashioned people like myself who go to cinemas for the purpose of seeing the pictures.

Courtesy Cops of the Ether

AS most of you know full well, there has never been anybody more enthusiastic than myself in championing the rights of wireless enthusiasts against the interference of pettifogging officialdom, but at the same time I have always been a staunch upholder of law and order. It was for this latter reason that many years ago when the oscillation nuisance was at its height I refused to join certain marauding bands in my neighbourhood who went round at dead of night and usurped the functions of the law by chopping down the aerial poles of known offenders.

My respect for law and order extends to other spheres of activity apart from wireless, and I was, therefore, exceedingly astonished to find myself ignominiously gonged when driving well within the speed limit through a residential area near London the other evening. With some show of impatience and indignation I drew into the kerb and waited for the police car to come up to me, and I was very surprised when there descended upon me two very unofficial looking individuals holding what looked like a portable wireless set.

With a polite smile they presented me with a printed pamphlet and explained that they were the courtesy cops of the ether and had stopped me because they had discovered from the portable ultra-short-wave receiver they were carrying that I was causing severe interference on the television wavelength, and as this was a district in which there were a large number of television viewers, I was marring their enjoyment of the programme. The television viewers in the vicinity, they told me, had formed themselves into a band of courtesy cops and parties of them were employed every night in stopping drivers whose cars were causing interference to television. Some were stationed at cross-roads detecting and stopping cars, and others were engaged in mobile work, as they were.

I at once protested against this unwarrantable taking of the law into their own hands and interfering with the liberty of the subject, and at the same time I protested also against their stopping me for, as I explained to them, my car ignition system was fitted with a very complete suppression installation, and I flung open the bonnet to illustrate my remarks. For a moment I was struck dumb with surprise because there was no sign of any suppressors at all, but closer inspection of the engine caused me to realise the true state of affairs, namely, that through some act of forgetfulness I must have driven off in the wrong car at the conclusion of the annual dinner of the local

The police were suspicious.

radio society which I had just been attending.

The two self-constituted sleuths received my explanations with some suspicion, and before I knew what had happened they had stopped a genuine police car and reported that they believed that I was in unlawful possession of the car, and not unnaturally the police *were* somewhat suspicious and we all had to adjourn to the police station. By the time their enquiries were completed another day had dawned, and when I finally did arrive home I ran into yet more police, as Mrs. Free Grid, after waiting up for me until 4 a.m. had dialled 999.

A Feline Fallacy

I HAVE had several letters from readers as the result of my investigations which revealed that stroking of cats was causing interference to television, due to the well-known fact that when cats' fur is rubbed with some other substance static charges are generated. Many readers claim that widespread interference must, therefore, be caused by the well-known habits which cats have of licking and scratching themselves. This theory is quite untenable, however, since my informants obviously forget that it is impossible to generate electrical charges of any magnitude by rubbing cat with cat. The substances must be dissimilar.

Output Stage and Loud Speaker

VALVE DAMPING, NEGATIVE FEEDBACK AND TRANSFORMER DESIGN

Concluded from page 136 of last issue

THE damping on the voice coil of the loud speaker, due to the low plate resistance of the valve is one of the most important properties of a valve driving a loud speaker. Triode power valves working under normal conditions have a load resistance of between two and eight times that of the plate resistance of the valve (Appendix I), and consequently the valve exerts very considerable damping. The term "damping factor" is suggested as being numerically equal to the ratio of load resistance to valve plate resistance, and is an indication of the degree of damping due to the plate resistance of the valve. The damping factor is calculated under static conditions, but it will be seen that in the case of the bass resonant frequency of a loud speaker the effective damping will be increased by the ratio of the impedance at bass resonant frequency to the impedance at 400 c/s. In the case of a typical triode valve and a loud speaker whose impedance at the bass resonant frequency is six times that at 400 c/s the damping factor may be as high as 18. Under conditions such as these the damping of even a poor loud speaker is sufficiently good to improve its response in an astonishing way. This damping does not occur to any appreciable extent in the case of tetrodes or pentodes unless negative feedback be employed. The damping with pentodes or tetrodes is not uniform over the cycle, but varies enormously as shown in Figs. 5 (a) and 5 (b) ($\beta = 0$). It will be seen that in the case of the pentode the plate resistance varies between 3,600 and 160,000 ohms, a ratio of 44.5 to 1, over the cycle. With a positive peak of signal voltage on the grid the damping is heavy, while at other portions of the cycle the damping becomes much less, particularly at the higher negative grid voltages.

IN the first part of this article the author dealt with sources of distortion arising in the valve as a result of errors in loading. He concludes with a discussion of negative feedback, output transformer design and distortion due to combination tones. The article is based on a paper read before the World Radio Convention organised in Sydney by the Australian Institute of Radio Engineers.

It is interesting to note that the damping effect of a valve on a loud speaker load is indicated by the area enclosed under the curve of constant grid voltage, and of plate voltage limits equal to the limits of plate voltage swing, as shown in Fig. 6. With a fixed plate voltage swing the area under the curve of a pentode valve, Fig. 6 (a), is strikingly less than that corresponding to a triode valve, Fig. 6 (b).

Negative feedback is effectively degeneration, resulting in a decrease of harmonic distortion and, in certain cases, also an increase in the damping factor caused by a decrease in the plate resistance of the valve. There are many methods of obtaining negative feedback, and space cannot be occupied in enumerating them all. A very interesting arrangement, which has been found very satisfactory with resistance coupling, is shown in Fig. 4. This has been called the "series feedback circuit," but the word "series" needs some slight explanation. The negative feedback is obtained from a voltage divider across the output load, and this is fed in series with the plate load resistor to the plate of the preceding valve. The feedback factor is not equal to the ratio of voltage divider across the load, since there is a shunting effect due to the plate resistance of the previous valve, and the grid resistor of the power valve in parallel. This latter factor is, however, constant under normal working conditions, and the feedback factor may readily be adjusted by a variation in the voltage divider. This method functions through a nodal point being developed in the plate resistor, the opposite ends of which vary in voltage approximately 180 degrees out of phase. The nodal point is not constant but shifts, due to distortion in the circuit. Due to the nodal point on the load resistor, the AC load presented to the preceding valve is less, and the gain and maximum voltage output from the stage are thereby reduced. It is essential to employ a valve having high-plate resistance in the earlier stage in order to avoid excessive shunting, and a resistance-coupled pentode is generally employed, since it also provides sufficiently high gain and sufficiently high voltage to permit the application of negative feedback, and still to be able to excite the output stage with a low percentage of distortion.

By F. LANGFORD SMITH, B.Sc., B.E., M.Inst.R.E. (Aust.), A.M.I.E.E., A.M.I.E. (Aust.)

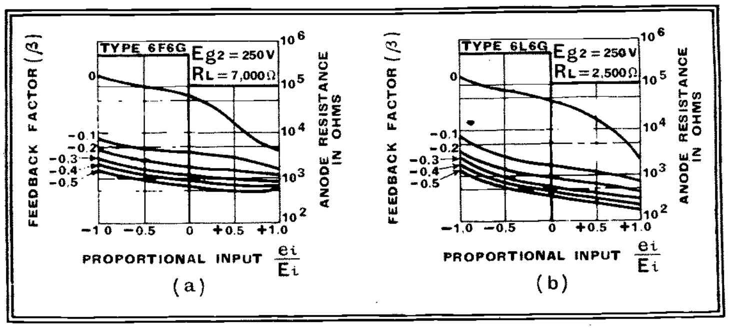


Fig. 5.—Cyclical variation of valve resistance for different degrees of negative feedback (a) in a pentode, (b) in a tetrode.

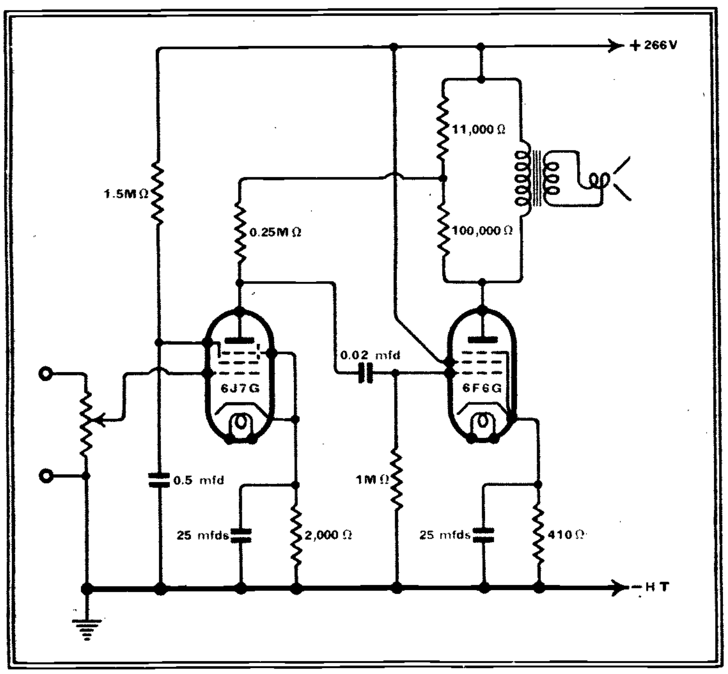


Fig. 4.—Series feedback circuit suitable for use with resistance coupling.

Current Feedback

The method previously described, and, indeed, all methods of "voltage feedback," result in a reduction of the plate resistance of the valve. It is possible, however, by means of "current feedback"

Output Stage and Loud Speaker—

to obtain negative feedback which provides a reduction of harmonic distortion, but results in an increase of the plate resistance of the valve. This is the case, for example, in the well-known arrangement with self-bias with the cathode bias resistor not by-passed. With such a circuit the damping from the plate resistance of the valve is very slight, and this method is therefore less satisfactory in response to transients.

Feedback Calculations

It is readily possible to calculate the degree of feedback to give any required degree of damping. The output resistance, R_o, of a valve under these conditions is—

$$R_o = \frac{1}{1/R_a - \beta g}$$

where R_a = plate resistance of valve, g = mutual conductance, β = fraction of output voltage feedback.

Hence β may be adjusted to give any required value of R_o. In this expression R_o may be regarded as a differential coefficient, and may be substituted for R_a in calculations where feedback is used. For full-grid excitation it is necessary to calculate the value of R_o at several points along the load line and to plot a curve as has been done in Figs. 5 (a) and 5 (b) for values of β from 0 to -0.5. It will be seen from these curves, first, that there is a large decrease in the plate resistance due to feedback, and, secondly, that the variation of plate resistance along the load line is reduced. In other words, the damping on the loud speaker is both heavier and more constant, due to feedback. It is evident that by the use of sufficient feedback the plate resistance of a pentode or tetrode may be reduced to any degree required, although a considerable variation over the cycle is inevitable. This variation may not be any greater than that occurring with a triode valve, and does not appear to be serious for values of β of the order of -0.2.

Any phase shift in the feedback network will result in an increased effective plate resistance, while a similar effect is obtained when the load is partially reactive.

In early work on negative feedback it was accepted that the amplitude of each harmonic component was reduced in proportion to the gain reduction factor. Later research [see Bibliography 7 (2), 7 (3), 7 (4), 7 (8)] has indicated that such simple treatment is subject to modification due to cross modulation in the amplifier. The errors in the simple treatment appear to be comparatively slight for practical cases where the distortion without feedback is not excessive, and in many cases the simple treatment may be considered sufficiently accurate.

The gain reduction factor of a negative feedback amplifier is—

$$1 - \beta A$$

where A = the amplification of the amplifier without feedback,

and β = the fraction of the output voltage which is fed back to the input, being negative for negative feedback.

This factor, therefore, also denotes the approximate reduction of harmonics with a resistive load due to feedback.

The application of a fixed negative feedback factor to an amplifier introducing frequency distortion is to improve the frequency response. With "voltage feedback" the effect of the feedback with a load of varying impedance is to improve the constancy of the voltage across the load. With voltage feedback of constant feedback factor on a loud speaker load the degeneration increases as the impedance increases at the bass resonant frequency, and at the higher audio frequencies, thereby reducing the rise of output voltage which would otherwise occur at these frequencies. For this reason it is unnecessary to fit any resistance-capacity filter across the load. An obvious consequence is that no tone compensation occurs, as with a pentode valve, towards the extreme limits of frequency range, and the response approaches that of a triode valve. A further consequence is that a small condenser placed across the load is not effective for attenuating the higher frequencies. With "current feedback" under similar conditions the effect is to approach more closely the constant current in the load.

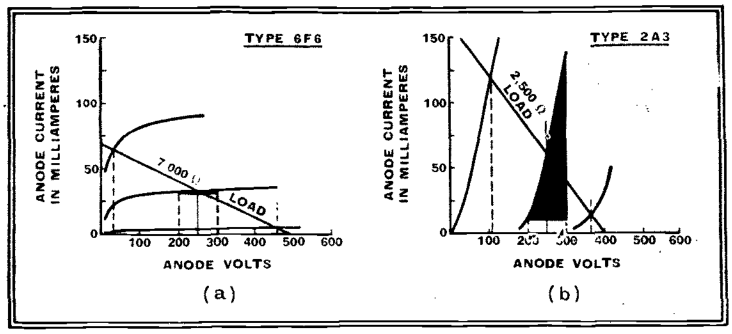


Fig. 6.—The damping effect on the loud speaker represented by the shaded area (a) for a pentode compared (b) with a triode.

A further possible effect of negative feedback is in the reduction of phase distortion in the portion of the amplifier covered by the feedback. The phase distortion, due to the valve in a single stage of power amplification, is negligible, but that due to the output transformer may be considerable. For this reason feedback is sometimes taken from the voice-coil circuit of the loud speaker, so as to correct distortion in the transformer as well as in the valve.

Use is sometimes made of a feedback ratio which is a function of frequency in order to give tone compensation [see Bibliography 7 (3), 7 (5)]. It is evident that a reduction of feedback factor at any frequency will boost the relative amplification at that frequency. In this way bass boosting may be obtained by a reduction of the feedback factor at bass frequencies. Similarly an uplift in the response at higher audio frequencies may be obtained by a reduction of the feedback factor at these frequencies. There is, however, danger of introducing objectionable harmonics by using a feedback network in which β is small at low frequencies. In the case where the reduction of β is in the higher frequency band the harmonics introduced are largely beyond the audible limit, and may not be serious. There is a further objection to the use of a feedback network for frequency compensation, since such a network must inevitably introduce phase shift, and it is possible for this to cause instability.

Various special forms of compensation or of attenuation [see Bibliography 7 (5)] may be obtained by careful design.

Transformer Design

Most treatments of transformer design assume that the loud speaker has a constant resistance equal to the equivalent impedance of the loud speaker at 400 c/s. As has been shown earlier in the paper, the loud speaker impedance characteristic has a minimum about 400 c/s, rising to a peak at a certain low frequency, usually about 80 c/s, and rising again at higher frequencies. For the purpose of calculation it is suggested that in cases where the individual characteristics of the loud speaker are unknown, an impedance of six times the impedance at 400 c/s should be used as the basis of design for the extremely low and extremely high frequencies.

In the case of a loud speaker with a bass resonance at 80 c/s and whose response is required to be as uniform as possible up to 8,000 c/s, it is necessary to consider the design of the loud speaker transformer at three different frequencies. The inductance of the transformer should be designed to give satisfactory results at the low-frequency resonance of the loud speaker, in this case 80 c/s. In the case of a triode valve it is desirable to maintain transformer linearity down to the resonant frequency, and, therefore, it will be necessary in the assumed case to design for negligible drop in output at 80 c/s with a secondary load of six times that at 400 c/s. This will mean that the inductance of the transformer should, in the assumed case, be six times that given by the more usual calculations. Of course, in the case of loud speakers having improved damping, the rise of impedance at the bass resonant frequency will be less, and the inductance of the transformer may be correspondingly less. Reasons of economy generally result in the inductance being below this ideal value, and in the case of triode valves this may be done with a slight loss in bass response, although accompanied by an increase in harmonic distortion due to elliptical loading. The power transfer efficiency from a triode valve to a loud speaker is less at the bass resonance due to the high load resistance, but this is

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more than compensated by the improved loud speaker efficiency at the resonant frequency.

In the case of pentode valves, the position at the low-frequency resonance is quite different, since the efficiency of transfer from valve to loud speaker is much greater due to the higher impedance of the loud speaker. For this reason a loud speaker, having a pronounced impedance peak at the low-frequency resonance point, used in conjunction with a wide range transformer, will generally give an acoustic output far too prominent at the resonant frequency. This may be overcome by the use of a loud speaker having a less prominent resonance, or more generally in the lower-priced loud speakers, by the employment of a transformer having an inductance considerably lower than the ideal. By this means the loud speaker impedance is effectively shunted by means of the reactance of the transformer, giving an elliptical load with a maximum impedance considerably less than that of the loud speaker with a perfect transformer. In a number of cases which have been measured, the rise of impedance of the loud speaker at the bass resonant frequency, measured on the primary of the transformer, barely showed any rise whatever. Although the frequency response is maintained level by this device, there is a serious effect on the harmonic distortion due to the elliptical load line entering the region of high distortion during part of the cycle, and in extreme cases even becoming flattened along the lower side due to the valve reaching cut-off. If the valve is operated at a low level this does not have any very serious effect. In midget receivers in which the transformer inductance is necessarily limited and in which the total acoustic output must also be limited for obvious reasons, the method is reasonably satisfactory, but a valve capable of giving an output of about 3 watts under ideal conditions may only be capable of giving about one watt under these conditions of low inductance before distortion becomes distressing.

The ratio of the transformer windings will need to be adjusted in accordance with the usual design formula so as to reflect approximately the correct load at 400 c/s.

Leakage Reactance

The rise of impedance of the loud speaker at the higher audio frequencies tends to cause a very slight rise in the voltage applied to the loud speaker in the case of a triode valve, but a marked accentuation of the high-frequency response in the case of a pentode valve. For this reason, in the case of a triode valve, it is desirable to reduce the leakage reactance of the transformer to the lowest possible level in order to maintain as much of the high-frequency response as is possible. In the case of a pentode valve, this is of less importance, since not only does the efficiency of the transfer increase at the higher frequencies but the effect of the leakage reactance becomes relatively less as the load impedance increases. It will, therefore, be seen that transformers for operating with pentode valves may be constructed with considerable leakage reactance without any serious effect on the reproduction.

A further effect which needs consideration is the variation of the inductance of the transformer with the DC current flowing through it. This is particularly important in the case of Class "B" output stages in which the average DC current varies considerably. In all cases the inductance of the transformer should remain reasonably constant up to the extreme peak current under the worst conditions. If an appreciable change of inductance is permitted, there will undoubtedly be an additional effect on the overall distortion, which, although difficult to calculate, is obvious in its results.

Pentode and tetrode valves with feedback may, for the purposes of transformer design, be treated in a similar manner to triode valves.

Combination Tones

A non-linear device, which is supplied with two or more pure sine-wave tones, is found to produce an output consisting of each of the two input frequencies, together with a number of spurious tones of frequencies equal to the sum or difference of the frequencies of the input tones, or of either or one of its harmonics and the fundamental of the other tone or one of its harmonics. In the presence of a complex wave form input a non-linear device would produce an extremely large number of spurious tones which are not present in the original. If a perfectly linear device is fed with a number of sine-wave frequencies, the output will be exactly similar to the input without the addition of any spurious frequencies. In the case of Class "A" triodes, either singly or in push-pull, each valve being operated under conditions equivalent to 5 per cent. second harmonic distortion when operating singly, the combination tones do not appear to be objectionable. In the case of pentode valves which are operated under conditions of maximum output into a loud speaker load, even though the square root of the sum of the squares of all the harmonic components when the valve is operated into a fixed resistive load is less than about 7 per cent., the output is found to contain extremely prominent combination tones which are largely responsible for what is known as "pentode tone." This pentode tone is produced partly by the higher percentage of odd harmonics, particularly the third and fifth harmonics, together with pronounced combination tones.

Cross modulation also is found to exist in the output of pentode valves [see Bibliography 9 (1)]. Cross modulation may be defined as the effect obtained when a variation in the amplitude of one input signal affects the output amplitude of another signal of different frequency but having constant input. It may be demonstrated by feeding the grid of the valve with two frequencies, one at, say, 110 c/s and the other at, say, 1,000 c/s. If no cross modulation is present a variation in input voltage of either signal will not cause any variation in the output of the other signal. If cross modulation is present a variation in the input voltage of one will cause a variation in the output voltage of the other. This effect is sometimes observed while listening to a violin or similar instrument with an organ accompaniment, the amplitude of the higher frequency sound varying in accordance with the more powerful low-frequency accompaniment.

It has been shown by Terman [see Bibliography 9 (2)] that combination tones exist in conjunction with any order of harmonic distortion, but that cross modulation does not occur when the harmonic distortion is only of the second order. This means that Class "A" triodes operated under normal conditions will not produce audible cross modulation, although there will be combination tones of small amplitude. A pentode valve operated under normal maximum conditions will produce both combination tones and cross modulation, the intensity being dependent upon the degree of distortion. It has been shown [see Bibliography 9 (3)] that the amplitudes of the combination tones are higher when the distortion is due to higher order odd harmonics, assuming constant harmonic percentage in all cases.

As indicated in the introduction, a limit of 2.5 per cent. for the third harmonic and of 0.5 per cent. for fifth harmonic distortion results in an output quality which has not, so far as the writer is aware, been criticised by the most musical ear. The fact indicates that not only the harmonic distortion itself but the indirect effects in the nature of combination tones and cross modulation are not objectionable when the harmonic distortion is maintained within these arbitrary limits.

Criteria of Performance

The importance of the higher order harmonics, which is not in proportion to their amplitudes, indicates that the conventional method of indicating the *total harmonic distortion* as the square root of the sum of the squares of the individual amplitudes is not in accordance with the effect on the listener. The writer hopes that this method of specifying distortion will be dropped in favour of a more satisfactory method. An interesting method of "weighting" the various harmonics has been adopted by the R.M.A. [see Bibliography 10 (4)], each harmonic being "weighted" by a factor proportional to the order of the harmonic. The resultant gives a distortion factor which is much closer to the true audible effect than the older method mentioned above. In the opinion of the writer, however, even the amount of "weighting" given in this formula is not equivalent to the objectionableness of the distortion, and still heavier "weighting" of the higher order harmonics is desirable. Considerable experimental work needs to be done before a new formula could be adopted, but the hope is expressed that

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the matter will be considered more fully.

An important factor in a power stage is that it is desirable to have a smooth and gradual increase in distortion beyond the point of full load, so that slight overload is not acutely distressing. Triode valves in Class "A" resistance-capacity coupled operation are particularly prone to distort badly as soon as the grid current point is reached. Grid-stopping resistors are helpful in reducing the trouble, but only to a partial extent.

Advantages of Pentodes

Pentode valves in Class "A" operation have a particularly smooth overload characteristic, and this is a strong reason for their popularity in spite of their heavy distortion at full load. Pentode valves with reduced excitation have particularly low harmonic distortion, since the greater part of the distortion, consisting of third and higher order odd harmonics, falls off very rapidly as the signal is decreased.

Tetrode valves are somewhat different from pentodes in that the distortion is largely of the second order, and decreases almost linearly with the signal. The higher order harmonic distortion increases rapidly as full load is approached, and so provides a smooth overload characteristic, although not so effective as that of a pentode.

Both tetrodes and pentodes exhibit a flattened wave form in the region of low-plate voltage swing, and by the shape of their characteristics are prevented from running into heavy grid current distortion.

With negative feedback, tetrodes show to advantage in having very low higher-order distortion at slightly reduced excitation. Pentodes require a higher feedback factor than tetrodes for an equivalent level of odd harmonics. The smooth overload characteristics of both pentodes and tetrodes is not so good when feedback is used, since the characteristics approach towards those of triodes, but there appears in this respect to be an advantage in tetrodes with feedback as compared with triodes.

Hum from poor filtering in the HT supply is not so pronounced with pentodes or tetrodes as with triodes, due to the high plate resistance of these types. When their plate resistance is reduced by means of feedback, the hum increases, as would be expected, and improved filtering becomes necessary.

Both tetrodes and pentodes have considerably higher plate circuit power efficiency than Class "A" triodes, and therefore give a higher power output for the same HT supply current. Tetrodes have a better efficiency than pentodes, and are, therefore, particularly desirable for higher power. This high efficiency is retained when feedback is employed.

The sensitivity factor of a pentode or tetrode valve with sufficient feedback to reduce the plate resistance to that of a triode is approximately the same as that of the triode, provided that the mutual conductances are identical.

The writer is grateful to Amalgamated Wireless Valve Co. Pty., Ltd., for permission to present this paper.

BIBLIOGRAPHY

1. Valves on Resistive Load.

(1) J. C. Warner and A. V. Loughren: "The Output Characteristics of Amplifier Tubes," *Proc. I.R.E.*, Vol. 14, p. 735, December, 1926.

(2) W. J. Brown, *Proc. Phys. Soc. of London*, Vol. 36, Part 3, p. 218, April 15, 1924.

(3) F. E. Terman: "Radio Engineering" (Second Edition), p. 276 et seq. (McGraw-Hill).

(4) W. G. Dow: "Fundamentals of Engineering Electronics," p. 263 et seq. (John Wiley and Sons, 1937).

(5) E. W. Kellogg: "Design of Non-distorting Power Amplifiers," *Trans. A.I.E.E.*, Vol. 44, p. 302, 1925.

(6) G. S. C. Lucas: "Distortion in valve characteristics," *Wireless Engineer*, Vol. 8, p. 595, November, 1931.

(7) F. E. Terman, "Radio Engineering" (Second Edition, 1937), p. 264 et seq. (McGraw-Hill).

(8) O. H. Schade: "Beam Power Tubes," *Proc. I.R.E.*, Vol. 26, No. 2, February, 1938.

2. Push-Pull Triods Valves on Resistive Load.

(1) B. J. Thompson: "Graphical determination of performance of Push-Pull Audio Amplifiers," *Proc. I.R.E.*, Vol. 21, p. 591, April, 1933.

(2) L. E. Barton: *Proc. I.R.E.*, Vol. 19, No. 7, p. 1131, July, 1931.

(3) J. R. Nelson: "Calculation of Output and Distortion in Symmetrical Output Systems," *Proc. I.R.E.*, Vol. 20, p. 1763, November, 1932.

3. Triode Valves on Partially Reactive Loads.

(1) Manfred von Ardenne: "On the Theory of Power Amplification," *Proc. I.R.E.*, Vol. 16, p. 193, February, 1928.

(2) "Valve Diagrams for Loudspeaker Load," *Wireless World*, Vol. 36, p. 324, March 29, 1935; also p. 344, April 5, 1935.

(3) M. G. Scroggie: "The Electrostatic Loudspeaker," *Wireless World*, Vol. 33, p. 248, September 22, 1933; also p. 272, September 29, 1933.

(4) W. G. Dow: "Fundamentals of Engineering Electronics," 1937, p. 272 et seq. (John Wiley and Sons).

(5) Ladner and Stoner: "Short Wave Wireless Communication," 1932, p. 331, et seq. (Chapman and Hall).

4. Loudspeaker Characteristics.

(1) H. M. Clarke: "The Moving Coil Loud Speaker," *Wireless Engineer*, Vol. 6, p. 380, July, 1929.

(2) N. W. McLachlan: "Loud Speakers," 1934 (Clarendon Press).

(3) F. H. Brittain and E. Williams: "Loud Speaker Reproduction of Continuous Spectrum Input," *Wireless Engineer*, Vol. 15, p. 16, January, 1938.

5. Transient Response.

(1) G. Builder: "The Amplification of Transients," *Wireless Engineer*, Vol. 12, p. 246, May, 1935.

(2) C. H. Smith: "Amplification of Transients," *Wireless Engineer*, Vol. 10, p. 296, June, 1933.

(3) N. W. McLachlan: "Transients in Loud Speakers and Amplifiers," *Wireless World*, August 7-14, 1929.

(4) C. W. Oatley: "The Distortionless Amplification of Electrical Transients," *Wireless Engineer*, Vol. 8, pp. 244 and 307, May and June, 1931.

(5) T. S. E. Thomas: "Transients and Telephony," *Wireless Engineer*, Vol. 8, p. 485, September, 1931.

(6) N. W. McLachlan: "The Behaviour of the Output Circuit to Transients," *Wireless Engineer*, Vol. 13, p. 630, December, 1936

6. Phase Distortion.

(1) Balth. van der Pol: "A New Transformation in Alternating Current Theory," *Phil. Mag.*, Vol. 7, No. 43, p. 477, March, 1929; also in *Proc. I.R.E.*, Vol. 18, p. 221, February, 1930.

(2) John C. Steinberg: "Effects of Phase Distortion on Telephone Quality," *Bell System Technical Journal*, Vol. 9, p. 550, 1930.

7. Negative Feedback.

(1) H. S. Black: "Stabilised Feedback Amplifiers," *Bell System Technical Journal*, Vol. 13, p. 1, 1934.

(2) R. W. Sloane: "Distortion in Negative Feedback Amplifiers," *Wireless Engineer*, Vol. 14, p. 250, May, 1937; also J. Frommer, Vol. 14, p. 369, July, 1937; also R. W. Sloane, Vol. 14, p. 607, November, 1937; also J. Frommer, Vol. 15, p. 20, January, 1938.

(3) B. D. H. Tellegen and V. Cohen Henriquez: "Inverse Feedback, Its Application to Receivers and Amplifiers," *Wireless Engineer*, Vol. 14, p. 409, August, 1937.

(4) R. Feldtkeller, Die 3: "Teilschwingung in Verstarken mit Gegenkopplung," *Telegr. und Fernsprechtechn*, Vol. 25, p. 217, 1936.

(5) G. H. Fritzinger: "Frequency Discrimination by Inverse Feedback," *Proc. I.R.E.*, Vol. 26, No. 1, January, 1938.

(6) H. Nyquist: "Regeneration Theory," *Bell System Technical Journal*, Vol. 11, p. 126, July, 1932.

(7) M. Marinesco, *Wireless Engineer*, Vol. 15, p. 22, January, 1938.

(8) L. I. Farren: "Some Properties of Negative Feedback Amplifiers," *Wireless Engineer*, Vol. 15, p. 23, January, 1938.

(9) D. G. Reid: "The Necessary Conditions for Instability of Electrical Circuits," *Wireless Engineer*, Vol. 14, p. 588, November, 1937.

(10) G. S. Brayshaw: "Regeneration in Linear Amplifiers," *Wireless Engineer*, Vol. 14, p. 597, November, 1937.

(11) "Feedback Amplifiers," *Electronics*, Vol. 9, p. 30, July, 1936.

(12) F. E. Terman: "Feedback Amplifier Design," *Electronics*, Vol. 10, p. 12, January, 1937.

(13) J. R. Day and J. B. Russell: "Practical Feedback Amplifiers," *Electronics*, Vol. 10, p. 16, April, 1937.

(14) A. R. Rumble: "Audio Feedback," *Communication and Broadcast Engineering*, Vol. 4, p. 14, April, 1937.

(15) L. Martin: "Characteristics of Inverse Feedback Circuits," *Radio Engineering*, Vol. 17, p. 12, May, 1937.

8. The Design of Loud Speaker Transformers.

F. E. Terman and R. E. Ingebretsen: "Output Transformer Response," *Electronics*, p. 30, January, 1936.

9. Combination Tones and Cross Modulation.

(1) A. C. Bartlett: "Inter-Modulation in Audio Frequency Amplifiers," *Wireless Engineer*, Vol. 12, p. 70, February, 1935.

(2) F. E. Terman: "Radio Engineering" (Second Edition), pp. 264-270 (McGraw-Hill).

(3) "The Relation of Modulation Products with Multi-tone Signal to Harmonic Distortion with Mono-tone Signal in Audio Amplifier Analysis," *Engineering Bulletin* C.E.B.36-5, Ken-Rad Corporation Inc., January 15, 1936.

10. Sundry References.

(1) F. Massa: "Permissible Amplitude Distortion of Speech in an Audio Reproducing System," *Proc. I.R.E.*, Vol. 21, p. 682, May, 1933.

(2) Harvey Fletcher: "Speech and Hearing," 1929 (MacMillan and Co.).

(3) H. A. Thomas: "Effect of Output Load Upon Frequency Distortion in Resistance Amplifiers," *Wireless Engineer*, Vol. 8, p. 11, January, 1931.

(4) *Journal I.E.E.*, Vol. 81, p. 104, 1937.

APPENDIX I.

DAMPING FACTORS OF TYPICAL VALVES UNDER STANDARD OPERATING CONDITIONS.

	Plate Resistance (Ohms.)	Load Resistance (Ohms.)	Damping Factor (R_L/R_o)
Triodes, Class "A"			
Type 45	1,610	3,900	2.42
,, 2A3	800	2,500	3.12
,, 50	1,800	4,350	2.42
,, 845	2,100	16,000	7.61
Pentodes, Class "A"			
Type 42 ... ... } ,, 6F6	80,000	7,000	0.0875
Tetrodes, Class "A"			
Type 6V6G ...	52,000	5,000	0.096
,, 6L6G ...	22,500	2,500	0 111

APPENDIX II.

COMPARISON BETWEEN TRIODES, AND PENTODES AND TETRODES WITH NEGATIVE FEEDBACK.

In the following table comparison is made between two 2A3's in parallel, two 6F6's in parallel and one 6L6, the two latter having negative feedback adjusted so as to give the same damping factor (R_L/R_o) as the triode combination.

Number of valves	2	2	1	
Valve type	2A3	6F6	6L6	
Plate voltage	250	250	250	volts
Screen voltage	—	250	250	volts
Grid bias voltage	−45	−16.5	−14	volts
Cathode current (no signal)	120	81	77	mA.
Cathode current (full signal)	126	85	86.3	mA.
Amplification factor ...	4.2	5.6	4.8	
Mutual conductance ...	10,500	5,000	6,000	μohms.
Plate resistance or R_o ...	400	1,120	800	ohms.
Load resistance (R_L) ...	1,250	3,500	2,500	ohms.
Damping factor (R_L/R_o) ...	3.1	3.1	3.1	
Feedback factor (β) ...	—	−0.175	−0.20	
Gain reduction factor ...	—	2.54	3.62	
Peak grid input volts ...	45	42	50.7	volts
Sensitivity factor	6.9	6.8	5.06	mW/V^2 RMS.
Power output	7	6	6.5	watts
Second harmonic	5	1.4	2.7	%
Third harmonic	1.6	2.4*	0.7*	%
Plate circuit efficiency ...	22.2	28.2	30	%

* On the assumption that no increase is caused by cross modulation.

HENRY FARRAD'S SOLUTION

(See page 152)

NO, it certainly was not! If it had been necessary to replace the items mentioned no doubt the estimate would have been reasonable. But if the HT supply had failed it would not have been possible for Emily Simple to notice that the green light in the tuning indicator was stationary, for there could not have been any green light. Therefore, the dealer was wrong. He probably found a simple open-circuit or even a displaced valve connector on the HF side, for which he could not make a very profitable charge honestly, and intended to charge for fictitious replacements.

Random Radiations

By "DIALLIST"

Battery Sets and A.R.P.

THERE'S not much doubt that the sales of battery sets have been increased considerably during the last six months by Air Raid Precautions. One Government publication on the subject suggests a receiver as part of the "dug-out" or "refuge-room" equipment, and the battery set is indicated since it is independent of possible electric supply blackouts, whether intentional or accidental. But, unfortunately, you can't just keep the ordinary battery set in cold store, so to speak, and just bring it out for use after not having looked at it for months. The trouble is that for 2-volt valves you need a filament accumulator, and accumulators must have periodic attention whether they are used or not. The best solution if you have such a battery set which you want only for emergency use is to arrange with a good charging station to store your accumulators for you and to guarantee to keep them in good condition. Good quality dry HTBs should have a shelf life of at least six months; they can be stored away so long as you choose a place which is both cool and dry.

Dry Filament Batteries

One obvious solution of the problem of the battery set which is intended to be kept as a stand-by and not regularly used is to employ the new valves with low-voltage, low-consumption filaments, and to obtain the LT current from a single dry cell of the right kind. If economical running is required, as no doubt it is, it's no use trying to make these valves up into small, light portable receivers, for in such there simply isn't room for the fairly hefty filament cell that is called for. You used to be able to buy, and I expect you still can do so, large square dry cells of the kind used by some of the railway companies for various purposes. These, I think I am right in saying, have a guaranteed shelf life of a good deal more than six months, and one of them would run a 4-valve receiver for hundreds of hours. Alternatively, it might be no bad idea to use the wet instead of the dry Leclanché cell. The ordinary bell cell wouldn't do, but there is one with a suitable depolariser contained in a large sac instead of in a porous pot.

A New Cell

SOME three years ago, if I remember aright, *The Wireless World* published an exclusive account of something entirely new in primary cells. It was then stated that the cell was still the subject of laboratory research work, and that it was not going into production until those responsible were satisfied with their product. I am told, however, that this cell, the Gordon, is to be available commercially very shortly. I haven't seen it in its final form, but, from what I read of it and heard of it originally, it seemed to have distinct possibilities. Magnesium is the most important of the ingredients used, and the electrolyte is just tap water. In its commercial form it is claimed that the cell will have a constant EMF of 1 volt throughout its service life, so that two in series should be excellent for filament heating, provided, of course, that they can stand up to the load for a reasonable length of time. I am looking forward to hearing more about this cell.

Bus Conductor's Holiday

COMING home late the other evening in a cross-country bus I found myself the only passenger, and the bus conductor began to make conversational openings when he had snipped my ticket and pouched the fare. He was looking forward, he told me, to his holiday, which wasn't so very far away as he had managed to secure one of the earliest turns. When I suggested that the weather was apt to be rather a problem if one took one's spell very early in the year, he assured me that he didn't care if it snowed ink. He got plenty of fresh air whilst doing his job; his holiday would be spent entirely at home tinkering with wireless sets. His hobby was to buy for an old song sets which people had given up as hopeless. These he pulled entirely to pieces, casting out all defective and doubtful parts. Then by combining the best components selected from several cast-off receivers he was able to make himself a first-rate set at the smallest possible cost. He was very proud of the one which he was then using. It was made from the remains of three sets and cost him something under a pound. He had recently purchased a fine batch of discarded receivers and he intended during that precious holiday to make something that would put all previous efforts into the shade. More power to his elbow! I hope that his this year's model will be a winner.

Non-stop Noise

MY sympathies are all with those who complained recently that a neighbour's wireless set was kept going full blast for as much as ten hours a day, to their own great discomfort. The evidence showed that the noise sometimes continued until 1 o'clock in the morning, and one neighbour stated that he had had to change his bedroom to the back of the house to avoid being disturbed. The magistrate inflicted a penalty of £1, *plus* the best part of a fiver in costs, and said that he wished that the Bench had the power to confiscate the receiver. Wireless is a source of so much pleasure to such vast numbers of people that any abuse of it, whereby it is turned into an infliction, is a thing that we should all seek to avoid.

Resonance Effects

Some time ago, when I'd taken a small furnished house for holiday purposes, I had a very unpleasant sample of the maddening kind of nuisance that someone else's loud speaker can cause. The set responsible was located in a house about sixty yards from mine, and it was kept going pretty constantly during the afternoon and far into the night. It suffered from two strongly marked resonance peaks, and whenever the corresponding notes occurred they just went through and through your head. Luckily my neighbours were reasonable. They hadn't the least idea that they were causing any trouble, but on coming to my house and hearing for themselves what their set sounded like there, they realised that I wasn't making a frivolous complaint and took the necessary steps. Some receivers have poisonous resonances which you may not notice very much at close quarters, though at a distance their effects can be devastating.

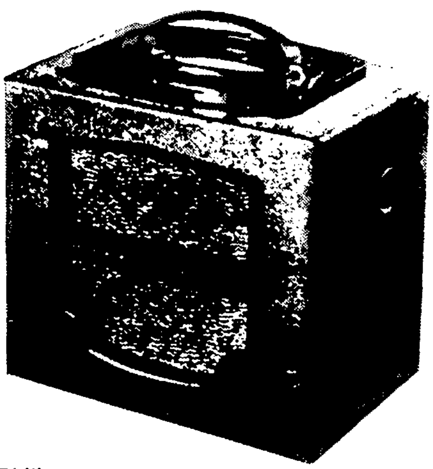
The National Wireless Register

THE response of *The Wireless World's* appeal to its readers to fill in and despatch the National Wireless Register form will, I feel certain, be excellent. I hope that you've sent yours in; but if you haven't, now's the time. Large numbers of people with some knowledge of wireless are sure to be wanted in an emergency (let's hope fervently that there won't be one), and the register will enable the authorities to make the best and quickest use of those who are available. Filling in the form doesn't bind you in any way; it just shows the compilers of the register that you are willing to give what help you can if you're wanted. Within a day or two of sending in the form you'll receive a letter from the Secretary acknowledging its receipt and saying that a further communication will come along presently. Don't imagine, by the way, that it's only skilled morse operators who are wanted. Anyone who can read blue-prints and understands the general theory of wireless can be useful. Send in your qualifications and the Wireless Telegraphy Board will let you know whether there's any niche that you can fill in its scheme.

NEW PHILIPS PORTABLE

BASED on the design of the Type 225B the new Type 228B portable is a four-valve superheterodyne incorporating a frequency changer, IF amplifier, double-diode triode second detector, AVC and first AF amplifier and a pentode output valve.

The new instrument retains all the qualities of range and selectivity associated with its predecessor and a new loud speaker has been fitted to improve the quality of reproduction. Changes have also been made in



Philips Type 228B battery superhet. portable.

the control panel and the metal carrying handle now sinks flush with the top of the moulding.

The average HT consumption is 8 mA and the price, complete with batteries, is 8½ guineas.

Recent Inventions

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section.

AUTOMATIC TUNING CONTROL

IN automatic tuning correction systems the correcting voltage derived from the usual frequency-discriminating circuits is applied to bring the local oscillator into step with the fixed intermediate frequency. Although this, in effect, corrects for any slight degree of initial mistuning, it still leaves the input or preselector circuits slightly out of tune with the incoming signals. This is liable to cause a certain amount of distortion or cross-modulation, and it also tends to reduce the effective selectivity of the RF stages.

According to the invention, a separate indicator is provided in order to allow the listener to make whatever additional adjustment may be necessary to bring the RF circuits dead into tune after the automatic control has done its work. For this purpose a diode D is coupled either immediately before (as shown) or immediately after the mixing valve V, say at the point P. The rectified current is fed to an indicator I, which can then be set to show maximum response by adjusting the tuning knob K, independently of the automatic action of the ATC voltage applied to the correcting circuit X.

Fabrica Italiana Magneti Marelli. Convention date (Italy), January 22nd, 1937. No. 492635.

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BROADCASTING STUDIOS

IN order to regulate the acoustic properties of a studio, and particularly to modify reverberation effects, the walls are lined with a sound-absorbing material made from sheets of brown paper or thin cardboard. Several sheets, pasted or clamped together at the top edges, are separated by thin spacers, and the lower edges are left free.

The action of the layer on the sound waves is compared with that of a low-pass electric filter-circuit consisting of resistance in series and capacity in shunt. The mass, or weight per unit area, of the brown paper corresponds to the resistance, and the space between each sheet represents the capacity. Both can therefore be varied, by calculation, to produce any desired degree of damping on the sound-waves.

A. B. Howe. Application date, June 19th, 1937. No. 497222.

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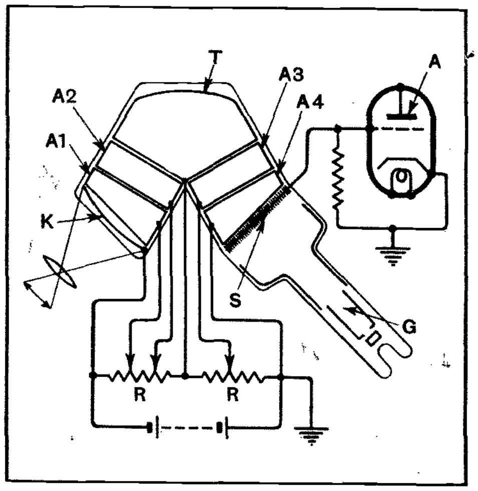
TELEVISION TRANSMITTERS

THE picture to be televised is first projected on to a photo-electric cathode K, and the resultant feeble stream of primary electrons is focused by a series of ring anodes A1, A2, on to a target electrode T, where it is amplified by secondary emission. The reinforced stream then passes through a second series of ring anodes, A3, A4, which focus it on to a screen S of the mosaic-cell type. The image charges set up on this screen are then scanned by a stream of electrons from the gun G of the tube, and the resulting picture-signals are fed to an amplifier A. The graded biasing voltages for the various electrodes are tapped off from a potentiometer R.

In the ordinary way any attempt to focus the stream from a plane cathode on to a plane target would produce distortion, since all the picture points could not be brought to the same focus. This difficulty is removed, according to the invention, by making both the cathode K and target T slightly concave, as shown.

B. M. Crowther. Application date, June 19th, 1937. No. 479406.



Television transmission tube in which the stream of primary electrons is amplified by secondary emission.

o o o o

TELEVISION SYSTEMS

THE picture signals developed in an electron camera are passed directly from the scanning aperture in the anode on to the first of a series of target electrodes arranged in a projecting part of the same tube, where they are subjected to intensive amplification by secondary emission.

According to the invention, the signals are modulated, as they pass through the tube, by applying a carrier-wave frequency directly to one or more of the target electrodes in the electron multiplier. Preferably a periodic blocking potential is also applied to the electron multiplier, in order to cut off the output during the flyback period of scanning.

Baird Television, Ltd., and T. C. Nuttall. Application date, March 30th, 1937. No. 493048.

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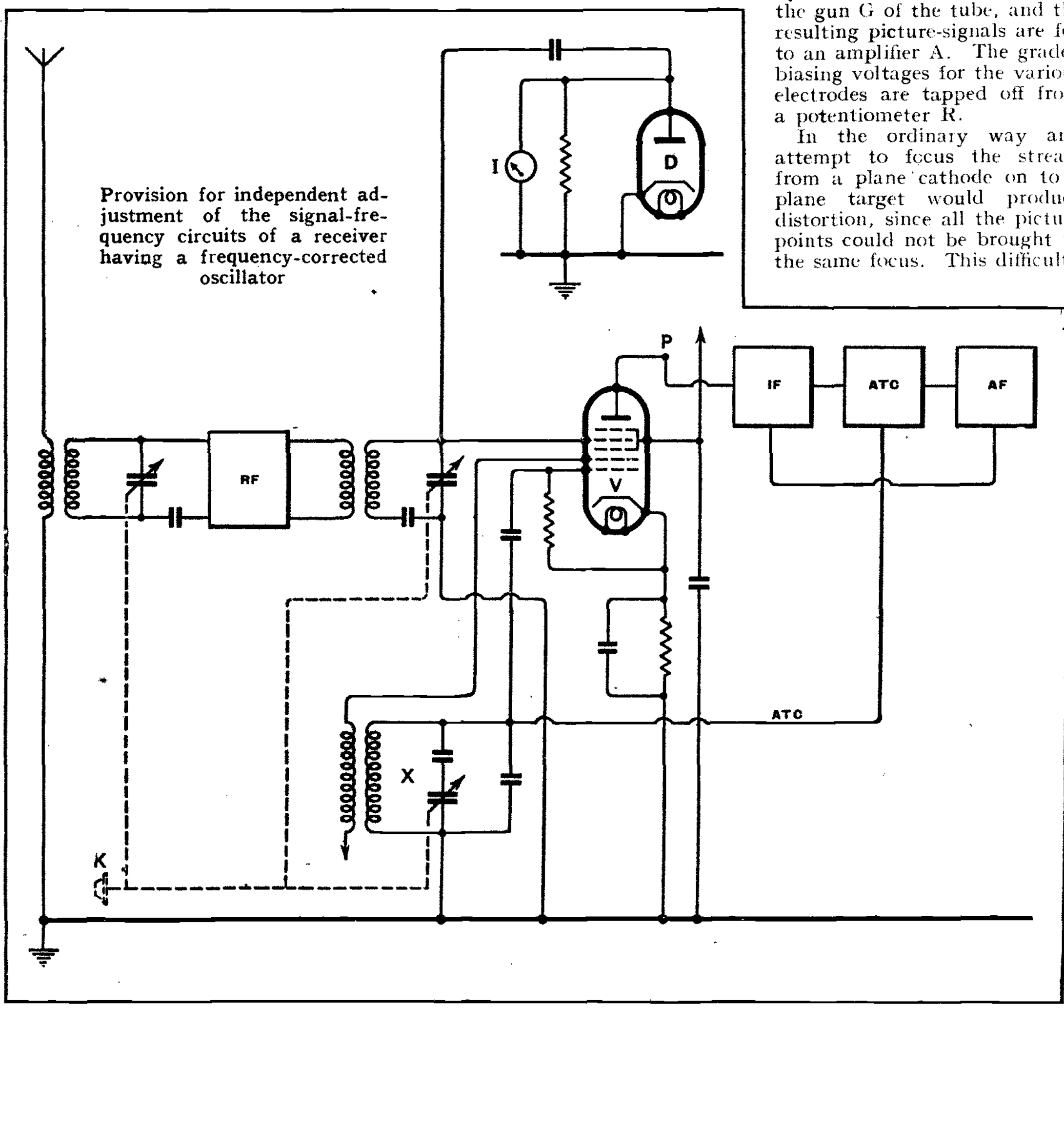
WAVE-BAND SWITCHING

IN an all-wave set the different coils corresponding to each waveband are housed in separate compartments in one or more different drums. The drums are mounted on the shaft of the wave-change switch, and make the appropriate circuit connections as the shaft is rotated.

Each coil is associated with padding and trimming condensers, which can be adjusted by screws from outside the drum. The powdered-iron core of each coil can also be adjusted, as desired, from outside. Each tuning unit can, if necessary, be withdrawn from the drum as a whole, in order to replace a defective part, without interfering with the other tuning units.

(Mrs.) H. Dent and C. E. Osmond. Application date, March 30th, 1937. No. 493102.



Provision for independent adjustment of the signal-frequency circuits of a receiver having a frequency-corrected oscillator

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0-25 v. 0-500 v.

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0-25 v. 0-250 v.
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0-2.5 ma. 0- 25 ma.
0.5 ma. 0-100 ma.
0-500 ma.

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COMMUNICATIONS RECEIVER 12-VALVE (+ Rectifier)
incorporating the SUPER TUNER UNIT (as supplied to the B.B.C.)
Switched Waveranges: 60 Mc/s to 1.7 Mc/s (5 to 190 metres).

Brief Circuit features: 465 kc/s Crystal Filter, Amplifier and Variable A.V.C., Signal Meter, Output Pentode (Pen. B4 rated 8 watts).
"THE WIRELESS WORLD" Test Report, Oct. 27th, 1938, states:—"High Sensitivity maintained down to 5 metres . . . we are confident in recommending it for serious long-distance working . . . volume and quality is excellent . . . where most receivers are comparatively dead the EVRIZONE is full of life." Send for details and copy of complete Test Report. Price **£45**
COMPLETE KIT of parts available to Constructors. Price £30 16 0. Speaker extra.

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With 3 Valves (H.F., Detector, Mixer). Chassis 10in. × 6¼in. × 3in. Price **8 Gns.**

MAGIC MIDGET TRANSPORTABLE—HOME Model
Waveranges: 16-45, 40-90, 200-250, 800-2,000 metres.

Brief Specification: 4 waveband Superhet AC/DC 200-250 volts, 4 valves (plus rectifier), 3 watts Output, 6½in. Mains Energised Speaker, Selectivity approximately 9 kc at 10·1 ratio. In Walnut veneer cabinet, 12½in. × 13in. × 7in., weight 11 lbs.
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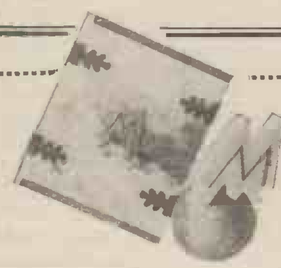

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DEGALLIERS, Ltd.—See our advertisement on Inside Back Cover.

NOTE New Address.—31, Craven Terrace, Lancaster Gate, W.2. Paddington 2745. [7934

COMMUNICATIONS Receivers.

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(12—550 continuous, 1000—2000 m.)

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A few extracts from

The Wireless World

TEST REPORT, Jan. 5th, 1939

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. . . keen selectivity which enables one to get well within one channel on either side of the London Regional transmitter before the side bands begin to appear.

On long waves separation of the Deutschlandsender from Droitwich and Radio-Paris requires no skill in the handling of the controls, and the performance on this band is exceptionally good with ample sensitivity in reserve and very little background noise.

. . . A momentary test up to full volume on the local station failed to reveal any marked threshold of distortion, though judging from the sound level the output must have been very close to the rated upper limit of 10 watts.

. . . Full marks are due to the designer for the skill with which a 12-valve circuit has been compressed into a chassis very little bigger than that of the average 5-valve superheterodyne."

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V

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V.

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1939 RADIO

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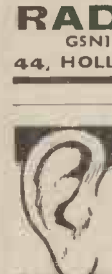

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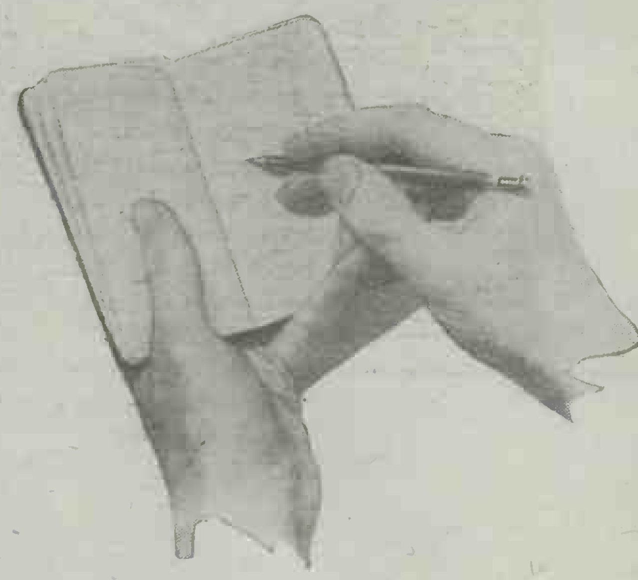

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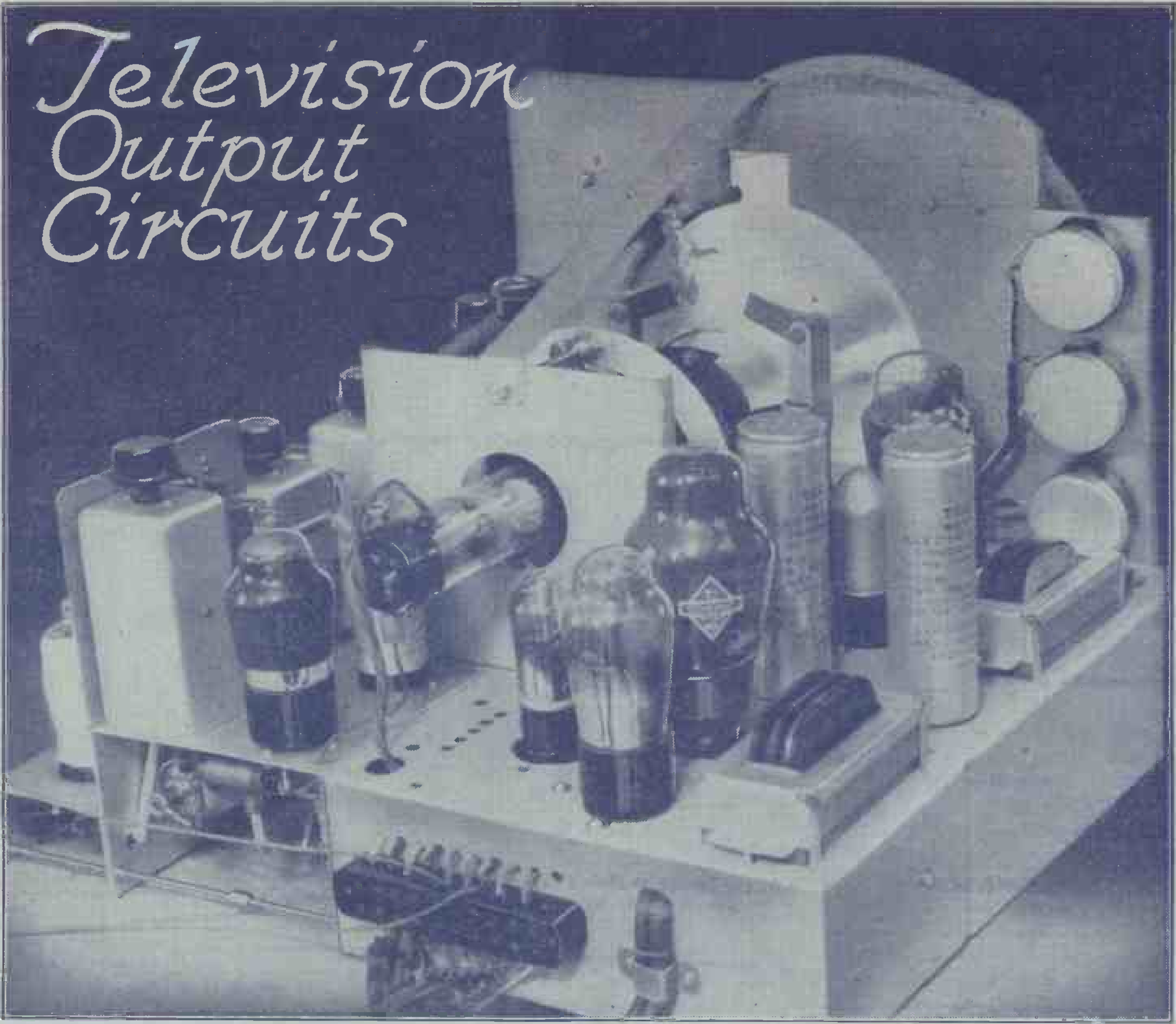

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The News Bulletins

Alarmist or Soporific?

A *VOLUMINOUS* correspondence on the allegedly alarmist tendencies of the B.B.C. news bulletins has been proceeding in the pages of *The Times*. Various complainants urge that the bulletins are war-mongering, emotional, non-representative, dismal, and likely to send us to our beds "with palpitating hearts and incipient nightmares." As one correspondent puts it, "if there are jitter-bugs among us, the B.B.C. brought them themselves."

The general trend of opinion seems to be that while "no one can reasonably expect the News Editor to gather nothing but honey when there is so much gall about," the bulletins tend, by injudicious selection of non-representative items and by the issue of statements shorn of their contexts, to give a misleading picture of the attitude towards Britain of potential enemies abroad.

Supporters of the B.B.C., who, incidentally, seem to be in the minority this time, say that the Corporation faithfully reports the news that comes to it without fear or favour, and express the hope that it will not be led into "pandering to the ostrich mentality" by issuing merely reassuring and soothing items of foreign news in place of the "unvarnished and sometimes unpalatable truth." Other correspondents stress the fact that the B.B.C. has to depend for its news on agencies, and judging by the large amount of space devoted by the Press to "defence news" and disquieting rumours, such items are likely to preponderate in the material supplied.

We suggest that the Corporation should set doubts at rest by giving facilities for an investigation, to take the form of a series of post-mortems on bulletins. The investigating committee, which should include at least one member with experience of daily newspaper work, would, of course, have access to the material from which the bulletins were compiled.

Broadcasting and A.R.P.

A Reader's Suggestion

THE problem of how best to convey warnings to the public of pending air raids is one which must be of great concern to the authorities responsible.

Sirens will be effective, but their range is limited and the telephone, if that were used, has the disadvantage that its sphere of operation is limited to subscribers.

The ubiquitous broadcast receiver seems to offer the best solution to the problem of how to communicate rapidly with nearly every household in time of emergency.

Hitherto the argument put forward against broadcasting is that it would only be effective if the sets happened to be switched on at the right moment.

A correspondent puts forward the suggestion in a letter published in this issue that considering that sets are often left on most of the day there is no appreciable extra expenditure to the user involved if it is left permanently on at such times as an air raid warning might be anticipated. It would then be a simple matter, at any time of the day or night, for the B.B.C. to put out a kind of super tuning note as a warning, to be followed if necessary by instructions. The sets would only require to be left tuned to the station from which the warning would emanate.

Television Output Circuits

SYNC SEPARATION AND THE CR TUBE CIRCUIT

MOST television receivers include one vision-frequency stage, the output of which is fed to the cathode-ray tube for modulating the electron beam. Its output is often fed also to an amplitude filter for separating the synchronising pulses so that they are free from the picture signal. Sometimes, however, the sync separator is fed from the detector and sometimes from a cathode resistance in the VF stage.

The chief objection to feeding the separator from the detector is that the signal at this point is usually too small for reliable and non-critical operation of the separator. The signal at the output of the VF stage is naturally much larger, and it can be accepted as axiomic that the larger the signal the easier it is to effect good separation of the sync pulses.

The methods of effecting separation following the VF stage are legion, and one particularly simple arrangement is shown in Fig. 1. The VF stage is conventional with a screened tetrode or pentode V1 and a corrected coupling R2 and L. It is coupled to the CR tube through the RC coupling comprising C1 and R3 with the DC restoring diode V2.

This diode conducts only on the tips of the sync pulses, and builds up a charge on C1 which maintains a voltage across R3 substantially proportional to the direct-current component of the signal. The signal across R3 is a good copy of that at the anode of V1 but with the anode voltage of V1, derived from the HT supply, removed. The phase of the picture signal is positive and of the sync pulses negative.

ONE of the most difficult parts of a television receiver to design is the connection between the receiver, the tube, and the sync separator. There are many possible arrangements, but they nearly all have some technical disadvantage. In this article are described some of the more usual systems together with one which is free from the usual difficulties.

By

W. T. COCKING

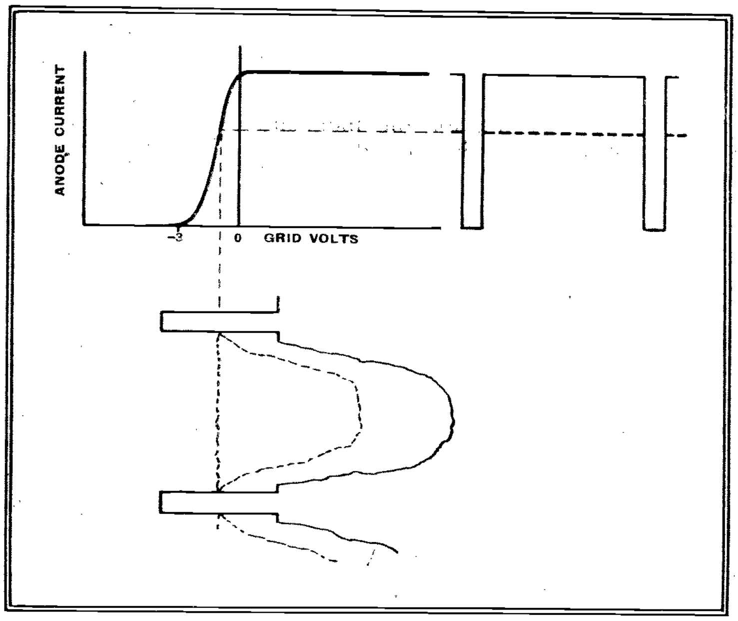

Fig. 2.—This diagram shows the method of operation of the sync separator of Fig. 1. The flat top to the valve curve is secured through the use of a low anode voltage on V3 in conjunction with the vision signal driving the grid positive.

In addition to being applied to the CR tube, the signal is fed through R4 to the sync separator V3. With a sync pulse amplitude of 5 volts V3 is given a grid bias of about −3 volts by making the cathode +3 volts by means of R8. The screen potential is chosen so that anode current cut-off occurs at about −3 volts grid potential. The anode voltage is then made low compared with the screen voltage.

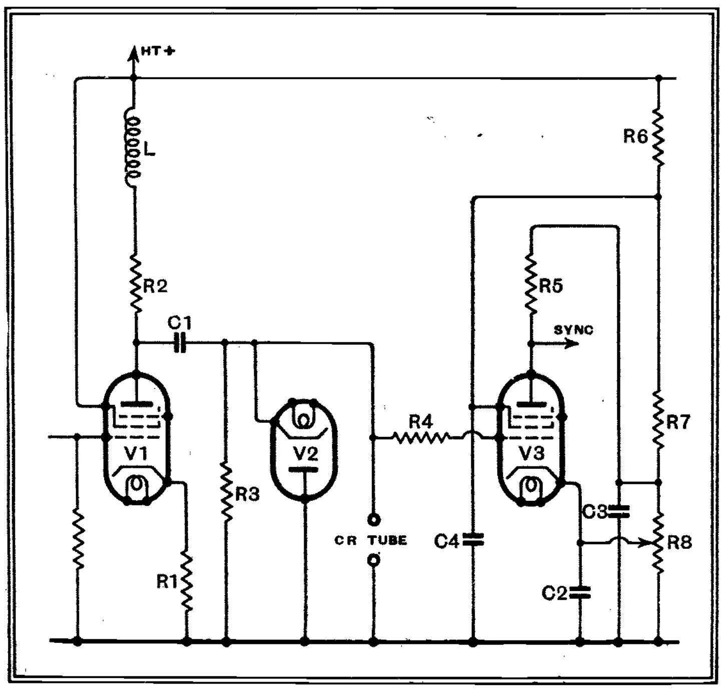

Fig. 1.—A typical output circuit is shown here; V1 is the VF amplifier, V2 the DC restoring diode, and V3 the sync separator. For proper operation R4 must be of high value and the shape of the sync pulse is then distorted.

The shape of the grid-volts-anode-current characteristic then takes the general form shown in Fig. 2. The input signal is applied as shown, and the picture portion of the signal sweeps over the flat top of the characteristic and gives no change of anode current. The sloping portion of the curve is swept over only by the sync pulses, and corresponding current pulses appear in the anode circuit and set up voltage pulses across R5. These are shown on the right in Fig. 2. The phase of the sync pulses in the output is positive, so that it is correct for feeding to most time-base generators; for example, gas-triodes.

Unfortunately, the action is in practice greatly complicated by grid current. Whenever the grid-cathode potential is more positive than some −1 volt, and this is during the whole of the picture signal, grid current flows. The valve then has an effective input resistance Rin which is quite low, and the voltage across R3 which is effective in operating V3 is Rin/(Rin+R4).

It is clear that if R4 is made much larger than Rin quite good sync separation can be obtained in the grid circuit alone. If R4 is 100 times Rin, for instance, only about 1 per cent. of the picture signal would be applied to V3, but the full sync voltages would be developed on it, because the grid is negative on these pulses and Rin tends to infinity.

With a high value of R4 the signal actually effective in operating V3 is shown in Fig. 2 by the dotted line. The upper bend in the grid-volts—anode-current curve no longer plays any part, for the signal never reaches it. The out-

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put pulse amplitude is accordingly reduced somewhat.

With a moderate value of R4, the input is of the form shown by the dash line. The main effect is a reduction in the amount by which the grid of V3 is driven positive, and results in reduced grid and screen-grid current and a longer life for the valve.

If V3 is fed directly from a detector giving large output in positive phase, the use of a moderate value for R4 is to be recommended, and by a moderate value is meant a resistance of the order of 10,000 ohms. When it is fed from a circuit such as that of Fig. 1 involving DC restoration, however, the writer's experience is that a high value is essential. With a moderate value the process of DC restoration is upset.

Sync Separation

This is clear when the action is considered. Ignoring V3 for the moment, the sync pulse brings the cathode of V2 negative with respect to its anode so that the diode conducts. Electrons flow out of C1 through the diode from cathode to anode, leaving a positive charge on C1. After the pulse, the picture signal drives the cathode positive and the diode becomes non-conductive.

During the picture signal, therefore, C1 becomes less positive because electrons flow into it through the resistance R3. For proper DC restoration it is necessary that the value of R3 be very much larger than the resistance of V2 when conducting.

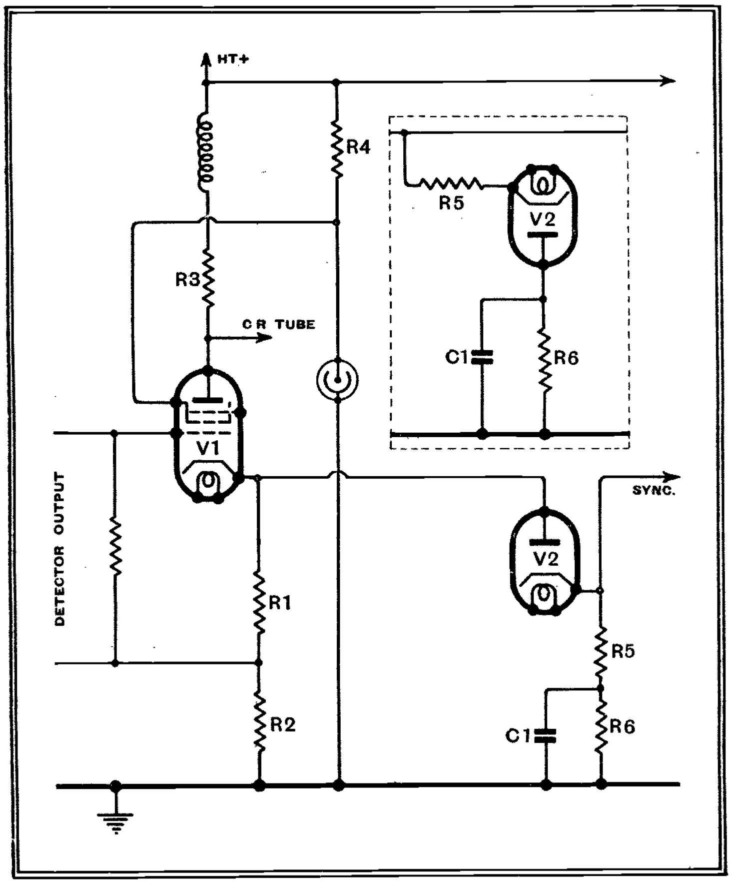

Fig. 3.—Sync separation can be effected by means of a diode coupled to the cathode of the VF stage. Two alternative arrangements of the diode are possible; the second circuit, shown between dotted lines, is often the better.

Now consider what happens when V3 is in operation. The action is unchanged until V3 is driven into grid current, which occurs throughout the picture signal. Electrons now flow into C1 to reduce its positive charge not only through R3 but also through R4 and Rin. In effect, therefore, the value of R3 is greatly reduced.

It is usual to make R3 about 1 megohm, and this gives very good DC restoration when C1 is of the order of 0.005 μF. and a low resistance diode is used. It is clear, however, that the conditions are seriously upset if R4 is 10,000 ohms or so, for even if we allow that the input resistance of V3 is as high as 10,000 ohms, which is unlikely, R3 will be shunted by a resistance of only 20,000 ohms.

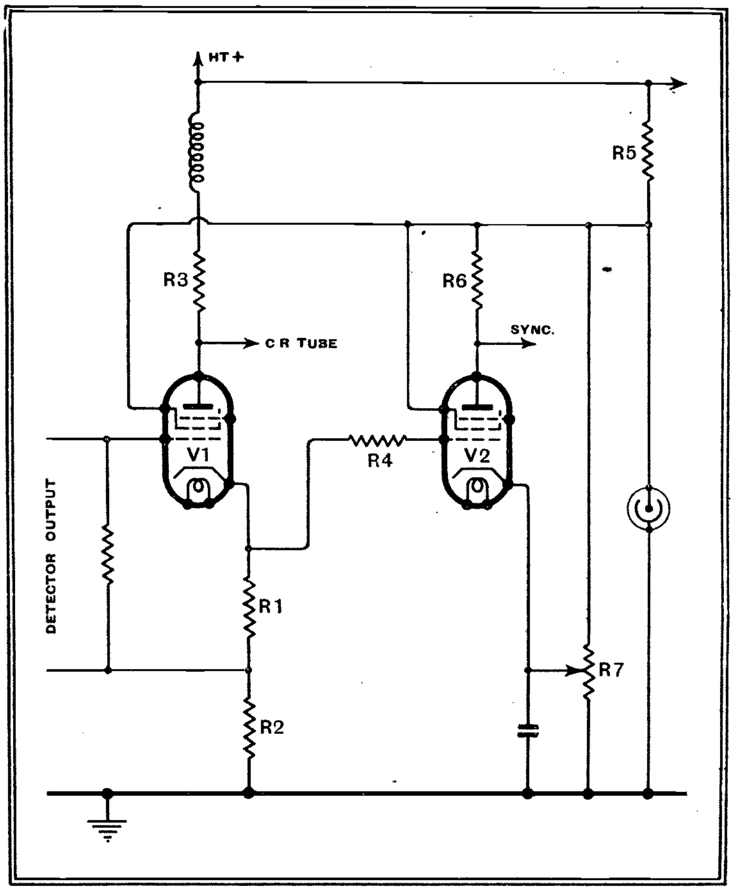

Fig. 4. — Provided that a stabilised screen supply is used, a tetrode or pentode sync separator can be fed from the cathode of the VF stage.

It is, therefore, necessary to make R4 as high as possible, and in practice quite good results are obtained when it is about 0.5 megohm. Less perfect DC restoration is obtained, and it is advisable to increase C1 to some 0.5 μF.

The drawback to this course lies in the input capacity of V3. The time-constant of R4 and the input capacity becomes so large that the steepness of the sides of the sync pulse is lost. This makes the timing of the striking points of the time-base generators dependent on the pulse amplitude, and it may also make the line pulse timing dependent on the picture content at the extreme right-hand side of the picture. If there is a white border to the picture, for instance, the voltage on the valve may not be able to change rapidly enough for the sync pulse to follow at its proper time.

This gives an effect known as "pulling on whites," where a few lines may move when there is a white object on the extreme right of the picture. With care in design and adjustment this effect can be kept small, and the circuit can be made to give good results. The settings of the time-base controls, however, are more critical than with more perfect separators.

The Cathode-Coupled Circuit

An arrangement which is sometimes used to overcome these difficulties is shown in Fig. 3. The VF stage V1 has an additional resistance R2 connected in its cathode circuit, and the input is applied as shown between grid and the junction of R1 and R2, not between grid and earth. This means that the whole of the detector circuit must be floating.

The CR tube is fed from the anode in the usual way and the sync separator from the cathode. It is desirable to use a valve requiring a lower screen than anode potential, and to stabilise the screen voltage by the neon voltage stabiliser. This automatically stabilises the screen and *anode* currents, and hence the cathode potential relative to earth.

As regards the cathode circuit the valve acts substantially as a triode, and

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an amplified copy of the input appears across R1 and R2 and in the same phase as the input. The sync pulses are positive and the picture signal negative. One disadvantage is that there is negative feed-back through the control-grid to screen-grid valve capacity which results in a high effective input capacity and low input resistance at high frequencies for V1. The effect is exactly the same as though a normally connected triode were used.

Sync separation is effected by the diode V2, which has its cathode biased positively by R6. This bias can be automatic, as shown, or fixed, in which case a resistance would be joined between the junction of R5 and R6 and the screen of V1. The bias is arranged to be slightly greater than the cathode potential of V1 on a black level signal.

Valve Capacities

On black level V2 is non-conductive, for its anode is negative with respect to its cathode. V2 is also non-conductive on all picture signals, for these drive its anode still more negative. The sync pulses, however, drive the anode positive, the diode passes current, and a voltage is developed across R5.

An alternative arrangement of the diode is shown inset in Fig. 3. Here the diode is non-conductive on the sync pulses and conductive on the picture modulation. It functions in exactly the same way as the grid-cathode path of V3 in Fig. 1.

At first sight this arrangement is inferior to the one in which the diode is non-conductive on the picture signal, because it cannot completely eliminate the picture signal. There is, however, little deformation of the shape of the sync pulses, since R5 need not exceed 10,000 ohms or so.

In practice, however, it often gives better synchronising, and the reason lies in the fact that the stray capacity across the resistance R5 can be exceedingly small, whereas the anode-cathode capacity of the diode is several micro-micro-farads. This capacity is much more harmful in the main circuit of Fig. 3 than in the inset arrangement, for in the former it acts as a partial short-circuit to the diode when it is non-conductive.

Any very rapid change in the picture content, as a sudden transition from black to white or vice versa, causes a pulse to appear across R5. The pulse is usually of small magnitude and of very short duration, but it is sometimes sufficient to trigger the line time-base generator. This effect is usually only important on line synchronising, and is always negligible on the frame circuit if an integrator is used. In practice, the inset circuit often gives better results than the main one.

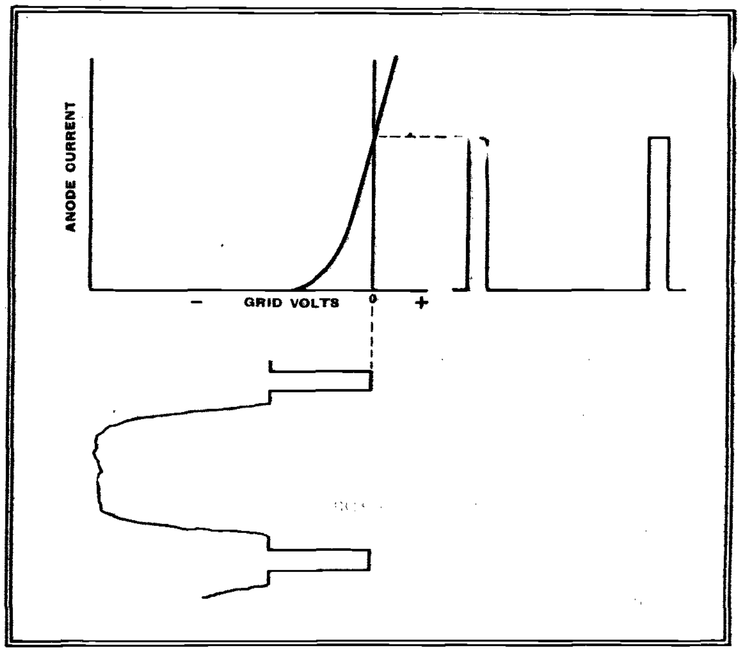

Fig. 6.—The action of the sync separator of Fig. 5 is illustrated here. The picture signal is removed by making it drive the valve beyond anode current cut-off.

An arrangement giving almost perfect separation is shown in Fig. 4. A tetrode or pentode separator is used following a VF stage which is exactly the same as before. The cathode potential of V2 is adjusted to be about the same as the no-signal cathode potential of V1, and the anode and screen potentials are chosen so that anode current cut-off occurs at about –2 or –3 volts on the grid. It is essential that the screen supplies of both valves be voltage stabilised.

With this circuit the picture signal drives the grid of V2 negative and beyond anode current cut-off. The separator is, therefore, perfect, and the low grid-anode capacity of a screened-grid valve prevents any appreciable transference by this route. A triode can be used, but the grid-anode capacity may lead to some trouble just as with the circuit of Fig. 3. The phase of the output sync pulses is negative, so that an extra phase-reversing stage is needed for many time-base generators.

There is no doubt, however, that the use of cathode coupling in the VF stage is a nuisance, for it makes a stabilised screen supply necessary, it prevents any point on the detector circuit from being earthed, and it gives a high input capacity to the VF stage.

An alternative arrangement which the writer has found very useful is shown in Fig. 5. At first sight it may seem rather wasteful, but on examination this will be seen to be more apparent than real. V1 is the normal VF stage and its output is taken through C1 to V3, R3 and V2 effecting DC restoration. V3 is a triode usually operated with equal cathode and anode resistances R5 and R4.

Under these conditions there is heavy negative feed-back along R5, and the gain measured between the input and cathode or anode is rather less than unity—0.8-0.9 times being average figures. The phase of the cathode output is the same as the input, while the anode output is of opposite phase. The CR tube is connected directly to the cathode without DC restoration and with complete safety, while the sync separator is fed from the anode.

First of all, consider the direct connection of the CR tube. In order to save

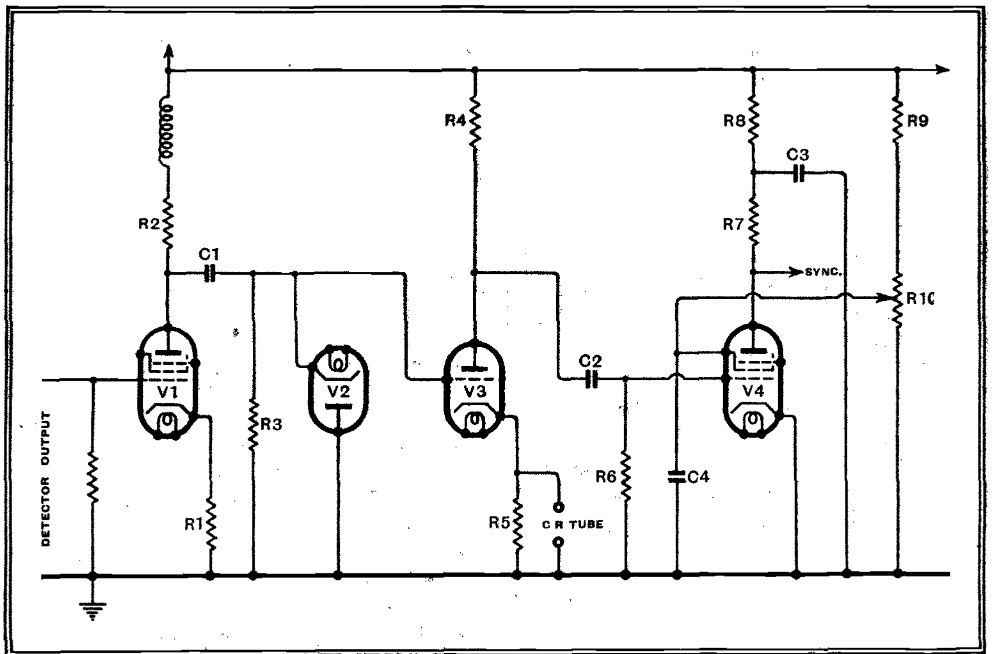

Fig. 5.—This circuit can be recommended as being highly satisfactory, simple to put into operation, and free from the disadvantages of most alternatives. V1 is the VF stage and V2 the DC restoring diode. V3 is a phase-splitter and the CR tube is fed from its cathode while the sync separator V4 is fed from its anode.

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the DC restoring diode its grid is sometimes connected straight to the anode of the VF valve, the no-signal anode voltage being backed off by increasing the normal tube bias. This connection is rather dangerous from the point of view of tube life, however. Unless the greatest care is taken, there is a great likelihood of the tube being underbiased for a few moments when switching on and off, owing to the rise and fall of the voltages in the different circuits being at different rates. In any case, if V1 fails to pass anode current for any reason, such as a broken heater or a bad contact in a heater, cathode or screen pin, the anode potential will rise straight away to the full HT voltage and carry with it the tube grid.

CR Tube Connections

As a safety measure, therefore, it is wise to use DC restoration, and in Fig. 5 it would be quite satisfactory to connect the tube grid to the grid of V3. To do this would increase the stray capacity on the intervalve coupling, and by connecting it to the cathode of V3 the circuit capacity is reduced. This permits the use of a higher value for R2 and greater gain from V1.

The direct connection of the tube grid to the *cathode* of V3 is perfectly safe because the voltage changes when switching on or off only drive the tube grid negative. Moreover, a failure in V3 will only result in the tube grid falling to earth potential, that is, it will change its potential in a negative direction.

There is another advantage to be gained from the cathode connection. Viewed across R5, V3 has a very low output impedance, which is usually of the order of 500 ohms. The output impedance of the valve is actually $R_o = (R_a + R4)/(1 + \mu)$, where R_a and μ are respectively the anode AC resistance and the amplification factor of the valve. With a valve of the MH4 class and R4 having a resistance of 7,500 ohms, R_o is 550 ohms. If R5 is also 7,500 ohms, the total effective resistance in the output circuit is about 510 ohms.

With such a resistance the stray capacity across R5 can be as high as 80 $\mu\mu$F. for a drop in response at 2 Mc/s of 1 db. A capacity of this order is not likely to be found, but the important point is that it is tolerable, for it makes it unnecessary to strive after the attainment of very low capacity in the tube coupling. Normally, it is necessary to be as careful with the tube grid lead as with the grid of an amplifier, and this is usually very inconvenient. The attainment of a grid lead of only two or three inches in length between receiver and tube is generally difficult, and necessitates very careful design.

With this suggested output circuit, however, extreme care is no longer needed, and the connection could be several feet in length without harmful effects. In practice, it rarely need be as long as this.

The input impedance of V3 is fairly high and consists chiefly of the reactance of the input capacity, which is rather less than the sum of the grid-anode and grid-cathode capacities. There is usually some feed-back through these capacities, but that through the grid-anode capacity is in opposite phase to that through the grid-cathode capacity, and the two tend to neutralise one another. With R4=R5 it is necessary for complete neutralisation of feed-back for the stray capacities across R4 to equal those across R5 and for the grid-anode and grid-cathode capacities to be equal.

The output voltage across R4 equals that across R5, and is about 90 per cent. of that across R3 with the values given above. The phase of the signal on the anode side is negative and is coupled to the sync separator V4. The grid-cathode path of this valve together with C2 and R6 effect DC restoration, and the screen voltage is adjusted by R10, so that anode current cut-off occurs at about -2 to -3 volts grid bias. The picture signal thus drives the valve beyond anode current cut-off as shown in Fig. 6. The phase of the sync pulse output is negative, which is correct for some time-base generators. Others, which need a positive pulse, will require the insertion of a phase-reversing stage following V4.

The Phase of the Sync Pulse

As compared with the circuit of Fig. 1, one extra valve is necessary if we disregard the phase of the sync pulse output. For a time-base generator requiring a positive sync pulse an extra valve is needed for phase reversing, so that the arrangement is two valves down on Fig. 1. Its performance is greatly superior, however. If the time-base needs a negative sync pulse, then it is Fig. 1 which needs the extra phase-reversing valve, and each circuit employs the same number of valves.

If we make a comparison with Fig. 3 we again have a better performance, but more valves. In making the comparison do not forget the neon voltage stabiliser in either Fig. 3 or Fig. 4; it may cost as much as a valve, and is more troublesome since it may need ageing before being used.

After considerable experience with all sorts of sync separators the writer has no hesitation in recommending the arrangement of Fig. 5, for it is the only one which he has found to be completely trouble-free and non-critical in adjustment. On setting it up the only adjustment needed is to R10, which governs the current cut-off point of V4.

PROBLEM CORNER—8

Test Your Powers of Deduction

ANOTHER letter from the postbag of Henry Farrad, who has acquired a reputation for solving wireless problems from the most slender of clues.

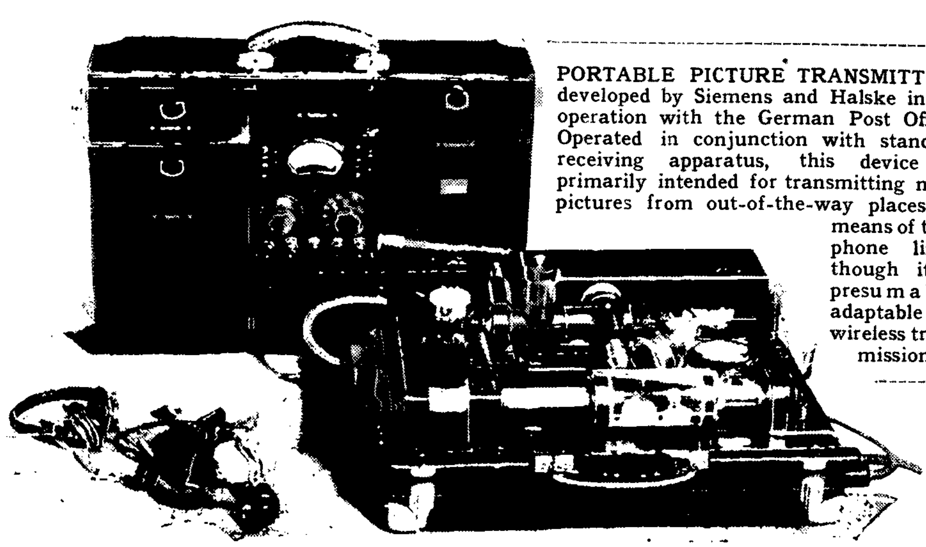
Chestnut Cottage,
Little Sloham,
Suffolk.

Dear Mr. Farrad,

My boy, who I believe is a friend of yours, gave me a wireless before he went away after his last furlough just a month ago. It is a wonderful thing; when he carried it in like an attaché case someone was speaking from it; it is positively uncanny. Or perhaps I should say it *was*, for the last few days it has been silent except for a faint sound that soon dies away, and now there is not even that. Of course, I haven't dared look inside it, and there is no wireless expert in our village, so far as I know. The other day just before it stopped I heard the news man saying it was necessary to get a licence for it at the Post Office, but the weather was so bad I didn't get down there for a day or two, and when the wireless stopped I thought perhaps that was why it was cut off. But now I have bought a licence and it is still off. Should I write to the B.B.C. about it and ask them to put me on again? Although probably you don't know me at all, my boy speaks such a lot about you, and I should be so grateful if you would advise me.

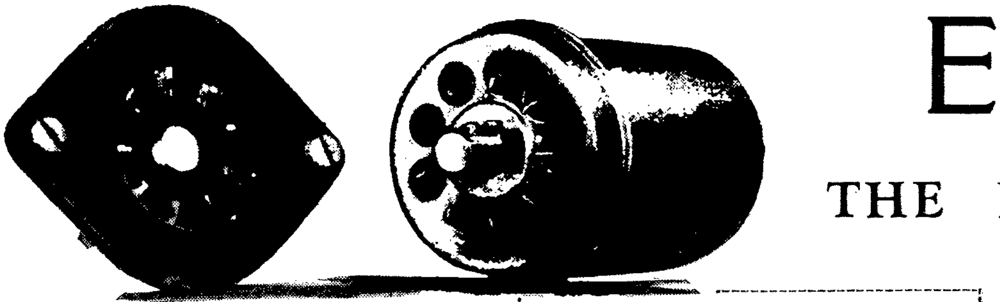
Yours sincerely,
(Mrs.) Millicent Midget.

What was wrong? Turn to page 195.



PORTABLE PICTURE TRANSMITTER, developed by Siemens and Halske in co-operation with the German Post Office. Operated in conjunction with standard receiving apparatus, this device is primarily intended for transmitting news pictures from out-of-the-way places by means of telephone lines, though it is presumably adaptable to wireless transmission.

Amplification by Secondary Emission



THE MULLARD EE50

A DISTINCT departure from normal valve practice is described in this article and it is one which is of especial interest to the television worker. By making use of secondary emission a considerable increase in mutual conductance is obtained without a corresponding increase in the interelectrode capacities.

FOR some types of apparatus, especially for television amplifiers, valves having very high mutual conductances are necessary to obtain useful amplification with circuits of only low impedance. It is also important that this high value of mutual conductance be unaccompanied by any great increase in valve capacities or input damping.

There are several methods by which a high mutual conductance can be achieved in a radio valve. For example, the cathode area can be increased to give a higher emission, which necessitates a higher cathode-heating wattage to maintain the same operating temperature; or the distance between the cathode and control grid can be reduced. Both these solutions have the obvious and important disadvantages of increased heat development, a tendency to primary grid emission and increased inter-electrode capacities. For operation at very high frequencies both temperature effects and high capacities are to be avoided.

Other methods of increasing the mutual conductance have been explored and the application of secondary emission has been found to be a satisfactory solution. Making use of this principle a valve has been developed which attains the high mutual conductance of 14 mA/v. with low input and output capacities and acceptable input damping.

The original development of the secondary emission valve was made available in the TSE4, which is now superseded by the type EE50 in the new "all-glass" construction, providing additional electrical and mechanical advantages.

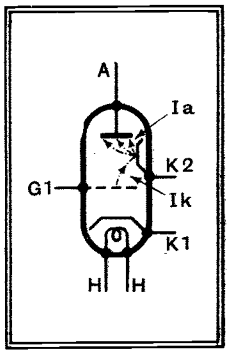


Fig. 1.—In this diagrammatic representation of the new valve the path of the electrons is shown by dotted lines.

Electrons emanating from a cathode traverse the intervening grid or grids and impinge upon an electrode where secondary electrons are liberated as a result of the bombardment. These secondary electrons can move away from this electrode under the influence of a relatively positive potential at which an adjacent electrode is maintained. The electrode at which the secondary emission occurs is known as the secondary emission cathode or auxiliary cathode and its efficiency as a cathode is expressed by the secondary emission factor δ. This factor is the average number of secondary electrons released for each of the electrons striking the auxiliary cathode, and usually known as the primary electrons.

The Auxiliary Cathode

The quantity and path of the secondary electrons depend upon the mechanical arrangement and the potentials of the electrodes, as well as the physical properties of the material at the surface of the bombarded electrode. The materials normally used in the construction of valves have low secondary emission factors. For instance, in a valve having a nickel electrode at 150 volts positive with respect to the cathode, $\delta = 0.94$, and it is not possible to obtain electron multiplication using nickel under these conditions because the total secondary emission from the electrode will be less than the primary current flowing to it.

The behaviour of secondary electrons in a valve depends mainly on the potential gradient in the vicinity of the electrode from which they are liberated; that is on the type of valve and its operating conditions. As an example, take the case of a triode which normally operates with the anode at a positive potential and the grid biased negatively; any secondary electrons which leave the anode soon lose their initial velocity and return again to the anode because there is no other positive electrode to attract them. The conditions in a tetrode, however, are usually different and secondary emission from the anode is drawn towards the positive auxiliary grid unless the valve has been specially designed to avoid this effect by critically spacing the electrodes.

By making use of a material having a secondary emission factor greater than unity, electron multiplication can be achieved and the method adopted is illustrated in Fig. 1.

The primary electrons pass from the cathode K1 through the control grid G1 in the usual manner and are then subjected to the influence of certain other electrodes, omitted from Fig. 1 for simplicity. These direct the electron stream towards the auxiliary cathode K2 which is suitably treated to have a high secondary emission factor.

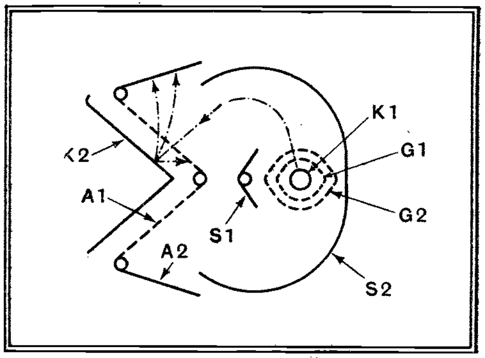


Fig. 2.—The general arrangement of the electrodes is shown here together with the electron paths.

The Secondary Current

The secondary electrons liberated are then attracted towards the anode and form the anode current. This current is greater than the primary current by an amount dependent upon δ. The grid controlling the primary current will, therefore, influence a greater anode current and a higher mutual conductance than normal is obtainable. As each primary electron liberates several secondary electrons which pass to the anode, the supply of electrons at the auxiliary cathode must be supplemented from an external source. While in normal multiple grid valves a negative charge is led away from the positive electrode, it is necessary to supply a negative charge in the case of the auxiliary cathode of secondary emission valves.

In the application of secondary emis-

Amplification by Secondary Emission—
sion for electron multiplication many problems arise. The presence of the cathode and secondary emitting electrode in the same bulb can result in the secondary emission surface becoming coated with a layer volatilised from the cathode (Ba, BaO). The effect of this is to reduce the secondary emission factor, but assuming that this and other difficulties can be surmounted by suitable design, it is of primary importance to investigate the possibilities of the application of secondary emission.

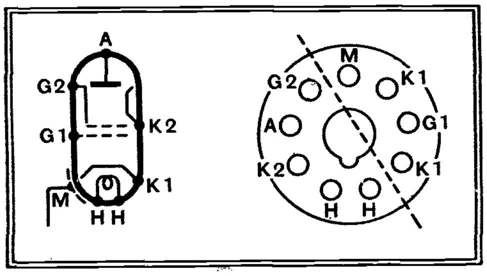
Comparing two valves designed for a similar purpose, one employing secondary emission and the other of usual design, it will be found that at the same anode current the mutual conductance of the secondary emission valve is appreciably higher than that of a valve not using secondary emission. Two of the factors which limit the maximum mutual conductance and anode current are the maximum permissible anode dissipation and the maximum secondary emission obtainable from the auxiliary cathode.

The Electrode System

It can be shown that for the same values of anode current and for valves of similar design, a secondary emission valve has a mutual conductance greater than a normal valve by the factor $\delta^{1/K}$. Moreover, its mutual conductance is proportional to $\delta^{1/K}$. under these conditions.

Except at low cathode currents the constant K has a value of about 1.6 and the mutual conductance is therefore proportional to $\delta^{0.6}$. In a valve having an auxiliary cathode for which $\delta = 5$, the mutual conductance will be $5^{0.6} = 2.5$ times that of a valve without secondary emission for the same anode current.

The difficulty due to volatilisation of the cathode coating has been overcome in the Mullard secondary emission valve by deflecting the electron stream. As volatilisation in vacuo takes place along practically straight lines, the remedy lies in

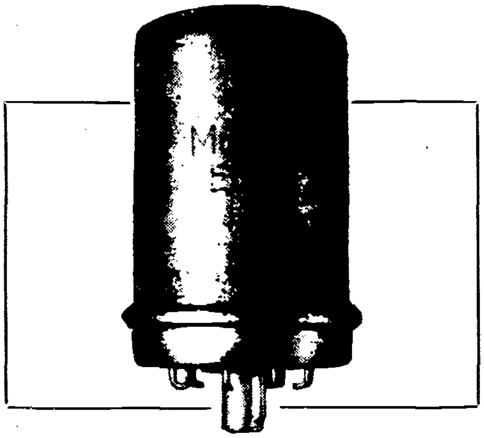


Arrangement of electrodes and base connections. The dotted line across the valve holder indicates the correct positioning of the interstage screen located below the chassis.

the use of a construction in which the auxiliary cathode is screened from the volatilised material emanating from the cathode. The electrons emitted from the cathode can be deflected on to the auxiliary cathode by an electrostatic field.

Fig. 2 shows the basic arrangement of the EE50. The cathode K1, the control grid G1 and the auxiliary grid G2, which operates at 250 volts positive with respect to the cathode, are similar to an ordinary tetrode valve. The auxiliary cathode K2, operating at 150 volts positive with respect to the cathode, is protected from the cathode material by the screen S1, which together with screen S2 is at cathode potential.

The effect of these two screens at low potential, in conjunction with the anode



Mullard EE50 "all glass" valve which supersedes the original secondary emission valve TSE4.

A1 and auxiliary cathode at a high positive potential, is to direct the primary electron stream along the path indicated by the dotted line in the diagram, towards the auxiliary cathode K2. The divergent stream of electrons emerging from the screen grid G2 is refracted and finally, as two convergent beams, impinges on the auxiliary cathode, where secondary electrons are dislodged and accelerated through the open mesh of the anode, situated at about 1.5 mm. from the surface of the auxiliary cathode, to be collected by an anode A2 made of solid material. Although this anode is a continuation of A1 it is not made in the same form, because there would then be a tendency for electrons to oscillate in the spaces between the wires, giving rise to increased output damping when operating at the higher frequencies.

The Anode Voltage

If the open-mesh anode is not present, the potential difference between the remaining anodes and the screen grid would need to be considerable in order to establish a potential gradient at the surface of the auxiliary cathode high enough to draw all the secondary electrons to the anode. In any case it is obvious that the anode must be at a higher positive potential than the auxiliary cathode, and in the EE50 the anode voltage has been fixed at 250 volts, and it is then 100 volts positive with respect to the auxiliary cathode.

TENTATIVE DATA FOR EE50

Indirectly heated secondary emission valve of "all-glass" construction.

Heater voltage ...	... = 6.3 V.
Heater current ...	... = 0.30 A.
Capacities :	
Grid-anode	... <0.003 $\mu\mu$F.
Input	... 7.3 $\mu\mu$F.
Output	... 7.1 $\mu\mu$F.
Operating Characteristics :	
Anode voltage ...	... = 250 V.
Screen grid voltage	... = 250 V.
Secondary cathode voltage	= 150 V.
Negative grid bias	... = −3 V.
Anode current ...	... = 10 mA.
Secondary cathode current	= −8.0 mA.
Screen grid current	... = 0.7 mA.
Mutual conductance (at Ia = 10 mA.) ...	... = 14 mA/V.
Internal resistance	... = >0.1 megohm

Grid Bias

The advantages of the EE50 are of special value in wide-band amplifiers using low-circuit impedances, such as television amplifiers. Due to the high mutual conductance of 14 mA/v, the high AC resistance (>100,000Ω) and low input and output capacities, it is possible to obtain appreciable amplification with the low circuit impedances necessary to obtain a uniform response over a wide band of frequencies. When using this high value of mutual conductance it is, of course, necessary to take adequate precautions against instability.

A practical point of some importance is the method of providing bias for the control-grid. Valves are usually biased

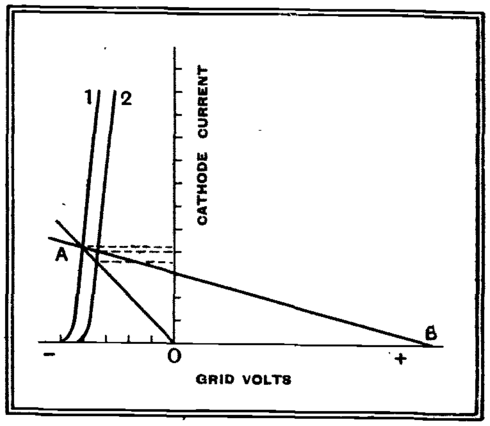


Fig. 3.—This diagram illustrates the effect of the bias system adopted.

by means of a cathode resistance, and the working point on the characteristic is given by the intersection of the resistance line OA with the curve, as illustrated in Fig. 3.

Small differences in the characteristics of valves or small variations in the operating voltages then cause only slight changes in the anode current. In the case of the EE50 the negative bias for the control grid is also obtained from a resistance in series with the cathode. But since the bias is a function of the cathode current and this does not include the anode current, which is supplied by the auxiliary cathode, the compensating action of the bias is negligible. Special measures have, therefore, to be taken to provide some compensation. This can be effected by using a higher value of cathode resistance as indicated by the line BA in the Fig. 3 and applying a positive counter voltage to the grid so that the initial working point is the same as before. This positive voltage is represented in Fig. 3 by OB.

The line BA shows the total bias de-

Amplification by Secondary Emission—
veloped across the cathode resistance as a function of the cathode current, and comparing it with the line OA it will be seen that the variation of cathode current between the conditions of curves 1 and 2 is considerably reduced by the adoption of the higher value of cathode resistance.

Under the conditions usually encountered in the circuit of television amplifiers, where parallel damping resistances of less than 5,000 ohms are used to obtain satisfactory response over wide frequency bands, it can be shown that the stage gain is proportional to g/C, where g is the mutual conductance of the valve and C the total capacity in parallel with the anode circuit.

This capacity is the sum of the output capacity of the amplifier valve, the input capacity of the succeeding valve, stray capacity of the circuit and the self-capacity of the coil. The input capacity referred to will include the additional grid capacity due to Miller effect in the valve which is equal to Cga multiplied by the amplification in the valve.

Comparing three types of valve previously available, i.e., an RF pentode VP4B, a television pentode TSP4, and an acorn pentode AP4, the following results are obtained when the stray capacity of the circuit is assumed to be 6 $\mu\mu$F.

Valve	Mutual Conductance g	Total Capacity C	Ratio g/C
VP4B	2.0 mA/V	19.5 $\mu\mu$F.	0.11
AP4	1.4 ,,	12.0 ,,	0.12
TSP4	4.7 ,,	24.0 ,,	0.2

It will be clear that improvement in the ratio g/C can be obtained by increasing the mutual conductance or reducing the total capacity C, which involves a reduction in $(C_{ak}+C_{gk})$.

Thus, the acorn valve AP4 gives a slight increase in g C compared with the VP4B, in spite of its lower mutual conductance. Moreover, it has been assumed that the stray circuit capacity would be the same for both these valves, which is unlikely in practice, and the acorn valve would probably show a greater improvement than that indicated.

Owing to the very high mutual conductance the secondary emission valve represents a considerable improvement. The ratio g/C amounts to 0.68 for the EE50, assuming the same stray capacity of 6 $\mu\mu$F. and the stage gain is nearly four times that of the TSP4. Another application of the EE50 in addition to RF and IF amplifiers is its use as a phase-splitting valve in push-pull amplifiers. In this application, use is made of the fact that the auxiliary cathode current flows in the opposite direction to that of the anode current. If suitable load resistances are connected in series with the anode and the auxiliary cathode, the alternating voltages developed across these resistances will be in phase opposition and can be used for driving a push-pull stage.

A Free Booklet

With next week's issue of *The Wireless World* will be presented a 32-page booklet entitled "Better Reception." Dealing with all the more important aspects of reception, this booklet has been compiled with the needs of the new reader especially in mind and to these it is hoped that it will serve as an introduction not only to a deeper interest in wireless matters but also to the pages of *The Wireless World.*

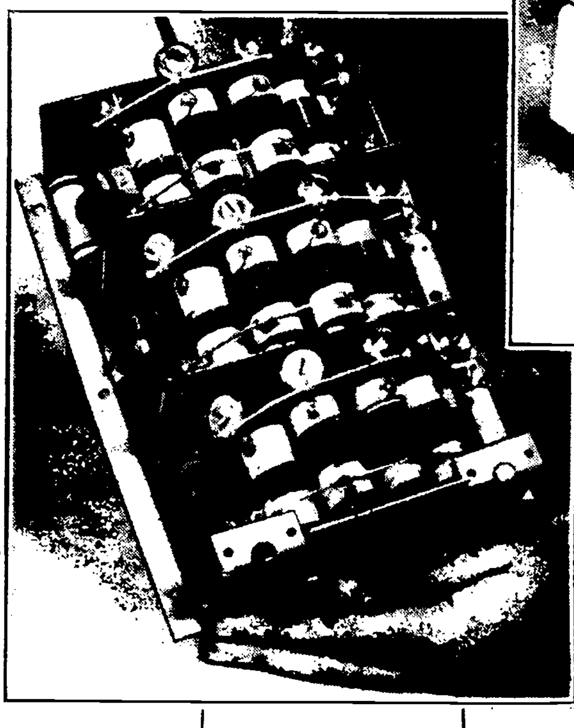
We hope that regular readers will assist us in this endeavour by drawing the attention of their wireless friends to this special issue.

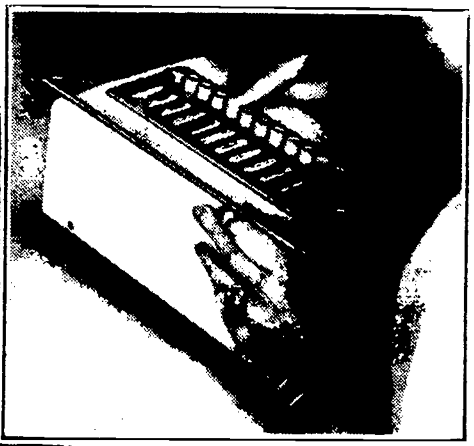
Wireless Operators' *Vade Mecum*

Handbook of Technical Instruction for Wireless Telegraphists. By H. M. Dowsett. Pp. 624, with 578 figures. Published from the offices of *The Wireless World* by Iliffe and Sons, Ltd., Dorset House, Stamford Street, London, S.E.1. Price 21s.; by post 21s. 9d.

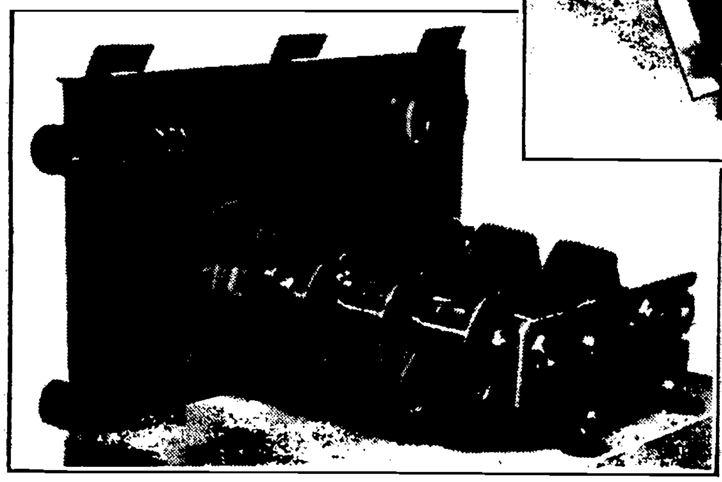
THE sixth edition of this well-known work has now appeared. Although the aims of the book are not vastly dissimilar to those of the first edition of 1913, the apparatus now described is, however, in striking contrast to the spark transmitters and magnetic detectors that were then dealt with.

An important object of the book is to provide a complete theoretical course for prospective marine wireless operators who intend to sit for the Postmaster-General's certificate of competency. As this examination is of a practical nature, no study of books can entirely displace practical work, but those who have mastered the contents of "Dowsett" will find little difficulty in translating their knowledge into practice.

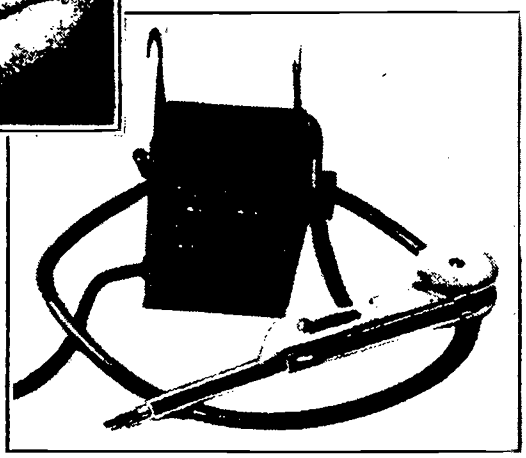




AT THE PARIS COMPONENTS EXHIBITION. Press-button tuning devices were well to the fore at the recent exhibition organised by the S.P.I.R. (French radio trade organisation). The photographs show: (above, right) remote control press-button unit for attaching to any—



—receiver; (above) coil assembly for a five-band receiver; (left) triple gang band-spread condenser; (right) magazine soldering iron, fed from a coil of solder wire housed in the handle.



Multi - Vibrator for Ganging

SIMPLIFYING THE PROCESS OF RECEIVER ALIGNMENT

By H. HARRIS

IN this article is described an unusual form of ganging oscillator that has been found a valuable aid in the alignment of broadcast receivers, especially superheterodynes. It is easy to operate, requires no particular skill on the part of the user and leads to a considerable saving in the time taken to adjust correctly a large and complicated all-wave set.

THE alignment of superheterodyne receivers by the aid of signal generators and multi-channel systems has been frequently described. After the alignment of the IF transformers at the correct frequency has been carried out in various ways, the usual procedure is to inject, via the aerial and earth terminals of the receiver, various signals to which the receiver is adjusted by means of trimmers and padders. Calibration is set by adjusting the oscillator circuit trimmer at some point low down on the waveband, while correct ganging of the oscillator and signal frequency circuits is arranged by the adjustment of the padding condenser at the top of the band.

Upon the accuracy of the adjustment of the padding condenser depends the sensitivity of the receiver and its preselection. The optimum performance is obtained when the oscillator circuit is tuned to the frequency that is exactly the IF away from the frequency to which the signal frequency is tuned.

Usually a fixed signal at the top of the band is tuned in and the output of the receiver noted upon an output meter. The padding condenser is then slowly adjusted while the tuning condensers are rotated slightly in one direction or the other and notice is taken of whether the output of the receiver is increased or decreased. If it increases, then the padder continues to be adjusted in the same direction, at the same time re-adjusting the gang condenser until an optimum output is noted. If it decreases, then the padder is adjusted in the opposite direction, at the same time re-adjusting the gang condenser as before, until an optimum output is noted. This is sometimes a tricky operation and is dependent upon the skill and patience of the operator.

Re-trimming Necessary

Frequently the operation of padding is found to have had an effect upon the calibration and alignment at the lower end of the scale. Theoretically it is bound to do so. Thus the signal and oscillator circuits have to be re-trimmed again at the lower end of the scale and then the padding rechecked. This procedure continues until the operator is satisfied that one operation has a negligible effect on the other.

As mentioned before, these are tricky operations, and the final accuracy depends upon the patience and skill of the operator. With modern multi-waveband receivers the time taken to align a receiver properly by the method described may be considerable; therefore, any method or gear that would reduce the time would be very desirable to receiver manufacturers or large service organisations, particularly if these also lead to greater accuracy of alignment and require less skill of the operator. In this connection the writer has found that a multi-vibrator of the type to be described is an exceedingly useful instrument. The time required for the padding operation can be cut to one-tenth or less, while the skill required is negligible.

The principle of operation may be grasped by realising that in the usual method of alignment with isolated, fixed signals, when the gang condenser is adjusted to tune to a signal, what is happening is that the oscillator frequency is being varied until it is approximately the IF away from the signal in question. Thus, when the operation of padding is commenced, the gang is adjusted until the signal is tuned in and the signal frequency circuits may then be tuned to a widely different frequency to that of the signal being received, but the oscillator is beating with the small signal generated across the impedance of the circuits off resonance.

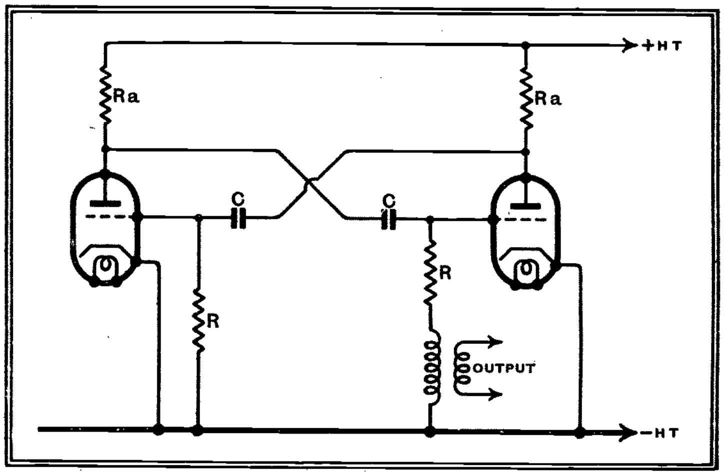


Fig. 1.—Fundamental circuit of the multi-vibrator using two triode valves.

Now in order to obtain the best performance the signal frequency circuits must be tuned to resonance at the same time that the oscillator is tuned to the correct frequency for producing the IF beat, otherwise low gain and poor sensitivity will result. As altering the position of the gang rotor will also alter the oscillator frequency, it is clear that if the change is such that the signal frequency circuits are nearer in tune to the signal, then the oscillator frequency will have to be re-adjusted to the correct value. This is done by means of the padding circuit, but the exact position of the gang rotor to put the signal frequency circuits in resonance is not known, and it has to be found by gradual adjustment of both signal and oscillator circuits. When the signal frequency and oscillator frequency circuits are both tuned to their correct frequencies then the greatest possible output is shown on the output meter. This is the "optimum" output. Now, if there was always a signal being injected ***at the frequency to which the signal circuits are tuned,*** irrespective of the position of the gang, then there would be no need to rock the gang or gradually to edge the signal and oscillator circuits nearer and nearer into alignment; all that would be necessary would be the adjustment of the oscillator frequency to give a beat with that signal that was already tuned in, and this would at once give the optimum output.

Continuous Band of Frequencies

The calibration at the lower end of the scale, of course, would be set initially by adjusting the oscillator frequency to beat with a certain known signal and adjusting the signal frequency circuit to correspond. What is required, then, is a continuous band of signals so that whatever the tuning of the signal frequency circuit there will always be a signal of that frequency available. A near approach to this continuous band of signals can be obtained from a 500-cycle multi-vibrator.

The fundamental circuit of a multi-vibrator is shown in Fig. 1, and consists of two resistance-coupled valves in which the anode of each is coupled to the grid of the other. This arrangement is oscillatory and produces a signal extremely rich in harmonics. The frequency of the fundamental oscillation is dependent upon the time constant of the grid circuit. The frequency may be fixed, or locked by the

Multi-vibrator for Ganging—
introduction into the circuit of a locking signal. This will be a multiple or sub-multiple of the fundamental frequency.

With a 500 c/s multi-vibrator, harmonics spaced by 500 cycles are produced. These can be made to extend into the high frequencies, and in the multi-vibrators made by the writer harmonics up to the thirty-thousandth and beyond are usable. This means that a continuous band of frequencies spaced at 500 c/s and extending up to 15 megacycles (or 20 metres) is available. So closely spaced are these signals that at all radio frequencies in use in receivers they cannot be separated by tuning, and a continuous signal from top to bottom of each waveband appears. This is because the receiver is never tuned to more than 250 c/s from a signal. So that if the calibration at the lower end of a waveband is set by adjusting the oscillator trimmer to a fixed or known signal and the signal frequency circuits then trimmed, the padding operation merely consists of turning the gang to a point at the top end of the band, without worrying about exactly tuning in to a particular signal and turning the padding condenser until a maximum output is obtained. No rocking of the gang is necessary, as whatever the frequency of the oscillator there will always be a signal within 250 c/s of the one necessary to beat with the oscillator and produce the IF.

If the padder has to be adjusted much, then of course the calibration at the lower end of the band will have to be re-set again, and so on; but the simplicity of the padding operation is such that an enormous amount of time may be saved, as no gang rocking or extreme care is necessary. The audible signal received is a 500 c/s note plus multiples of the same, and is of such a character that even trimming by ear can be carried out almost as accurately as with the aid of an output meter, and padding just as easily. Normally, to adjust the padding circuit of a receiver by ear is hopeless, as the changes in signal strength caused by slightly rocking the gang and slightly changing the padder are sometimes inaudible.

Speed and Simplicity

With the multi-vibrator signal, on the other hand, there is no "edging" of the oscillator and signal circuits nearer and nearer into alignment, the padder merely being adjusted for a maximum output, this automatically corresponding to the optimum output obtainable in the usual way. This is because there is always a signal with which the oscillator can beat, irrespective of its actual frequency, and, therefore, the signal that is selected to beat with when padding is the one that gives the greatest output, i.e. the one to which the signal frequency circuit is tuned, as this will give the largest EMF across the circuit and will, therefore, give the biggest beat with the oscillator frequency.

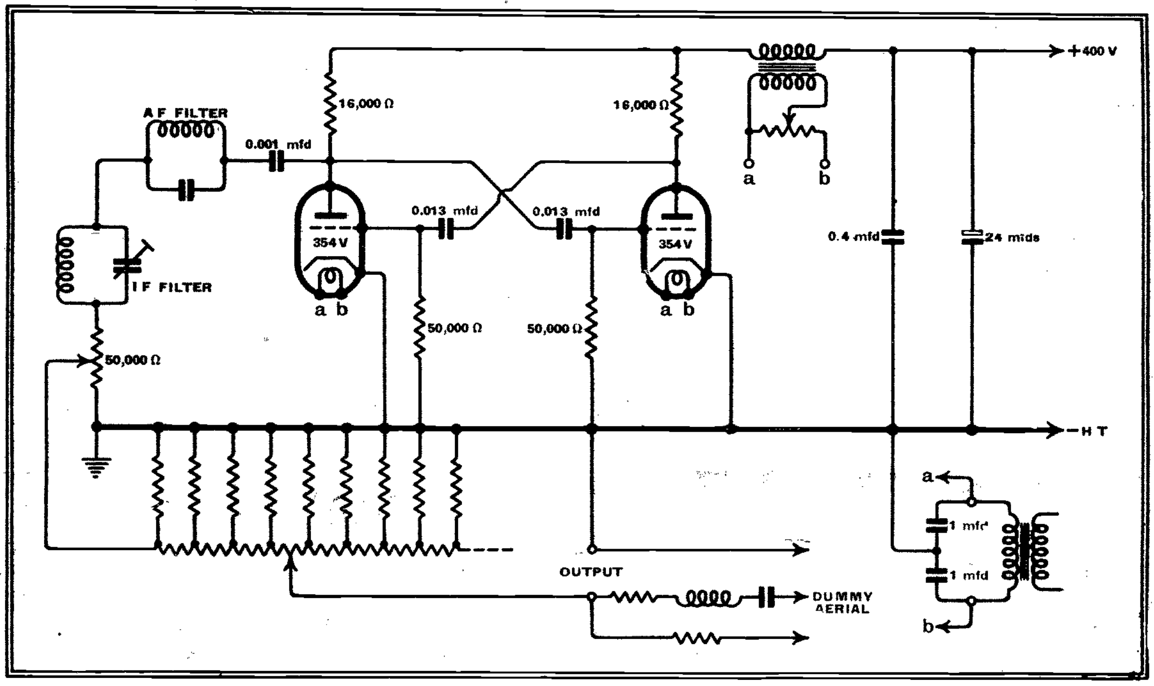


Fig. 2.—Complete circuit of a multi-vibrator with component values. The instrument is designed for a fundamental frequency of 500 c/s.

Another, and important, use of the multi-vibrator is that by its means the *whole of each waveband on the receiver can be checked* easily and quickly by turning from top to bottom, or vice versa, and noting any variations in output, as the output from the multi-vibrator may be made fairly constant over large wavebands and does not vary greatly from point to point. Thus dead spots in the tuning range are easily observable which would pass unnoticed in the usual way of checking by means of a small number of fixed signals on each waveband. Oscillator crossovers due to incorrect choice of the beating oscillator frequency when trimming the oscillator circuit are easily seen. Of course, the use of the multi-vibrator is not to supersede a standard signal generator, or the usual fixed-frequency sources generally used for calibration checks. Rather is it to be used in conjunction with them and to enable comparatively unskilled operators to achieve a degree of accuracy and speed in aligning a receiver which was only previously obtainable by a highly skilled one. The method is now used to a great extent in American factories.

The actual multi-vibrator being used by the writer consists of two fairly low-impedance triodes used in the circuit as shown in Fig. 2. It will be noticed that a filter circuit is shown in the output circuit. This is to attenuate frequencies below 150 kc/s and to filter out the IF frequencies so that these are not applied to the input of the receiver to cause certain difficulties. The locking signal is of 50 c/s, and is obtained from the valve-heater supply circuit by means of a potentiometer and step-up transformer. The potentiometer is not essential, but was used when experimenting to find the value of locking voltage required. This is only of the order of 20 or 30 volts, and is not critical with the values and voltages shown. A difficulty experienced when the multi-vibrator was set up was to couple an attenuator of low impedance to the circuit without upsetting the working of it. Usually the output is obtained from an RF transformer in series with one grid leak, but this was found to be unsatisfactory, as a transformer to cover the band from 150 kc/s to 20 Mc/s *efficiently* was found to be impossible to design. It was found that the best arrangement that gave the greatest output in the attenuator on short waves was as shown, where the filter circuit and a high-resistance potentiometer are shunted across one anode resistance. The attenuator is then fed from the potentiometer output.

Calibration

With the final arrangement as described the variation of output between the two frequency extremes may be compensated for. The potentiometer and attenuator may be calibrated arbitrarily so that comparative readings of input to different sets may be made, or standard inputs fixed. These two controls and the on/off switch are the only variables in this extremely simple piece of gear. So simple and cheap are these multi-vibrators to make that each bench, or operator, may be equipped with one. This is simpler and better than making one large one to supply an RF transmission line, as to increase the output sufficiently to feed a line would mean very much larger valves and might

Multi-vibrator for Ganging—

cause difficulties through interference. The maximum signal obtainable at the 150 kc/s end of the band is of the order of one millivolt. The reason for this low output, which nevertheless is more than ample, is that the output power of the oscillating valve is divided very much more evenly between fundamental and harmonics than is the case usually with the ordinary valve oscillator. It has been observed in use that adjustment of the receiver for maximum output on the multi-vibrator signal appears to be very much easier than with one fixed signal only. This is probably connected with the fact that the signal consists of a 500 c/s note plus harmonics, each of practically equal strength. Thus the curtailment, or admission, of the upper harmonics as the adjustment of the tuned circuits is carried out is far more noticeable when they are strong than when they are weak.

In conclusion, it may be stated that although the use of the multi-vibrator for aligning superheterodynes has been emphasised, it can be employed with great advantage for aligning straight receivers. The procedure here is to set the calibration by adjusting the trimmer of the sharpest tuned circuit, using reaction if fitted, on a fixed signal and then de-tuning from this signal to the multi-vibrator signal and adjusting the remaining circuits on this. Again, the multi-vibrator signal may be used for checking response over the whole band merely by tuning from top to bottom and noting the output.

If it is arranged so that the output of the line that supplies the usual fixed series of signals and the multi-vibrator output can be switched at will into a common dummy aerial and this connected to the receiver, no time will be wasted in changing from one source to the other and the full benefits of the multi-vibrator system derived.

Multi-Band Tuning Indicators

USES OF POLARISED LIGHT

RECENT development work in the field of optics has provided us with light polarising material which can be manufactured in the form of thin flexible sheets. This material has a useful application for indicators of various types and particularly for the tuning indicators of multi-band wireless receiving apparatus. A dial for the tuning indicator of a receiver may comprise two plates of this material, in juxtaposition, and such an arrangement is shown in the accompanying drawings.

Referring to Fig. 1, one dial plate A is cut from a sheet of the material, and a horizontal scale, for example, a long-wave scale, indicated by the letters LW is arranged transversely to the "grain" of the material. The "grain" is indicated by the vertical shading lines, and it will be understood that light waves polarised in vertical planes will pass through the material, while the plate will be opaque to light waves polarised in horizontal planes. A horizontal slot B is formed in the plate A above the long-wave scale and opposite the medium-wave scale, indicated by the letters MW, formed on the plate C. The horizontal medium-wave scale is arranged parallel to the "grain" of the material of the plate C, and a slot D is provided in the plate C opposite the long-wave scale formed on plate A.

An exploded view of this dial is shown in Fig. 1, but it will be understood that the plates A and B are placed together, and the arrangement is such that the slot B in plate A forms a frame round the medium-wave scale of plate C, and similarly the slot D in plate C forms a frame for the long-wave scale on plate A. A light source E is arranged behind the dial, and a disc or screen F is rotatably mounted between the light source and the dial. The screen comprises a single sheet formed of the same light polarising material as the scale, and is mounted on a shaft G which is mechanically coupled to the waveband switch (not shown). The arrangement is such that screen F is rotated through 90 deg. when the switch is altered to change the waveband. The screen F is so arranged that when the set is in a condition to receive stations on the long waveband the "grains" of the material of the disc are vertical as shown in Fig. 1.

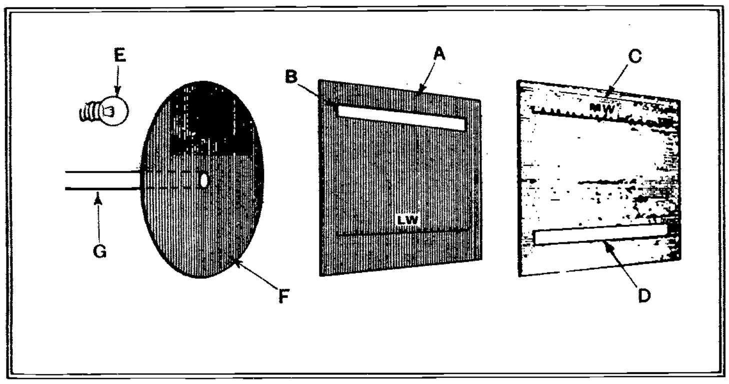


Fig. 1. — Exploded view showing disposition of the rotatable screen and the two indicating scales, which are opaque respectively to horizontally and vertically polarised light.

In operation, the screen filters out all the rays from the light source E, except those polarised in vertical planes; the polarised rays pass through the plate A, which is transparent for them, but are cut off by the plate C, which is opaque to these rays, except at the slot D. Consequently, the long-wave scale is illuminated by light transmitted through the slot D and the remaining surface of the dial is unilluminated.

When it is desired to change the waveband of the receiver, operation of the waveband switch causes the screen F to be rotated through 90 deg., whereby the "grain" of the material is horizontal. The screen now filters out all rays from the light source E, except those polarised in horizontal planes, and, since the plate A is opaque to these rays, the light only passes through the slot B in the plate. This light falls on the medium-wave scale of plate C, which is transparent for such rays, and, consequently, the medium-wave scale now becomes visible, whereas the rest of the surface of the dial is darkened.

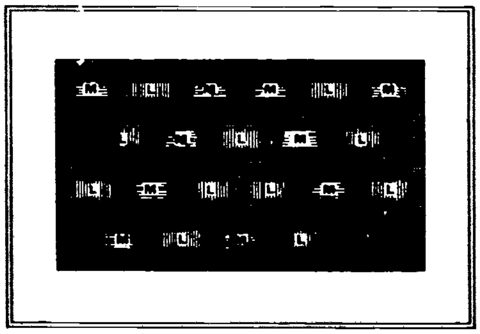


Fig. 2.—Another two-band indicating scale in which the desired station names are illuminated by appropriate polarisation of the incident light.

A modification of the arrangement shown in Fig. 1 is illustrated in Fig. 2, which shows the front surface of a dial indicating long- and medium-wave stations intermixed. The dial again comprises two plates of light-polarising material; the back sheet is formed with a number of apertures, shown dotted and lettered L in the drawing to indicate stations in the long waveband, and the long-wave station names are formed on the front plate so as to be framed by these apertures. Similarly, the front plate is provided with apertures M, indicated by the full lines, and stations in the medium waveband are formed on the back plate so as to be framed by the apertures M. The back plate is cut so that the "grain" of the material is horizontal, and the front plate cut so that the "grain" of the material is vertical.

The "graining" of the material is indicated by the shading lines, and it will be apparent that the medium-wave station names will be illuminated when the "grain" of the screening material arranged between the light source and the dial is horizontal, and the long-wave station names illustrated when the "grain" of the screening material is vertical.

The remainder of the surface of the dial is opaque to both kinds of polarised light and remains unilluminated all the time.

A suitable light polarising material for this purpose is that sold under the trade name "Polaroid."

UNBIASED

By FREE GRID

Death Rays in Denmark

READERS have been most kind and helpful—or, at any rate, they meant to be helpful—in writing to me about the wavelength and circuit diagram of the device which is used to stop car engines by wireless, and which is popularly known as the "death ray." Unfortunately, however, none of them have any real technical information to impart, and I am as much in the dark as ever. Some readers even seemed to misunderstand the reason for my desiring to have this information, which is, of course, that I may stop cars which interfere with my television reception.

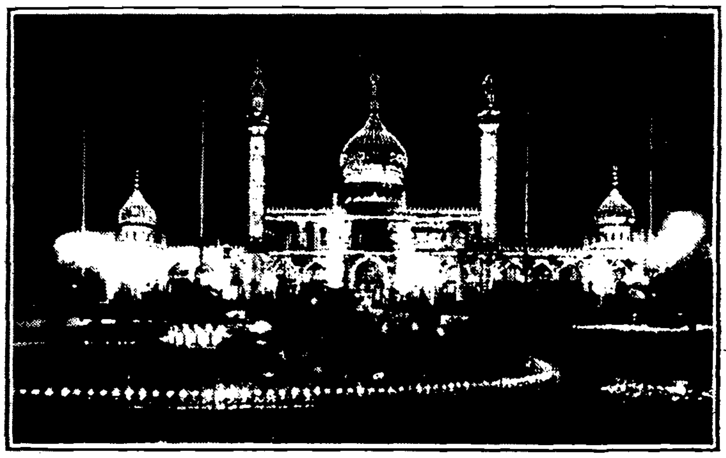
One reader from Denmark, whose name I cannot decipher, sends me in a long account of some mysterious happening in his native country at a place called Odense. At a certain spot near this town no fewer than nine cars came to a sudden standstill within a short period of time on the night of January 23rd. In each case it was found that the ignition system of the car had developed a serious fault. The cars were towed to a near-by garage, and in the case of one of them the damage was immediately repaired, but when the car passed the mysterious spot again on the resumption of its journey it developed the same trouble as before, and stopped abruptly.

The local police are convinced that a wireless experimenter was at work with one of these so-called death-ray devices for stopping cars, and some support is lent to their views by the fact that a mysterious individual clad in ultra-shorts and a doublet visited the garage to which the broken-down cars were towed and asked permission to inspect the result of the damage. My correspondent rather unkindly states that the individual in question bore a striking resemblance to myself and asks what I intend to do about it.

The answer is that I intend, as soon as my business commitments permit me, to go over to Denmark and investigate the trouble, and I hereby invite my correspondent, together with the victims of these car outrages, to join me in the Tivoli Gardens in Copenhagen to drink beer at my expense while we discuss the matter. *Skaal!*

There the matter rests for the moment, although if I can get the necessary information I shall seriously think of asking the Editor's permission to publish full constructional details of a handy portable car stopper in the pages of this journal, as this is, in my opinion, the only effective way to deal with this menace to television. I feel quite sure that lofty appeals to motorists' better feelings will have but little result, and, moreover, I can claim to know something about it, as I am a motorist myself.

Eventually I hope to see some enterprising wireless manufacturer come out with a television set fitted with a neat automatic car-stopping device which the car itself actuates; that is to say, if an "unsuppressed" car passes the house of a television listener the very interference it causes will trigger off the car stopper built into the receiver.



Our rendezvous by night.

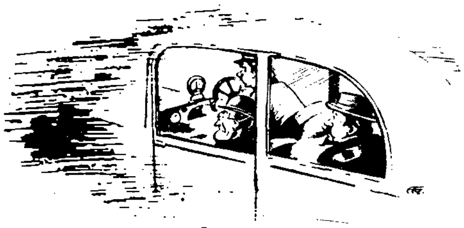
A Radio Fog Disperser

APPARENTLY this is not the only country where very severe fogs are experienced at times, and possibly some of you may remember the disastrous blanket of fog which brooded for some days over the Liége district a few years back and caused quite a furore owing to its unusual density and persistence. We are quite used to these sort of fogs over here, of course, but we don't seem to do very much about them. Other countries are less lackadaisical, however, and it was with very great pleasure that I received an invitation to visit a certain foreign country recently to inspect the new anti-fog measures employing radio principles with which they were experimenting.

As you know, one of the chief difficulties in a dense fog is for cars and other vehicles to keep to the road, and one often finds them resolutely following a tram, since the latter vehicle cannot, of course, wander off the road. It was this fact that was the cause of these experiments to be initiated. I need hardly say that I accepted the invitation with alacrity, and the same evening saw me *en route* for Harwich to catch the Hook steamer to the Continent. Arriving at my destination I was escorted to a car and driven along a road over which an artificial fog had been created by some method or another, probably by inviting Members of Parliament to make speeches by the roadside.

We were easily able to keep to the road, in spite of the denseness of the fog, as the needle of a small dial mounted above the dashboard deviated to left or right according to the direction in which the driver allowed the car to wander. It was done, of course, by means of a device borrowed from the shipping world, in which similar indications are given to a boat by means of a submarine cable through which modulated radio-frequency energy is pumped. In this case, however, use was made of existing lighting cables buried in the ground, and it would be possible, I was told, by using a much higher frequency, to employ the water or gas pipes, if desired, even though they were not insulated from the surrounding earth.

In addition to the use of existing buried cables for the guidance of traffic fitted with the very simple detection gear required, it was possible for a broken-down car to summon assistance, the *modus operandi* being to modulate the existing carrier by means of speech frequencies generated by an additional small unit on the car. Cars so fitted could also be connected through to the ordinary telephone service of the country, so that a driver who was slowed up by the fog could notify friends that he would be late for his appointment.



Driving blind.

To my mind, this fresh application of wireless principles is one of the most important yet, and I look forward to further developments. We may even live to see the system adopted in London, although, knowing something of the attitude adopted towards new ideas in this country, I doubt it, unless we all become super-centenarians.

NEWS OF THE WEEK

CINEMA TELEVISION

Technical and "Political" Aspects of the Boon-Danahar Transmission

THE televising of the Boon-Danahar fight at Harringay Arena to-night, February 23rd, has created a stir in the wireless and cinema worlds. As stated last week, this is the first occasion that the B.B.C. has been permitted to televise a big fight, and also the first time a B.B.C. transmission has been shown to a paying audience at a cinema.

Commenting on the event, *Cinema* states that "The agreement for the broadcast on February 23rd is seen by responsible leaders of the industry as bringing in sight the end of the opposition between the B.B.C. and the cinema industry on a number of matters, covering the question of the provision of artistes for broadcasting by cinema and theatre companies, and the provision of films to the B.B.C., with facilities for the public relaying of programmes as a reciprocal contribution from the B.B.C."

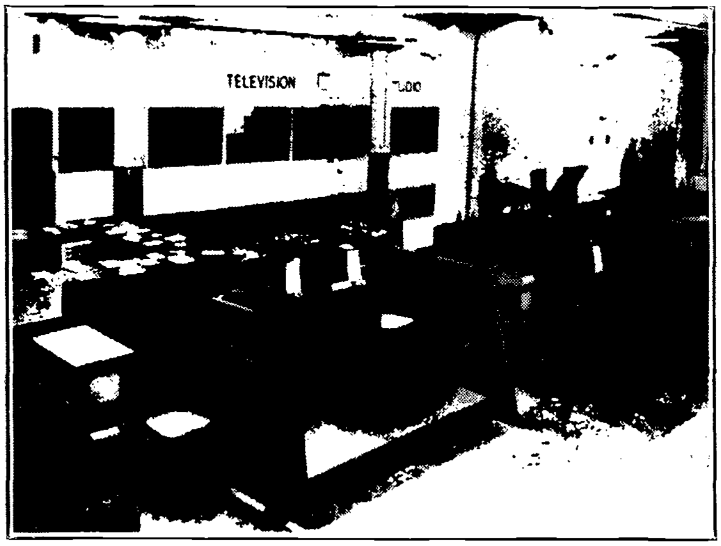
Technically the broadcast is of great interest. Baird apparatus has been installed at the Marble Arch Pavilion and the Tatler News Theatre. The former has been closed since Sunday to allow engineers to erect a new screen, measuring 15ft. by 12ft.; that at the Tatler is 12ft. 6in. by 10ft. The brilliancy obtained in the high lights is about 10 lux, which is comparable to that of films.

Projection cathode-ray tubes are used and have a diameter of 16in.; the picture on the tube, however, is about 6in. wide only and is projected with the aid of a 14in. lens.

The tubes are operated at 45,000 volts with a beam current of 300-400 μA; the normal power in the screen being about 18 watts. Each projector contains two tubes which are operated continuously. One being a stand-by which can be brought into action at once in the event of a failure.

Except for the HT supply, the apparatus is housed in a single container requiring connection only to the aerial feeder. The whole gear has been passed by the L.C.C. for public use.

A B.B.C. announcement states that permission to reproduce the televising of the Boon-Danahar fight in certain places of public entertainment must not be regarded as a precedent. It further adds: "It must not be taken that any general extension of permission for the rediffusion of B.B.C. television programmes in places of public entertainment is contemplated."



THE LAYOUT of the television exhibition at Selfridge's West End store which, as announced last week, will remain open for seven weeks, is clearly seen in this photograph. Visitors can see the performance in the glass-fronted studio in the background, whilst viewing the picture received on the televisors in the foreground.

START POINT'S AERIAL

South Coast Field Strength Tests

A TEAM of B.B.C. engineers will shortly begin a tour of the principal South Coast towns for a series of signal strength measurements coinciding with aerial adjustments at the B.B.C.'s new station at Start Point, Devon.

The two mast radiators at the transmitter mark a new departure in B.B.C. practice, the results of which should be a marked increase of signal strength in certain directions with a minimum of power dissipation over the sea. Adjustments are critical, and with each change made during the experiments the signal strength measuring unit will be reporting from several localities.

It is believed that Start Point will give satisfactory signals as far as Portsmouth and perhaps beyond. The new aerial design will also combat fading. Transmission tests are expected to begin before the end of next month and an experimental service should start in May.

To fill in the gaps in the Bristol area, the Clevedon transmitter will come into operation at the same time as Start Point, replacing the West Regional transmission from Washford, and Start Point will work on the vacated wavelength of 285.7 metres. Clevedon will take over the 203.5-metre wavelength used by Bournemouth and Plymouth, which will close down.

VALVE FRAUDS

Judge's Warning to Traders

AT the conclusion of the case at the Central Criminal Court last week when George Hyman and Aaron Hitner were found guilty of conspiring to defraud Mullard's by attempting to obtain valves by false pretences, the Common Serjeant gave a warning to people in the wireless trade. He said: "I am satisfied that for some time this fraud has been going on—I don't say by you, but by other people—and some people seem to have taken the view that, however wrong it might be, it was not a criminal offence. I hope the result of this case will be that everyone connected with the valve trade will know it is a criminal offence and a very serious one."

It was alleged that Hyman, who was a shareholder in a company called Radioco, Ltd., in obtaining valves from Mullards, signed a B.V.A. stamp representing that they were for use in sets manufactured by his company or for replacement in sets returned for repair, thereby receiving them at a much lower price than valves purchased for retailing. Valves which were specially marked were delivered to Hyman's company and, it was alleged, almost immediately taken to Hitner's premises to be sold at a much higher price.

NORTH ATLANTIC AIR MAIL

Wireless and Weather Services

RELIABILITY in routine operation, on the North Atlantic air-mail now impending, will rely not only on the mechanical dependability of the multi-engined long-range flying-boats and the skill of their crews, but also on the swift and accurate working of a highly organised service of wireless and meteorology.

At Foynes on the Irish Coast and at Botwood, Newfoundland, special long-range wireless stations have been provided to maintain contact with the ocean-going flying-boats.

Relying on wireless reports from a network of shore stations, and also from ships out on the North Atlantic, the meteorological organisation is reinforced by data previously secured by observers crossing the North Atlantic by steamer; this latter information dealing with wind movements at the heights at which aircraft will be operating being obtained by the send-

LONG-WAVE "BATTLE" AT MONTREUX

Extending Synchronisation of Medium-Wave Stations

MIDNIGHT on the last Saturday in September is expected to see the change-over to the Montreux Wavelength Plan, which it is hoped will emerge without undue trouble from the conference which opens on March 1st, and at which each country will be represented by its Postal Administration and broadcasting organisations.

Opinion on the Continent is that a battle royal will be fought over the long-wave band, which has been in an unsettled condition ever since the Lucerne Plan of 1933, partly owing to the recalcitrance of the Luxembourg station in clinging to an unauthorised wavelength. Whether this giant, in one of the smallest countries in Europe, can be made to toe the line is doubtful.

It is believed that attempts will be made to persuade broadcasting stations to extend the system of wavelength synchronisation. This may reduce the listener's choice of foreign stations, but the argument in favour of fewer stations and better quality may win the day.

News of the Week—

ing up of small pilotless balloons—the movements of which are followed by means of special instruments.

TELEVISION IN ITALY

ITALY'S television station, which is under construction at Monte Mario, near Rome, is to transmit on 441 lines, the same as in Germany. This fact is not surprising, as it is learned that the first televisors to be marketed in Italy will be made by Telefunken and imported from Germany. Telefunken are also to market a television adaptor for those who already possess a broadcast receiver.

One of the USW stations at Monte Mario, that which works on 6.9 metres, is not included in the latest list of stations, which points to the fact that the modifications to this station in readiness for its part in the television service are under way.

WIRELESS FOR SMALL VESSELS

AN experimental transmitter-receiver for installation in small German ships has been submitted to the German postal authorities for approval. Working on fixed wavelengths of 600 and 625 metres, the transmitter can be used for either telegraphy or telephony. Current is supplied by a car battery capable of providing six hours' uninterrupted service. A daylight range of fifty miles is guaranteed.

The receiver covers 15 to 2,000 metres, and the hiring or purchase cost is low enough to bring the apparatus within the grasp of most small shipowners.

LICENCE FEES IN INDIA

ALTHOUGH All-India Radio, in an endeavour to encourage listeners to renew their wireless licences, reduced the renewal fee from Rs.10 to Rs.8 in in December, 1936, it has not, according to the *Indian Listener*, had the desired effect of increasing the percentage of renewals, moreover, the loss of two rupees on every licence has resulted in a reduction of approximately Rs.100,000 in A.I.R.'s income. It has, therefore, been decided that the concession fee for a renewed licence should be fixed at Rs.9, with the proviso that the application must be made before the expiry of the old licence.

FROM ALL QUARTERS

Television Advisory Committee

THE chairmanship of the Television Advisory Committee, which had become vacant through the death of Lord Selsdon, has been accepted by Lord Cadman. He was created a Baron in 1937, and is chairman of the Anglo-Iranian Oil Company. Lord Cadman, who is Emeritus Professor, Birmingham University, is a member of the Advisory Council of the Department of Scientific and Industrial Research, and served on the first Television Committee, appointed by the Postmaster-General in 1934, under the chairmanship of Lord Selsdon, whom he now succeeds.

Obituary

WE regret to announce the death of M. Paul Berché, the French radio technician, who has been associated with our French contemporaries, *L'Antenne* and *L'Haut-Parleur*.

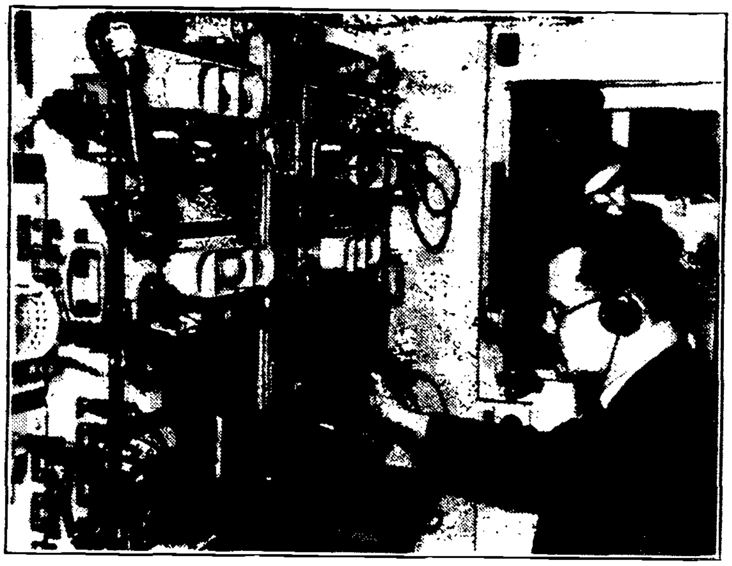
Marconi Station for Finland

MARCONI'S WIRELESS TELEGRAPH COMPANY has secured the contract from Finland for the supply and erection of a 50-kW short-wave broadcasting station to be installed at Pori, near the Gulf of Bothnia. The station is to be completed in time for the Olympic Games which will be held in Finland in 1940, and will thus provide a world-wide channel for the rapid dissemination of news and commentaries.

How the World Listens

THE International Broadcasting Union has compiled an interesting list of the wireless licence figures of the principal countries of the world on December 31st last. The following is an extract:—

Germany (including Austria)	11,503,019
Great Britain	8,908,900
France	4,705,859
Japan (September)	3,850,044
Poland	1,016,473
Czecho-Slovakia	771,647
Denmark	762,711
Switzerland	548,533
Norway	364,548
Finland	293,790
Turkey	46,244



AT THE BERLIN MOTOR SHOW. Germany's latest O.B. van, which is a model of compactness combined with accessibility, was to be seen at the German International Motor Show which was opened by Herr Hitler last Friday.

Proposed Exclusive French Wavelengths

WE were unfortunately misinformed regarding the proposed exclusive wavelengths for France which were published in last week's issue. France's five exclusive medium wavelengths in the projected plan to be discussed at Montreux are: 419, 321.5, 280.6, 260.9 and 233.5 metres. Her one exclusive wavelength in the long-wave band would be reduced from 1648 metres to 1639 metres.

Long-Distance Television

GOOD television reception, limited only by motor-car interference, at Frome, Somerset (127 miles from Alexandra Palace), is reported by R.M. Electric, Ltd. The receiver was a Rogers Majestic Model 11/99T, incorporating the standard Baird vision chassis, but with an additional single-stage vision amplifier.

A New Name

Radio and Electrical Marketing is the new title of the *Wireless Retailer and Broadcaster*, the weekly trade paper published by Odhams, Ltd., of which Mr. F. H. Robinson is supervising editor and manager. It was first published in 1922 as the monthly magazine, *The Broadcaster*.

Appealing to Pirates

AN announcement in the current issue of *The Indian Listener* reads: "A radio licence is twice blessed. It blesseth him that gives and him that takes. Take it out."

MARCH MEETINGS

Wednesday, 1st, 6 p.m. I.E.E. Wireless Section, Savoy Place, London, W.C.2. Symposium of papers on Direction Finding presented by Dr. R. L. Smith-Rose.

Tuesday, 7th, 7.30 p.m. Institution of Electronics (Physics Section), 75 Gloucester Place, London, W.1. "Rays and Radioactivity," G. H. Sturdy.

Tuesday, 28th, 7.30 p.m. Institution of Electronics (Telecommunications Section), 75, Gloucester Place, London, W.1. "Television System in the Baird Company," N. W. Maybank.

Friday, 31st, 6.45 p.m. R.S.G.B., monthly meeting at the I.E.E. "Band-Pass Crystal Filters," E. L. Gardiner (G6GR).

TELEVISION PROGRAMMES

Sound 41.5 Mc/s. Vision 45 Mc/s

An hour's special film transmission intended for demonstration purposes will be given from 11 a.m. till 12 noon each week-day. The National or Regional programme will be radiated on 41.5 Mc/s from approximately 7.45 to 9 p.m. every day.

THURSDAY, FEBRUARY 23rd.

3, Steve Geray and Magda Kun in Cabaret. **3.30,** British Movietonews. **3.40,** 219th edition of Picture Page.

9, "Fantastic Garden" (2nd edition), a programme of song, dance and orchestral music. **9.30,** Gaumont-British News. **9.40,** Film. **9.45,** 220th edition of Picture Page. **10.15,** News.

FRIDAY, FEBRUARY 24th.

3–5, Kitty de Legh as Jennifer in a full-length version of Noel Coward's comedy "The Young Idea."

9, Selected dresses from the British Industries Fair. **9.15,** British Movietonews. **9.25,** Foundations of Cookery: Marcel Boulestin. **9.40,** Cartoon Film. **9.45,** "The Fletcher Case," a "Telecrime" by Mileson Horton. **10.5,** Music Makers: Audrey Piggott ('cello). **10.15,** News.

SATURDAY, FEBRUARY 25th.

3, "In Our Garden": C. H. Middleton. **3.10,** Cartoon Film, **3.15,** British Movietonews. **3.25** "Harlem in Mayfair," a coloured cabaret.

9, Cabaret (as on Thursday at 3 p.m.). **9.30,** Gaumont-British News. **9.50,** "The King of Spain's Daughter," a fantasy of rural Ireland by Teresa Deevy. **10.15,** "Bridge Without Sighs," verse and cartoon. **10.25,** News.

SUNDAY, FEBRUARY 26th.

3, "The Civil Air Guard," O.B. from Hanworth Aerodrome. **3.30,** The Hogarth Puppets in a children's programme. **3.45,** Cartoon Film. **3.50,** Wilfrid Walter in his sketch "Dancing Partners."

8.50, News. **9.5,** "The Dark Lady of Sonnets," by G. Bernard Shaw. **9.30,** Cartoon Film. **9.35,** Moiseiwitsch. **9.45,** Sports Film. **9.55,** Sight and Sound: Painters and Poets in a test of skill.

MONDAY, FEBRUARY 27th.

3-4.40, "Ladies in Waiting," an all-women detective play by Cyril Campion.

9, Marjorie Mars and A. Bromley-Davenport in "Square Pegs." **10.45,** News.

TUESDAY, FEBRUARY 28th.

3, Comedy Cabaret. **3.45,** Film. **3.50,** Gaumont-British News.

9, "The Young Idea" (as on Friday at 3 p.m.). **11,** News.

WEDNESDAY, MARCH 1st.

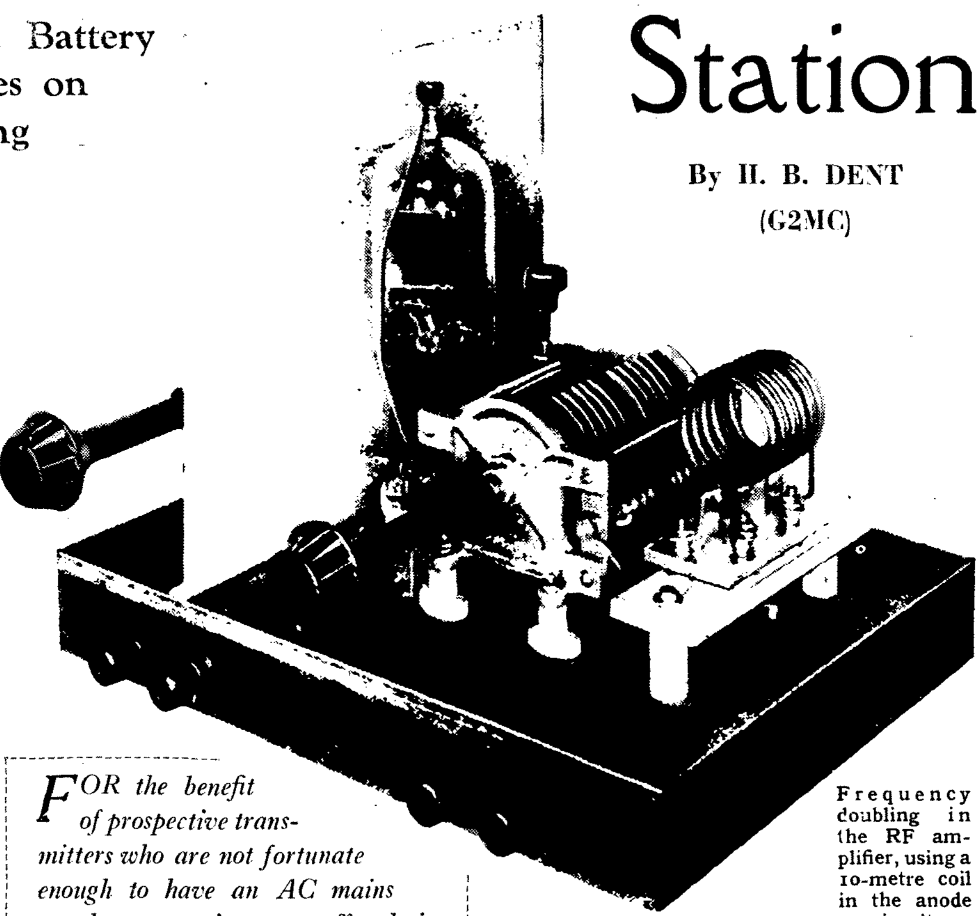
3, O.B. from Bull's Cross Farm, Waltham Cross. **3.20,** British Movietonews. **3.30,** Cabaret.

9, W. B. Yeats—reminiscences of the poet. **9.10,** Cartoon Film. **9.15,** Gaumont-British News. **9.25,** "Arlecchino," Busoni's theatrical capriccio. **10.25,** News.

The Amateur Transmitting Station

Part VIII.—DC Mains and Battery Operation : Some Notes on 10-Metre Working

By H. B. DENT
(G2MC)



Frequency doubling in the RF amplifier, using a 10-metre coil in the anode circuit.

FOR the benefit of prospective transmitters who are not fortunate enough to have an AC mains supply, suggestions are offered in this instalment on methods of feeding the transmitter from DC or battery sources

IN the foregoing articles in this series it has been assumed that an electric supply of the alternating-current kind is available. Though not affecting the basic principles of the transmitter design this assumption has, of course, simplified matters in that the most suitable type of valve, irrespective of its filament characteristics and HT requirements, could be chosen.

It is hardly to be expected that all who may be beginning to take an interest in amateur transmission will be so favourably situated, for there are still large areas in the country where DC is distributed, while in others no electric supply of any kind is available.

The problem that confronts those so placed is how to operate a transmitter in these circumstances.

Let us take the case of a DC supply first. It would not be difficult to find a valve that could be used in the oscillator stage, as any indirectly-heated output pentode will answer if a strict watch is kept on the current flowing through the crystal. The RF amplifier presents a problem, for in the interests of economy the filaments of the two valves ought to be run in series, but most transmitting valves take about one ampere of current.

Filament heating from the DC mains would seem to be out of the question, and the alternative is an accumulator. So far as HT is concerned, the 200 volts or so that will be available are quite enough for the oscillator, and at a pinch could be made to suffice for the RF amplifier, but better results might be forthcoming by the use of pentodes or tetrodes in push-pull. As an alternative two triodes, or a dual triode, such as the new Mullard TVO3–10 which has top anode connections, could be used in a push-pull circuit as shown in Fig. 23. Neutralising is effected by cross-connecting the grids and anodes.

Rotary Converters

The best solution to the HT problem, however, would be found in the installation of a small rotary converter giving an AC output. A ten-watt transmitter built as described requires an AC input of about 70 watts for CW operation, while if power is increased to 25 watts the input goes up to about 90 watts, allowing a little in excess of actual requirements in both cases.

Machines of this size are readily obtainable, as they are made for operating AC receivers and small radiogramophones from DC mains. Anyone who has a private electrical installation of 25 or 50 volts could obtain the power needed for a transmitter from a rotary converter, since such machines are made for any DC input ranging from 6 volts to 250 volts.

If it is proposed to use telephony possibly the best course would be to build a DC-operated audio-frequency amplifier on conventional lines, that is to say, using AC/DC valves throughout, and if necessary employ four valves in parallel push-pull in the output stage. Twelve watts of audio power would readily be obtainable in this way, giving sufficient output to modulate a 20- to 25-watt transmitter.

Small transmitters can be operated from batteries, but strict economy will have to be exercised. The crystal oscillator gives an RF output of the order of three watts at 42 and 21 metres for a total HT consumption of 30 mA at 250 volts, so this unit alone will make a useful low-power transmitter. An extra 30 or 50 mA for a power amplifier would seem quite out of the question when the only available source of HT is dry batteries.

It is, therefore, worth while giving serious consideration to the possible alternative sources of HT. One is a small rotary machine giving, say, 250 or 300 volts DC output at 50 to 60 mA, and taking its power from a six-volt accumulator. The tritet crystal oscillator could then be fitted with a 6.3-volt indirectly-heated valve, such as a 6L6G operated with moderately low screen and anode voltages, so that the total HT consumption is limited to about 25 mA.

The RF output on the fundamental and the second harmonic frequencies of the crystal will be sufficient to drive a pentode power amplifier such as the Tungsram OS-12/501 or the Mullard TZ05/20, both of which can be used with a 6-volt accumulator. As the Mullard TVO3-10 also operates from 6 volts it could be used.

Vibrator HT Units

Vibrator HT supply units can be pressed into service for amateur transmitters, but these are really more suitable for operating on a continuous load than with an intermittent load, such as that imposed by a keyed crystal oscillator and Class "C" power amplifier, as the "no-load" voltage is usually rather high. Output currents of the order of 50 to 60 mA can be obtained at 250 volts with this form of HT unit.

Since it is necessary to keep a reasonable load on the HT unit it might be best in a case of this kind to key in the amplifier stage, and the continuous oscillator load will then prevent an excessive rise in output voltage.

The Amateur Transmitting Station—

Telephony transmitters can quite well be operated from vibrator units as the load is a continuous one. Even the modulating amplifier may also derive its HT from the vibrator, provided adequate smoothing is employed.

A large 6-volt accumulator, such as one of 80-ampere-hour capacity or so, will be needed, and a spare should be available so that one is at the charging station while the other is in use.

It is impossible in this series to deal with all the aspects of amateur transmitting; the object being to start the beginner on a path where the minimum number of snags are likely to be encountered.

There are numerous variations of the circuits described here, and it is only to be expected that, in conversation with other amateurs, he will be told that such-and-such a circuit gives the best results.

This is largely a matter of personal experience, and one of the main interests in transmission is the trying out of new ideas and suggestions.

It is a great mistake, however, to pull the transmitter to pieces and rebuild it to someone else's circuit, for there is then no reliable means for comparison.

By all means try other arrangements, but keep the original transmitter intact to provide a basis for comparison.

Apart from an occasional reference nothing has been said of the ultra-short waves, which expression, though strictly speaking embracing those below 10 metres, will, for our purpose, include this wavelength. Five-metre transmissions call for a special power amplifier, as one would adopt a layout that gave the shortest possible connections, and so they must be passed over for the present.

Ten metres, on the other hand, can be used with the existing equipment, and as a temporary measure the RF amplifier could be operated as a high-power frequency doubler. It is only necessary to set up the transmitter as for 20-metre operation except for the fitting of a 10-metre coil in the anode circuit.

Ten-metre Output

An RF output of about three to four watts will be obtained in this way, and the coil can be constructed as shown in the illustration. It consists of six turns of ⅛in. outside diameter copper tube, the coil diameter being 1½in. with the turns spaced ¼in. centre to centre. For the base a piece of Perspex, which is a transparent material obtainable from Premier Supply Stores, was used. It measures $3\frac{1}{2} \times 1\frac{1}{2} \times \frac{3}{16}$, and six Clix power-type pins are fitted so that it can be plugged into the Eddystone base on the amplifier unit.

A single turn of No. 18 SWG enamelled copper wire is mounted inside the anode coil as a coupling for a low-impedance feeder. Adjustment for coupling is effected by bending this coil out of the perpendicular. This method of adjustment may seem a little crude, but it is perfectly satisfactory in practice.

A coil of this kind is every bit as rigid as one wound on a former. The neutralising condenser does not have to be disconnected, nor is it necessary to make any alteration in its capacity.

As previously stated this is a temporary measure, and an early opportunity should be taken to make up a frequency doubler stage to insert between the crystal oscillator and the final amplifier. The Tungsram OS-12/501 would probably function quite well as the frequency doubler, and it may be possible to go more fully into this matter at a later date.

In designing the power supply unit the possibility that an addition on these lines might be made was taken into account, which is one reason why provision was made for a 6.3-volt filament supply, while the chokes and transformer were chosen to provide if necessary an output current of over 100 mA.

It was stated in Part VI that if a switch be inserted in the primary circuit of transformer T1 the HT supply can be switched off, but it is regretted that with the interconnected primaries of Fig. 16 it will not do so. Each transformer should have a separate terminal block, and only two interconnections must be made.

An alternative place for the switch would be in the lead which joins to the centre tapping on the HT secondary winding.

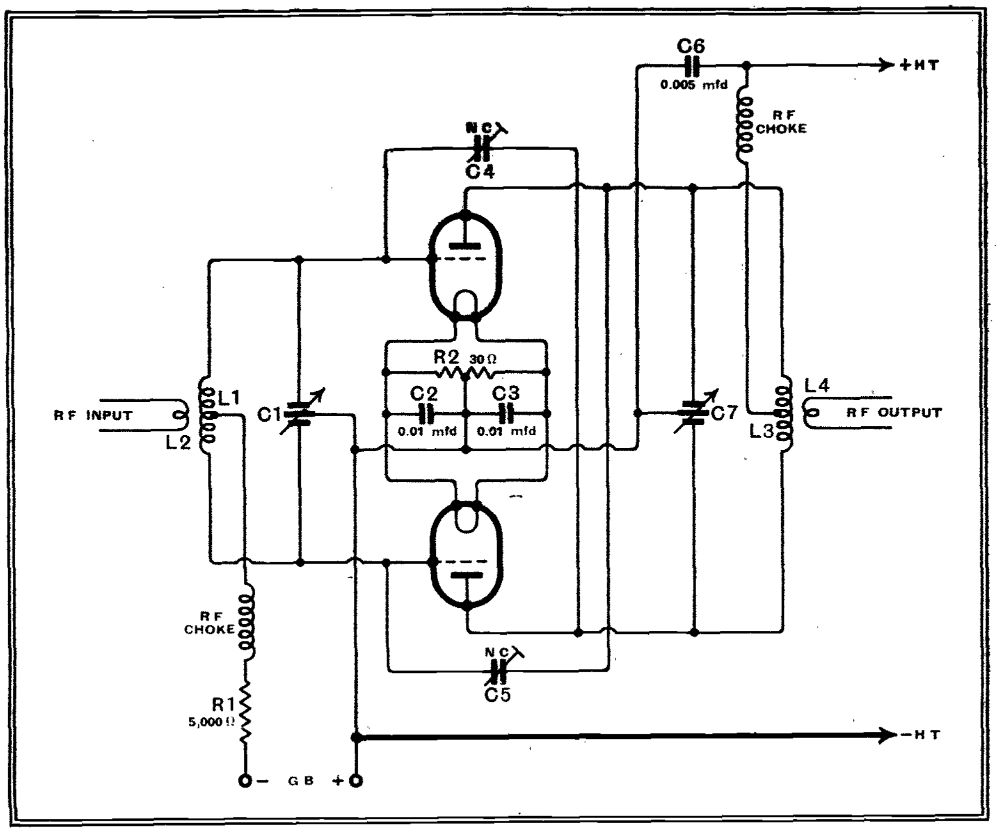


Fig. 23.—Push-pull neutralised RF amplifier. Either a double triode or two separate valves may be used.

The Wireless Industry

THE 1939 price list of frequency control units for amateur transmitters has just been issued by the Quartz Crystal Co., Ltd., Kingston Road, New Malden, Surrey.

A well-known American company, which has produced a new high-fidelity receiver, would like to get into touch with a British firm with a view to manufacture under licence in this country. Applications for fuller information, addressed to this office, will be forwarded.

"Silverex," a chemical compound for depositing a silver surface on metals, has been introduced by Runbaken Electrical Products, 13-15, Liverpool Road, Deansgate, Manchester, 3.

Transformers of various types—power, modulation, intervalve, etc.—together with HT and LT chargers, are described in a booklet issued by the Woden Transformer Co., St. John's Square, Wolverhampton. Details of Woden amplifiers for PA or transmitter modulation are also given.

A leaflet describing the Marconi-Ekco Wave Analyser, Type TF 455, has just been issued by Marconi-Ekco Instruments, Ltd. The instrument is primarily for the direct measurement of the components of complex voltage waves of 300 microvolts to 300 volts amplitude; frequency range, 20-15,000 c/s.

National Radio and Television Service Company are now able to supply replacement cone assemblies for all Epoch speakers.

The latest catalogue of new books on civil and electrical engineering published by H. K. Lewis and Company, Ltd., 136, Gower Street, London, W.C.1, includes a number of works on wireless subjects.

The Exide Company's range of accumulators and HT batteries includes types to fit recently introduced models by various manufacturers. These new sets include the Cossor Model 31, H.M.V. 1401, Marconiphone 876, H.M.V. 1400, Marconiphone 872 and Alba 30.

The Candler System Company regrets that supplies of the "Book of Facts" recently offered to readers of this journal are exhausted. A new issue is in the press and copies will be sent to all enquirers at the earliest possible moment.

Diverse Transformer Loading

PROBLEMS OF MULTIPLE-SPEAKER INSTALLATIONS

By N. PARTRIDGE, B.Sc., A.M.I.E.E.

It is required to feed power to four separate loads simultaneously from an output stage having an optimum load of 3,400 ohms, the power being divided as follows :

Load 1	**15 ohm speaker**	**5% of output**
,, 2	**15 ,, ,,**	**40% ,,**
,, 3	**30 ,, ,,**	**5% ,,**
,, 4	**200 ohm line**	**50% ,,**

What ratios should be provided on the output transformer to achieve this result ?

THE above may be reminiscent of an examination paper, but it is a very practical question. Problems of this type are frequently met in radio, PA, recording, etc.

The needs of the radio amateur are usually limited to supplying two or more speakers of either similar or different impedances so that each receive equal shares of the output. In the cinema the main speakers behind the screen must be given more power than the monitor speaker in the operating room. The same applies in recording work, where the cutting head is given the major portion of the available power and the monitor speaker only sufficient to ensure comfortable hearing. In PA work any demand may be made, and it is quite usual for an amplifier to feed several outgoing lines of different impedances and requiring power in unequal proportions.

The first step is to discover how the audio - frequency power generated in the anode load of a valve can be split up in any required proportions. Suppose a certain valve has an optimum load of R ohms as illustrated in Fig. 1. If the single load (R) is replaced by two loads in parallel, each of 2R ohms, it is evident that the ohmic value of the combined loads will still remain R but that one half of the power will be generated in each of the two paralleled loads.

Extending this idea, the load could be made up of, say, 10 resistances in parallel, each of 10R ohms. The total load is R ohms as before, but the output power is divided into 10 equal parts. It is now possible to group these resistances in any desired way and replace the groups by single resistances of equivalent value as shown in Fig. 2 (a) and (b). The output has been resolved into three parts of 10 per cent., 30 per cent. and 60 per cent. by substituting three resistances $r_a = 10R$, $r_b = \frac{10R}{3}$, and $r_c = \frac{10R}{6}$, instead of the single resistance R.

This process can be generalised by imagining the load split into one hundred equal parts and expressing the required grouping as percentages of the total.

General Statement 1.—The AC power developed in the anode circuit of a valve can be divided into any given number of parts (say "n") and in any stated proportions (say a per cent., b per cent., c per cent. . . . n per cent.) by replacing the normal load R by "n" loads in parallel, the values being $r_a = \frac{100R}{a}$, $r_b = \frac{100R}{b}$, $r_c = \frac{100R}{c}$ . . . $r_n = \frac{100R}{n}$.

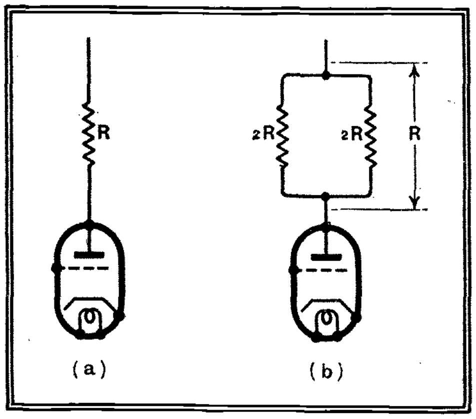


Fig. 1.—Illustrating the diversion of power in an output anode circuit into two separate loads.

It must be noted that the foregoing is true only if $a + b + c$ . . . $+ n = 100$. It is obvious that the output cannot be split into, say, 25 per cent. and 40 per cent., leaving the balance of 35 per cent. unused! This would be equivalent to omitting some of the resistances in Fig. 2 (a), in which case the total load would not add up to R ohms and the entire argument collapses.

Being able to divide the output power as we like, it is an easy step to replace the loads (r_a), (r_b), (r_c), etc., by an equal number of output transformers stepping up or down to whatever impedances one wishes. Fig. 3 (a) will be the equivalent of Fig. 2 (b) providing the primary impedances of the transformers are 10R, $\frac{10R}{3}$ and $\frac{10R}{6}$. Supposing the secondary impedances are to be Z_a, Z_b, and Z_c, then the transformer ratios calculated by the usual formula will be

$$\sqrt{\frac{10R}{Z_a}},\ \sqrt{\frac{10R}{3Z_b}},\ \text{and}\ \sqrt{\frac{10R}{6Z_c}}.$$

All along we have been careful to make the combined impedance of the several loads in parallel remain R ohms. It is therefore unnecessary and uneconomical to use three transformers as suggested in the previous paragraph. A single transformer with three secondaries having the ratios calculated above, and a primary impedance of R ohms will be just as good. This is shown diagrammatically in Fig. 3 (b).

**General Statement* 2.—To feed any number of loads Z_a, Z_b, Z_c . . . Z_n from an output stage demanding an anode load of R ohms so that the output power is divided amongst the various loads in the proportion of a per cent., b per cent., c per cent. . . . n per cent. respectively, the primary of the output transformer should be designed for an impedance of R ohms and the ratios (ignoring transformer losses) should be

$$\sqrt{\frac{100R}{aZ_a}},\ \sqrt{\frac{100R}{bZ_b}},\ \sqrt{\frac{100R}{cZ_c}}\ \ldots\ \sqrt{\frac{100R}{nZ_n}}$$

respectively.

The problem we set out to examine has been solved, but there are probably a number of readers who, although appreciating the explanation given above, would prefer to see it illustrated with some actual figures instead of hypothetical x-y-z's. With this in view the question with which this article opened will be worked through.

To obtain a clear mental picture of the procedure, each step will be described in detail. The starting point is the know-

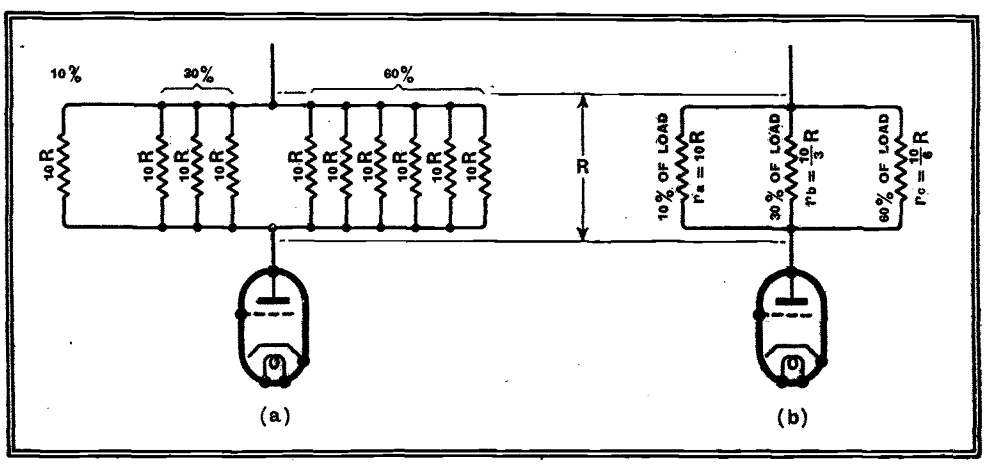


Fig. 2.—Extending the idea illustrated in Fig. 1 by imposing several unequal loads.

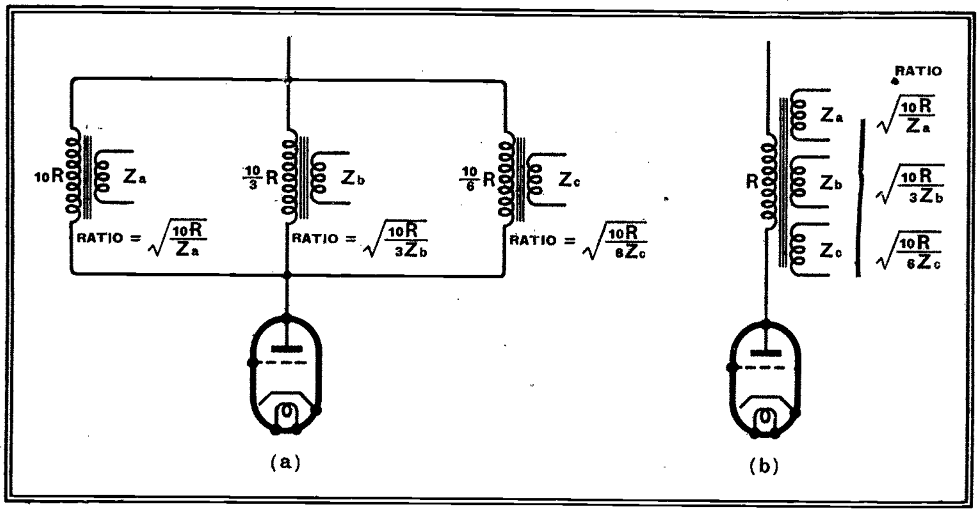


Fig. 3.—Equalising diverse loading by means of multiple transformers.

ledge that the output stage requires an anode load of 3,400 ohms. This gives the conditions illustrated in Fig. 4 (a). The next move is to split the anode load so as to divide the output power in the proportions of 5 per cent., 40 per cent., 5 per cent. and 50 per cent. The first general statement shows how this can be done, and indicates that the 3,400-ohm load should be replaced by four separate loads in parallel of

$\frac{100 \times 3{,}400}{5} = 68{,}000$ ohms, $\frac{100 \times 3{,}400}{40} =$ 8,500 ohms, $\frac{100 \times 3{,}400}{5} = 68{,}000$ ohms and $\frac{100 \times 3{,}400}{50} = 6{,}800$ ohms.

This is illustrated in Fig. 4 (b).

Separate Transformers

*Instead of employing four "direct" loads as in Fig. 4 (b), we can insert four transformers so designed as to match the four impedances stated in the question to the corresponding loads deduced above. The specifications of these transformers will be:—

(1) Primary 68,000 ohms, secondary 15 ohms. Ratio $\sqrt{\frac{68{,}000}{15}} = 67.2$.

(2) Primary 8,500 ohms, secondary 15 ohms. Ratio $= \sqrt{\frac{8{,}500}{15}} = 23.8$.

(3) Primary 68,000 ohms, secondary 30 ohms. Ratio $= \sqrt{\frac{68{,}000}{30}} = 47.6$.

(4) Primary 6,800 ohms, secondary 200 ohms. Ratio $= \sqrt{\frac{6{,}800}{200}} = 5.84$.

The transformers are shown properly connected in Fig. 4 (c).

To have a separate transformer for each load is not economical. It is rather similar to using separate mains transformers for the HT and each of the LT windings in a power pack. The arrangement would work excellently, but it saves space, weight and money to lump all the primaries into one and link all the secondaries with this common primary. The same applies in the present case. We know that the four primaries in parallel give an impedance of 3,400 ohms, so a common primary of 3,400 ohms can be used having the four secondaries linked with it. The ratios will remain exactly as already calculated. This final step is illustrated in Fig. 4 (d).

Precisely the same results would have been obtained by substituting the appropriate values in the second general statement where R = 3,400, a = 5, b = 40, c = 5,

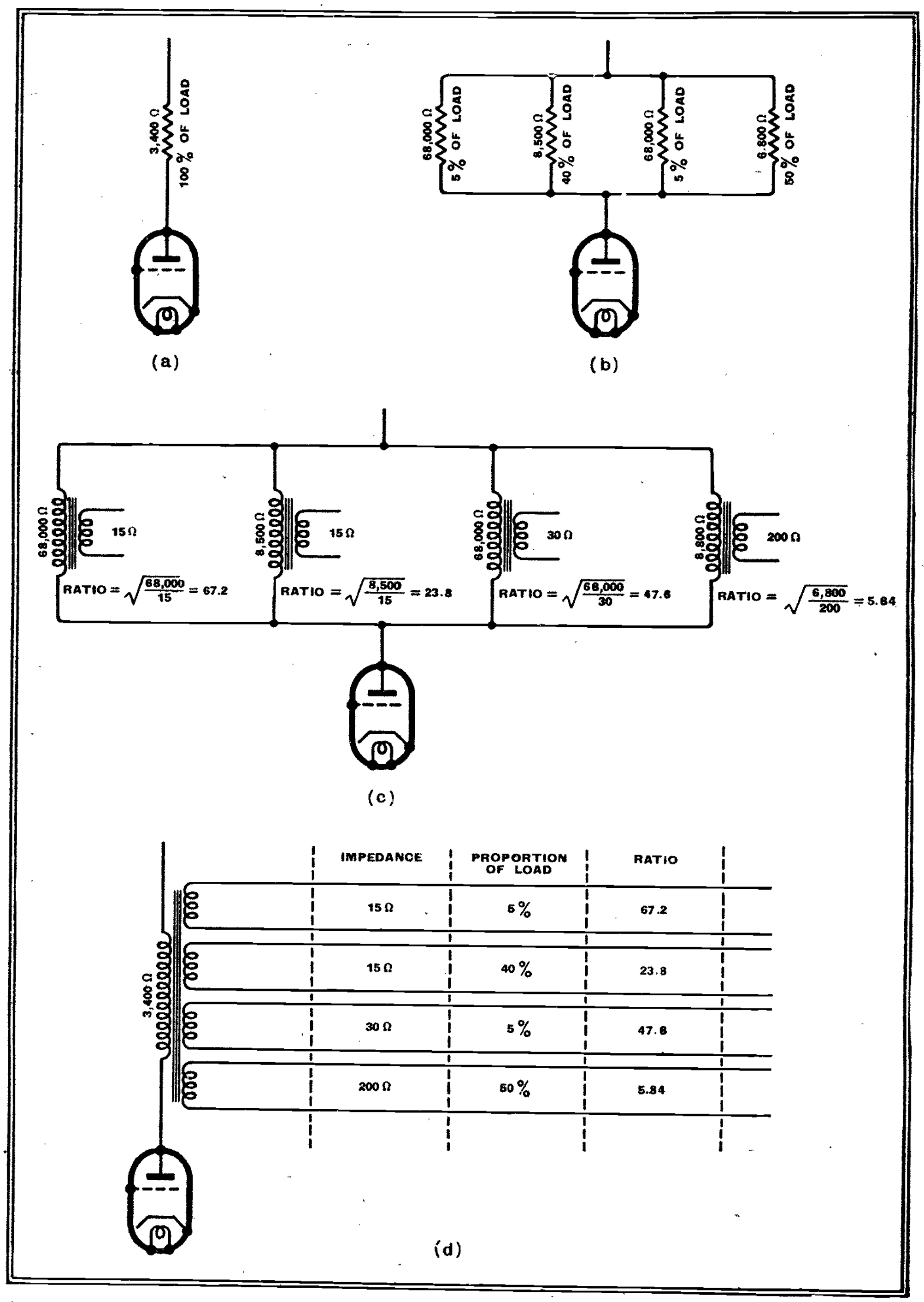


Fig. 4.—Explaining successive steps in solving the problem given at the opening of this article.

*The load impedances should be treated vectorially, but for obvious reasons this is not practical in the case of loud speakers and other electro-mechanical acoustic devices. The method employed assumes that the various loads have similar phase angles and it should be specially noted that it does not necessarily assume non-reactive loads.

Diverse Transformer Loading—

d (which being the last term is called "n" in the general statement) = 50, $Z_a=15$, $Z_b=15$, $Z_c=30$ and Z_d (or Z_n) $=200$. Direct substitution is the quickest way of arriving at the answer, but should be adopted only after one has thoroughly understood how the method was deduced from first principles.

A knowledge of the ratios alone is not sufficient to enable the transformers to be correctly manufactured. The gauge of wire with which the secondaries should be wound will depend upon the percentage of the total load to be handled as well as upon the load impedance. Another difficulty is to ensure tight coupling between all windings, failing which the various secondaries may give quite different frequency response curves. However, these matters do not properly belong here and must be left for another occasion.

Letters to the Editor

The Editor does not necessarily endorse the opinions of his correspondents

Wireless and A.R.P.

AS warden in a country parish some 40 miles from London, I find difficulties in conveying quickly to the scattered inhabitants the warnings received by telephone from the chief warden of the district concerning possible air raids.

Sirens are ineffective for various reasons, and few of the cottages have telephones. There remains personal communication by cyclists and motorists, which requires time. Most cottages and farms possess wireless sets, and this would appear, as far as country districts are concerned, to afford a means of quick communication from the nearest broadcasting station, provided the sets were kept throughout the night tuned to the necessary wavelength, when, in the event of necessity, the B.B.C. would put out an air-raid warning in the shape of some super-tuning note and the cost of keeping the sets running would be small compared with the importance of being ready to receive a warning at any moment.

Perhaps some of your technical readers may see their way to discuss the feasibility or otherwise of some such scheme.

C. R. PINDER, M.I.M.M.

Basingstoke, Hants.

Motor Car Interference

I SUGGEST that this problem might be more easily understood by both radio and automobile enthusiasts if they would compare the process of ignition to the projection of a weight, e.g., a shell or cannon ball.

In a car we desire to cause a spark to jump a gap. Mechanically this is similar to firing a shell, and it may be done in two ways, either by the slow building up of an adequate pressure confined so as to be applied to the projectile, or by the sudden release of pent-up energy contained, for example, in a spring.

The modern gun is the example of the confined application of pressure, the old Roman catapult is the example of the release of pent-up spring tension.

The arm of the catapult "whipped" after the release of the projectile, and it is this whipping which corresponds to the high-frequency surge of the present-day ignition system. Radio enthusiasts want to do away with this whip, and the solution is to be found in the gun or, in other words, the use of a higher voltage suitably damped.

This will probably mean oil-immersed ignition coils, better insulation, new plug designs and larger distributor heads, all adding expense to the car, so I do not expect an immediate adoption of really interference-free ignition systems on all cars. The solution of the problem, however, will probably improve car performance as well as reduce radio interference.

Swanley. H. G. P. TAYLOR.

I NOTICE that there has been in recent issues some comment on the possible effect of suppressors on the efficiency of car engines, and so give my own conclusions, reached after testing over a period of three years and some 60,000 observed miles.

One period (30,000 miles) was covered by a 9 h.p. o.h.v. engine and another period by a 16 h.p. six-cylinder s.v. engine. The effect of suppressors on the small engine was negligible as regards pulling power, but top speed was rather more difficult to reach; put another way, the pick-up from 40 m.p.h. to peak speed was certainly slower.

On the larger engine top speed was cut by about 5 m.p.h., but the general performance (pulling and acceleration) did not seem to suffer, probably due to the greater h.p. and the six-cylinder engine. A suspicion that I was having to use slightly more throttle caused me to check petrol consumption, and this, I found, had increased by about 2 m.p.g. on both cars. This was checked every 1,000 miles by doing about 100 miles on measured gallonage (no indicators used) without suppressors. Although the general consumption increased with the growing mileage of the cars, the difference without suppressors (i.e., 2 m.p.g.) remained constant. During the whole period of testing the ignition, i.e., plug points, contact-breaker, etc., were checked for correct settings at approximately every 500 miles.

I then carried out tests to find the effects of neglecting the plugs and contact-breaker as regards starting and misfiring. To my surprise, I did 12,500 miles without touching either plugs or breaker (the plugs had then done a total of 30,000 miles) until a broken exhaust valve brought the test to an end, the garage people cleaning and resetting the plugs, etc., when working on the engine. No misfiring was ever noticed and the engine started on the first press of the starter even during the coldest periods; in fact, the test only ended in the week following the very cold spell just before Christmas, when the plugs had reached over 12,000 miles.

To sum up, I am convinced that, taking all things into consideration, there is a loss of about 15 per cent. in engine efficiency, but it would seem to be a matter of increasing the cost, to the average motorist, on his petrol bill without other serious effects and of increased cost plus a cut in performance to the high-speed man. My personal feeling is that I would be well pleased to do without suppressors. J. QUARMBY.

Oldham.

Foreign Relays and Quality

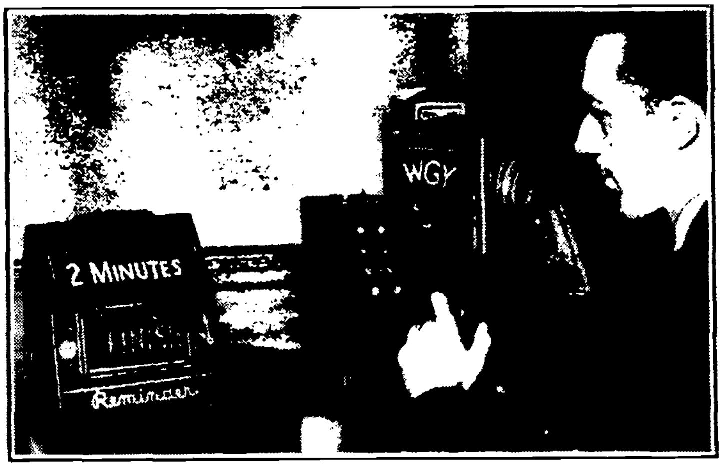
I SHOULD be interested if any reader could inform me as to how the recent relays from Germany of Henry Hall's Orchestra, and of the light orchestra on the morning of February 13th, were transmitted to this country.

The quality of reproduction of these transmissions, as received in South London via Brookmans Park, was extraordinarily fine. In view of the "quality" (courtesy title) which is normally available from our own broadcasting chain when anything more than a few miles of land line are involved, it was barely credible that the transmissions specified could have been "piped" along several hundred kilometres of land line!

In addition, the studios used on these two occasions were very pleasantly "live," and as a result, the music was airy and interesting. In many of our own broadcasts the matter sent out is handicapped from the start by production in studios that are too heavily damped. Judging from the published articles, the B.B.C. is aware of this deficiency, and it is to be hoped that the work of rebuilding existing studios will be accelerated. The inclusion of a little more "liveness," and attention to microphone placing, would often do much to render programmes as a whole more palatable.

I hope that some of our own engineers heard at least one of these transmissions and noted the effect produced. Broadcasts in Germany have long been noted for this kind of realism. "QUALITY LOVER."

London, S.E.26.



SPEECH TIMER. In addition to showing a broadcasting speaker when he is due to stop, this American (General Electric) device also gives him a warning to begin his peroration at a predetermined number of minutes before his time is up. In keeping with the tempo of American broadcasting, adjustments can be made in minutes and seconds.

HF Cables

CONSTRUCTION AND USE OF LOW-LOSS CONDUCTORS

By C. E. MAITLAND, B.Sc.
Baird Television, Ltd.

As is well known, ordinary cable as used for DC or mains frequency AC is unsuitable as a conductor for high frequencies. The design, construction and measurement of characteristics of low-loss HF cables are discussed in this article.

THERE is a growing use for cables working at high frequencies for such purposes as local television redistribution in flats or hotels, public demonstrations, transmitting, receiving and monitoring systems, and for a great variety of experimental and testing apparatus.

A knowledge of the general behaviour of these cables at ultra-high frequencies, and the effect of any particular construction on the electrical characteristics and its relation to the ultimate performance is very useful in gauging relative merits, and makes an interesting study.

First of the many features marking the difference between cables at high and low frequencies is the difficulty of reducing the attenuation of the signal. Losses in ordinary insulating materials, such as rubber, impregnated cotton or paper increase rapidly with frequency, and the need for careful measurement and selection soon becomes apparent.

To illustrate how this and other requirements call for a wide variety of construction, a drawing is shown of a number of typical high-frequency cables (Fig. 1).

No. (1) is a ⅜in. diameter lead cable with an inner conductor of 14/0.0076in. tinned copper strand supported in the centre of a thin strip of special low-loss rubber. This strip is given a slight twist along its length to centralise it, and this method of insulation reduces the amount of dielectric used, and with it the attenuation of the cable. There is little extra loss through using a sheath of lead instead of copper since the conductor resistance loss is largely due to the inner conductor, as this is of necessity small compared with the sheath.

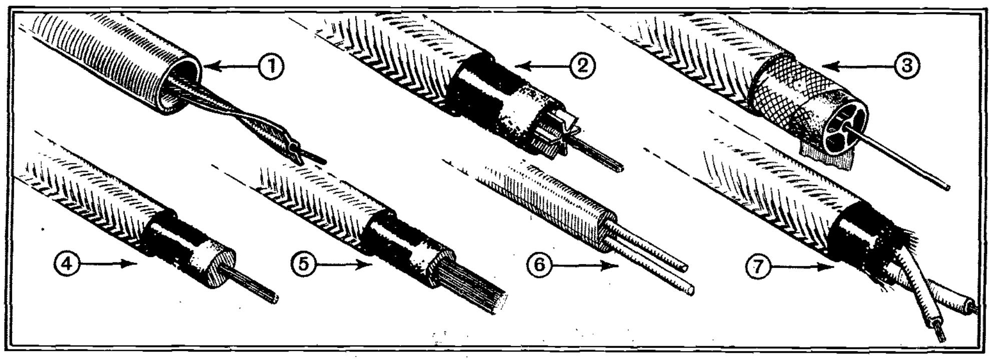
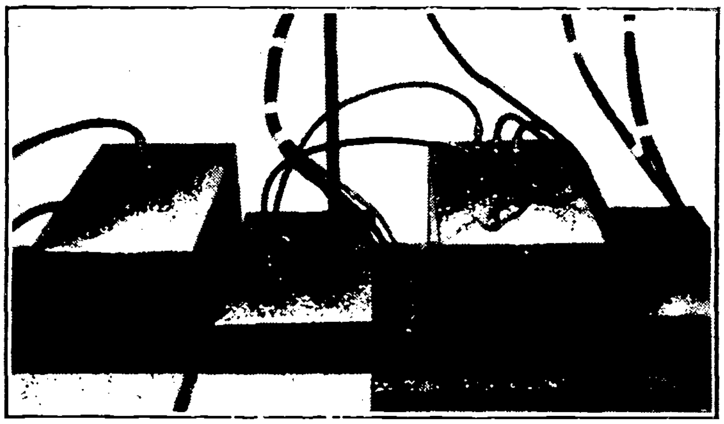


Fig. 1.—Construction of various single and twin cables as used for high-frequency work. Characteristics are given in the text.

No. (2) is a $\frac{7}{16}$in. diameter fully flexible cable employing a braided tinned copper sheath with a protective covering. The inner conductor is a 14/0.0076in. tinned copper strand supported in a ribbed section insulator of low-loss bitumen compound, the air spacing assisting in the reduction of loss.

No. (3) is a $\frac{7}{16}$in. diameter cable with a 3-star section insulator of very open construction, in the centre of which runs a 0.015in. diameter aluminium wire. The sheath in this case consists of a wrapping of aluminium foil, covered with an open mesh tinned copper braid. Two features of this cable are high characteristic impedance and the light weight of conductor and sheath.



Photograph showing some of the high-frequency cabling of the Baird system of local redistribution of the Alexandra Palace television programmes, and generation of a 50-frame, 405-line interlaced still picture, both being distributed by line at a frequency of 45 megacycles.

No. (4) is a flexible cable similar to No. (2), but with a diameter of $\frac{5}{16}$in. and solid insulation. This has the advantage of being more compact than previous types, but as the size of the insulator is too small to allow of air spacing, the loss is correspondingly higher.

No. (5) is similar to No. (4), but has a specially large inner conductor of 110/0.0076in. tinned copper strand to give a low characteristic impedance, as is required where one line is used to connect a number of other lines in parallel direct to the supply. In this case the main requirement of the insulator is that it is tough enough to prevent short circuiting of the cable when flexed; the loss is rather high.

No. (6) is a very simple type used largely for aerial connection between a dipole and receiver, and consists of two close spaced 20 SWG enamelled copper wires with a moulded rubber covering. This differs from all previous types in having no screening, and also in being suitable for use with balanced circuits instead of unbalanced circuits.

No. (7) is a $\frac{7}{16}$in. diameter flexible cable with a braided tinned copper sheath and two inner conductors of 23/0.0076in. tinned copper strand. Each conductor is separately insulated with a solid layer of low-loss bitumen compound, and they are then twisted together with jute.

Calculating Losses

These examples show a number of methods of reducing dielectric loss, and how other requirements may add to the difficulty of achieving this. It is thus useful to be able to find the amount of loss to be expected under given conditions, and this is given very accurately by the following formula for high-frequency cables.

$$A = \frac{R}{2}\sqrt{\frac{C}{L}} + \frac{G}{2}\sqrt{\frac{L}{C}}$$

where A is the attenuation per unit length in Nepers.

R is the total high-frequency resistance of both outer and inner conductor per unit length in ohms.

C is the capacity per unit length in farads.

L is the inductance per unit length in henrys.

G is the conductance per unit length of mhos.

(For conversion to loss in decibels, 1 Neper = 8.68 decibels.)

In this equation the dielectric loss is

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given by the second term on the right-hand side. From this formula the effect of different quality dielectrics on the total loss of a typical cable is shown in the accompanying graph (Fig. 2).

Considering next the loss caused by the conductor resistance, it would seem that the simplest way of reducing this would be to increase the size of the inner conductor until the loss reached a low enough value. But, paradoxically enough, this may actually increase the loss instead of reducing it.

The explanation of this effect is that the characteristic impedance of the cable is lowered as the size of the inner conductor increases, and for the same output the cable will have to deal with higher currents and lower voltages. As a consequence, the I^2R loss in the cable will increase and may eventually predominate. The effect is accentuated by the fact that the resistance of the inner conductor, owing to the high-frequency skin effect, is inversely proportional to its diameter and not to its cross-sectional area, and the drop in conductor resistance is of less effect than that of the lowered characteristic impedance.

There is thus a certain optimum relation between sheath and inner conductor diameter to give a minimum total loss. The relation between this diameter ratio and the cable loss, and also the characteristic impedance, is shown graphically in Fig. 3, from which it will be seen that a

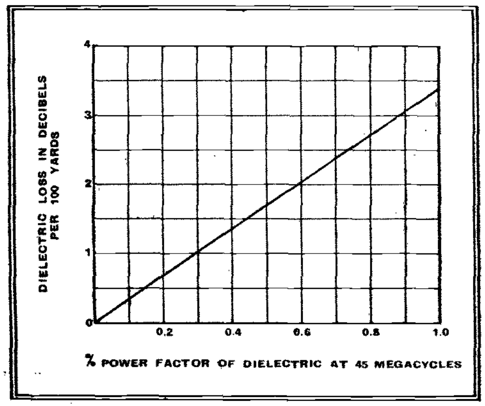


Fig. 2.—Showing the effect of different dielectrics on cable losses. Cable constants: L, 0.46 microhenrys per yard; C, 46.4 m-mfds. per yd.; Z, 100 ohms.

concentric cable with copper sheath and inner conductor will have a minimum high-frequency loss when the ratio of the inside diameter of the outer sheath to the diameter of the inner conductor is 3.59 to 1, and that its characteristic impedance will be 76.6 ohms.

Of next importance to obtaining suitable characteristics in a cable is their measurement; the two essential qualities are characteristic impedance and loss.

A simple and reliable method of measuring the first of these is by calculation from measurements of inductance and capacity made on an ordinary high-frequency bridge.

A yard or so of the cable forms a convenient length for measurement, and will give values within the range of most bridges, and if the measurement is made at a relatively low frequency, say, at one megacycle, this length will be sufficiently

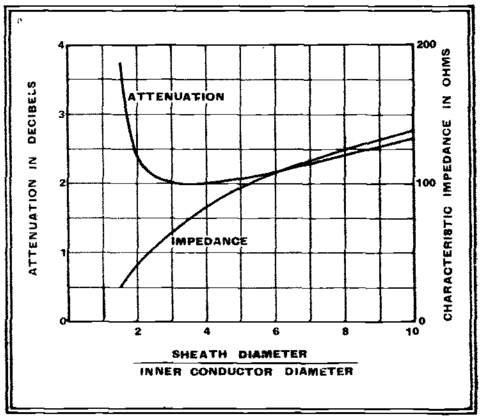


Fig. 3.—Cable attenuation and characteristic impedance for single concentric cable with sheath and inner conductor of copper. For convenience a dielectric constant of unity is assumed in estimating impedance.

remote from a quarter-wavelength to avoid unwanted resonance and consequent fictitious results.

The characteristic impedance Z is given in ohms by the formula

$$Z = \sqrt{\frac{L}{C}}$$

where L is the inductance per unit length of the cable in henrys and C is the capacity of the cable per unit length in farads.

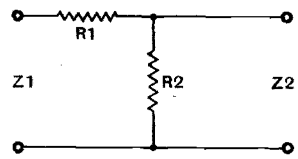
In connection with the characteristic impedance, an important point arises which bears on measurements of attenuation. These latter are usually made with apparatus of fixed input and output impedances, thus involving some means of matching when connected to cables of widely differing characteristic impedance.

Error Through Reflections

An incorrect termination to the cable will result in reflections which can introduce large error into the measurement, especially in the case of a high quality cable where the normal attenuation will be a small quantity. To overcome these difficulties, matching networks of the type illustrated in Fig. 4 will provide a correct match between two impedances of any value, so long as the network resistances are chosen in accordance with the table given, and the two impedances are purely resistive, or at any rate negligibly reactive.

With correct termination obtained in this way, cable attenuation can be measured by the use of a signal generator and a sensitive indicator, such as a field strength measuring unit. Readings are taken of the strength of the signal to give a certain deflection on the indicator, and of that required to give the same deflection when the cable is inserted in the circuit. If the ratio of these two inputs is (n), then the cable loss is 20 Log_{10} (n) decibels.

An example is shown in the photograph of this measurement being made at a frequency of 45 megacycles, in which is also illustrated the use of special concentric plugs and sockets for rapid connection and the maintenance of adequate screening. This has a further advantage that an extra short length of a yard or two of cable can be plugged into the circuit as a simple



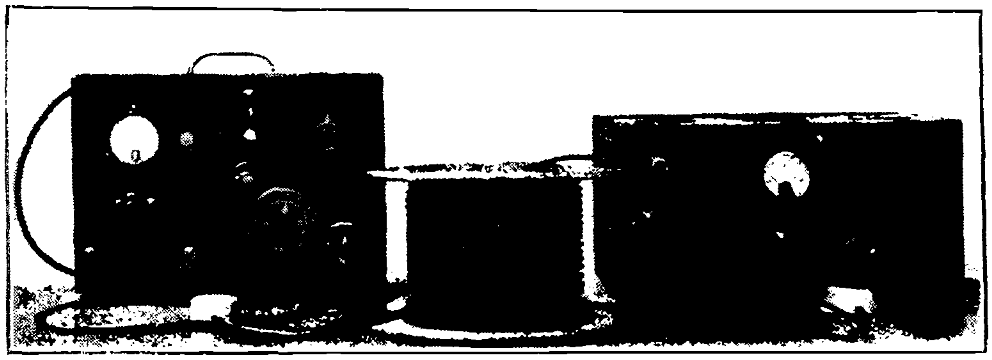
The table given below shows the values of R_1 and R_2 required for various values of Z_2 with a fixed value of Z_1 of 100 ohms. Resistance values for cases where the higher impedance Z_1 is not 100 ohms can be found quite simply; thus, if Z_1 = 50 and Z_2 = 5, then taking the figures for R_1 and R_2 for Z_1 = 100 and Z_2 = 10, and dividing by two, the required values are found to be 47.5 and 5.2.

Z_2	R_1	R_2	Network loss in decibels Z_1 to Z_2	Network loss in decibels Z_2 to Z_1
10	94.9	10.4	5.80	25.8
20	89.4	22.5	5.54	19.5
30	83.7	35.8	5.30	15.2
40	77.5	51.4	5.00	12.9
50	70.7	70.7	4.64	10.6
60	63.2	95.3	4.24	8.66
70	54.8	127.5	3.80	6.88
80	44.7	179.0	3.20	5.12
90	31.6	285.0	2.36	3.28
100	0	∞	0	0

Fig. 4.—Network for matching unequal impedances. It will be noted that the network loss is based on the voltage ratio and is thus not the same in the two directions.

check on correct termination and absence of reflections, which, if present, would be indicated by sudden variations of loss with changes of total cable length instead of a gradual change.

The cables shown in Fig. 1 have been



Apparatus for the measurement of cable losses.

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measured in this way, and the results are given in the accompanying table.

Cable No.	Inductance in micro-henrys per yard.	Capacity in micro-microfarads per yard.	Character-istic impedance in ohms.	Loss in decibels per 100 yds.
1	0.53	39.7	115	4.0
2	0.46	46.4	100	3.0
3	0.77	28.2	165	4.5
4	0.37	75.0	70	14
5	0.173	180	30	34
6	0.40	70.0	75	11
7	0.66	50.0	115	11.5

It will be seen that the general standard of these cables, which are typical of those in use to-day, is good, and in the case of the cable with the highest loss, reference to the graph of Fig. 3 will show that this is to be expected.

With a large number of different uses, there is a corresponding variety in these cables. A high-impedance cable such as No. 3 is useful where a cathode-coupled valve output circuit is employed, since the impedance of the valve circuit is in most cases above 150 ohms and a high impedance cable is best suited. Again, transformation from one impedance to another is often effected by means of a quarter wavelength of a cable of characteristic impedance which is the geometric mean of the two impedances to be coupled. In such cases it is useful to have a selection of cables of various impedances to provide the correct transformation.

These examples could be further multiplied, but sufficient has been outlined to indicate the many features in high-frequency cables of interest in the field of ultra-short-wave work, and that the future will see many fresh applications.

In conclusion, the author would like to express thanks to Messrs. Baird Television, Ltd., for permission to publish this article.

Random Radiations

By "DIALLIST"

With Care

"A GRAND piano has arrived for you by rail," announced my wife when I came in the other day. Grand pianos are not up my street, but wireless sets are, and I gathered that an out-sized specimen of these must have turned up. And, sure enough, it was so. Going out to the shed I beheld a gigantic packing case which looked almost big enough to contain a billiard table. Equipped with hammer and case-opener, I set about it. The Eddystone people don't intend their receivers to suffer in transit, as you'll realise when I tell you that my first task was to remove forty-two two-inch nails securing the lid. Inside was shavings enough to bed down a couple of dray horses, and, nestling beneath that, two stout cartons. I opened the first and found that it was but an outer sheath; there was another inside it. Within that, packed tight by cardboard buffer things, was a communication receiver. Package No. 2 held the loud speaker.

An Adventure

Personally, I'm all for that kind of packing for wireless sets, even if it does take a bit of undoing in order to get at the contents. That set certainly arrived without so much as a scratch, and I should think that so packed it could go anywhere in the world safely. I'm always rather afraid of sets that come packed in nothing but a single flimsy carton, especially if the latter is of the kind whose top and bottom are fixed to slim wooden battens by small nails. One of these once put the wind up me badly. I was returning an expensive set after trial and thought that the safest way of getting it to London was to take it with me the next time I went there. I saw it safely into the van, adjuring the guard to treat it gently. Arrived at Eusterloo, I secured a hefty-looking porter and went to see that he handled the thing with care. He lifted it from the van, and as he held it in his arms there was a sudden awful rending sound. The bottom tore clean out of the carton and the set descended on to the stone platform with a crash that made my blood run cold. It didn't seem as though there could be a whole component or a sound connection left in it. However, when it came subsequently to be examined, the damage was found to be no more extensive than one valve with rather badly bent internals and one broken lead.

The Voice of France

THE other day when Mrs. Diallist was giving a bun fight, one of her guests, knowing no doubt how busmen traditionally take their holidays, drew me into conversation on the subject of wireless. She was loud and enthusiastic in her praise of the programmes from the French stations and others joined her in maintaining that you were nearly always certain to find something good going, no matter which station you tuned in or what the time might be. As I was sceptical I was urged to prove the pudding by the eating by tuning in then and there any French station that I liked. Bordeaux-Sud-Ouest happened to be nearest to the pointer's position on the dial; so I made the necessary movement of the tuning knob and switched on. There was the usual waiting for the valves to warm up. Then spake the announcer in a voice of thunder: *"Mesdames, Mesdemoiselles, Messieurs, souffrez-vous de la constipation sans le savoir?"* I fled to answer a completely imaginary summons from the telephone bell!

In For It

THAT horrible word "video" will, I am afraid, soon become part and parcel of the English language to describe the vision side of wireless broadcasting. The Americans have adopted it whole-heartedly and they are pretty well bound to pass it on to us. Much as I like Americans I can never quite forgive them for the unkind things that they've done to written and spoken English. I wish that they could keep "video" on their side of the Atlantic, but that's probably too much to hope for.

High-voltage Lighting

AMONGST the diversions provided by my Sunday paper was a paragraph about what was described as "an insulated boy," who was stated to have "powers of resistance to electricity equal to those of ten grown men." Thrilled by this promising beginning I read on. The youngster, I learnt, had been unfortunate enough to play with a telephone wire which had somehow become draped over the cables of a power line. Thereupon "7,000 volts flashed through his body and burnt the ground on which he was standing." But such was the lad's insulation(!) that he was merely rendered unconscious, badly burnt about the body and deprived of all the fingers of his right hand. To drive home his point the writer added that 7,000 volts would be sufficient to light every house in the village. More than sufficient, one would imagine, unless insulation of the village houses is also of some phenomenal kind! It's astonishing, in this electrical age, that the lay reporter who essays to write anything on the subject can seldom dip his pen in the inkstand without putting his foot in it.

Movie Television

IT is announced that the big fight to-night for the Lightweight Championship, between Eric Boon and Arthur Danahar, will be shown on the screen by means of television at two of London's cinemas. It isn't, of course, the first time that an important sporting event has been shown on the ciné theatre screen in this way; but it is, nevertheless, a milestone in the history of television, for these two theatres are the first of a big "chain" that will shortly be equipped for giving regular items by television. If the results are satisfactory, as no doubt they will be, the effects on the development of vision broadcasting may be far-reaching. It has been stated that if the B.B.C. had not given permission for the fight to be shown in movie theatres, the promoters would have refused the Corporation permission to televise it at all.

The Tables Turned

If the ciné theatres take up television on the grand scale, a rather curious position may result. In the past, proprietors of theatres and music-halls have been chary at times about allowing their programmes, or parts of them, to be broadcast from the "sound" stations. They felt that such broadcasting might result in people staying at home and hearing the performance for nothing with the aid of the loud speaker instead of going to the playhouse and paying their way. It was this fear which prevented the broadcast of the last Command Variety performance. Are we going to see the tables turned in television? Will the B.B.C. and the radio manufacturers become apprehensive that the reproduction of vision programmes in movie theatres may deter numbers of folk from buying vision receivers of their own? I don't think that there had need be any such fears, for it seems unlikely that whole television programmes will be reproduced at the theatres. If their borrowings from the vision programmes are confined, as probably they will be, to sporting events and certain O.B.'s, these may serve to whet the appetite of the public for television rather than to satisfy it.

The Thin End of the Wedge?

At the same time, I must confess that I hardly like the idea that the B.B.C.'s hand was, or could have been, forced in the matter of granting permission for the showing of the fight in ciné theatres. It opens all kinds of possibilities, some of them not exactly desirable. One wouldn't, for instance, like to see the B.B.C. being more or less compelled to transmit from the Alexandra Palace things that, for good enough reasons, it was loth to televise. The position of the Corporation should be strong enough to enable it to make a firm stand where necessary, and it has learnt by this time to beware of the thin ends of wedges.

A Curious Parallel

LISTENING the other night to a lecture on the destructive effects of high explosives, I was very much struck by the parallel that there is between these and certain wireless effects. As you know, a high explosive bomb gives rise to what is known as blast, or a "shock-wave." Graphically, the pressure part of the shock-wave rises very rapidly—almost vertically—to a sharp peak and then falls less rapidly to zero. Then comes the "suction" part, which is a long and rather shallow trough. The wave-form is, in fact, almost exactly similar to that of certain typical atmospherics. Atmospherics shock-excite our aerials, causing them to vibrate at their natural frequency; the shock-wave of a high-explosive bomb has almost exactly the same effect on buildings. Luckily, atmospherics are not of sufficient magnitude to disintegrate our aerials and the receivers attached to them!

The Mellow Tone

YOU don't, I think, come across nowadays quite so many receivers as you used to which achieve what is popularly known as the mellow tone by making full use of bass resonances and suppressing the upper audio frequencies *en masse*. Listeners have come to realise that, however majestic the carpet-beater kind of bass may sound when an orchestra is at work, severe cutting of the upper audio frequencies can make speech distinctly difficult to follow. I used to find that whenever I tried one of the more popularly priced receivers I invariably turned the tone control (if there was one) as far as it would go from the low-pitched end of its travel—and then wished that it would go a good deal farther. Lately I've come across several sets of this class which left me without that wish; in fact, I have been able to use them without turning the control hard over against its clockwise stop.

Why the Late Hour?

ON several evenings every week I'm annoyed by announcements in the nine o'clock news bulletin to the effect that interesting talks or eye-witness descriptions of events that matter will be given in the fourth news bulletin, which starts at ten o'clock. I believe that the statistics of the B.B.C.'s Listener Research Department shows that the fourth news bulletin has the smallest audience of any. I don't know the figures, but I should be inclined to think that, on the average, the number of people who listen to it is not much over a quarter of those who tune in the third news at nine. Listeners who have to be up betimes in the morning are either in bed or on their way there; whilst those who, like myself, seldom spring from their couches to greet the dawn, have settled down to a quiet hour or so of reading. And so all those thrilling things offered in the fourth news go largely unheard just because the time when they are broadcast is convenient to so few. Wouldn't it be a much better idea if some of the most attractive of them could be given immediately after the third news? Those who didn't want to listen, feeling that they'd had enough of news, and so on, could always switch over to the Regional programme. I am sure that if the B.B.C. could hear the groans and the cuss words that are uttered when they tell us that something that we very much want to hear is going to be given after ten o'clock, they'd take this plea to heart and do something about it.

News from the Clubs

Ashton-under-Lyne and District Amateur Radio Society

Headquarters: Commercial Hotel, 86, Old Street, Ashton-under-Lyne.
Meetings: Alternate Wednesdays at 8 p.m.
Hon. Sec.: Mr. K. Gooding, 7, Broadbent Avenue, Ashton-under-Lyne.

The number of members is now approaching the fifty mark. 2CDY has now obtained the call of G6DV. Several stations have changed their aerials to the W3EDP type, and report improved results over the popular end-on Hertz. The Society is now affiliated to the R.S.G.B.

In the near future it is hoped to have a demonstration of several Eddystone short-wave receivers. For the benefit of beginners a programme of lectures is being mapped out. These will deal with the fundamentals of short-wave radio.

Brentwood and District Radio Society

Headquarters: "Old Basing," Alwyne Avenue, Shenfield.
Meetings: First and third Thursday of each month.
Hon. Sec.: Mr. B. A. Pettit, "The Laurels," Worrin Road, Shenfield.

At the Annual General Meeting the officers for 1939 were elected. The Society's transmitter, G8HV, is active on 160 metres and reports would be welcomed of transmissions on 1,806 kc/s. The Society produces its own journal every month.

Exeter and District Wireless Society

Headquarters: Y.W.C.A., 3, Dix's Field, Southernhay, Exeter.
Meetings: Mondays at 8 p.m.
Hon. Sec.: Mr. W. J. Ching, 9, Sivell Place, Heavitree, Exeter.

On February 13th Mr. Cornish, of the General Electric Co., gave an interesting lecture on "Short-wave Aerials," and on February 20th Mr. G. S. Bradley talked on "Ultra-short-wave Communication Links." On February 27th a visit is to be paid to the telephone exchange by kind permission of the Exeter Postmaster.

Eastbourne and District Radio Society

Headquarters: The Science Room, Cavendish Senior School, Eastbourne.
Hon. Sec.: Mr. T. G. R. Dowsett, 48, Grove Road, Eastbourne.

At the last meeting of the Society Dr. E. W. Smith, of the Telegraph Construction and Maintenance Co., Ltd., gave a lecture entitled "Telcon High-Frequency Cables." In his lecture he went into the whole question of the design and construction of cables for high-frequency work, and gave many interesting demonstrations to illustrate his points.

Croydon Radio Society

Headquarters: St. Peter's Hall, Ledbury Road, South Croydon.
Meetings: Tuesdays at 8 p.m.
Hon. Pub. Sec.: Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

In his radio reminiscences given at the last meeting Mr. H. Bevan Swift dealt with the whole history of the amateur movement and of the early days of broadcasting.

At the next meeting, to be held on February 28th, a representative of Everett Edgcumbe, Ltd., will give a lecture on "Radio Servicing Instruments and their Uses."

The Medway Amateur Transmitters Society

Headquarters: The Navy Wives' Club, Dock Road, Chatham.
Meetings: Tuesdays at 8.15 p.m.
Hon. Sec.: S. A. C. Howell, "Veronique," Broadway, Gillingham.

The annual meeting was held on January 3rd. On January 10th a lantern lecture was given on "The Use of Cathode Ray Tubes in Television." Mr. J. E. Bryden was the lecturer, and he used slides lent by the Edison Swan Electric Co. On January 17th Mr. Greaves, of the Mullard Wireless Service Co., Ltd., dealt with "Thermionic Valves," and on January 31st Dr. F. C. Stephan, of the Telegraph Condenser Co., Ltd., lectured on the subject of "Condensers."

Sussex Short-wave and Television Club

Joint Hon. Secs.: Mr. C. J. Rockall, "Aubretia," Seafield Road, Rustington; Mr. E. C. Cosh, "Anslyn," Mill Road, Angmering.

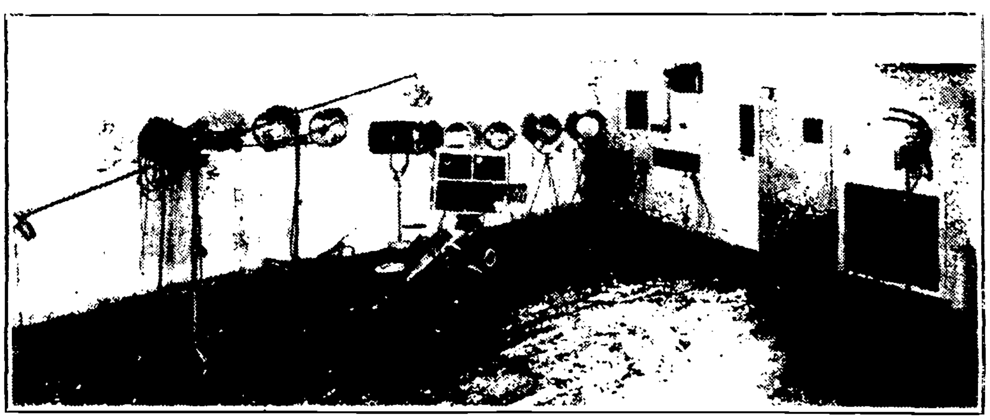
Recent events have included lectures by representives of Standard Telephones and Cables, Ltd., and Voigt Patents, Ltd. The Society have also paid a visit to the Portsmouth Technical College. The programme arranged for the next few months is as follows:—

February 24th.—Lecture by Mr. C. Charman, entitled "Aerials from the Amateur Standpoint."
March 9th and 23rd.—Morse Class.
March 28th.—Lecture by R. F. Hansford, entitled "The Cathode Ray Tube."
April 6th and 20th.—Morse Class.
May 4th and 18th.—Morse Class.
June 1st.—Morse Class.

HENRY FARRAD'S SOLUTION

(See page 177)

FROM the fact that the set was working when being carried about it can be concluded that it is battery-driven. If Mrs. Midget was so naïve in her surmise concerning the cessation of reception—and there are still some like her even at this date—it is fairly safe to conclude that she knows nothing about the necessity for recharging LT cells. The symptoms are quite consistent with this explanation.



THE SOUND STAGE of the new B.T-H. film laboratory at Rugby, where the latest equipment for processing and printing 16-mm. and 35-mm. sound film has recently been installed; facilities for the post-recording of sound on "silent" film is included. As the four walls of the studio are differently treated variations in acoustic conditions can be obtained by changes in working position on the floor.

Recent Inventions

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section

WIRELESS IN THE STRATOSPHERE

THE invention is concerned with a short-wave wireless outfit for use, say, on a stratosphere balloon, where the aerial normally projects outside an all-metal nacelle or cage and so is not accessible from inside. In these circumstances, if the exposed aerial should freeze over when in the stratosphere, or if it should be deformed or damaged in the process of taking-off, the wireless transmitter is automatically put out of action.

To prevent this, means are provided for casting off the damaged aerial and replacing it by a new one, from inside the cage, without losing either heat or oxygen from the latter. The spare aerial, which for use with "centimetre" waves may be of the herring-bone type, is collapsed like an umbrella, and is passed through an airlock tube from inside. As soon as it emerges into the open the ribs automatically open out by spring action. The outer mounting may be made with a universal joint so that the aerial may be "pointed" in any desired direction.

O. Bormann and J. Pintsch Kom-Ges. Convention date (Germany), March 13th, 1936. No. 495019.

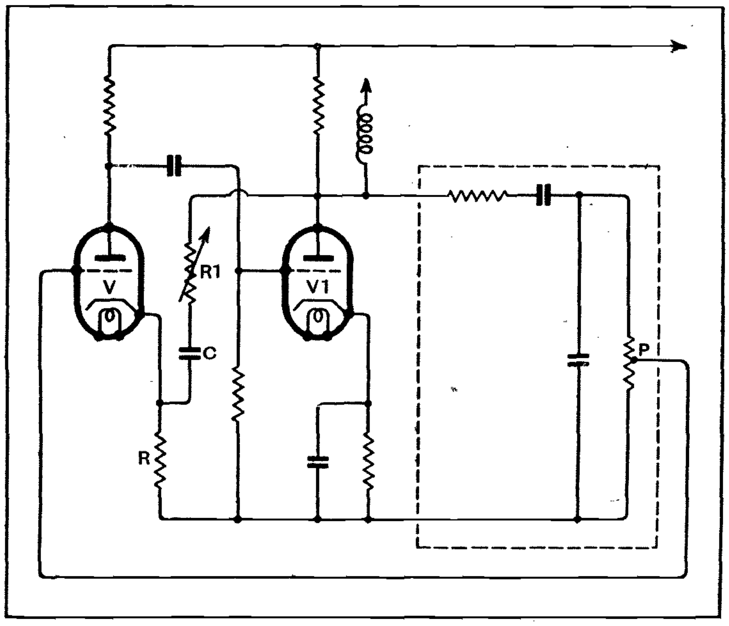
o o o o

VALVE COUPLINGS

AN amplifier is back-coupled through a filter circuit consisting of a non-resonant combination of resistance and reactance in order that the feed-back may give "zero" phase-change for a selected frequency, and a phase-change which varies in opposite senses for frequencies on either side of the one selected. In addition, a negative feed-back is supplied from a fractional part of the output voltage. The arrangement is designed to generate, or selectively amplify, oscillations of substantially pure sinusoidal waveform.

In the Figure, the parts shown inside the dotted-line square form a "filter" output circuit, from which voltage is fed back from the point P to the grid of the first valve V. A fraction of the output voltage is also fed back from the valve V1 through a variable resistance R and condenser C to a resistance R1 in the cathode circuit of the valve V. By varying the value of the resistance R, the amount of feed-back can be adjusted, so that the circuit acts either as an oscillation-generator or as a selective amplifier.

P. W. Willans and Muirhead and Co., Ltd. Application date, April 12th, 1937. No. 497148.



Feed-back circuit for generation or selective amplification of oscillations.

o o o o

CATHODE-RAY TUBES

A CATHODE-RAY tube is formed with three or more glass stems which are arranged symmetrically around the centre glass bulb. The object is to allow the primary stream of electrons to be strengthened by successive stages of secondary emission.

The picture to be televised is focused upon a photo-electric cathode mounted at the end of one of the stems. The resulting stream of primary electrons is then drawn forward by the voltage of the adjacent anode until it reaches the centre of the glass bulb. Here the magnetic field from an external winding deflects the stream into one of the other stems, which contains, at its far end, a secondary or target electrode.

The impact of the primary stream against this target liberates secondary electrons which are similarly drawn forward by the voltage of a near-by anode towards the centre of the bulb. Here the amplified stream again enters the magnetic control field, but, since its direction of travel is now different, it will be differently deflected towards a third stem containing a third target electrode. The process can be repeated indefinitely, or until the amplified stream reaches the required strength.

The British Thomson-Houston Co., Ltd. Convention date (Germany), July 30th, 1936. No. 497160.

o o o o

AUTOMATIC "QUALITY" CONTROL

AUTOMATIC selectivity control operates to increase the width of the side-bands admitted to a set when the carrier-wave is strong, as it is when receiving from a near-by station. Conversely, for distant signals the admittance band is narrowed down, so that although the quality may fall off, selectivity is improved. Reproduction, in the latter case, is unfavourably affected by the increased attenuation of the outer side-band frequencies relatively to those nearer the carrier-wave. This effect is most noticeable in the sharply tuned IF stages of a superhet set.

According to the invention, a negative feed-back is established between the second detector and the preselector circuits of the set, through which voltages corresponding to the rectified signals are applied in phase-opposition to the incoming signals. The object is to increase the modulation depth of the outer side-band components relatively to those lying nearer the carrier-wave. This offsets the subsequent attenuation that must be expected in the IF stages, and so gives a flatter frequency response and a corresponding all-round improvement in the quality of reproduction.

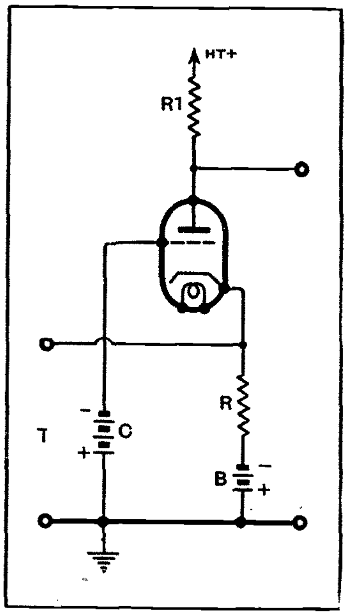
Hazeltine Corporation (assignees of A. Vivian). Convention date (U.S.A.), August 13th, 1936. No. 493477.

o o o o

TELEVISION AMPLIFIERS

THE ordinary single-valve amplifier introduces a phase-difference of 180° between the input and output signals. This phase-reversal has little significance when the valve is handling sound signals, but in television it has the effect of converting a positive into a negative image. The proper phase can, of course, be restored by passing the signals through a second amplifier, but a more economical remedy may be desirable.

According to the invention, a single-valve amplifier is arranged to eliminate the phase-reversal in question. As shown in the Figure, television signals over a wide band of frequencies are fed from a low-impedance transmission line through terminals T to a resistance R in the cathode lead of the amplifier. The resistance should have a value which is large compared with the reciprocal of the mutual conductance of the amplifier, and is arranged in series with a battery B which neutralises the effect of the current flowing through the valve, so that normally there is no potential drop across it. Under these conditions the output signal in the anode resistance R1 will maintain the phase of the input signal. The grid of the amplifier is earthed through a biasing battery C.



Avoiding phase reversal in an amplifying stage.

E. L. C. White and J. Hardwick. Application date, March 6th, 1937. No. 496872.

o o o o

PROGRAMME INDICATORS

A FRAMED indicator is arranged to display the item being broadcast, at any given hour, from any one of a selected list of stations. On the front of the casing is a sheet on which a list of transmitting stations appears in a vertical column, with the programme items set out in a horizontal line against each. The horizontal spacing is divided into twenty-four divisions, one to each hour of the day, these being marked at the top of the casing.

A pointer is moved by a clock-driven band along the horizontal "hour" slip, and serves to show the particular item being broadcast at any given hour, and also to indicate the time of day. The "hour" slip is preferably made as a continuous band, which is fitted with two pointers, so that one is visible on one day, and the second on the next day. The clockwork drive may be fitted with an alarm, which can be set to give audible warning of any particularly desirable item.

J. C. Rogerson. Application date, September 15th, 1937. No. 496837.

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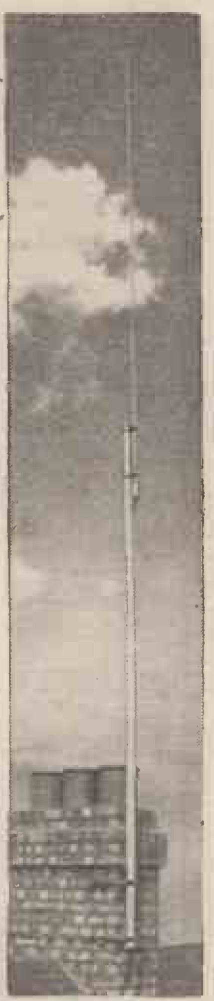

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(Associated with PYE Ltd.)

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RS639 — Illustrated 8 stages, 6 valves, 4 wavebands, for AC Mains.

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ADVERTISEMENTS for these columns are accepted up to FIRST POST on MONDAY MORNING (previous to date of issue) at the Head Offices of "The Wireless World," Dorset House, Stamford Street, London, S.E.1, or on SATURDAY MORNING at the Branch Offices, 8-10, Corporation Street, Coventry; Guildhall Buildings, Navigation Street, Birmingham, 2; 260, Deansgate, Manchester, 3; 26b, Renfield Street, Glasgow, C.2.

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NEW RECEIVERS AND AMPLIFIERS

*DEGALLIERS Ltd.—See our advertisement on Inside Back Cover. Also classified advertisement Surplus Receivers.

NOTE New Address.—31, Craven Terrace, Lancaster Gate, W.2. Paddington 2745. [7934

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ALBA, Ferguson, Ever-Ready, Halcyon, Portadyne, Sparton, Spencer and other first class makes always in stock; wholesale only.—Trade enquiries to Leonard Heys, 36, Henry St., Blackpool. [0610

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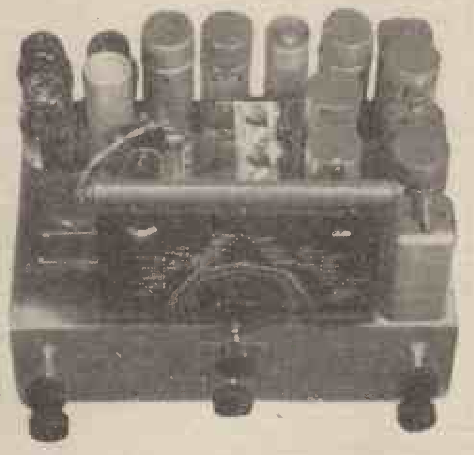

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The Wireless World

TEST REPORT, Jan. 5th, 1939

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V

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BRITISH Belmont 8-valve Plus Magic Eye All-wave A.C. Superhet Chassis, 4 wave-bands, two short, medium and long, fitted latest Mullard octal base American type valves. Brief specification: Short wave 6-18 metres (covers television sound), short wave 2, 18-50 metres, medium band 200-550 metres, long 900-2,000 metres. Valve combination 6K7, Pre H.F., 6J7 oscillator, 6J7 mixer, 6K7 I.F., 6Q7 (DDT) detection, A.V.C. and first L.F. two 6F6s parallel output, 5Y3 rectifier, plus 6G5 Magic Eye visual tuning, handsome dial, station names etched on glass; controls 2-speed tuning, volume and on/off, combined variable tone control and selectivity switch wave change plus gramo. switch. Size of chassis, 13½in.×10in.×3in. Supplied complete with valves, escutcheon, knobs and chassis bolts, but less speaker; £5/19/6 each.

COMPLETE Receiver in Handsome Walnut Cabinet, details as above, complete with speaker: £7/7 each.

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DECCA 6-valve 3 Wave-band Battery Chassis, fitted complete with Mazda and Osram valves, QPP output; these chassis give a sparkling performance on all wave-bands, and are the product of a well-known manufacturer; complete with valves, £3/3 each.

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B.I. 25 Mfd., 25-volt, wire end tubulars; 6d. each.

B.I. 4 Mfd., 200-volt, wire end tubulars; 10d. each.

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PLESSEY Rotary Switches, make and break Yaxley type, 18 contact; 4d. each.

PLESSEY Rotary Switches, make and break Yaxley type, 6 contact; 3d. each.

RADIO Clearance Bargains Continued in Third Column.

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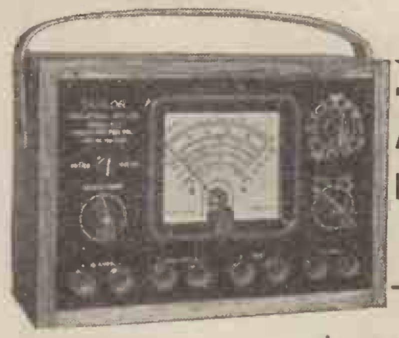

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is a fully guaranteed precision-built instrument. Although its cost is unusually low for such a comprehensive meter, its sensitivity, accuracy and reliability leave nothing to be desired. Fitted with a sturdy 4½" moving coil jewelled movement it covers D.C. volts 0.002-2,000; A.C. Output and volts 0.2-2,000; D.C. Current 10μA-20 amps; A.C. Current 10μA-5 amps; Resistance 0.1 ohm-5 megohms; with internal battery. Output—18 to +60 D.B. at the touch of two switches, and an adaptor is available to increase the voltage range to 5,000-10,000 A.C. and D.C.

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SPECIFICATION: *Extremely high sensitivity; Input Impedance 22 ohms; Maximum Input 500 milliwatts; Frequency characteristic ± 10 dB from 100 to 6,000 c.p.s.; Weight 6 ozs. earpiece only, 16 ozs. double earpieces with band. Double earphones with headband, £9 0 0. Single earphone with moulded handle, £4 4 0.*

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8+4+4+4 Mfd., 570v. working, +4 mfd. 300v. working, metal case, size 2½in.×1½in.×4½in., common negative; for E.M.I. replacements, etc.; 3/- each.

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8 Mfd., 450v. working, +16 mfd., 350v. working, can type, common negative; 1/6 each.

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60 Mfd., 150v. working, can type; 1/- each.

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25 Mfd., 3-volt working, tubular, wire ends; 6d. each.

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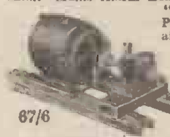

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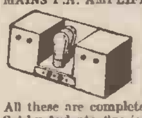

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36 Assorted 1-watt Wire-ended Resistance, 5/6; 24 tubular condensers, assorted capacities up to 0.5 mfd., 6/-; volume controls, assorted capacities (less switch), 7/6 dozen; with switch, 11/6 dozen; mica condensers, assorted, 1/9 dozen; Mainsbridge type condensers, 1 mfd., 2 mfd., 4 mfd., 8 mfd., 8/- dozen; valveholders, 5-pin, 7-pin, 9-pin, 2/6 dozen; battery leads, multi-way, 6/6 dozen; parcel of assorted servicing components, comprising resistances; tubular, mica, variable, electrolytic and block condensers; wire; sleeving; volume controls; valveholders, etc., etc., 10/- each; parcel containing at least 100 articles.

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AMPLIFIERS.—Seven watt, push-pull for M.H.4 and two P.X.4's, or equivalents; absolutely complete kit of parts, best components, with circuit, 52/6, less valves.

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B.I. 4 mfd. 200 v.w. Tubular Condensers, 1/-; B.I. 4 mfd. 500 v.w., 2/9.

18-GAUGE Tinned Copper 60ft. Coils, for 1/3; 80:1 microphone transformers, 1/6; K.B. chokes, 350 ohms 60 m.a., 1/6.

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When old Jenkins got home t'other night,
His wife cried, "Now just get this right.
I've just missed a good show
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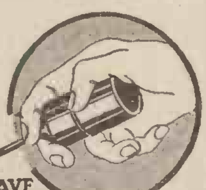

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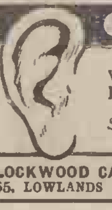

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SATOR Volume Controls, ½ meg. with switch, 10,000 with switch, .5,000 with switch, 5,000 wire wound less switch; 1/3 each or 6/6 dozen.

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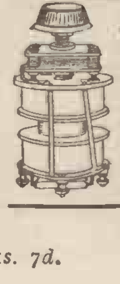

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