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EDITORIAL COMMENT

No Compromise with Quality !

But the B.B.C. Thinks Otherwise

SHOULD we compromise with quality of broadcast reproduction, or should our aim be to attain the most faithful reproduction which the skill of the manufacturers can achieve ?

One would have expected that the answer of the B.B.C. and the whole industry would have been that they were prepared to co-operate to give reproduction as good as the transmissions permit. But we have been rudely startled recently to discover that the B.B.C. holds no such view and that a compromise with quality is regarded as justifiable, and even to be encouraged.

For some while past we have felt that it would be a useful service if the B.B.C. were to transmit from time to time standard frequencies so as to enable the owner of a receiver to judge the performance which he is getting from his set, and recently there has been correspondence on this subject which has once more brought it to the public notice. The result of this renewed demand for such a service from the B.B.C. has been the disclosure of an attitude on the part of the Corporation which is, at the very least, disturbing in relation to its possible effect on the future of quality reception.

We are well aware that, because of the present congested state of the ether in Europe, highly selective receivers are necessary. But on account of this need for selectivity the B.B.C. adopts the view that the manufacturer is justified in limiting the frequency response of his receiver, and that if standard frequencies were radiated the more selective receivers of the manufacturers would be penalised in comparison with those designed mainly for local reception.

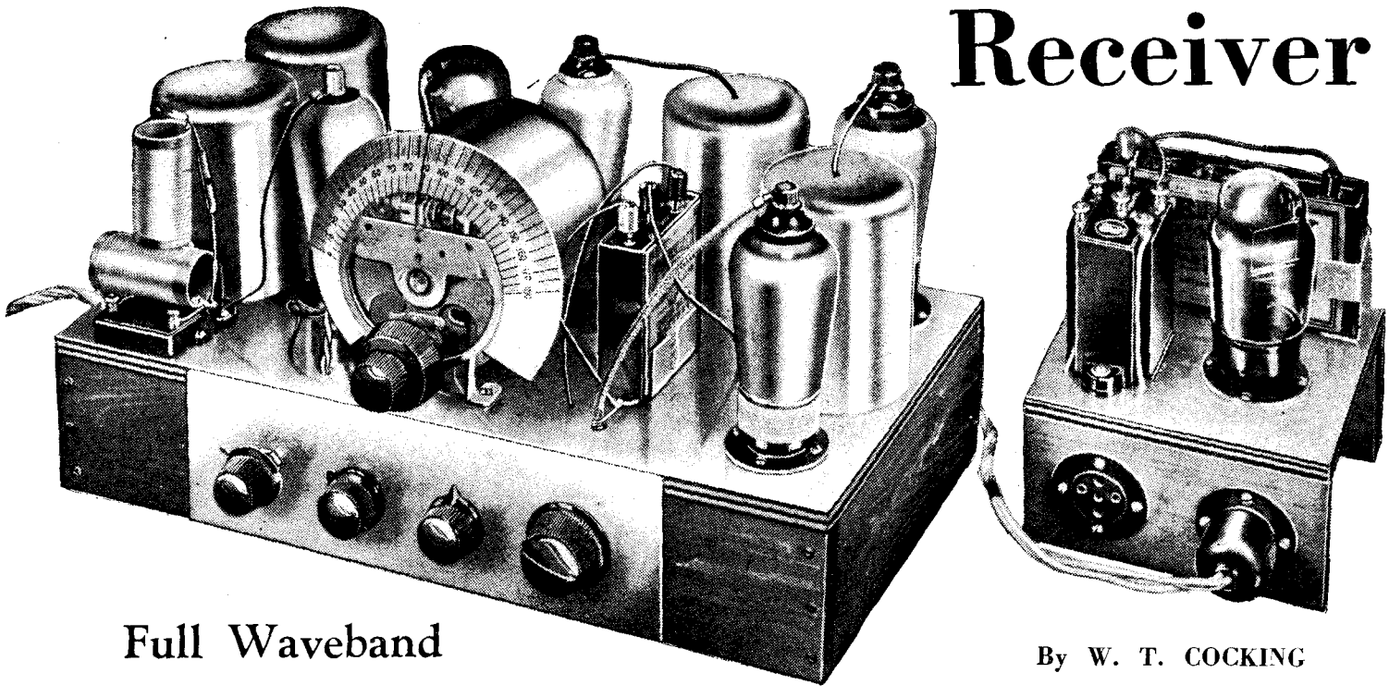
In our view the B.B.C. should do everything possible to help the public to appreciate the high standard of quality of which broadcasting is capable, and we deplore anything in the nature of a conspiracy, however well intentioned it may be, between the B.B.C. and manufacturers which has for its effect a sacrifice of quality merely in order to simplify the task of the designer and producer of sets.

No Compromise Necessary

There is no reason why receivers should not be designed for the highest possible quality reception from nearby stations, or any station not suffering from adjacent-channel interference, yet capable of giving very high selectivity when required to do so. It is quite unnecessary in these days to assume that receivers must be designed to meet exacting requirements of selectivity to avoid adjacent-channel interference, and that all other reception must fall into line with an equally narrow frequency band. If the B.B.C. persist in this retrograde policy as regards quality, it would be equally logical for them to limit the frequency band of the transmissions.

If set manufacturers must not be penalised by making a comparison in quality possible, then surely a restriction in the transmitted frequency band is the simplest way to put all types of sets on the same footing and end the pursuit of the ideal in reproduction by thus making it impossible of achievement. This would make sure that the public would always recognise "wireless" as distinct from anything better.

The Battery Single-Span Receiver



Full Waveband Coverage Without Ganging or Switching

By W. T. COCKING

SINGLE-SPAN tuning represents one of the most interesting receiver developments of recent years, and the principles underlying its operation were fully described in recent issues of *The Wireless World*.[1] The outstanding advantages of the new system are the absence of any ganging and the possibility of obtaining a tuning range wide enough to cover the 200-2,000 metres band in a single sweep of the variable condenser and without any necessity for coil changing. In addition, the absence of second channel interference and other forms of whistle generation render the system particularly adaptable to modern broadcasting conditions, while the introduction of variable selectivity leads to a further improvement in the performance obtainable.

The wide tuning range and absence of ganging are achieved by a modification of the now familiar superheterodyne. The use of an intermediate frequency higher than that of any received signal, together with an oscillator working on a frequency higher than the intermediate frequency, permits all frequencies lower than the intermediate frequency to be received with a single small coil and variable condenser in the oscillator circuit. In the Single-Span Receiver, for example, the intermediate frequency is 1,600 kc/s and the oscillator functions over a range of 3,100 kc/s to 1,750 kc/s, thus permitting signals between 1,500 kc/s (200 metres) and 150 kc/s (2,000 metres) to be received. This alone would not give single-span tuning, for normal superheterodyne practice dictates that certain circuits must be tuned to the signal itself. The difficulty is overcome by the use of signal-frequency circuits so designed that they are responsive to all signals within the 150-1,500 kc/s range, but attenuate signals outside that range, and so prevent second channel interference.

The use of a high intermediate frequency is not in itself new, and it was used many years ago in the Infradyne receiver. For the process of frequency changing, however, this type of set aimed at using the sum of the signal and oscillator frequencies rather than the difference, with the result that a wide tuning range with a given coil and condenser was hardly possible, and signal frequency tuning was still necessary. As a result, the system offered little or no advantage over the ordinary superheterodyne and soon fell into disuse.

Advantages of a High I.F.

It is interesting to find, however, that a system employing an aperiodic aerial circuit and, therefore, more nearly akin to single-span tuning, was developed by von Kramolin as early as 1927, although he envisages the use of a fairly low intermediate frequency. In an example, he suggests the use of a frequency of some 500 kc/s for the I.F. circuits, with which reception can be obtained over a band of 1,500-550 kc/s, (200-550 metres) with an oscillator circuit tuning between 2,000 and 1,050 kc/s as the sole tuning control. Since the second channel range in 2,500-1,550 kc/s, it is theoretically possible to employ aperiodic signal frequency circuits and obtain freedom from second channel interference. The design of a suitable filter, however, would be a matter of considerable practical difficulty on account of the proximity of the receiving and second channel ranges.

The high intermediate frequency employed in Single-Span Receivers avoids difficulties of this nature and permits a tuning range covering both medium and

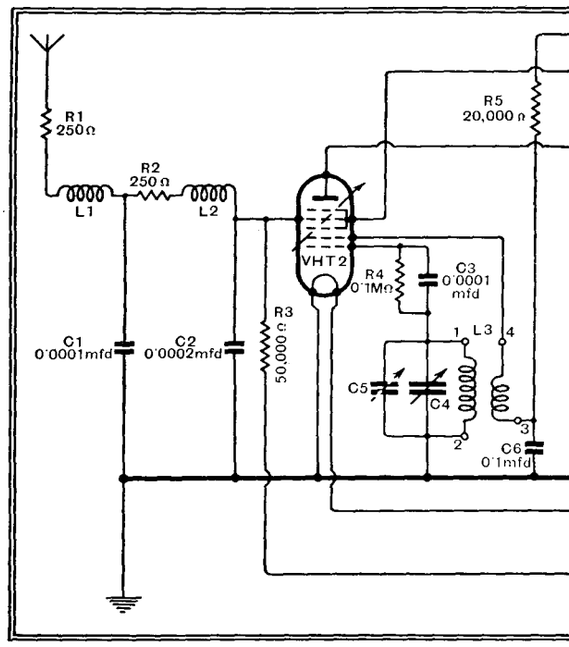


Fig. 1.—The complete circuit diagram of the receiver

[1] March 23rd, 30th, and April 6th, 1934.

long waves to be obtained. This alone, however, would not be sufficient to produce a successful receiver, and special design, not only of the aerial filter, but also of the I.F. circuits is essential to a satisfactory performance. The aerial filter must be as efficient as possible and give a substantially even response over the receiving range, but yet give a high degree of attenuation in the second channel region. In the I.F. circuits, the tuning coils and condensers must be designed for minimum losses and the ratio of inductance to capacity chosen for maximum selectivity rather than for optimum amplification. Furthermore, to obtain adequate selectivity for modern conditions it is necessary to employ reaction. By combining reaction with a special circuit arrangement and automatic volume control, it becomes almost entirely a selectivity control and has comparatively little effect upon the amplification.

Requirements for Battery Operation

The Single-Span Receiver[2] was built upon these lines and its performance well bore out the expectations based upon a study of the theoretical considerations. Single-span tuning, however, is by no means confined to a mains-operated set, and the principle is equally applicable to a battery receiver. The receiver described in this article is essentially the same as the earlier mains model, and the alterations which have been made are only those necessary for the different types of valves and those needed to preserve economy of anode current consumption, for no others have been deemed necessary or advisable.

The circuit diagram of the receiver appears in Fig. 1, and it will be seen that the first valve in the set is a heptode frequency-changer. The aerial filter, which permits all signals between 200 and 2,000 metres to be simultaneously applied to the control grid of the tetrode section of this valve while attenuating all signals outside this range, consists of the two coils L1 and L2 with the resistances R1 and R2 and condensers C1 and C2. The oscillator section, with which all tuning is carried out, comprises the coil assembly L3 with the tuning condenser C4 and the padding condenser C5.

[2] *The Wireless World*, April 13th, 20th, 27th, 1934.

THE principle of single-span tuning, in so far as it permits single-control operation without the use of ganged condensers, is a radical departure from accepted methods. Its further advantages of providing a very wide tuning range without the need for wave-band switching and of eliminating second channel whistles make it ideal for modern conditions. The principle is by no means confined to mains operated sets, and in this article will be found constructional details of a battery operated receiver capable of giving an outstanding performance

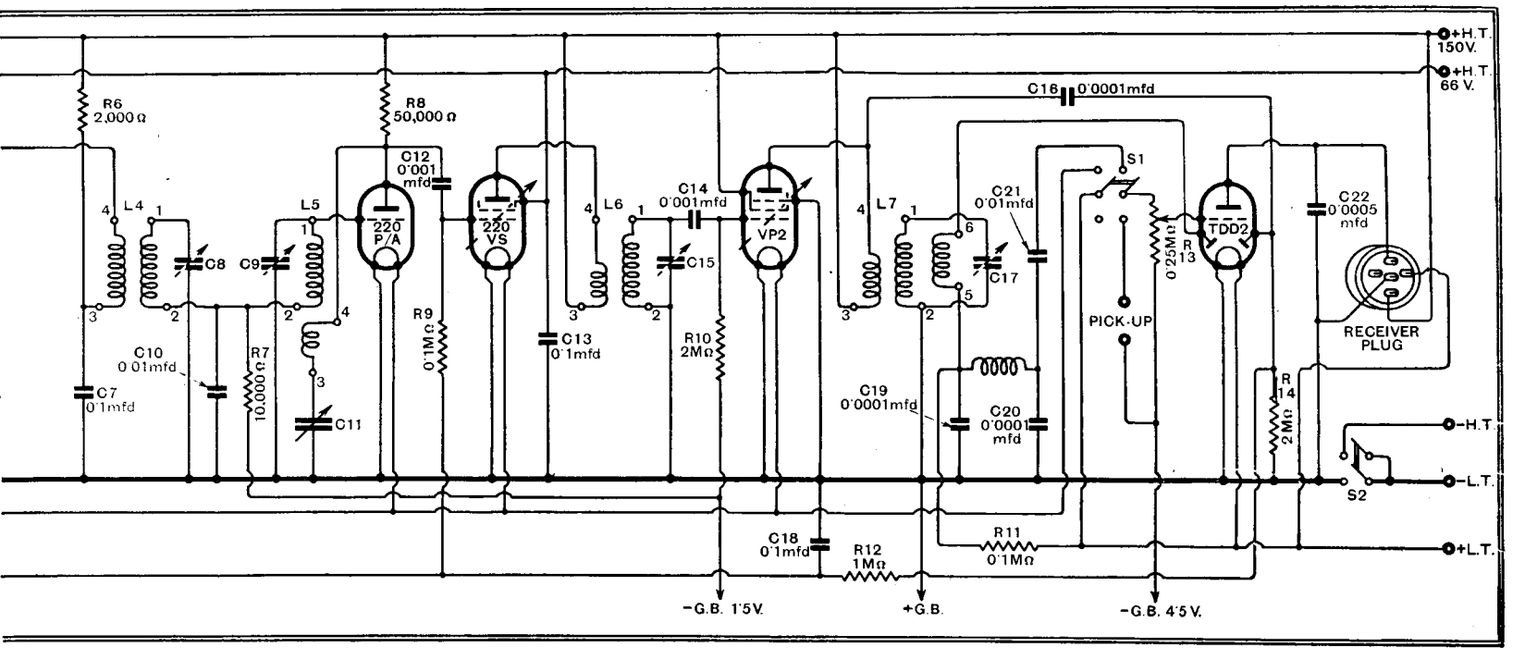
The intermediate frequency first appears in the tetrode anode circuit of this valve and preliminary selection is afforded by the pair of coupled tuned circuits L4 and L5, to the latter of which reaction is applied. The potentials developed across the trimming condenser C9 are applied to the grid of a triode valve which serves the dual purpose of providing reaction and of isolating the circuit to which reaction is applied from the I.F. amplifier proper.[3] If such isolation were not obtained it would be difficult to make any effective use of reaction.

This buffer valve is coupled to the first I.F. valve by a resistance-capacity coupling, and this I.F. valve, of the screen-grid type, is coupled to the second stage of amplification by a tuned transformer of 1-2 ratio. An H.F. pentode is used in the second stage and feeds another tuned transformer carrying three windings. The primary is connected in the I.F. valve anode circuit, the secondary is tuned, and the tertiary feeds the diode detector. This last valve in the receiver unit is a duo-diode-triode, and it is worthy of note that the two diodes have different characteristics. The detector diode is mounted round the negative limb of the filament, and functions normally, but the A.V.C. diode is mounted round the positive limb. This diode is fed by the 0.0001 mfd. condenser C16, and its load resistance R14 is returned to −L.T. As a result, the voltage drop along the detector diode and triode portions of the filament appears as a delay voltage in this diode circuit, and sufficient delay on A.V.C. is obtained without additional biasing.

The L.F. Circuits

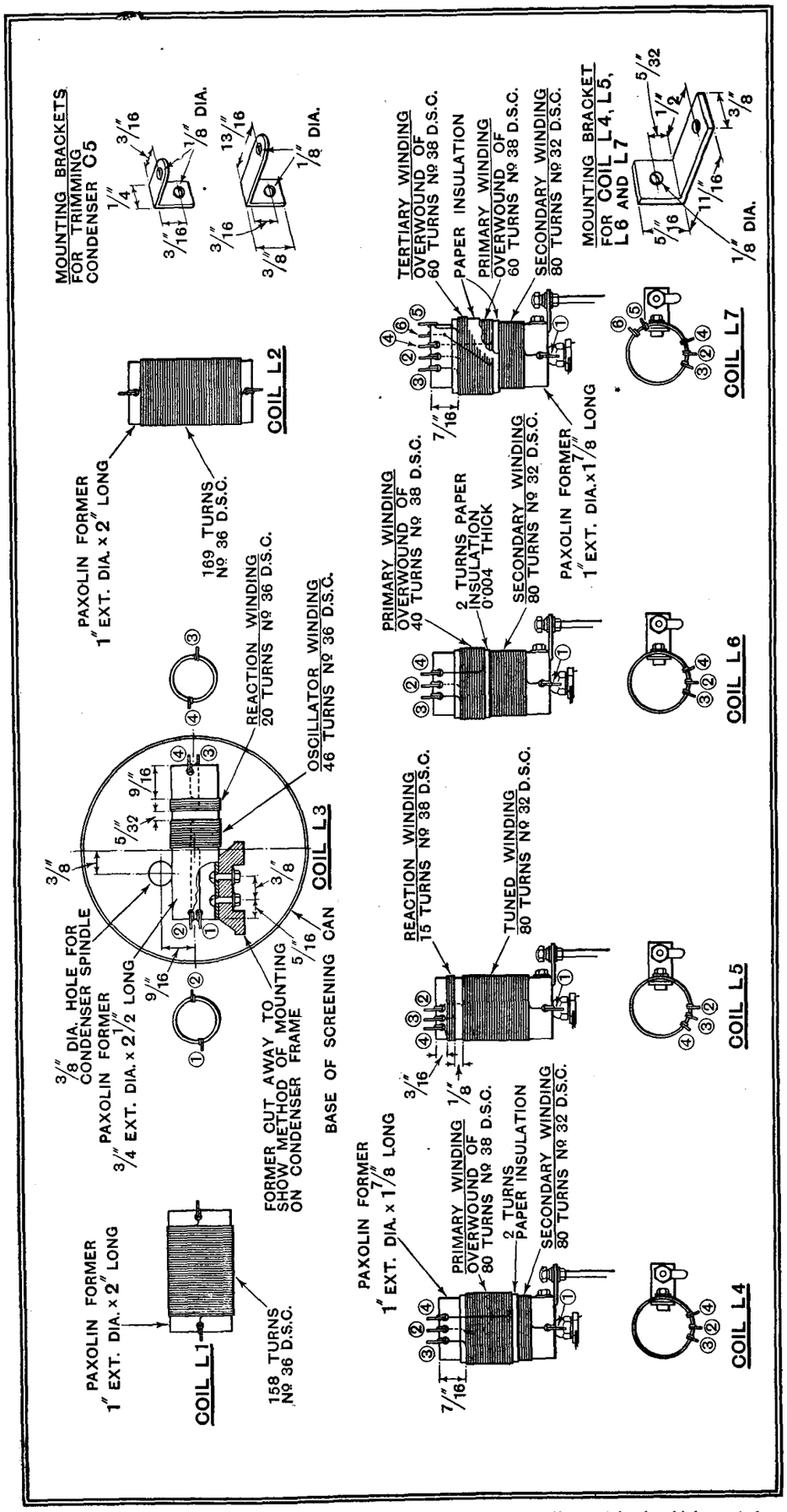
A.V.C. is applied through the usual filter R12 and C18 to the control grids of the frequency changer and the first I.F. valves, which in the absence of any A.V.C. bias are operated at zero grid potential. This is permissible, since with the particular valves selected grid current does not start until the grid reaches an appreciably posi-

[3] The use of a buffer valve is dealt with by F. M. Colebrook, B.Sc., in a paper entitled "A Study of the Possibilities of Radio-Frequency Voltage Amplification with Screen-grid and with Triode Valves," which appeared in *The Journal of the Institution of Electrical Engineers* for February, 1934.



unit of the Battery Single-Span Receiver. A heptode frequency-changer is employed, and a duo-diode-triode second detector valve provides delayed A.V.C.

HOW TO MAKE SINGLE-SPAN COILS



These drawings show the constructional details of the various coils, and it should be noted that all windings must be in the same direction.

LIST OF PARTS

After the particular make of component used in the original model, suitable alternative products are given in some instances.

RECEIVER.

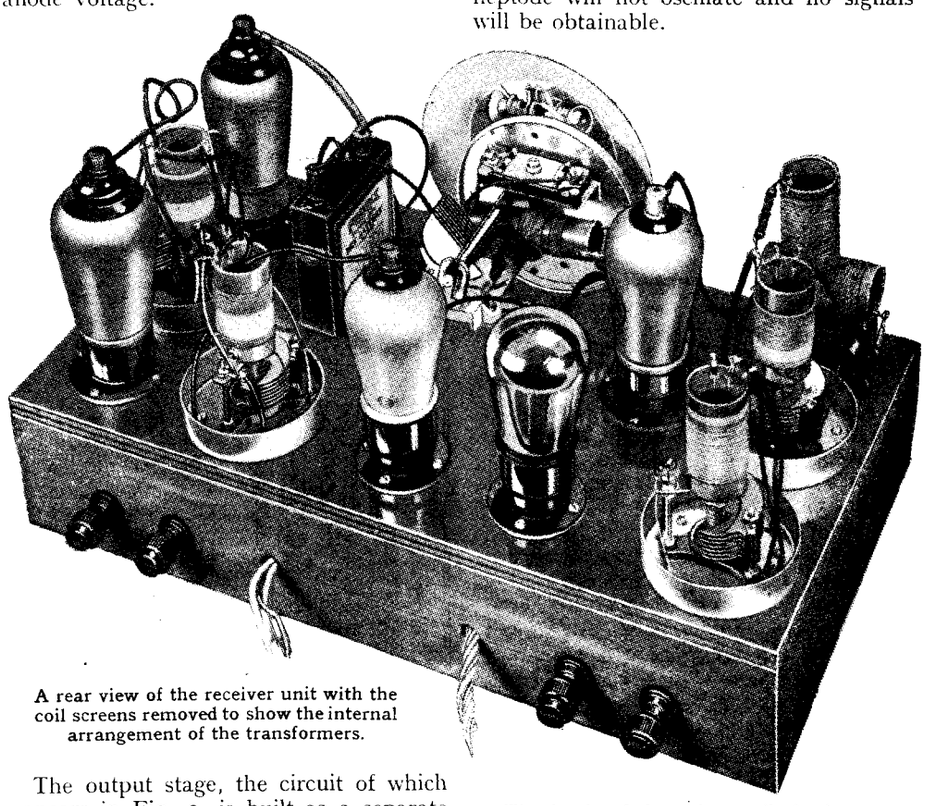
1 Variable condenser, 0.00016 mfd., **C4 Polar Type "E"**
1 Dial, slow motion type **Polar Micro-drive semi-circular**
2 Bulbs, 2 volts 0.06 amp. **Bulgin Type "H"**
1 Slow motion reaction condenser, 0.0002 mfd., **C11** (Polar) **Eddystone 957**
1 Tapered volume control, 250,000 ohms and knob, **R13** **Rothermel Type 72-121** (Ferranti, Claude Lyons, Magnum)
1 Rotary Q.M.B. D.P.D.T. switch, S1 Claude Lyons 2163
1 Rotary Q.M.B. D.P.S.T. switch, S2 Claude Lyons 2161
3 Valve holders, 5-pin **Clix Chassis Mounting Standard Type**
2 Valve holders, 7-pin **Clix Chassis Mounting Type**
1 Compression condenser, 100 mmfds., **C5 Colvern**
4 Microdensers, 100 mmfds., **C8, C9, C15, C17** **Eddystone 900**
1 Fixed condenser, 0.0001 mfd., **C1** **Graham-Farish Bakelite Case Type**
1 Fixed condenser, 0.0002 mfd., **C2** **Graham-Farish Bakelite Case Type**
4 Fixed condensers, 0.1 mfd., **C6, C7, C13, C18** **Graham-Farrish Tubular Type**
2 Fixed condensers, 0.01 mfd., **C10, C21** **Graham-Farish Tubular Type**
2 Fixed condensers, 0.001 mfd., **C12, C14** **Graham-Farish Tubular Type**
1 Fixed condenser, 0.0005 mfd., **C22** **Graham-Farish Tubular Type**
4 Fixed condensers, 0.0001 mfd., **C3, C16, C19, C20** **Graham-Farish Tubular Type** (Dubilier, Peak, T.C.C., Telsen)
2 Resistances, 250 ohms ½ watt, **R1, R2 Ferranti G.5**
1 Resistance, 2,000 ohms ½ watt, **R6 Ferranti G.5**
1 Resistance, 10,000 ohms ½ watt, **R7 Ferranti G.5**
1 Resistance, 20,000 ohms ½ watt, **R5 Ferranti G.5**
2 Resistances, 50,000 ohms ½ watt, **R3, R8 Ferranti G.5**
3 Resistances, 100,000 ohms ½ watt, **R4, R9, R11** **Ferranti G.5**
1 Resistance, 1 megohm ½ watt, **R12 Ferranti G1**
2 Resistances, 2 megohms ½ watt, **R10, R14 Ferranti G1** (Dubilier, Erie, Graham-Farish, Claude Lyons, Seradex, Watmel)
1 Screened H.F. choke **Wearite Type HFP** (Bulgin, Kinva)
1 10-way connector **Bryce**
1 5-pin plug **Bulgin P.3** (British Radio Gramophone Co.)
1 4-way battery cable **Bulgin B.C.2**
1 5-way battery cable **Bulgin B.C.3** (Belling-Lee, Goltone, Harbros)
6 Knobs **Bulgin K.6**
4 Ebonite shrouded terminals A. E. Pick-up (2) **Belling-Lee Type "B"**
4 Coil screens, 3¾ x 2⅝in. diam. **Mains Power Radio, Ltd. Broadway Works, Eastern Road, Romford, Essex.**
1 Coil screen, 4 x 3⅝in. diam. **Colvern**
Materials for coils:
12in. Paxolin tube, 1in. diam. **Wright & Weaire**
2½in. Paxolin tube, ⅞in. diam **Wright & Weaire**
Quantity No. 32, 36 and 38 D.S.C. wire.
or **1 set of coils**
2 Lengths of screened sleeving **Harbros** (Goltone)
1 G.B. battery, 4½ volts
1 G.B. battery clip **Bulgin No. 2**
6 Wander plugs **Clix No. 12B** (Eelex)
2 Spade ends **Clix No. 3**
2oz. No. 20 tinned copper wire, 6 lengths Systoflex, wood, etc.
Plymax baseboard, 15 x 8 x ⅜in. **Peto-Scott**
Screws:
24 ⅜in. No. 4 R/hd.; 6 ½in. No. 4 R/hd.
All with nuts and washers.
2 ⅝in. No. 6BA with metal threads and nuts and washers.
Valves:
1 Ferranti VHT2, 1 Cossor 220P/A, 1 Cossor 220VS, 1 Mullard VP2, 1 Mullard TDD2.

OUTPUT UNIT.

1 Q.P.P. transformer, 1:8 **R.I.** (Varley)
2 Fixed condensers, 0.005 mfd., **C23, C24** **Graham-Farish Tubular Type** (Dubilier, Peak, T.C.C., Telsen)
1 Resistance, 150,000 ohms ½ watt, **R15. Ferranti G.5** (Dubilier, Erie, Graham-Farish, Claude Lyons, Seradex, Watmel)
2 Valve holders, 5-pin **Clix Chassis Mounting Standard Type**
1 Valve holder, 7-pin **Clix Chassis Mounting Type**
1 5-pin plug **Bulgin P.3** (British Radio Gramophone Co.)
1 G.B. battery, 9 volts
1 pr. G.B. battery clips **Bulgin No. 1**
2 Wander plugs **Clix No. 12B** (Eelex)
1 Loud speaker, permanent-magnet moving coil **Blue Spot "Star"**
Quantity No. 22 tinned copper wire, 2 lengths Systoflex, wood, etc.
Plymax baseboard, 5 x 5½in. x ⅜in. **Peto-Scott**
Screws:
14 ⅜in. No. 4 R/hd.; 2 ⅝in. No. 4 R/hd.
All with nuts and washers.
1 ¾in. No. 6BA with metal thread and nut and washer.
Valves:
1 Marconi or Osram QP.21.

The Battery Single-Span Receiver—

tive potential. The second I.F. valve is not controlled for A.V.C. purposes, and is given a fixed bias of −1.5 volts. It should be noted that this valve is designed to operate with a screen potential equal to the anode voltage.



A rear view of the receiver unit with the coil screens removed to show the internal arrangement of the transformers.

The output stage, the circuit of which appears in Fig. 2, is built as a separate unit, since this facilitates the employment of alternative equipment. The triode section of the duo-diode-triode in the receiver acts as the first stage L.F. amplifier both on radio and gramophone, and is coupled to the output valve by a 1-8 ratio push-pull transformer. The output valve is a double-pentode of the quiescent push-pull type, and gives an output adequate for most purposes when used with a sensitive type of loud speaker.

Constructing the Coils

In the interests of economy the apparatus has been designed for use with an H.T. supply of 150 volts, and it consumes a total current with no-signal of only 17 mA., an average of slightly under 3 mA. per valve. The same performance could only have been secured at a lower H.T. voltage by increasing the current consumption, with the inevitable result of a larger bill for H.T. battery replacements. In the interests of maximum economy the radio-gramophone switch is arranged to break the L.T. supply to the four early valves on gramophone, so that the total current consumption, both L.T. and H.T., is much less on gramophone than on radio.

The coils employed are identical with those used in the A.C. set, and the drawings given in this article need little amplification. L1 and L2 are both single layer coils and are supported by the wiring. L3 is bolted to the frame of the oscillator tuning condenser, and care should be taken to see that both windings on this coil are in the same direction and that the connections are made correctly. If the winding direction of one coil, or the connections to one coil, be reversed, the heptode will not oscillate and no signals will be obtainable.

The basis of the other coils is the same, and is a single layer winding on a piece of 1in. diameter tubing; the differences between L4, L5, L6, and L7 are only in the primaries. L4 carries an overwound primary of 80 turns of wire, but L5 has no primary, although there are 15 turns of wire, wound on the main former at the end of the tuned winding, for reaction purposes. L6 is similar to L4, but the primary has only 40 turns. L7 carries an overwound primary of 60 turns, and a tertiary of the same number of turns wound over the primary. In every case adequate insulation between the windings is obtained by wrapping two layers of a fairly thin and hard paper round the previous winding.

The tuned winding can in every case be secured by soldering the ends to tags fastened to the former; two layers of paper should then be wrapped round the coil at the low potential end, and the outer turn secured by a tiny blob of sealing wax at its two corners. One end of the wire for the primary should then be soldered to its appropriate tag and loosely run on to the paper covering for the start of the primary. At this point it should be secured to the paper by a small blob of sealing wax. The primary may then be wound and the end again secured with sealing wax, the wire then being looped back to the appropriate lug.

These four I.F. coils are mounted on the trimming condensers by small brackets. The brackets are carried by the condenser terminals for the moving plates, and it will be found that the coil lug No. 1 in every case comes close to one of the terminals for the fixed plates, to which it should be joined by a stout wire, so giving additional rigidity. The condensers themselves are mounted on the screen bases by their one-hole fixing bushes. Care should be taken to see that the coils are correctly mounted on the condensers and that their terminal lugs are not too large, otherwise the lugs may foul the top of the screening can. Such a short-circuit would probably prevent reception, but it might only lead to a poor performance. It may, however, short-circuit the H.T. supply and damage the transformer primary concerned.

The remainder of the construction is straightforward and follows normal practice; it will be dealt with next week, therefore, together with the initial adjustments and some notes on the performance to be expected from the receiver.

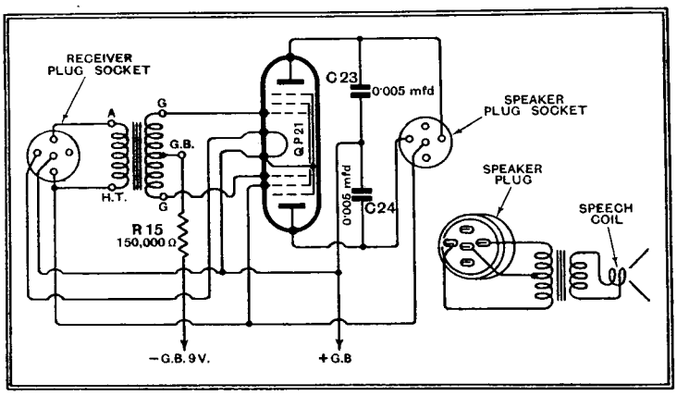


Fig. 2.—The circuit diagram of the output equipment which is built as a separate unit to facilitate modifications for special circumstances.

The Radio Industry

AERIALITE, LTD., of Junction Mills, Whittington Street, Ashton-under-Lyne, are manufacturing several different types of aerial for fitting on cars, including models for the running board and the hood lining.

◇ ◇ ◇

A very neat and compact Kabi "hum-balancing" potentiometer, no greater than a sixpence in diameter, has been introduced by F. W. Lechner and Co., Ltd., 61, Spencer Street, Clerkenwell, London, E.C.1.

Steady progress is being made in the building of the new Cossor factory (the fifth), which will give employment to a thousand workers.

◇ ◇ ◇

A new Hivac 2-volt battery H.F. pentode valve is described in a leaflet issued by the makers, the High Vacuum Valve Co., Ltd., 113-117, Farringdon Road, London, E.C.1.

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A correction: Vortexion, 182, Broadway, Wimbledon, London, S.W.19. Style and address given last week was incorrect.

Modern Sound Film Technique

The British Acoustic Full-Range System

By A. L. M. DOUGLAS

CONSTANT improvements in sound gear make the task of the studio recordist less arduous and anxious than in the early days of the talkies. This article describes the latest apparatus in use in the British Gainsborough Studios.

ONE factor there is which never troubles the broadcasting engineer but which the sound film recordist must always take into consideration, namely, the casting of shadows. Bulky recording gear is anathema in the film studios. In the British Acoustic Full-Range Recording System the small tubular local amplifier is of negligible bulk to allow rapid operation in the studio and the reduction of shadows which a large microphone assembly is always prone to set up.

The system is of the variable area split track type, and is characterised by several unique features combined with flexibility in operation.

The microphone is of the magnetic type in which a light corrugated strip or ribbon of a non-ferrous alloy is freely suspended in a powerful magnetic field. In the latest pattern the ribbon is open to attack by the air pressure waves front and rear, after the manner of the microphone used for some years by R.C.A. Photophone.

H.T. and L.T. are fed along the same multiple cable as the speech lines, and are derived from local batteries housed in the soundproof monitoring booths. It has been found from long experience that a mobile booth, which can be wheeled about the studio floor, greatly facilitates correct monitoring; the microphone boom operators and local conditions are under direct observation, and close contact with the producing staff is possible.

The booth contains a mixing panel with three microphone inputs and gain controls. In addition, there is a main gain control operating on the combined output of all three faders, and an adjustable direct reading volume indicator, which is a speech potential meter with a Westinghouse metal rectifier. This is arranged to float on the end of a cord, so that the recordist may place it directly in his line of sight to the scene. There is also an intercommunication telephone for speaking to any of the recording rooms; and a plug connected with a pair of headphones, which may be worn by a musical director or other person, enabling him to hear directly from the mixed microphone output.

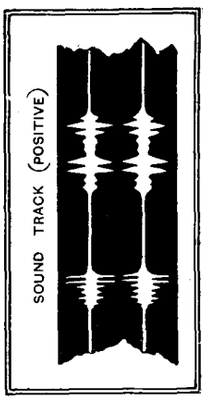
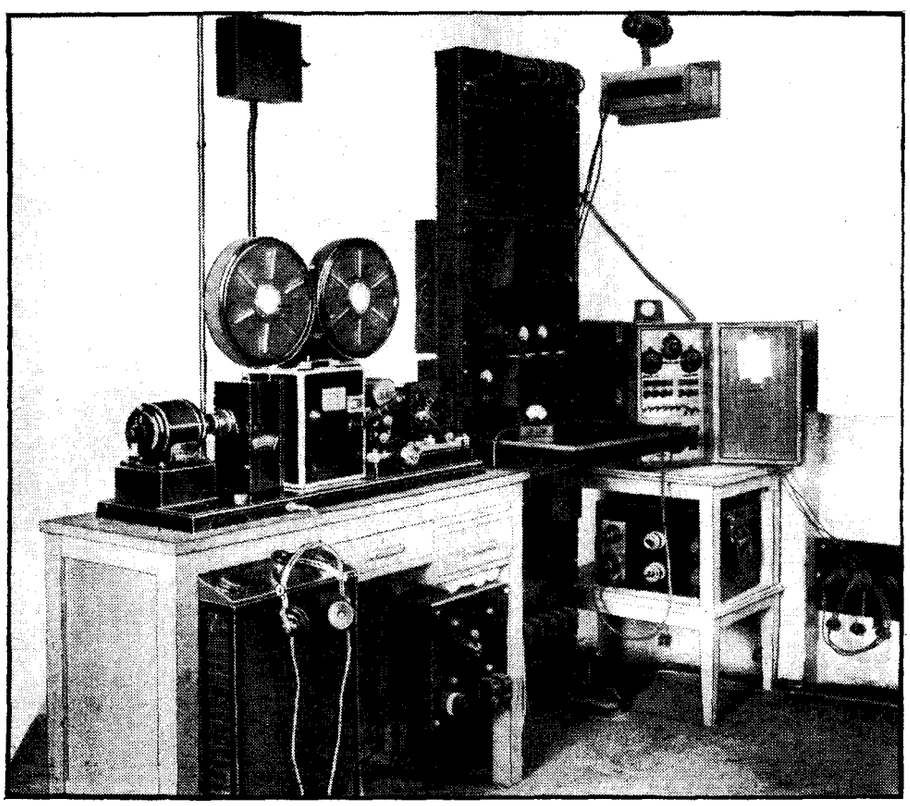


Fig. 1.—A section of magnified positive film as it appears in recording of the variable area split track type.

Other equipment includes a check loud speaker, a standard lamp, and an A.C.-operated buzzer for signalling.

The booths are very light and free running, and all batteries may immediately be withdrawn *en bloc* from the rear. H.T. and L.T. check meters are fitted to the mixing panel. The emission of the microphone amplifier may thus always be observed.

Connection is made with the booths by a flexible cable, sufficiently long to reach to any part of the studio and plugging into a wall distribution board. Each circuit is, of course, carefully screened, thus allowing the A.C. supply to be carried in the same cable without ill-effect.



The sound camera and amplifier assembly.

Reducing Ground Noise

From the wall board, permanent shielded lines run to the main amplifying equipment. This is housed in a warm room with the recording camera.

The amplifier is constructed in rack form, and can be clearly seen in the photograph. The circuit arrangement is given in Fig. 2, from which it will be observed that there are two stages of voltage amplification following the microphone amplifier, and a current stage driving the string galvanometer.

Following this is another valve feeding

Modern Sound Film Technique—

into a split input, part going to a two-stage amplifier driving the main Voigt loud speaker and the booth speaker, also the volume indicator; and part going to the polarising or ground noise reduction amplifier. Here it is rectified and applied to the galvanometer as D.C. varying in intensity with the speech potentials. When no modulation takes place, the D.C. deflects the strings and mirror to the top of the mask, thus photographing only a narrow double line of light on the track. The whole of the remainder is therefore black in the print, so that dirt, emulsion granularity and small abrasions do not influence the reproducing cell.

The applied D.C. varies inversely as the amplitude of the speech currents, thus the greatest deflection of the strings is obtained for a small sound and vice versa.

At the foot of the rack is the main switch and fuse panel. Power is derived from accumulators for H.T. and L.T. of 240-v. and 8-v. respectively.

The type S sound camera is characterised by extremely even running. It is practically impossible to get a "wow." The mechanical filter system is shown diagrammatically in Fig. 3. The film is accurately aligned by the drum D, which has a very slight taper leading up to the rear flange. The film is so positioned that it runs up the taper and abuts on the flange, and so is kept absolutely parallel, since the drum flange runs dead true. Recording is carried out on the opposite side, the film standing just off the front edge of the drum.

The galvanometer is horizontal and projects a split image through a special mask on to the film, photographing a double track. By this means the actual mirror excursion for a given amplitude is halved, inertia is greatly reduced, and in consequence the high-note response is very strong. The appearance of the track is shown in Fig. 1. The mirror and strings are oil damped, and, being a preadjusted unit, can be rapidly changed in the event of a fault developing during operation.

The useful working range of the system is from approximately 40 to 12,000 cycles per second, but galvanometers are adjusted to have a response to 15,000 cycles.

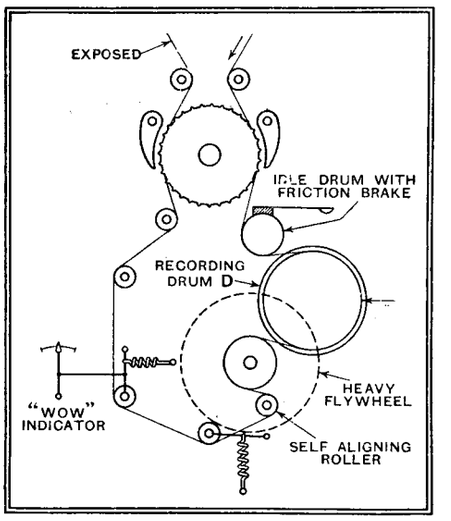


Fig. 3.—The mechanical filter system in the sound camera.

Current for the camera exciter lamp is drawn from the A.C. mains through a metal rectifier and smoothing circuit, as also is the galvanometer field current.

The camera is driven by a three-phase synchronous motor, as is all the other equipment in the studio. The starter is mounted on the camera table.

Rapid "Mixing"

A Marconi oscillator, adjustable from zero to 10,000 cycles, is used for daily checking of the oscillograph and to set recording levels, and is indispensable for checking resonant peaks.

Other apparatus associated with the recording gear includes re-recording heads and interlocking gear for ensuring perfect synchronism between these and the picture projectors. Each sound head has a two-stage local amplifier attached, thus bringing the output to a similar level to that from the microphone. Disc re-recording gear is also available.

A novel mixing panel is installed in the orchestration theatre control room, in which the fader knobs describe an arc of a circle rather in the manner of a "beer engine." This enables an extremely rapid movement to be given, and is of great value in the mixing of sound effects, etc., into a finished film. Short-circuiting switches are fitted to these faders.

The complete studio channel is also available built into a light six-cylinder truck, thus providing recording of equal fidelity for exterior or location work. By careful design, every component on these trucks is interchangeable with the corresponding studio equipment. Provision is made for charging the batteries on the road, as, of course, the A.C. for picture and sound cameras has to be derived from a rotary converter operated from accumulators. An accurate frequency meter enables synchronism to be maintained.

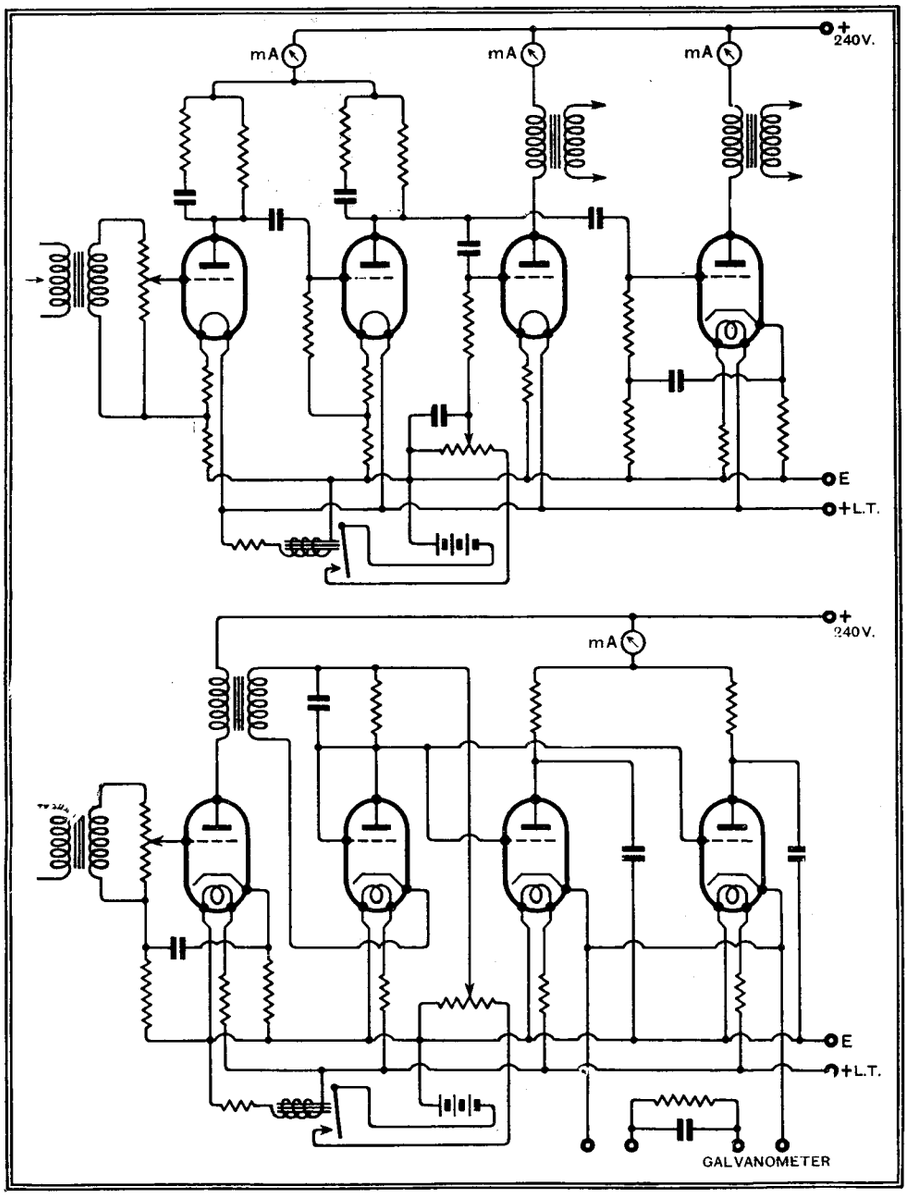


Fig. 2.—Diagrams showing the general circuit arrangement in (above) the main amplifier and (below) the polarising or ground noise reduction amplifier.

UNBIASED
BY FREE GRID

My Light-controlled Clock

AS Shakespeare once remarked, some people are born dense, some suffer from the effects of our modern educational system, while others are unfortunate enough to have been dropped on their heads during babyhood.

I am moved to this quotation by the persistence of elementary enquiries which I continue to receive concerning the precise working of my light-controlled clock which I described in the March 30th issue of this journal. Here is a typical letter which I have received from Worthing, a seaside resort of which I have very vivid recollections, having been unfortunate enough to be marooned on the end of the pier while undertaking some scientific research work one Easter many years ago at a time when the middle portion got washed away.

"In order that this clock business may be satisfactorily and finally settled," writes this correspondent, "perhaps you will of your goodness in some future issue insert answers to the following further queries on this intensely fascinating subject:—

"(*a*) How do you manage if, upon arrival at the boarding-house, apartment house, or hotel, you find the mains are:—

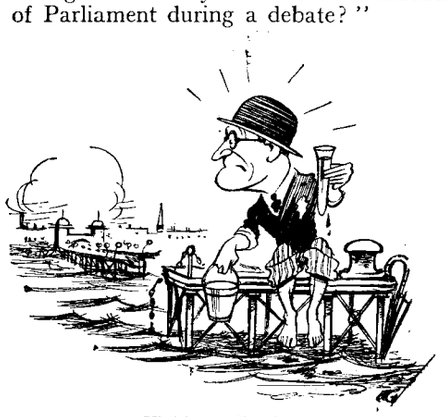
"(1) A.C. at some frequency other than 50 cycles?

"(2) D.C.?

"(3) Gas and water only?

"(*b*) How do you compensate for the clock being out of action whilst changing the 'ordinary gas-filled bulb' for 'the one filled with fog'?

"(*c*) At what class of shop are electric bulbs filled with fog obtainable, or, alternatively, can you explain in simple language how to convert a gas-filled bulb to a fog-filled one? Would it be any use taking an ordinary bulb into the Houses of Parliament during a debate?"



Vivid recollections.

With regard to question (*a*) (1) it should, of course, be obvious that in such a case the clock would receive its "correcting" impulses at a greater or lesser number of times per second, according to the frequency of the mains. With regard to questions (*a*) (2) and (*a*) (3) I would point out that in my original article I explained that this clock was designed to meet a particular case only, namely, one in which it so happened that A.C. mains were present; therefore, these two questions do not arise.

With regard to question (*b*) it is perfectly obvious that my correspondent has failed to read my original article correctly. The clock is not a synchronous motor arrangement, but merely a high-grade "clockwork" clock in which the escapement is monitored by regular electrical impulses.

Question (*c*) is all-important, and very easily dealt with. A fog-filled bulb is, of course, made very simply by coating the inside of it with a photographic emulsion during manufacture. The fogging is then produced automatically when the light is switched on. So far as I know, these bulbs cannot at present be obtained commercially, but doubtless a lamp manufacturer and a manufacturer of photographic goods will eventually co-operate in this matter, just as they have done in the production of special photographic floodlighting bulbs.

Ye Olde Raylwaye

I MUST utter a word of protest at the complete lack of initiative which seems to permeate the traffic manager's department of some of our railways.

I was inveigled the other day into taking a Sunday rail trip to one of our old Cathedral cities. The railway authorities had spared no efforts, so far as their limited imaginations permitted them, to make the trip a success. A special train, equipped with "observation coaches," had been provided, and it had been arranged that the train should slow down when passing the most interesting parts of the countryside.

The *pièce de résistance* of the whole trip was the presentation to each passenger of a printed list indicating all the various factories, cemeteries, and other places of interest which the train would pass. I found this quite successful in the case of those objects of interest close to the line.

But, dealing with places and objects some little distance away, the whole thing was absurd. I found it extremely fatiguing to the eyes after the first few miles to have to keep dodging from printed sheet to window, and I could not help thinking how much more enterprising it would have been to make use of wireless, or, rather, of a simple public-address system with the microphone presided over by some knowledgeable official.

Such a procedure would have enabled us all to lounge back comfortably in our seats and yet to miss nothing. As it was, I soon had a crick in the neck, and my fellow sightseers seemed to be in no better plight.

There are, of course, always women, and even certain men, who will seize any and every occasion to exercise their jaws, and this trip was no exception. I presume, therefore, that, so far as these cretinous creatures are concerned, loud speakers would be an abhorred interruption. There is no real reason, however, why the various coaches should not be wired up so that each passenger could have a pair of 'phones which he could don or otherwise as fancy dictated.

For females and others who might find the wearing of 'phones uncomfortable, I would suggest that earpieces be sewn into the headrests after the manner of the pillow-'phones with which some hospitals

Fatiguing to the eyes.

are equipped. At any rate, I offer the suggestion to the railway companies concerned without the least hope that they will take the slightest notice.

Give Us the Earth

BUILDERS on the estates which are springing up like mushrooms around our large cities are vying mightily with each other in their attempts to attract Mr. Everyman.

Their latest idea is to equip each house with a wireless aerial in the loft. I cannot help thinking that they would do a better service to their customers if they installed a really efficient earth. This should definitely *not* consist of a metal plate buried in the garden with a long trailing lead to the room in which the set is to be used. The earth-plate should be buried deep down in the earth under the room in which it can be expected that the set will be used.

The connecting wire would be led up through the concrete and the floor boards to a suitable connection on the skirting board. For purposes of moisture, a pipe could also be let down through the concrete, its upper end terminating in a funnel. Access to this would be via a small trap-door in one of the floor boards, although there is usually quite enough moisture under these dwellings (save the mark!) without the necessity for this refinement.

HINTS and TIPS

Practical Aids to Better Reception

INTERACTION between the H.T. supply system and the L.F. coupling transformer is one of the commonest causes of hum in an A.C. mains set. It is not generally realised that a very simple test as to whether this is really responsible for a noisy background can be carried out in a few minutes.

Testing for Interaction

A procedure that gives conclusive results is as follows: The transformer is dismounted and connected in circuit in the usual way (electrically speaking) by means of leads not less than a foot in length. The transformer is then moved as far away as possible from the power supply equipment, and if the noise ceases it can be assumed quite definitely that interaction was responsible for it. If this conclusion is reached, the next step is to find the position for the transformer which corresponds to minimum hum.

IT has already been stated briefly that one of the many advantages of the Single-Span method of reception is that it allows tuning of the receiver to be controlled from outside the set in a way that is quite out of the question with any other circuit arrangement.

Single-Span Remote Control

For the benefit of those who are interested in the subject it will be opportune to give some practical details as to how the principle of remote control may be applied.

In ordinary receivers it is usual to go to great pains to reduce the value of stray capacity across the tuned circuits to the lowest possible figure. Not so in the Single-Span set as recently described in these pages; instead, a relatively large trimming condenser is deliberately shunted across the oscillator circuit, which, it will be recalled, forms the sole tuning adjustment. It therefore follows that the oscillator condenser may be mounted at an appreciable distance from the receiver; the capacity of the screened connecting lead which must necessarily be used for this condenser will take the place of that of the trimming condenser.

Actually the trimming condenser is normally set to a capacity of some 60 or 70 micro-microfarads, and so the capacity of the extension lead must not exceed that figure. This means that low-capacity cable of the type sold for screened aerial downleads must be used, and that the limit of length must be set to some 5 or 6 feet—quite enough for a "chair-side" control. When necessary, however, a screened cable of lower self-capacity might be devised, thus allowing remote control from a more distant point.

The connections of the remote condenser are shown diagrammatically in Fig. 1, from which it will be seen that the metal screening of the cable forms the "return" electrical connection. It is desirable to mount the remote tuning condenser in a small metal box, which may be fitted with spring clips for mounting on the arm of a chair or in any other way that may be convenient for the user. When the self-capacity of the extension cable is low the trimming condenser C5 must be retained, but it will be set at a lower capacity value than usual, in order to compensate for the added stray capacity.

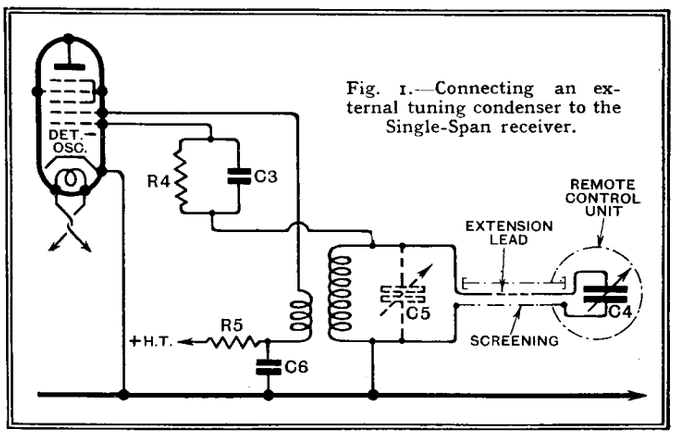


Fig. 1.—Connecting an external tuning condenser to the Single-Span receiver.

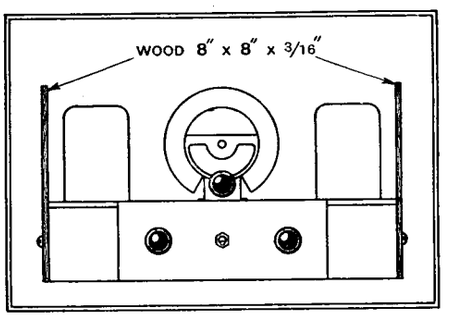
EVERYONE knows by now that for best quality the modern superheterodyne must be accurately tuned to the wavelength of the incoming signal. Very slight detuning, even to the extent of 2 or 3 kilocycles, can, and often does, introduce an unpleasant form of distortion. But it is less generally known that detuning of the oscillator circuit (which generally "takes charge" of the tuning of the receiver as a whole) may be produced by fluctuations in mains voltage. A case was recently investigated where the quality of reproduction of a well-designed superheterodyne was found to change appreciably from minute to minute; it was ultimately found that the mains voltage was varying to such an extent that the wandering oscillator frequency was producing the distortion.

Wandering Mains Voltage

IT is a great help when wiring a receiver, or even when carrying out subsequent tests and adjustments for which access to the underside of the chassis is required, if a pair of temporary supports be arranged in the manner indicated in the accompanying sketch. These supports, which are screwed to the ends of the base compartment, may consist of strips of plywood about 8in. square.

Wiring and Adjusting

This hint will be found particularly useful by builders of the Single-Span receiver; it is understood that the Peto-Scott Company are supplying supports of this kind with all kits of parts supplied for the new receiver.



Temporary wooden supports which facilitate access to the underside of a receiver chassis.

WE are often inclined to forget, when planning a mains-operated receiver, that the voltage required for grid bias purposes must be subtracted from the total delivered by the rectifier and smoothing unit before arriving at the voltage available for the anode circuits. In ordinary practice an extra voltage of anything between 10 and 40 volts over and above the anode rating of the output valve must be provided if the set is to be operated at full power.

A Reminder

THE Single-Span system of tuning helps to bring home to us the fact that the adjacent-channel selectivity of a superheterodyne depends largely on the intermediate frequency circuits. In receivers planned on the new principle *all* selectivity comes from the I.F. amplifier. Accordingly, if interference from the "next-door neighbours" (on the tuning scale) is encountered, it is to these circuits that attention should especially be paid when dealing with any type of superheterodyne. Mistuning of the I.F. transformers, excessively close coupling between circuits, or even definite faults such as leakage or broken connections, should be suspected when this form of interference is encountered.

Interference from the Next Channel

News of the Week

Current Events in Brief Review

Woman in Control

POLAND is claiming the honour of having the only woman broadcasting engineer in Europe. This is Miss Natalie Piskor, who has held a position in the Warsaw control room for a number of years.

New Station for I.F.S.

THE Irish Free State may shortly have a new broadcasting station devoted entirely to sponsored programmes. According to the *Irish News*, it is suggested that the Cork station should be separated from the National organisation, given to a private company as a commercial enterprise and put under the auspices of the Ministry of Industry and Commerce. An official announcement is expected in the near future.

An Inspector of Broadcasting

A NEW post, that of Inspector-General of Broadcasting, has been established in France, its first occupant being M. Pellenc, a well-known Post Office engineer. The *Journal Officiel*, in defining the duties of the new official, includes the organisation and maintenance of the entire State radio system, the collection of radio licence fees, and the defence of listeners against man-made static. Another important appointment is that of an Officer for External Relations, whose task will be to establish a *liaison* between the broadcasting service and the various Ministries, private and foreign stations, and the Press.

New Radio Control in U.S.

THE U.S. Federal Radio Commission appears to be doomed in view of the imminent creation of a Federal Communications Commission. Except for its complete control over radio, writes our Washington correspondent, the new Commission's jurisdiction will be limited. The Commission will be divided into component parts with directors designated to administer the several types of wire and radio services separately.

The Commissioners will probably number five.

Another Milestone

PIANOFORTES incorporating radio-gramophones are not unheard of, but it is a commentary on the growing importance of wireless that a Paris firm is now offering "a radio-gramophone incorporating a piano." When the pianoforte keyboard is folded up the instrument has the appearance of an elegant radio cabinet.

Straight from the Shoulder

BLACK sheep among amateur transmitters are the subject of a devastating editorial in the May, 1934, *Globe Circular*, the organ of the International DX'ers Alliance. The attack is levelled at amateurs who obtain supposed verifications of remarkable long-distance working by unfair or unsportsmanlike methods.

"These actions," writes the Editor, "reflect seriously not only on the DXer, but on his colleagues, the radio stations, and the entire sport. The vast majority of DXers are honest, and would not report a station unless they had some definite proof of identification. . . . To those who, while not openly dishonest, nevertheless use unethical DX methods, we beg of you to give them up *now*."

High Patronage

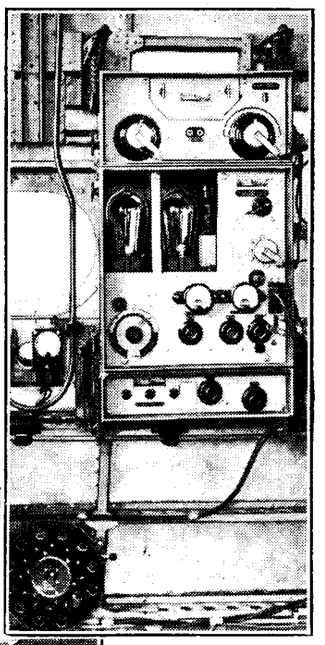
THEIR Excellencies the Governor of Uganda, the Governor of Kenya, and the Resident of Zanzibar have become patrons of the newly formed Radio Society of East Africa, which has just been granted honorary affiliation with the Radio Society of Great Britain. Its members are mostly amateur transmitters and others interested in short-wave work.

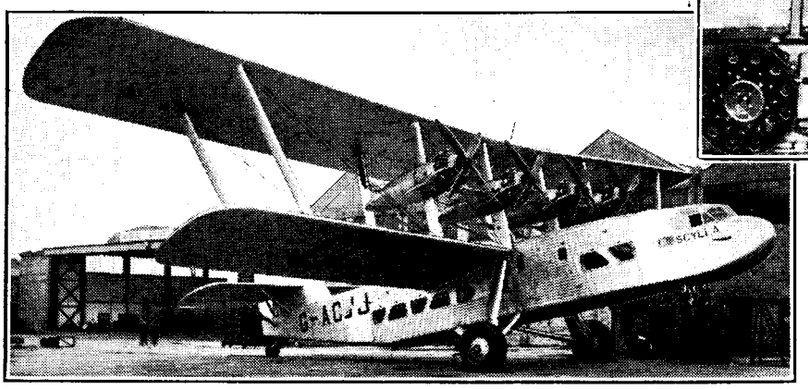
An Amateur's Double

BY securing first place in the Radio Society of Great Britain's transmitting contest on the 1.75-megacycle (170 metres) band, Mr. H. G. Collin, D2GQ, becomes the first member of the Society to attain the championship in two consecutive contests. He won the first place in the 3.5-megacycle (180 metres) competition last November. Mr. Collin's station is situated at Wickford, Essex, and in both these contests an input of only 10 watts was used.

Talking to the Antarctic

SPECIAL messages to the fifty-six members of the Byrd Antarctic Expedition are to be transmitted from W2XAF, Schenectady, at 4.30 and 5 a.m. (G.M.T.) on 31.48 metres, on the mornings of June 4th, June 18th, July 2nd, July 30th, August 13th, August 27th, September 10th and 24th.





AIR LINER RADIO. The new Short four-engined Imperial Airways liner "Scylla" and its Marconi wireless transmitting and receiving equipment. A waveband of 500-1,000 metres is covered.

Transatlantic Mishap Explained

FRANCE is blaming American radio engineers for the farcical incident early last month when M. Louis Barthou's radio talk to the U.S. in connection with the Lafayette Centenary was suddenly interrupted by the words, "Won't you kiss me, Lucien?" Astonished listeners in America had been suddenly switched through to a relay of *La Petite Chocolatière* by Lille PTT. The transmission went out from the French Colonial station at Pontoise, and it was at first alleged that the *contretemps* was due to carelessness at the short-wave station. The French Postmaster-General now explains that a temporary break in transmission was caused by a valve failure. Before the trouble could be rectified the impulsive engineers in America had switched over to the alternative short-wave transmitter at Pontoise, which was broadcasting the comedy programme. This explanation follows allegations that the "accident" was planned.

New Television Company

THE registration of a new company, the Marconi-E.M.I. Television Company, Limited, took place on Tuesday, May 22nd. The shares are held equally by the Marconi Company and Electric and Musical Industries, Limited. The agreement relates to high-definition television. The Board of the new Company consists of His Excellency the Marchese Marconi, the Rt. Hon. Lord Inverforth, Chairman of the Marconi Company, Mr. Alfred Clark, Chairman of E.M.I., Mr. Louis Sterling, Managing Director of E.M.I., Mr. H. A. White, Managing Director of the Marconi Company, Mr. I. Shoenberg, Director of Research of E.M.I., and Mr. H. R. C. Van de Velde, Acting General Manager of the Marconi Company.

INTERNATIONAL BROADCASTING UNION

June Meeting in London

A RECEPTION by the Lord Mayor at the Mansion House, and a banquet by the Postmaster-General at Lancaster House, are among the high-lights of the London meeting of the International Broadcasting Union at Grosvenor House from June 12th to 20th. Although this is a routine meeting of the Union it is the first that has been held in London since the Union was founded at Savoy Hill in March, 1925.

During the nine days of the Conference at least sixty hours will be devoted to the close discussion of international broadcasting problems, particularly in relation to the use of propaganda. It is known that there are two schools of thought on this subject, one party contending that, propaganda being inevitable, no time should be lost in placing it under control. The other party contends that, owing to the dangerously wide influence of broadcasting, propaganda should be avoided.

Since 1925 there have been sixteen meetings of the Assembly and ninety-five of the Council.

It is noteworthy that at the preliminary meeting the delegates represented transmitters having a total radiated energy of 80 kilowatts. At this year's meeting they will represent a radiated power of 4,250 kilowatts!

The B.B.C. will also entertain the Conference delegates. There will be an inspection of Broadcasting House, with special demonstrations, and the delegates will also view the new high-power station at Droitwich.

The final function will be a banquet given by the B.B.C. at Grosvenor House.

Page 379 follows after the Programme Supplement

PRINCIPAL BROADCASTING STATIONS OF EUROPE

Arranged in Order of Wavelength

(Stations with an aerial power of 50 kW. and above in heavy type)

Station.	kc/s.	Tuning Positions.	Metres.	kW.
Kaunas (Lithuania)	155		1935	7
Brasov (Roumania)	160		1875	20
Huizen (Holland). (*Kootwijk, 50 kW. after 3.40 p.m.*) (*V.A.R.A. and A.V.R.O. Programmes.*)	160		1875	7
Lahti (Finland)	166		1807	40
Moscow, No. 1 (U.S.S.R.)	174		1724	500
Radio Paris (France)	182		1648	75
Istanbul (Turkey)	185		1621	5
Königswusterhausen (Deutschlandsender) (Germany).	191		1571	60
Daventry National	200		1500	30
Ankara (Turkey)	200		1500	7
Minsk (U.S.S.R.)	208		1442	100
Reykjavik (Iceland)	208		1442	16
Eiffel Tower (Paris)	215		1395	13
Motala (Sweden). (*Relays Stockholm*)	216		1389	30
Warsaw, No. 1 (Poland)	223		1345	120
Luxembourg	230		1304	150
Kalundborg (Denmark). (*Relays Copenhagen*)	238		1261	75
Leningrad (U.S.S.R.)	245		1224	100
Oslo (Norway)	254		1181	60
Madona (Latvia)	265		1132	20
Moscow, No. 2 (U.S.S.R.)	271		1107	100
Geneva (Switzerland). (*Relays Sottens*)	401		748	1.3
Moscow, No. 3 (U.S.S.R.)	401		748	100
Ostersund (Sweden)	413		726.2	0.6
Boden (Sweden)	413.5		726	0.6
Oulu (Finland)	431		696	2
Hamar (Norway)	519		578	0.7
Innsbruck (Austria). (*Relays Vienna*)	519		578	0.5
Ljubljana (Yugoslavia)	527		569.3	5
Viipuri (Finland)	527		569.3	13
Bolzano (Italy)	536		559.7	1
Wilno (Poland)	536		559.7	16
Budapest, No. 1 (Hungary)	546		549.5	120
Beromunster (Switzerland) (Schweizerischer Landessender).	556		539.6	60
Athlone (Irish Free State)	565		531	60
Palermo (Italy)	565		531	4
Mühlacker (Stuttgart) (Germany)	574		522.6	100
Riga (Latvia)	583		514.6	15
Agen (France)	583.3		514.3	0.6
Vienna (Bisamberg) (Austria)	592		506.8	120
Radio Maroc (Morocco). (*S.-w. Stn., 48 m.*)	601		499.2	6.5
Sundsvall (Sweden). (*Relays Stockholm*)	601		499.2	10
Florence (Italy). (*Relays Turin*)	610		491.8	20
Brussels, No. 1 (Belgium). (*French Programme.*)	620		483.9	15
Lisbon (Portugal)	629		476.9	20
Trondheim (Norway)	629		476.9	1.2
Prague, No. 1 (Czechoslovakia)	638		470.2	120
Lyons, PTT (France)	648		463	15
Langenberg (Germany)	658		455.9	60
North Regional (Slaithwaite)	668		449.1	50
Sottens (Switzerland) (Radio Suisse Romande)	677		443.1	25
Belgrade (Yugoslavia)	686		437.3	2.5
Paris, PTT (France)	695		431.7	7
Stockholm (Sweden)	704		426.1	55
Rome, No. 1. (*Short-wave station, 25.4 metres*)	713		420.8	50
Kiev (U.S.S.R.)	722		415.5	100
Tallinn (Estonia)	731		410.4	20
Seville (Spain)	731		410.4	1.5
Munich (Germany)	740		405.4	100
Marseilles, PTT (France)	749		400.5	5
Katowice (Poland)	758		395.8	12
Midland Regional (Daventry)	767		391.1	25
Toulouse, PTT (France)	776		386.6	2
Leipzig (Germany)	785		382.2	120
Barcelona, EAJ1 (Spain)	795		377.4	5
Lwow (Poland). (*Relays Warsaw*)	795		377.4	16
Scottish Regional (Falkirk)	804		373.1	50
Milan (Italy). (*Relays Turin*)	814		368.6	50
Bucharest (Roumania)	823		364.5	12
Radio, LL (Paris)	827		362.8	2
Moscow, No. 4 (U.S.S.R.)	832		360.6	100
Berlin Funkstunde. (*Short-wave Stations,*) 16.89, 19.73, 25.5, 31.38 *and* 49.83 *metres.*)	841		356.7	100
Bergen (Norway)	850		352.9	1
Valencia (Spain)	850		352.9	1.5
Strasbourg (France)	859		349.2	15
Poznan (Poland)	868		345.6	16
London Regional (Brookmans Park)	877		342.1	50
Graz (Austria). (*Relays Vienna*)	886		338.6	7
Helsinki (Finland)	895		335.2	10
Limoges, PTT (France)	895		335.2	0.5
Hamburg (Germany)	904		331.9	100
Radio Toulouse (France)	913.2		328.5	10
Brno (Czechoslovakia)	922		325.4	32
Algiers (Algeria)	931		322.2	12
Brussels, No. 2. (*Flemish Programme*)	932		321.9	15
Göteborg (Sweden). (*Relays Stockholm*)	941		318.8	10
Breslau (Germany)	950		315.8	60
Poste Parisien (France)	959		312.8	100
Grenoble (France)	968		309.9	20
West Regional (Washford Cross)	977		307.1	50
Cracow (Poland)	986		304.3	2
Genoa (Italy). (*Relays Turin*)	986		304.3	10
Hilversum (Holland). (*KRO and NCRV*) (*7 kW. till 5.40 p.m.*).	995		301.5	20
Bratislava (Czechoslovakia)	1004		298.8	13.5
North National (Slaithwaite)	1013		296.2	50
Parede (Portugal)	1031		291	5
Heilsberg (Germany)	1031		291	60
Rennes, PTT (France)	1040		288.5	2.5
Scottish National (Falkirk)	1050		285.7	50
Bari (Italy)	1059		283.3	20
Bordeaux-Lafayette	1077		278.6	12
Zagreb (Yugoslavia)	1086		276.2	0.7
Falun (Sweden)	1086		276.2	2
Madrid, No. 2 (EAJ7)	1095		274	7
Naples (Italy). (*Relays Rome*)	1104		271.7	1.5
Radio Vitus (Paris)	1112.6		269.6	0.7
Kosice (Czechoslovakia). (*Relays Prague*)	1113		269.5	2.6
Belfast	1122		267.4	1
Nyiregyhaza (Hungary)	1122		267.4	6.2
Hörby (Sweden). (*Relays Stockholm*)	1131		265.3	10
Turin, No. 1 (Italy)	1140		263.2	7
London National (Brookmans Park)	1149		261.1	50
West National (Washford Cross)	1149		261.1	50
Moravska-Ostrava (Czechoslovakia)	1158		259.1	11.2
Monte Ceneri (Switzerland)	1167		257.1	15
Copenhagen (Denmark). (*S.-w. Stn., 31.51 m.*)	1176		255.1	10
Frankfurt (Germany)	1195		251	17
Trier, Cassel, Freiburg-im-Breisgau and Kaiserslautern.	1195		251	—
Prague, No. 2 (Czechoslovakia)	1204		249.2	5
Lille, PTT (France)	1213		247.3	5
Trieste (Italy). (*Relays Turin*)	1222		245.5	10
Gleiwitz (Germany). (*Relays Breslau*)	1231		243.7	5
Cork (Irish Free State)	1240		241.9	1
Juan-les-Pins (France)	1249		240.2	2
Rome, No. 3 (Italy)	1258		238.5	1
San Sebastian (Spain)	1258		238.5	3
Nürnberg and Augsburg (Germany)	1267		236.8	2
Bodö, Stavanger and Kristiansand (Norway)	1276		235.1	0.5
Dresden (Germany)	1285		233.5	1.5
Aberdeen	1285		233.5	1
Linz, Klagenfurt and Salzburg (Austria)	1294		231.8	0.5
Danzig. (*Relays Heilsberg*)	1303		230.2	0.5
Swedish Relay Stations	1312		228.7	0.25
Budapest, No. 2 (Hungary)	1321		227.1	0.8
Hanover, Bremen, Flensburg, Stettin and Magdeburg.	1330		225.6	1.5
Lodz (Poland)	1338.9		224.1	1.7
Montpellier, PTT (France)	1339		224	5
Dublin	1348		222.6	1
Milan, No. 2 (Italy)	1348		222.6	4
Königsberg (Germany)	1348		222.6	0.5
Turin, No. 2	1357		221.1	0.2
Warsaw, No. 2 (Poland)	1384		216.8	2
Lyons (Radio Lyon) (France)	1393		215.4	5
Tampere (Finland)	1420		211.3	1.2
Newcastle	1429		209.9	1
Béziers (France)	1429		209.9	2
Magyarovar (Hungary)	1438		208.6	1.25
Miskolc (Hungary)	1438		208.6	1.25
Fécamp (Radio Normandie)	1456		206	10
Pecs (Hungary)	1468.6		204.2	1.25
Bournemouth	1474		203.5	1
Plymouth	1474		203.5	0.3
Bordeaux Sud-Ouest (France)	1492		201.1	1
Nimes (France)	1492		201.1	0.2

The Short-Wave World

Good Reception from U.S.A.—High-power Rumour—Increasing Popularity of the Short Waves

RECENT remarks in this column about the impossibility of receiving Australia on the medium broadcast band, as compared with the extreme ease with which it is possible on the short waves, have brought forth an interesting letter.

Mr. K. Judd, of Orpington, produces verification of the reception of the Australian broadcast stations 2UE and 5CL on the medium broadcast band. He also claims to have heard ten other Australian and four New Zealand stations, together with 26 in Argentina, 21 in Mexico, 7 in Japan. He also claims several other startling scalps.

Truly, we of the short-wave fraternity do not realise what *is* possible on the much-despised "long waves." In a sense, however, these claims back up the argument that short waves have been poor for the last three years, while the longer waves have been abnormally good. One ventures to suggest that in five years' time even the reception of the U.S.A. on 300 metres will be a rarity. What the short waves will be like we dare not imagine.

Strong "Sigs" from the West

At the time of writing these notes conditions are very greatly improved. The Hawaiian amateurs, K6KKC and K6COG, have been coming in with clockwork-like regularity at 08.00 on the 20-metre band, and the East and Central U.S.A. stations have been exceptionally good between 21.00 and midnight.

Before long we may expect to hear the West Coast transmitters in the early mornings. They have never yet failed us during the early summer.

One or two Japanese amateurs, too, have been making themselves heard in this country during the afternoons, also on 20 metres. It is rather strange that such good conditions on the amateur bands should not coincide with an improvement on the short-wave broadcast bands.

100 Kilowatts?

A very prominent feature of the last fortnight has been the great strength of the American amateur "phones" on the 20-metre band, although the broadcast stations on 19 metres have not been by any means conspicuous.

The writer has never ceased to marvel at the very small difference in strength between a good American amateur putting out 200 watts of telephony and a 20-kW. broadcast station only 1,000 kc. or so away from his frequency.

Probably the solution lies in the fact that 100 per cent. modulation (or more!) is popular with the amateur who specialises in telephony, whereas most of the broadcast stations only seem to average about 30 per cent.

Rumour (probably unfounded) suggests that a 100-kw. or even 150-kw. short-wave station may be "on the air" by the autumn. Its location, naturally, will be that home of everything big, the U.S.A.! Whether this be true or not, it is certain that the coming winter will see an enormous drive with the object of popularising short-wave reception, particularly in America.

More Short-wave Transmitters

The home constructor is turning more and more to the short waves as an outlet for his energy and ingenuity, and it is only right that he should be given some encouragement by the interested parties—the big manufacturing concerns.

Short waves are so absolutely international in character that local systems of broadcasting do not have the least influence on their development, unless we take into account large-scale ventures like that of the B.B.C., whose Empire Station, if not the highest-powered, is certainly the most important and most complete in the world.

At the moment there are about 110 short-wave broadcast stations in regular operation. By this time next year there will probably be 150 or more. *Then* the problem of overcrowding will begin to assume a serious aspect.

MEGACYCLE.

The Art of Ganging

III.—The Effect of H.F. Chokes on a Ganged Receiver

THE previous articles in this series have dealt with the actual ganging adjustments and the theory underlying the design of a ganged receiver, and this article reveals the cause for many unsuspected faults in such sets. It is shown that faulty H.F. chokes may lead to serious errors in ganging.

ALTHOUGH accurate matching of the coils in a receiver is an essential to the attainment of accurate ganging, and the use of a well-matched gang condenser is also necessary, this alone is not sufficient for keeping all the circuits exactly in step with one another over the whole tuning range. Many factors may come into play to alter the effective values of the inductance and capacity, and it is upon these effective values which we rely rather than upon the values measured externally to the receiver.

Apart from questions of stray capacity, which are relatively simple to solve in practice, and which chiefly affect the tuning range, there is a number of factors which may be responsible for inaccurate ganging. When any of these is present it is usually found that the set can be trimmed correctly at a low wavelength, but that the ganging does not hold at higher wavelengths. This is easily checked by attempting to retrim the circuits at a number of higher wavelengths. If all is in order, the retrimming will lead to exactly the same trimmer settings as when the process was carried out at a low wavelength, but as the optimum settings are determinable with the greatest accuracy at a low wavelength, it is a wise plan to regang at a low wavelength after the checking has been done. Should it be found, however, that the ganging does not hold, the next step must be to determine the cause of the defect. If the ganging runs more and more out of step as the wavelength is increased, it may usually be taken as a sign that the matching of the coils is faulty. A defective gang condenser may lead to the same symptoms, or it may cause the ganging to be inaccurate over a portion only of the tuning range, depending upon the precise nature of the defect.

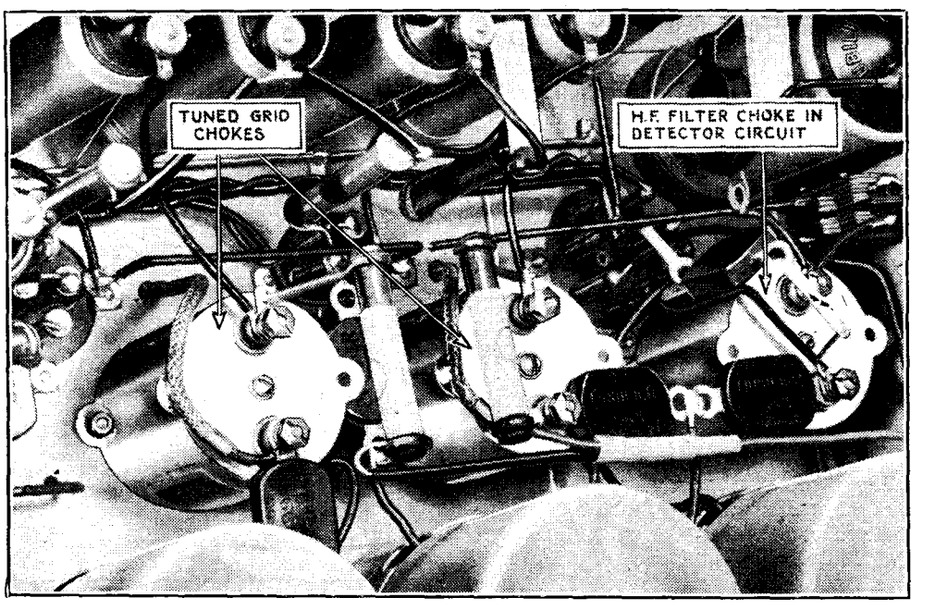
H.F. Chokes

Another cause of inaccurate ganging, particularly when it occurs only over a very small part of the tuning range, is a faulty H.F. choke in a tuned grid circuit, such as Fig. 1, and this is one which is often unsuspected. In most types of H.F. choke the inductance and self-capacity is distributed, and cannot be considered as separate quantities in the manner of ordinary tuned circuits. The main resonance, of course, usually occurs at some 1,500-2,000 metres, and so falls at the upper end of the long waveband. Subsidiary resonances at lower wavelengths are probable in addition, particularly with sectionalised and binocular types of choke, and in a well-designed component the chief ones are arranged to fall midway between the two wavebands where they are in no way harmful.

In cases where the subsidiary resonance of a choke falls within the tuning range, however, it may exercise a profound effect upon the ganging. The impedance of a choke at frequencies higher than resonance is capacitative, but at lower frequencies it becomes inductive, and at the resonance frequency it acts as a pure resistance of high value. Instead of considering the choke as acting upon the tuned grid circuit merely to increase the stray capacities slightly, therefore, we have to consider it as adding a capacity which becomes smaller in value as the wavelength is raised until it vanishes completely at the choke resonance frequency. At still lower wavelengths the choke behaves as a shunt inductance, but it is easier to visualise the effect as a negative capacity—that is, the choke acts in such a way that it *reduces* the effective stray capacity to an extent which varies with wavelength.

It will be obvious that if a choke of this type be employed it will be impossible to obtain correct ganging. The effect will be present only over a very small band, or bands, of wavelengths, however, so that it will usually be noticeable chiefly by a reduction of efficiency at certain dial settings rather than by any marked effect upon the ganging. On the long waveband the effect may easily be responsible for wide discrepancies in ganging, but it is then due more to an insufficiently high inductance value for the choke than to subsidiary resonances. Difficulties of this nature, of course, can be overcome by choosing a good-quality H.F. choke or by using a tuned transformer H.F. coupling instead of the tuned grid circuit.

It is not always realised that the tuning of the grid circuit of a valve may be seriously affected by the nature of its anode circuit in certain cases. In practice, this occurs to the greatest extent with a triode detector, due to the internal grid-anode, inter-electrode valve capacity. The input impedance of a valve is due only partly to the reactance of the small condenser formed by the grid and cathode elements, and depends largely upon the nature of the anode circuit load impedance at the frequencies under consideration, the effective amplification of the valve, and the value of



Screened H.F. chokes are commonly employed in a multi-stage receiver to reduce interaction between successive stages.

The Art of Ganging—

the grid-anode capacity. When the anode circuit load impedance is resistive or capacitative, the input impedance is also capacitative in nature, but when the anode load becomes inductive the input impedance may become inductive also. In the case of the ordinary detector, the anode circuit load impedance is capacitative to H.F. currents on account of the small by-pass condenser C of Fig 1, which is usually connected between the anode and cathode of the valve. The effect of the detector valve upon the preceding tuned circuit, therefore, will be that of a small condenser, as already pointed out. This capacity, however, may not be constant at all wavelengths, for in general the amplification of the valve at high frequencies will vary with wavelength, and so cause the input capacity to vary.

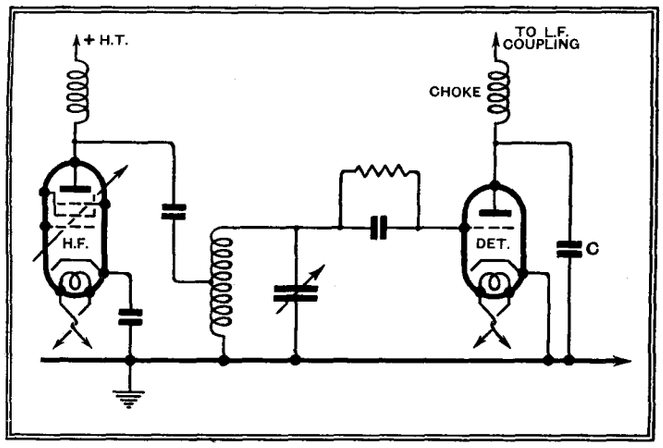


Fig. 1.—The H.F. and detector circuits of a typical receiver illustrating the different points at which H.F. chokes may be used.

The importance of this point lies in the fact that, unless the input capacity is constant, its effect cannot be balanced out at all wavelengths by any adjustment of the trimmers, and accurate ganging will not be possible. Fortunately, this effect is not very great in most cases, and it may usually be neglected. If the anode-cathode by-pass condenser is large, so that the detector amplification at high frequencies is small, the input capacity is at a minimum, and the constant physical grid-cathode capacity forms a large part of it. The variations in capacity over the waveband, therefore, are not very great. On the other hand, if the anode circuit by-pass condenser be small, so that the amplification is appreciable, and the input capacity becomes large and very variable, the input resistance of the valve also becomes low, and the tuned circuit is heavily damped. Due to this damping, the effects of the misganging caused by the variations in input capacity are not very noticeable.

Stability and the Detector Load

It will be seen that any variations in the anode circuit load impedance must have some effect upon the ganging, and this will be found particularly noticeable in the case of a receiver fitted with reaction, for, in effect, reaction operates by varying the input impedance of the valve. When the control is operated so that the set passes from the non-oscillating to the oscillating condition, the input impedance will change from being capacitative to inductive, with an inevitable effect upon the tuning of the circuit to which reaction is being applied. It is usually recommended, therefore, that ganging be carried out with the reaction control set as nearly as possible to the oscillating point without the set actually oscillating. In this way, the most accurate ganging is obtained when maximum reaction is used, and this will only be employed when the maximum sensitivity or selectivity is required, at which time the greatest accuracy of ganging is needed.

The H.F. choke in the detector anode circuit may also cause trouble, particularly if the anode-cathode by-pass condenser is small or non-existent. If the choke has a resonance within the tuning range of the receiver, the detector load impedance will change from being capacitative to being inductive, and even in the absence of reaction this may lead to self-oscillation which might easily be confused with instability of the H.F. circuits. Even if actual instability does not occur, the effect upon the ganging of the intervalve coupling may be serious. In cases where difficulty in ganging the circuit preceding the detector is experienced, therefore, the detector anode circuit should never be forgotten.

The Diary of an Ordinary Listener

ON looking through my notes on last week's programmes there seems rather a preponderance of Operatic Music, and this is odd, because, as a rule, I do not much care for broadcast opera unless I know the work well. Visible action is generally required to give point to the music, otherwise much of the dialogue and recitative is apt to become boring.

On Wednesday, May 16th, Turin gave a spirited performance of "No No Nanette." It seemed somewhat strange to hear the familiar "Tea for Two" and other well-known numbers sung in Italian, but certainly neither Vincent Youman's music nor the sparkle of the dialogue appeared to suffer by the translation.

On Friday, May 18th, I listened with interest to "La fille de Madame Angot" which Poste Parisien was relaying from the Porte-Saint-Martin Theatre, and felt rather like the man reading "Hamlet" for the first time who was struck by the number of familiar quotations the play contained. In the days of my boyhood Lecocq's music was on every barrel organ.

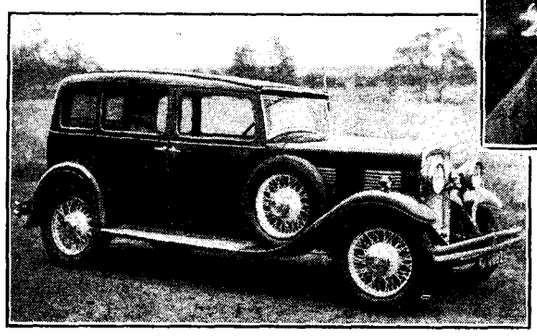
I found it interesting, also, to listen for a short time to the German community singing from Berlin in which the conductor seemed as indefatigable and painstaking as one would expect from such a thoroughgoing nation. Kalundborg's main evening programme was devoted to Italian opera music by the Station Orchestra conducted by Fritz Mahler, of which I heard extracts from "Cavalleria rusticana" and "The Barber of Seville."

When I happen upon any music that appeals to my individual taste I like to sit quietly and listen to it; therefore when I heard the strains of Gounod's "Faust" transmitted the other evening by Paris P.T.T. I sat tight and prepared to enjoy the familiar opera which I am not ashamed to confess I can still appreciate although the modern fashion is to scoff at it.

The first part came through very clearly, but towards the end the station showed distinct signs of fading and I could hardly hear Valentine's emphatic cursing of his sister.

On Monday, May 21st, the most attractive programme appeared to be Verdi's "Aïda" relayed from the National Theatre at Munich, but I found that the Munich station was not at its best on that evening, so I turned to the ever-faithful Huizen and had no cause to regret the change as the Hague Bach choir with orchestra and soloist were giving a splendid concert of 17th and 18th century music. Afterwards we had a really fine selection of English records, among them a chorus from "Elijah" sung by the Royal Choral Society, and Brahms' "How lovely is thy dwelling place" by the choir of the Temple Church.

CALIBAN.



POLICE WIRELESS. A Marconi engineer testing a new police wireless transmitting and receiving equipment installed in a saloon car. The receiver can be seen next to the dashboard, which carries the control switches, and the transmitter is below.

BROADCAST BREVITIES

By Our Special Correspondent

Will Droitwich Fade?

THE fading of Daventry at ranges of over 200 miles during the summer has been confirmed by tests made by the provincial stations. The question is now asked, Will Droitwich also fade?

Good Old A.V.C.

Always guarded in their replies, the B.B.C. engineers decline to guarantee that Droitwich will always be the perfect gentleman in this respect, but they do suggest that the careful design of the new aerial may help to overcome the tendency. Also, it is pointed out that the higher general level of signal strength should make fading less noticeable, while the widespread use of A.V.C. should overcome the effect in receivers.

The Receiver Helps

It is worth noting that the B.B.C. now entertains much greater respect for the ordinary listener than ten years ago, when every effort was expended in providing a signal which the "yob"—in other words, the average listener—could pick up with a clothes line and a piece of cheese. Nowadays the engineers rely upon the efficacy of receivers to counteract, in part, certain deficiencies in transmission.

I wish a receiver could be evolved which would similarly counteract deficiencies in programmes.

Colonel Dawnay's Decision

ON second thoughts, and notwithstanding my happy but premature paragraphs to the contrary, Colonel Dawnay has decided to suspend the alternative programme system between 1800 and 2000 on weekdays during the summer.

"Most people are out of doors, anyway," is the excuse given by the B.B.C. After a glance at the advance programme lists, I sincerely hope that most people *will* be out of doors.

No Broadcasting for One Month

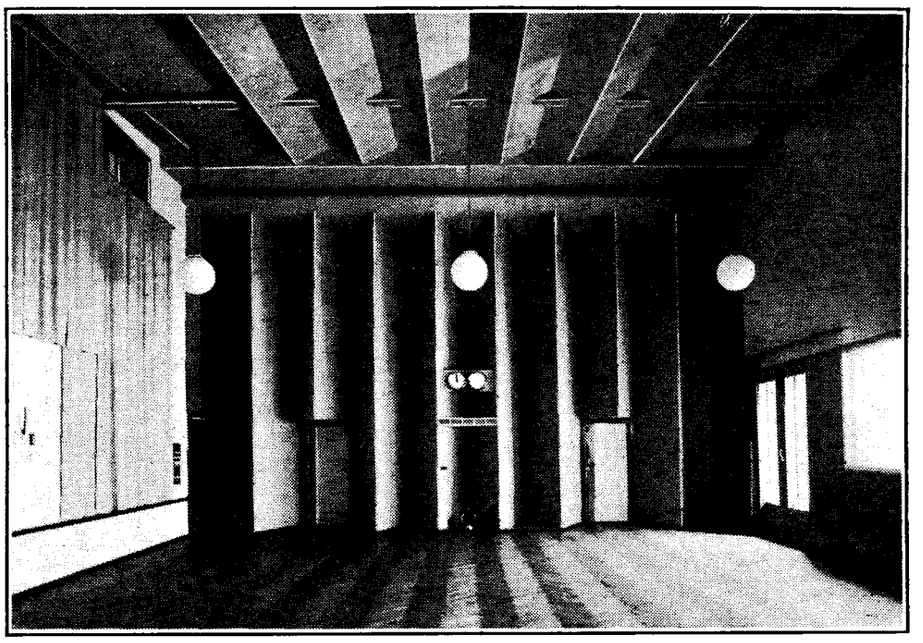
This recalls an idea which struck me last year and will bear repeating now. Why not a close season for broadcasting, a complete break of a month or more enabling broadcasters and listeners to recuperate?

It would help us to appreciate broadcasting more. Or would it?

Novel as Radio Play

"THE Lost Horizon" is the title of an important new radio play to be broadcast in the National programme on June 27th and in the Regional on June 28th. The play, which has been adapted for the microphone from the original novel by James Hilton, concerns a small party of people who find themselves isolated in Central Asia and brought face to face with a new philosophy of life.

The original novel was praised for its ingenuity and distinction of writing, and the B.B.C. is gratified that an author of James Hilton's calibre is prepared to submit his work to the medium of the microphone.



STUDIO ACOUSTICS. Here is the last word in broadcast studio design. The photograph was taken in the Small Orchestra Studio at Konigsberg. Movable walls and a specially shaped roof conspire to give the best acoustic effect for any particular programme while eliminating undesirable resonances.

The Honest Drapers

THE drapers sadly misunderstand the functions of the B.B.C. in suggesting that special broadcasts on fashion might be arranged in order to make the British public "fashion wise." They have gone the wrong way about the scheme, for the B.B.C. resolutely sets its face against conscious propaganda in any shape or form.

Too Busy to Listen?

It would have been much wiser to get the Chairman or the Secretary of the Drapers' Organisation to write a radio play or compose a dance tune in which frills and furbelows, hand in hand with sex appeal, would get past the bemused officials to the homes and hearths of Britain.

Evidently the drapers have no time for listening or they would know how these things are done.

"T.T." Thrills via Wireless

MOTOR cyclists who have the time to spare will tune in the running commentary on the Senior T.T. on June 15th which is to be relayed from the Isle of Man. There will be three commentators. Major Vernon Brook will occupy the most strategic position at the Grand Stand, but vivid glimpses of the progress of the race will also be described from Craig-na-Baa by J. L. Finnigan and from the hair-raising hairpin bend at Ramsay by Victor Smythe. This sort of broadcast ought to popularise pocket wireless among office workers.

Buying Time

FOR 900 dollars you can run the New York station of the National Broadcasting Company for one hour, according to the N.B.C.'s new Rate Card for sponsored programmes. The next most expensive station is Chicago, charging 460 dollars an hour, Boston coming next at 400 dollars an hour. If you take the "Red" network, which includes these stations and seventeen others, you pay 5,380 dollars for the hour.

The People Who Listen

Without extra cost you have the services of the N.B.C. artists, of the programme department, and of the staff announcers. The programme department "creates, builds and produces hundreds of radio programmes each week," while skilled writers prepare the spoken words for programme presentation.

The N.B.C. networks, it is stated, embrace a total radio audience of over 50 million listeners, owning nearly 17 million radio sets.

The Aldershot Tattoo

THE Aldershot Tattoo has figured annually in the broadcast programmes for seven years. Continuity will not be broken in 1934, for on June 16th two relays of half an hour each are to be heard by National programme listeners. The first will comprise the combined display by the Royal Horse Artillery and Grenadier and Coldstream Guards.

The second relay will include the Rally of Empire and Grand Finale with the evening hymn, "Abide with Me," sung by the whole assembly, followed by the Grand Salute and the National Anthem. The relay gives listeners an opportunity of hearing the thousand instruments—bugles, drums, fifes, brass and reed—played by the cream of British Army bandsmen.

A Nasty One

FROM a letter received by the B.B.C. a few days ago:—

". . . I know the old reply to this—that these stations are only built to serve just a few miles short of the district the complaint comes from."

We listeners are a suspicious lot.

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers.
Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page.

Voltmeter Resistance

WHEN readers ask for information on the inferences that may be drawn from their measurements of anode voltage, it would be helpful if the resistance rating of the instrument used for measurement were specified. For instance, a correspondent says that the reading of voltage on the anode of the I.F. valve in his Everyman A.C. Super is only 85 volts, and assumes that this is excessively low.

If the meter is of, say, the "1,000 ohms per volt" type, it is certain that something is wrong, and that the valve is being supplied with insufficient voltage. But if the instrument has a more usual and lower resistance, then in all probability the actual working voltage is near enough to the figure intended by the designer.

"Single-Span" Aerial Systems

A READER who is building the Single-Span receiver asks whether, in view of the special input circuit embodied in this receiver, it would be possible to employ a "transmission line" screened aerial lead-in, with matching transformers at each end.

In these circumstances it would be distinctly safer to employ an ordinary screened down-lead of the low-capacity type. Matching transformers, as supplied with the alternative type of lead-in, are not designed to suit the aerial circuit of the Single-Span receiver, and so there would probably be serious losses, particularly on the long waves.

Direction of Windings

MOST of us are satisfied to find out the proper connections to a reaction coil by the method of trial and error; if reaction is not obtained with the original connections, then the two leads to the coil are reversed.

But there is no need for this somewhat haphazard procedure. In reply to a reader who apparently objects to it, we may say that there is a simple rule for determining the "sense" of a reaction winding with respect to the grid coil to which it is coupled.

Here is the rule. Imagine that currents are flowing outwards from both the grid and anode of the valve; reaction effects will be obtainable if these currents flow through the coils in *opposite* directions.

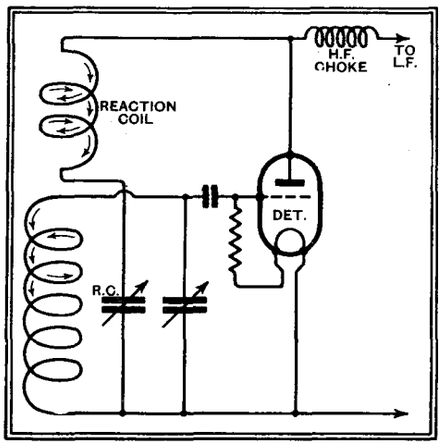


Fig. 1.—Illustrating a rule for ascertaining the correct sense of reaction windings.

The rule is illustrated in Fig. 1, in which the imaginary currents are shown as flowing through the reaction coil in a clockwise direction, and in an anti-clockwise direction through the grid coil. Of course, reaction would still operate if the connections of *both* grid and reaction coils were reversed.

A Disconnected Condenser?

A CORRESPONDENT has found out that the stability of his "straight" A.C. mains receiver is improved by connecting a by-pass condenser between the metallic coating of the H.F. valve and the metal chassis. We are asked to say if there is any harm in retaining this condenser as a permanent part of the set, and also to explain why it exerts so beneficial an influence.

In effect, a by-pass condenser connected in the manner described is in parallel with the condenser which is commonly connected across the bias resistor in the cathode lead. It would seem fairly certain that in our correspondent's set this latter condenser is defective. It probably has an internal disconnection, and the condenser that has been added is doing its job. We are assuming that the metallic coating is connected internally to the cathode pin, and not (as in some recent types) to its own separate pin.

Capacity of Screened Wire

EVEN if great care be taken, it is inevitable that the extensive use of screened wire in the connections of tuned circuits will have an appreciable effect in adding to the amount of stray capacity across the circuits. A reader who expects to have to make use of this aid to stability asks us to assign an average figure for the capacity per foot of "well-made screened H.F. leads."

We have not sufficient data to be able to give an average value, but think that a figure of 20 micro-microfarads per foot is reasonable. In making this estimate we are guided by measurements made of the usual commercial screened sleeving with a conductor of the lightest gauge of wire likely to have sufficient mechanical strength.

Short-circuiting the Grid

IT is often recommended that the grid circuit of a valve should be temporarily short-circuited as an aid to the tracing of hum and certain other troubles. A correspondent enquires whether this advice can be taken quite literally, or whether there is some risk of doing damage by applying short-circuits indiscriminately.

It is perhaps best to make it a rule always to apply the temporary "short" across the grid-circuit impedance (transformer secondary, grid leak, etc.). Take the case of a battery valve, as shown in Fig. 2 (a); the connection should be made in the position marked X. By short-circuiting grid and filament direct as indicated by the dotted line marked Y, the valve will be operated with zero bias; this means that the result of the test may be misleading, and also there is the possibility of damaging the valve.

With regard to indirectly heated mains valves (see Fig. 2 (b)), there is practically no risk of robbing the valve of its bias when making a test. The only real difference between applying short-circuits at X or Y is that in the latter position the resistance of the grid circuit load (in this case the transformer secondary) is placed in parallel with the bias resistance, and so the operating conditions of the valve may be affected to some slight extent

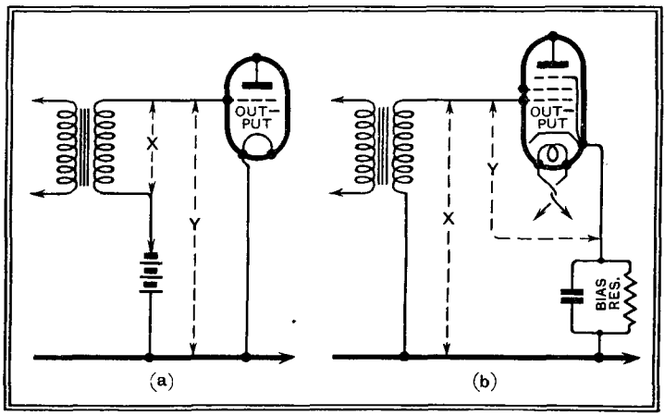


Fig. 2.—It is possible that bias voltage may be disturbed when applying an experimental short-circuit.

The Wireless World
INFORMATION BUREAU

THE service is intended primarily for readers meeting with difficulties in connection with receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

Communications should be by letter to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service.

Personal interviews are not given by the technical staff, nor can technical enquiries be dealt with by telephone.

A Successful D.C. Transformer

H.T. from the L.T. Battery

By Dr. F. NOACK

IT must have occurred to many that a simple form of H.T. generator might be devised by applying the principle of charging a bank of condensers in parallel from a source of low voltage, and then discharging the condensers in series. According to a Berlin correspondent this idea has now been put into practical form in Germany.

IT has always been thought that the transformation of a direct current potential to a higher or lower potential is an impossible feat. Such a transformation cannot, of course, be accomplished by the usual A.C. transformer, since this works on the principle of electro-magnetic induction, which only applies when the primary current varies in strength, or in strength and direction. Whenever, for example, it has been necessary to convert direct current to a higher voltage, a roundabout method has been employed, such as the use of a rotary converter, or of a vibrating contact breaker in conjunction with an induction coil having a suitable step-up ratio.

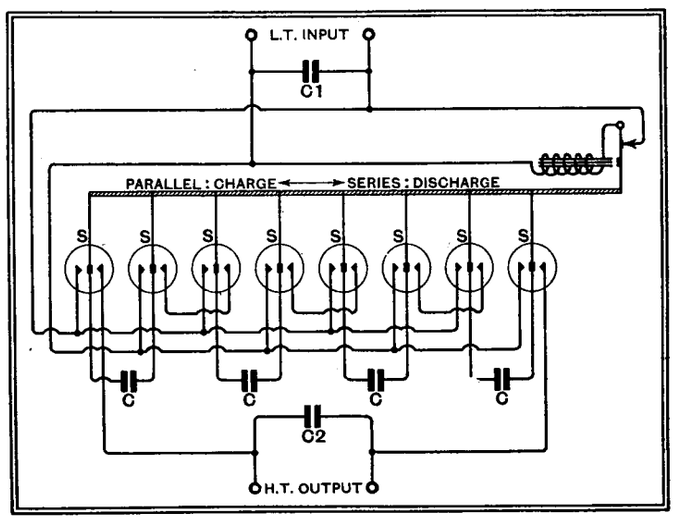


Fig. 1.—Series-parallel condenser bank, with switching actuated by a vibratory mechanism.

But there is another and more direct way of carrying out D.C. transformation which has been known for a long time, and has actually been put into practice in the laboratory. The principle is simple—a bank of condensers is charged in parallel and discharged in series. If two equal condensers are connected in parallel and charged with a 100-volt supply, each one takes up a potential of 100 volts. Then if the two charged condensers are connected in series (with the right polarity, of course) the two potentials are additive and the voltage across the two is 200 volts; a combination of two condensers used in this way thus acts as a "transformer" with a ratio of 1:2, and so on. Theoretically, this plan is very attractive; in practice, of course, the difficulty is to carry out this series-parallel switching in a satisfactory and sufficiently rapid manner, and it is this difficulty which has hitherto prevented the commercial use of the principle. Recently, however, a German concern, the Firma Jahre, of Berlin, seems to have overcome the difficulty and to have produced "the first practical direct-current transformer."

It is obvious that when any current is taken from such an arrangement the output voltage is bound to fall. If the transformer is to work with good efficiency, it must therefore be kept well supplied with fresh charges. This is done by arranging for the condensers to be charged at small intervals of time—say, 50 times a second. Energy is, of course, consumed in driving the necessary switching arrangements, but—as will be seen later—this can be kept to quite a small amount.

It might be thought that the switching processes, at the high voltages used, would present great difficulties; but this is not the case. In the circuit employed the only potential across the switch contacts is the difference between the charging voltage and the voltage to which the condensers fall owing to the loss of secondary current. This difference can be kept quite small if the switching frequency and the capacities of the condensers are properly chosen. The result is that there is practically no sparking at the switch contacts, so that these have a very long life. The values of the capacities and the frequency are so chosen that the switching device works in resonance, and the driving current for a transformer capable of giving a no-load voltage of 10,000 volts amounts only to some 7.5 milliamperes.

Figs. 1 and 2 illustrate two methods of connection. Fig. 1 represents the circuit of an apparatus suitable especially where rather large currents at high voltage are required. Here C1 is what is called the "input" condenser, C2 the "output" condenser, and C the "charging" condensers, while the various switches, worked simultaneously by the long vibrator-driven arm, are denoted by S. In this arrangement all the condensers C are of equal capacity, which must be large enough for the required output current to drop the "charge" potential only by a permissible amount.

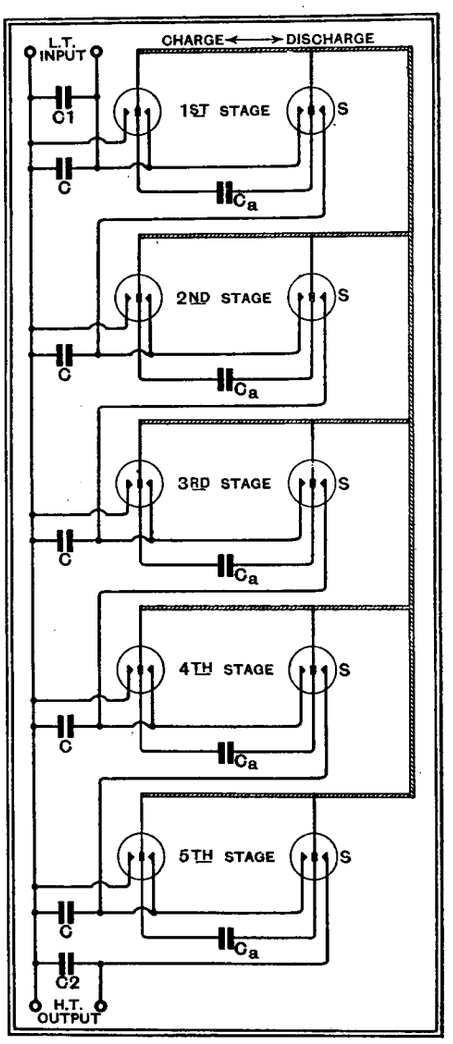


Fig. 2.—A D.C. transformer with voltage doubling at each stage.

Fig. 2 shows a different method of connection which is more economical than that of Fig. 1 both in the number of switches and the number of condensers. For instance, the actual arrangement shown in Fig. 2 gives a transformation ratio of 1:32, and has only ten switches, whereas if the circuit of Fig. 1 were used to give the same ratio, 64 switches would be needed, since 32 "charging" condensers would be required and each demands two switches. This economy is due to the fact that in Fig. 2 each "stage" is a voltage doubler, and the various stages are,

A Successful D.C. Transformer—

as it were, in series, each working on the voltage supplied by the preceding stage. Thus at the end of stage 1 the original voltage is doubled, at the end of stage 2 it is quadrupled, and so on, so that after only five stages the original voltage is multiplied by 32. This process can be traced out on the diagram; here C1 and C2 are again the "input" and "output" condensers, C the "charging" and Ca the "discharging" condensers.

Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

Transients

THE letter by Mr. H. K. Robin in *The Wireless World* of May 4th is very interesting, as it again focuses attention on two accepted theories which are mutually contradictory.

In paragraph 10 he refers to the generally accepted dictum that the human ear is unable to detect any change in the phase of one or more of the components of a composite sound consisting of a group of harmonics. This leads to rather disconcerting conclusions from the point of view of the "transient" theory, as may readily be seen.

Consider the waveform indicated in Fig. 1 (a). This exhibits in a most marked degree the steep wave-front which is supposed to be so necessary for perfect reproduction and so difficult to obtain in practice, and should strike the ear in an unmistakable manner.

The more mathematical of your readers will know that this wave form can be resolved into a series of sine form harmonics having definite magnitudes and phases. They will also know that, without interfering with any of the magnitudes but only by a suitable choice of the respective phases, this rectangular form may be altered to resemble very closely the triangular form shown in Fig. 1 (b).

This second form possesses nothing remotely resembling a transient, and might be expected to sound like a hum, yet if the "insensitivity to phase displacement" theory is correct, both should sound exactly alike.

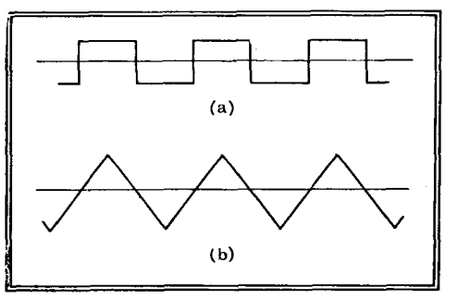


Fig. 1.

In 1927 and 1929 Dr. McLachlan contributed a series of articles illustrated by photographs of oscillograph records of transients before and after passage through an amplifier, but, apart from this example, all component manufacturers who publish such photographs are content to start with a pure sine wave and show that it is delivered reasonably free from distortion. It might, and probably would be that if a composite form were tried it would be unrecognisable in shape after passing through an amplifier of average goodness owing to phase shift of the harmonics, although the output from the speaker is still to the ear reasonably like the original.

Unfortunately, this still leaves unanswered the question whether the shape of the wavefront means anything or not, and a lot of careful experimenting will probably be required before a satisfactory answer can be found as to which, if either, theory is correct.

F. J. A. POUND.

Barrow-in-Furness, Lancs.

YOUR correspondent, Mr. Robin, has gone a little "off the rails" about the meaning of the word transient. Transient, both from what I believe to be its Latin derivation and from its English use, means passing away (in its electrical sense, an effect which dies away).

When any of the constants of an electric circuit are changed—whether we are thinking of A.C. or C.C.—a transient effect (or, for short, a "transient") occurs, which dies away, and (in effect) after a time new steady conditions are attained. I say "in effect" because a "transient" never completely dies away, but after a given time—according to the constants of the circuit—it can be assumed to be non-existent. Thus, a "transient" (in A.C. or acoustics) is not "periodic," and cannot be completely represented by a Fourier series.

In speech only the vowel sounds are periodic, and in music many effects—such as those of percussion instruments—are transient. Any complete analysis of transient effects is often impracticable, and at the best could only apply to one given set of conditions.

Any amplitude or phase distortion of the harmonic and fundamental components of a periodic function in transmission, over a system for the reproduction of sound, must show undesirable conditions. Although the human ear may take no notice of "phase-shift" in a periodic sound, these same conditions must surely modify the effect of "transients" on the ear.

In general, I think for good reproduction the greatest possible over-all linear response should be sought after, with due regard to "phase-shift." In this respect all "side-band cutting" should be avoided.

However, in quest of "purity" it is useless to exceed in the receiver the "goodness" of the transmitting station.

M. J. McBRIDE.

Parkstone, Dorset.

The "Microphone Orchestra"

IN *The Wireless World* of March 16th, 1934, there appeared under the title "A Real Wireless Orchestra" a description of new wind instruments invented by M. Ernest Sarnette, of the Paris Ecole Supérieure de Musique. The principal new instruments are: (i) A microphone tuba, the compass of which extends far above the usual for its prototype. (ii) A contra bass clarinet designed to replace the 'cellos or double basses. (iii) A new valve trombone with six pistons.

RADIO AND PHILATELY. The stamp-collector who includes a radio section in his album will be interested in these new Russian issues, each of which has a wireless *motif*. The slightly antique loud speaker on the right blends happily with its surroundings.

The inventor claims that with the aid of his new instruments it is possible to obtain, when recording on film, a better result with fourteen players than with a symphony orchestra of fifty musicians. He says:—

"I believe in creating a new type of orchestra for wireless performance. . . It is my feeling that the classic symphony orchestra has its place on the concert platform, but not before the microphone."

M. Sarnette's views on the violin must also be quoted. He regards it simply as a solo instrument. "A large number of violins produce a timbre which can be replaced easily and inexpensively, particularly in the case of the microphone orchestra."

Such views must not be allowed to go unchallenged. Would that Berlioz was alive to pour the flood of his wrath upon them! I leave it for other pens than mine to dispute what M. Sarnette says about the violin. Suffice it for me to state that the exquisite timbre of a large body of strings,

Correspondence which should be as brief as possible, should be addressed to the Editor, "The Wireless World," Dorset House, Stamford Street, S.E.1, and must be accompanied by the writer's name and address.

the feeling of bow-hairs pulling on gut, the veiled, mysterious quality of the mute are about the hardest sounds in the orchestra to reproduce naturally on a loud speaker. An approximate effect can be obtained only by means of the most expensive and carefully designed apparatus. But does that constitute a reason to give up the attempt to reproduce such subtle things?

The employment of these new instruments of (according to their inventor) "a new colour" would lead to the most terrible misrepresentations of a master's works. Changes of colour, unintended effects, uncalculated results produced on so unprecedented a scale would assuredly make Berlioz turn in his grave! For it was Berlioz who rightly called playing on the horn open notes intentionally written as closed, "a dangerous abuse."

It may be that M. Ernest Sarnette's instruments when reproduced by inferior wireless sets and talking film apparatus do give a fair imitation of the many classic instruments they displace. But is that the way to tackle the problem of poor reproduction? Rather, should not every effort be made to so improve the reproduction of all loud-speakers that even the uninstructed listener could have no hesitation in saying whether one contra bass clarinet or ten 'cellos were in use? It is as if the B.B.C. said to themselves, "We know the vast majority of wireless sets cannot reproduce notes below 100 or above 3,000 cycles per second, therefore why should we endeavour to transmit frequencies outside this range?" It is largely due to the inability of poor receiving apparatus to respond to all the wide range of complex vibrations produced by, say, ten 'cellos that they do not sound like 'cellos on the loud speaker. Along comes M. Sarnette, and by blowing through one new contra bass clarinet in front of the microphone produces in the great majority of loud-speakers a sound indistinguishable from ten 'cellos playing in unison! Note that this new instrument will only sound like ten 'cellos when reproduced by average (poor) apparatus.

May I express the hope that if the time ever comes when "real wireless orchestras" are employed in all its studio broadcasts the B.B.C. will not cease its public concert giving, if only for the reason that those of us who have really good receivers may not be denied the occasional joy of hearing a large orchestra with a full complement of strings.

Ballymoney, Co. Antrim. PATRIC STEVENSON.

Service Engineers

AS one whose daily bread is earned by straightening up the sorrowful efforts of many so-called service engineers in a manufacturer's service department, may I endorse "F. C. L.'s" opinions of the above-mentioned gentlemen in *The Wireless World*, February 23rd.

As one surveys the blackened wreckage of what once was a nice bright five-valve chassis before a worthy service engineer tried to fit, say, a new mains transformer, one wonders if a sooty crowbar was used as a substitute for a soldering-iron. We know that service engineers such as Mr. Watting describes himself to be in *The Wireless World* March 16th issue do exist, but unfortunately they are all too few and far between.

Indeed, what small retail business can support a full-blown, full-time service engineer in these days of keen competition, smaller profits, and low-price sets? Instead, the poor underpaid fellows may have to do everything, from pacifying harassed customers to delivering accumulators, or perhaps even canvassing. The state of their nerves after all this may afford them some excuse for sending us other makers faulty components and addressing us c/o some other manufacturer's works, which does often happen.

So what's to do about it?

"COLEITE."

More Howlers

Gems from the Programme Lists

By R. RAVEN-HART

OUR correspondent sends another selection of misprints and mistranslations in the foreign programme lists, with annotations of his own.

WHEN my last collection of howlers appeared, the French paper that had contributed most of them got quite annoyed. Just to prove that there is no partisanship, let us start with a gem from a *British* paper. It is a misprint, the announcement of a "Gregorian Chanty" relayed from a monastery—can't you see the Abbot with his mitre and his fiddle squatting on the capstan-head while the monks tramp around?

"Gregorian Chanty," relayed from a Monastery.

But I sympathise with editors. What are they to do? If they try to translate the titles, we get things like "Doux cœurs d'hier" (yes, they meant "Sweethearts"), and "Mon chapeau sur le coin de ma tête," which sounds very "square-headed"; "Dune dans la forêt" (that "Down" is a nuisance—I live in hopes of finding it some day translated as "duvet").

If, on the other hand, they merely reprint the titles, the unfamiliar words worry the typesetter, and we get versions like: "Dazy bones," "Learn to groon," "Rook a bye moon," "Who's afraid of the big bad solf?" (which also figures as "kolf"), "A call at the woodpackers," "The Teisha," "A cuckoo in the next," "Meet me to tinght in the cow-shed" (how does one tinght, anyway?), "The Policeman S. Holiday" (one is glad to learn his name at last), "Noisy Fellons" (George, tell those burglars not to make so much noise or they'll wake the baby), "Song a little dity in the morning" (we sympathise—one so often feels dity oneself early on), "Wake up chill, un wake up" (a similar theme, perhaps with a wet sponge in it), "Yellow doz blues" (mass-production—so many blues sound as if they were turned out that way), "Pump and circumstance" (yes, I suppose that had to happen sooner or later), "Young and heathy," "One tiny tar" (poor little cabin-boy), "In cat remember," "Brac and burnside" (Bric-a-brac?), "How dew is" or "How dev is," "Tutterflies in the rain" (or the curate who forgot his umbrella), "Yoking" (pastorale), "Sweetheart adrling" (which sounds like a useful new endearment), "Seven years with the wrony woman" (which doesn't), "Dream Faces upon William Hutchison's" (give the poor man air, can't you!), "Water Wagteril," "The Monn song," "Bale Goom, a Yorkshire patrol," "Pettin in the Parle" (a nice compromise between "park" and "parlour"), "On love" (in five hundred and sixteen volumes), "I don't no why" (nor no how neither).

"Pump and circumstance."

Semi-translations give some good efforts: "Les perles de Tu Boca," for instance, as if it were a place (there *is* a "Boca" in Buenos Aires, but hardly the place one would seek for pearls); or "Suite pour le royal firework"; or the polyglot "Boris Godounov: Je suffoque! Su Bojardi, in cominciam, It is a pity Prince Shuisky is absent, Farewell my son," which suggests Covent Garden with each star singing in his or her own language.

Even in French, misprints are not impossible—"Le rang des vaches," for instance, or "Le Tourbador," which seems to have something to do with turf-cutting. And there can even be something wrong with perfectly correct translations, as "Il y a un chez soi à Wyoming," or with perfectly correct titles, as "Soyez étreints, millions!" which inevitably suggests to the Frenchman of to-day the Lottery rather than the Ninth Symphony.

And *did* Mendelssohn write "Une photographie de vous"? and *is* "Pum munud hogyn drsg" Welsh?—and what is Handel's "Origine du dessin"?

But I think my preferences go to "Les pirates de Byzance," a new Sullivan opera; "Orphee aux en-connu Le concoh—(aLcmfcmfcmfhcmfhyp fers," which looks like Hindemith (note the rhythmic "cmf" motif with the atonal "h" breaking in); "Oh dry those dears" (ad blow thad dose ad the sabe dibe); "The invisible Eagle" (?N.R.A.); "Nights of Flagrance" (yes . . . yes); "I feel like a motherless Coleridge-Taylor"; "Grazly people," which has supplied the adjective I have needed for years; "The Star strips for ever" (yes, one does get tired of those lingerie films); and, from the Valkyrie, the song "Siegmoun suis-je et valse de mon pere," Wagner collaborating with Offenbach.

"Tutterflies in the rain."

New Apparatus Reviewed

Latest Products of the Manufacturers

MAGNUM LUCERNE COIL AND MULTI-CONTACT SWITCH

THE Magnum Loose Coupled Lucerne Coil has a separate aerial winding loosely coupled to the grid coil and a tapping is provided for short-circuiting the long-wave portion as in the case of the grid coil. There is also a reaction winding located in the space between the two sections of the grid coil, and this serves for both the medium and the long waves.

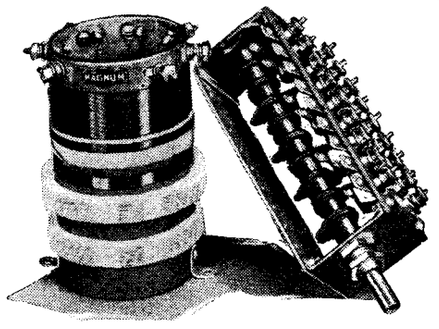
In a typical detector circuit, using a 0.0005 mfd. tuning condenser and one of 0.0003 mfd. for reaction control, this coil tuned from 200 to 610 metres and 910 to 2,150 metres respectively on the two wavebands with an aerial of normal size.

Owing to the loose coupling very good selectivity is obtained for a single tuned circuit, the efficiency is quite high, and on the whole it is a most satisfactory coil at the price, namely 4s.

Wavechange is effected by a single three-point switch which is a separate item not included with the coil, so it can be mounted on the panel in the most convenient position.

The Multi-Contact switch consists of several pairs of phosphor-bronze springs tipped with gold-silver contacts and assembled on a strip of bakelite which forms one side of a rectangular frame, the other three sides being metal. These springs are arranged to have a low capacity and a self-cleaning action. Switches with up to nine pairs of contacts are available as standard, and as the contacts are closed by a series of cams on an insulated spindle several switch combinations are possible in one assembly.

There is a definite stop for each position and switches with from two to five positions are made. The overall size is 1⅝in. × 1⅝in., but the length varies with the number of contacts; one with nine pairs, for example, as illustrated, measures 4¾in. long



New Magnum Lucerne dual-range coil with loose coupled aerial winding and multi-contact switch.

and costs 6s. 6d.; with five pairs the price is 5s. 6d., and with six or seven pairs 6s. A mains on-off switch can be included for 1s. 6d. extra. The makers are Burne-Jones and Co., Ltd., 296, Borough High Street, London, S.E.1.

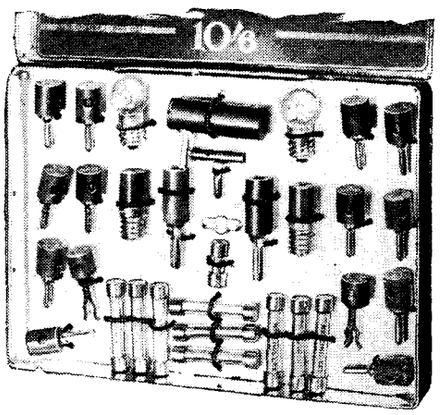
BELLING-LEE SPARES KIT

A USEFUL assortment of plugs, fuses, spade-end connectors and pilot lamps can now be obtained from Belling & Lee, Ltd., Cambridge Arterial Road, Enfield, Middlesex, neatly arranged in a tin box of a size that can be carried conveniently in the pocket, and the price is 10s. 6d.

It should prove exceedingly useful to the amateur experimenter, and particularly to the service engineer, for it often happens that a spare fuse, a plug, or any one of the many items in this kit would provide the required replacement on the spot and obviate delay in obtaining the replacement part from other sources.

In all there are thirty-two items, thirteen of which are fuses of one kind or another ranging from 150 mA. to 3-amp. types. There are fifteen assorted plugs and two pilot lamps, one a 6- and the other a 4-volt.

In order that the kit shall always be able to meet all emergencies, each item as it is



A useful spare parts kit containing an assortment of Belling-Lee specialities.

expended should immediately be replaced, for all the items are obtainable separately from the makers.

FERRANTI DRY ELECTROLYTIC CONDENSERS

THE new high-voltage Ferranti electrolytic condensers are made in two styles; one is housed in the familiar tubular aluminium case, while the other pattern is assembled in a rectangular impregnated cardboard container.

Following the customary practice the case of the tubular style is the negative electrode and the positive connection is brought out through the centre of an ebonite bush in the base, which being threaded on the outside serves also to take the large securing nut. A washer made of bakelised material is supplied for insulating the metal case from the chassis if required.

This style is made in 6 and 8 mfds. sizes; the normal working voltage is 470, but they will handle peak potentials up to 500 volts for short periods. With the specimens tested the leakage current varied between 0.25 mA. and 2.5 mA., with different condensers; the majority, however, passed less than one milliamp. at 470 volts, and it is quite likely that left in circuit for a longer period than our tests occupied those specimens passing the higher current would, in time, have settled down to about the same order of leakage as the others.

Ferranti tubular and impregnated cardboard-cased dry electrolytic condensers.

Prices of the tubular pattern are 4s. 9d. for 6 mfds., type CE51, and 5s. for 8 mfds., type CE52.

The cardboard-cased model consists of two separate 8-mfd. condensers, the elements being similar to those of the tubular pattern. The working voltage is, therefore, the same, and we found the leakage current to be of the order of 0.3 mA. for each condenser. Two specimens were tested, and this figure held good for the four condensers comprising the two units.

This model is listed as the type CE100, and the price is 6s. 6d. A baseboard fixing clip is included, as shown in the illustration. Each unit has four wires, two red and two black; these are the positive and the negative respectively of each separate condenser, and it is essential that they be connected in the right polarity, this applies also to the tubular pattern.

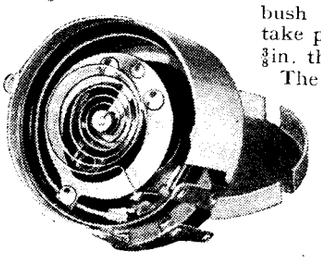
The makers are Ferranti, Ltd., Hollinwood, Lancashire.

NEW KABI POTENTIOMETER

A NEW Kabi wire-wound potentiometer, in which the resistance element is enclosed in a moulded bakelite shell contained within a metal case, has been placed on the market by F. W. Lechner & Co., 61, Spencer Street, Clerkenwell, London, E.C.1. It is rated to handle three watts, and is made in all the usual sizes up to 50,000 ohms. The moving arm is completely insulated from the spindle, and the metal case and contact is made with it via a spiral spring.

Two specimens, each of 10,000 ohms, were tested; one had a uniform resistance element and the other a graded track. Their measured resistances were 10,100 and 9,560 ohms respectively, and both were quite silent in operation.

A ⅜-in. hole is needed to clear the fixing bush which will take panels up to ⅜in. thick.



New Kabi wire-wound potentiometer.

The only criticism we have to make is that the spindle could, with advantage, be a little longer, as the ⅜in. extension does not allow much latitude in the mode of fixing and assembly on modern chassis-type sets. A minimum length of ⅝in. would be more convenient.

The price of these potentiometers is 6s. each for either pattern, and they are available with a built-in mains switch at 2s. extra. They are rated to handle three watts

The Wireless World

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CONTENTS

EDITORIAL COMMENT

The Question of Quality

Does the Public Really Care?

IN last week's issue we raised some points in connection with quality of reproduction and deplored the attitude of the B.B.C. of apparently accepting that a compromise was justified and that the transmission of a frequency scale would be unfair because it would reveal the limitations of receivers.

We are distressed to find, from correspondence we have received, that there seems to be an all too complacent attitude towards this question of quality, suggesting that wireless is already being accepted as "wireless," as if better quality than is generally available at the present time is neither expected nor required. Even musicians who recognise the limitations of most sets of to-day seem to think that the imagination can supply the deficiencies and that "considering it is wireless, reception is really very good."

A Commercial Opinion

One set manufacturer tells us that receivers which are really faithful in reproduction are not in general demand, but that the public prefers "mellow" reproduction, and receivers having a good high note response have had to be modified deliberately in order to remove top. At the transmission end, too, we find that it is the practice of the B.B.C. to avoid putting over sounds which depend upon a high note response for proper reproduction. In such circumstances it is difficult to see what can be done to raise the standard of receiver performance. It can probably only be achieved by educating the public to an appreciation of the limitations of their present reception and making it possible for them to have a new standard of comparison.

Readers of *The Wireless World* may be expected to recognise the importance of quality and to do all they can to encourage a high standard, but if the B.B.C. and the manufacturers have both satisfied themselves that high quality of reproduction is not wanted, it is going to be an uphill struggle to make any headway towards creating a public demand for a better performance.

Car Radio

Why Copy America?

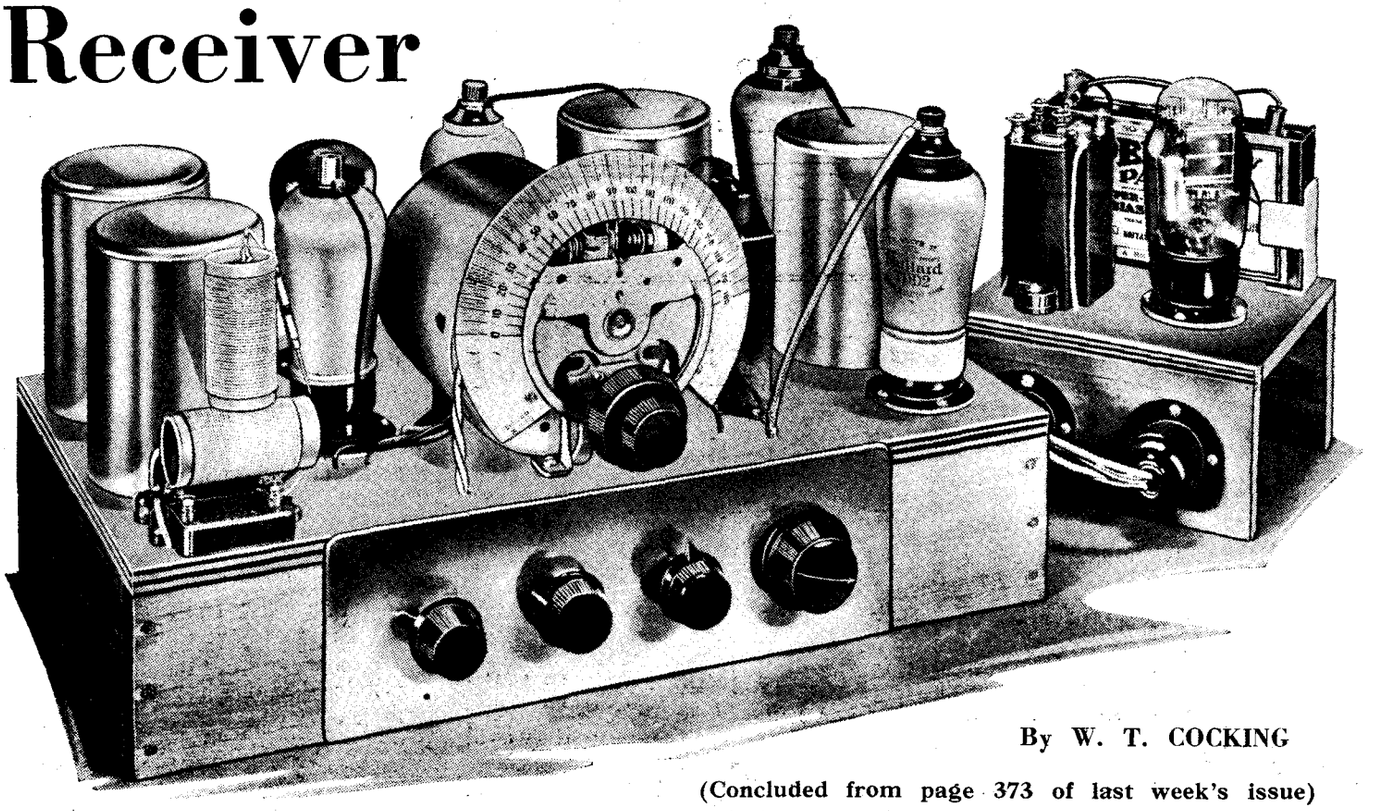
WHEN America introduced car radio, every manufacturer adopted the arrangement of installing the set in such a way that it was a permanent fixture, deriving its supply from the electrical equipment of the car and, as matters stand at present, it looks as if car radio will develop along the same lines in this country.

But why, we may ask, should we accept an American idea as necessarily the best and incapable of improvement? There are many occasions when, by attaching a wireless set permanently to the car we are deprived of its use when most wanted. A development along the lines of the very small portable sets might well offer a more satisfactory solution in this country.

Suppressors would require to be fitted to the car and it would also be advisable to instal an aerial as the use of a frame would be undesirable on account of directive properties. Charging the accumulator of the wireless set from the electrical equipment of the car would be a simple matter.

There seems to be very little justification for confining to the car itself a set which might otherwise be welcome in the week-end cottage or elsewhere when the car is not in use.

The Battery Single-Span Receiver



By W. T. COCKING

(Concluded from page 373 of last week's issue)

Adjusting and Operating the New Set

THE theoretical considerations underlying the design of the first battery operated receiver employing single-span tuning were discussed in last week's issue, together with the construction of the various coils employed. The present article deals with the receiver itself, and fully describes the initial adjustments which are needed to obtain the correct performance, while some notes are also given on the performance to be expected from the set.

CONSTRUCTIONAL details of the coils and the assembly of the I.F. transformers appeared in last week's issue of *The Wireless World*. The osciliator assembly consists of the coil L3, the condensers C3, C4 and C5, the grid leak R4, with the screening can, dial and mounting bracket. The tuning condenser C4 forms the basis of the assembly, and the coil L3 is fastened to its frame by two bolts, the condenser C3 and grid leak R4 being carried by the wiring. The padding condenser C5 is mounted on the screen base by two small brackets. The base is then placed over the one-hole fixing bush of C4, the bracket supplied with the dial is placed over the same bush from the outside, and the nut run on and tightened up. The internal connections of this tuning unit should next be made, and it can then be mounted on the chassis by means of the bracket, which also acts as the dial fixing.

The rest of the construction is straightforward and should be clear from the drawings which accompany this article. Care should be taken in the connections to the switches and to the inter-unit cable, for these are a little unusual, as one switch breaks the filament circuits of the early valves on gramophone and the inter-unit connections are arranged to permit the on-off switch to control the valve in the output unit.

The Q.P.21 output valve requires an anode-to-anode load impedance of about 24,000 ohms, and the output transformer must be of the quiescent push-pull type. If the specified speaker be employed the correct ratio will be secured by inserting the wander-plug on the speaker into the socket marked "6."

Adjusting the Receiver

When setting up the receiver for the first time, remove the screening cans from the I.F. transformers and set each trimming condenser at maximum capacity; that is, with its vanes fully enmeshed. Then make a pencil mark on the underside of the baseboard at the setting of each pointer on the knobs controlling these condensers. Now take the pencil mark as 180° on an imaginary scale, and set C17 at 130°, C15 at 150°, C9 at 160°, and C8 at 120°; a rough division by eye is accurate enough. The coil screens should now be replaced and C5 fully screwed home, and then unscrewed one complete turn.

The batteries can now be connected up, and the currents and voltages checked over to make sure that they are reasonably in accordance with the figures which accompany this article. It should now prove possible to tune in a station, and roughly adjust each I.F. trimmer for maximum signal strength. Several stations should then be obtainable and the accurate adjustment of the circuits can be proceeded with.

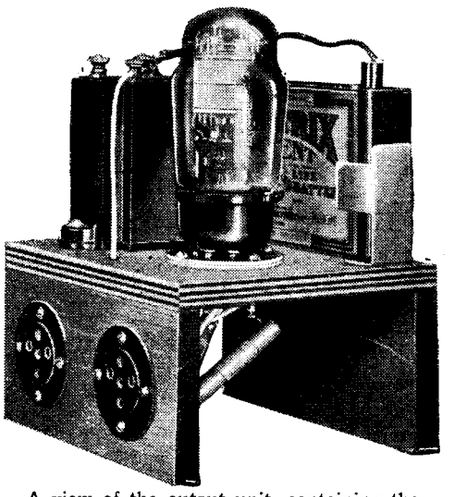
Owing to the action of A.V.C. in smoothing out changes in volume, it is difficult to set the trimmers accurately by ear except on a very weak station. It is advisable, therefore, to use a milliammeter as a volume indicator while trimming, and it should be connected in series with R6. The current indicated by the meter will vary with the signal strength, and will fall for an increase in strength. Maximum signal

The Battery Single-Span Receiver—

strength, therefore, corresponds to minimum current reading of the meter.

For the precise adjustment of the trimming, reaction should be advanced until the set is nearly, but not quite, oscillating, and a medium strength station tuned in. Then adjust C17 carefully for maximum signal strength, and follow with C15. As these circuits come into tune the set will probably start oscillating, in which case reaction should be slacked off a little. C8 must next be adjusted, again for maximum signal strength. It may happen, however, that with critical reaction there is no very definite optimum setting for this trimmer, but a point can be found on either side of which the set goes into oscillation. This point of non-oscillation is then the optimum setting. No adjustment to C9 is usually necessary at this stage, since the selectivity of this circuit is higher than that of any other, with the result that the others will be lined up to it. It will only be necessary to adjust this condenser if it be found that the circuits as a whole have been adjusted to the wrong frequency.

The only other adjustment is to the padding condenser C5. This governs the tuning range. The tuning dial should be set at maximum and C5 adjusted so that a babel of Morse transmissions just appears at this setting. The set is then tuned to rather more than 2,000 metres. If the I.F. circuits have been adjusted to the correct frequency all is now in order, and the dial settings should correspond roughly with the calibration of Fig. 1. Should the intermediate frequency be too high a setting. The efficiency of the set is not affected by such mis-adjustment of the circuits, but the dial settings are all more cramped than they need be. The I.F. trimming condensers, therefore, should all have their settings increased somewhat and be re-aligned at this lower frequency; C5 must then be re-adjusted as before.



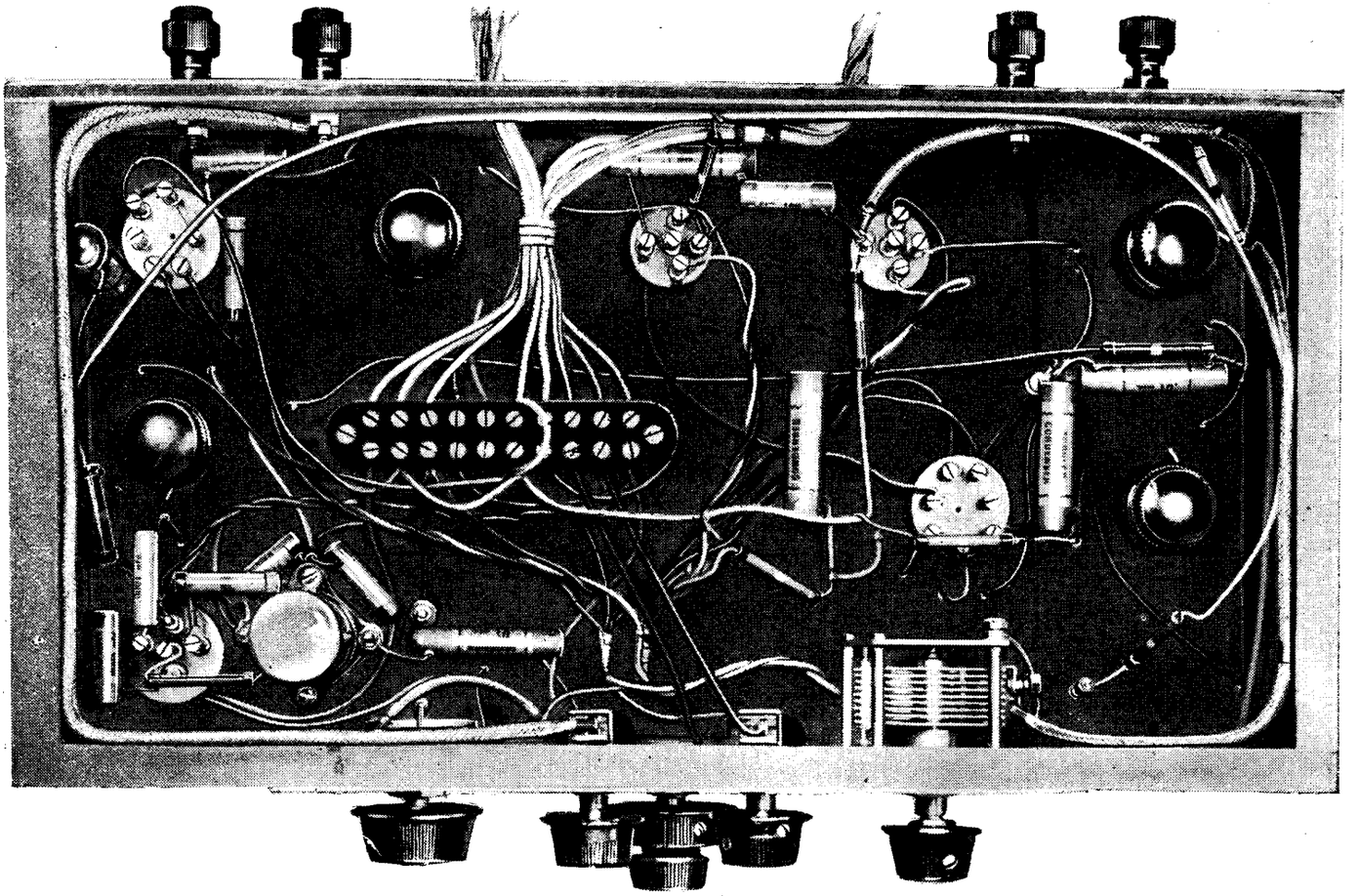
A view of the output unit, containing the output valve and its input transformer.

high, however, the discrepancies in the dial settings will become greater and greater as the wavelength goes down, until a 200-metres station tunes in at much too

Although it takes some time to describe, the adjustments are by no means difficult, and are much easier to perform than those of the conventional superheterodyne. The correct dial settings and tuning range will only be obtained if the I.F. circuits are all lined up to the right frequency, but a very wide latitude is permissible without affecting the sensitivity, selectivity or quality of reproduction.

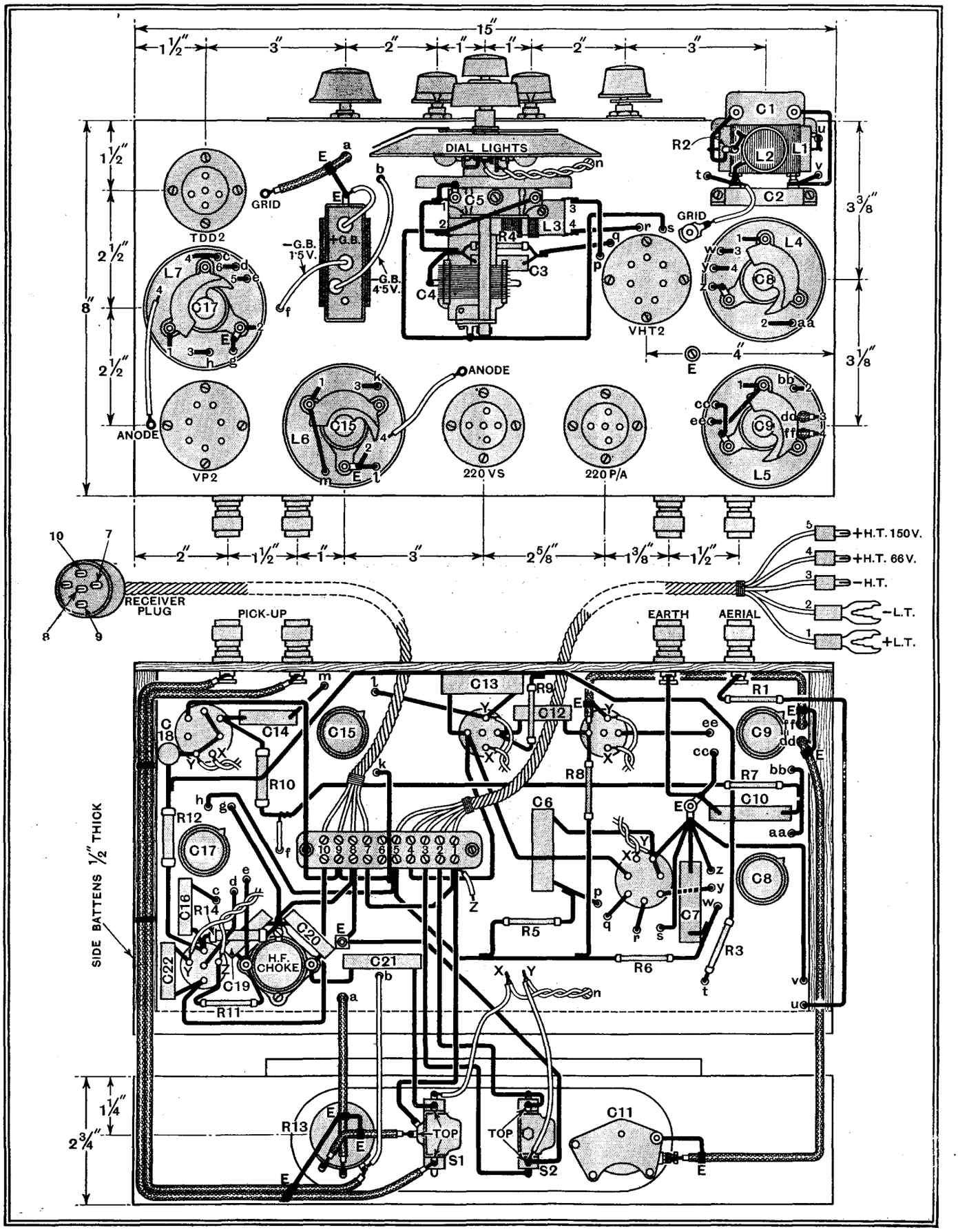
On test the receiver functioned admirably, and proved capable of an exceptionally good performance, being inferior to a mains set only in regard to the power output and quality of reproduction. It must not be thought, however, that the output and quality are in any way unsatisfactory, for they are not. They are the equal of many good mains sets, and excel those of most battery receivers.

The sensitivity is adequate for most purposes, and when used with an aerial of average efficiency the set can be relied upon to give good reception of all the stronger Continental transmitters and of many of the weaker. The selectivity is also adequate for such reception, and the feature of variable selectivity makes it possible to use the receiver in as unselective a condition as interference will permit, and thus always to obtain the best quality of reproduction consonant with the prevailing conditions. Since this variable selectivity is obtained through the combination of reaction and A.V.C., the apparent selectivity of the set is much lower than the true selectivity. This is



An underneath view of the receiver chassis, showing the wiring and layout of components.

PRACTICAL WIRING DIAGRAM OF THE RECEIVER



Full details of the construction and wiring of the receiver unit are given in these drawings.

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particularly noticeable in the case of the local station.

Even with reaction just short of the oscillating point the spread of a local station seems very wide in daylight, and will perhaps be some seven channels on either side of its proper channel. If the test be made after dark, however, when the field strength of foreign stations has increased, it will be found readily possible to receive stations up to about three channels from the local without interference.

The Performance

Automatic volume control functions well, and it will be found that, except on weak signals, the setting of the reaction condenser makes little difference to volume. The range of control obtained is great enough to make a local-distance switch unnecessary, but there is usually a perceptible increase of volume on the local station. The range of the manual volume control, which is also operative on gramophone, is sufficient to afford complete control.

A full-size blue print of the wiring diagram is available from the Publishers, Dorset House, Stamford Street, London, S.E.1. Price 1s. 6d. post free.

Background hiss proved negligible in the tests, as also did second channel interference and cross-modulation, while the whistles so often found in ordinary superheterodynes were conspicuous by their absence. The quality of reproduction was of a high order and the volume adequate for most domestic purposes, in spite of the output being limited to some 900 milliwatts. This is to be attributed to the high sensitivity of the loud speaker.

Before concluding, a few remarks about the output stage may be of interest. A two-unit construction has been adopted in order to facilitate the use of alternative output equipment, for many constructors may wish to use an existing Q.P.P. or Class "B" stage. An existing Q.P.P. output stage would probably be essentially the same as that specified for this set, save that two pentodes might be employed instead of the double pentode. Little in the way of alteration will usually be necessary, and it should suffice to retain the normal arrangement of the equipment and to connect the primary of the Q.P.P. transformer in the anode circuit of the last valve in the receiver.

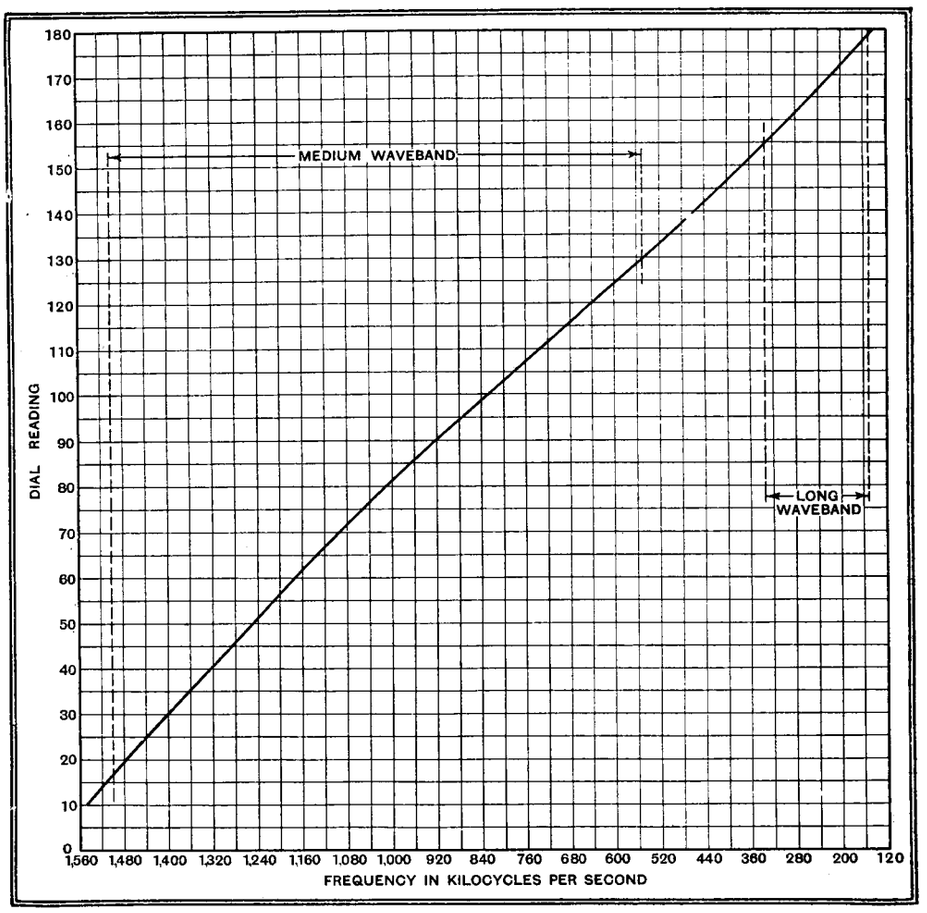
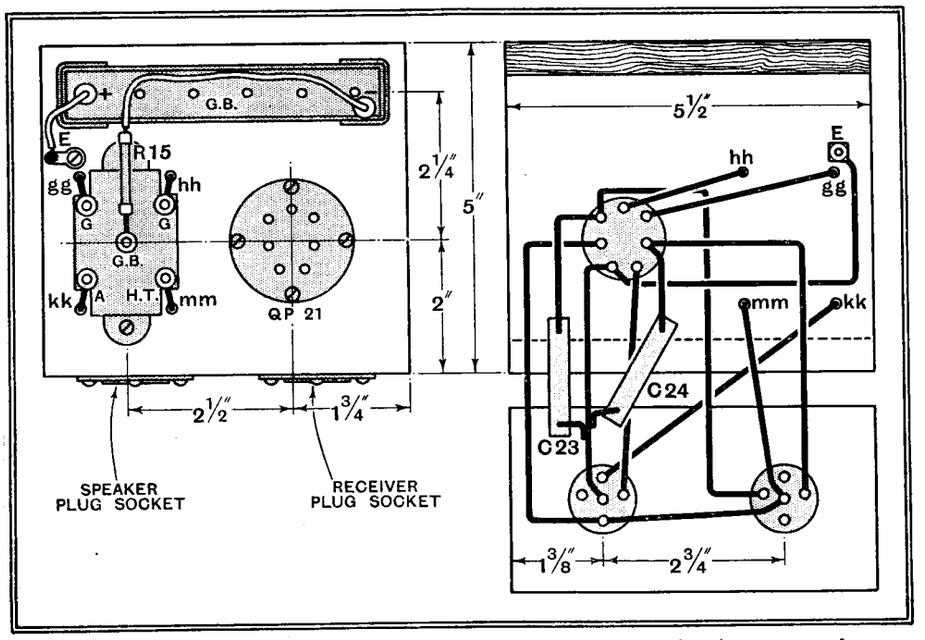


Fig. 1.—This curve shows the dial settings for frequencies within the tuning range in a typical case. It should not be expected, of course, that the settings will be exactly reproducible in all cases.

Alternative Output Equipment

With a Class "B" valve, however, a driver is also needed. Much depends upon the particular apparatus used, but it will usually suffice to employ resistance coupling between the T.D.D.2 and the driver valve. Where a low resistance driver valve is used, however, and particularly when the driver transformer has a step-down ratio, transformer coupling to the driver valve may become advisable.

It is intended that the apparatus be operated from a 150 volts H.T. supply, which may be either dry batteries or H.T. accumulators, but it can be used with a lower voltage. Both sensitivity and power output will suffer, of course, unless the initial grid bias be reduced, and the current consumption is then likely to be increased above that with a 150 volts supply. In the long run, the use of an H.T. supply lower than 150 volts is likely to be more expensive if efforts are made



The wiring diagram of the output unit; the resistance R15 is for the purpose of preventing parasitic oscillation.

A specimen receiver built to the specification described in this article is available for inspection by readers at 116, Fleet Street, E.C.4.

The Battery Single-Span Receiver—

to keep the sensitivity and quality unimpaired.

No attempt should be made to operate the set with an H.T. eliminator unless the use of a quiescent output stage is abandoned. If mains are available, it is better to build a completely mains-operated Single-Span receiver, and a model for A.C. mains has already been described.[1] It is intended to describe one for D.C. mains at an early date.

[1] *The Wireless World*, April 13th, 20th and 27th, 1934.

VOLTAGES AND CURRENTS.

Valve.		Anode Volts.	Screen Volts.	Grid Bias.	Anode Current.	Screen Current.
F.C.	VHT2—				mA.	mA.
	Tetrode ..	140	64	0	1.0	1.95
	Oscillator ..	110	—	—	1.55	—
Buffer	220P/A ..	50* (67.5)	—	−1.6	1.55	—
1st I.F.	220VS ..	145	64	0	3.22	0.8
2nd I.F.	VP2 ..	145	145	−1.6	1.1	0.35
Det.	TDD2 ..	140	—	−5.0	1.6	—
Output	Q.P.21 ..	143	145	−9.95	2.75	1.05

H.T. = 145 volts. Total no-signal current = 17 mA. Total L.T. current, 1.1 amp.: * measured value, true figure in brackets.

Broadcasting in France

Certainty of a Boom in Radio

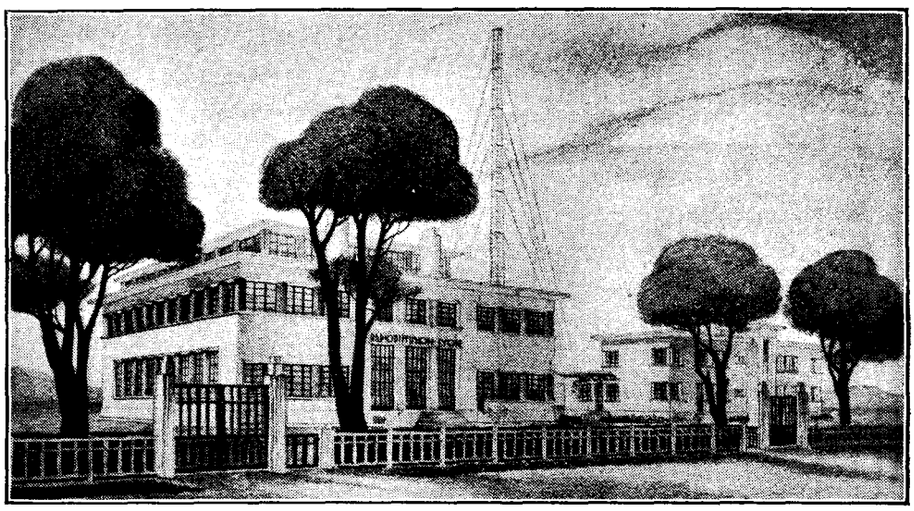
AN interesting set of circumstances is influencing the broadcasting situation in France at the present time.

It is only just recently that the control of broadcasting stations in France has been taken over by the Government. Hitherto independent companies, for the most part, have been responsible for such stations as have operated, and in most cases these have been maintained by revenue from advertisements.

There has been little or no co-operation between individual stations, and little development has taken place because of the uncertainty as to what action the Government might take.

This unsettled state of affairs has naturally had its effect upon the wireless industry in France so far as the receiving side is concerned. French firms have hesitated to sink capital into an industry which was dependent upon programmes emanating from transmitting stations whose position as regards permanency was itself precarious.

It is probably safe to say that as many sets have been sold in France to date on the strength of programmes available from foreign stations as on the attractions of the home transmitters. Although the potential market for sets is probably greater in France to-day than in any other country in Western Europe, there is no great French radio industry, and firms of foreign origin still supply a very large proportion of the sets, although most of these sets are now built in France, because the quota on imports makes it unprofitable to do otherwise.



A FRENCH "DROITWICH." The architect's drawing for the new French 120-kW. regional station of Lyons P.T.T. at Tramoyes, now under construction. This design is to be the standard for the dozen or more high-power stations eventually comprising the "Ferrié" scheme, which, if completed, should give France a premier place among the broadcasting nations of Europe.

That the next two or three years will see an enormous boom in radio in France seems practically certain. France can no longer afford to watch the effect of broadcasting in influencing public opinion and meeting emergencies in other countries and ignore the similar advantages which an efficient broadcasting service would offer France. It must be apparent to the French Government that France must be served through her area with an efficient coverage of broadcasting and that the programmes must be of a character designed to attract the masses of the population and ensure that listening-in will become a national habit, for until that state of affairs comes about the value of broadcasting as a national propaganda aid cannot be realised. We may expect, therefore, that in the very near future active steps will be taken to equip France with an efficient broadcasting service with acceptable programmes, and that a boom in receiver sales will be created. It is likely, too, that every encouragement will be given to manufacturers to supply cheap standardised sets for the masses of the population, as was done in Germany in the case of the "Volks-Empfänger."

It is of interest to note that another minor factor which may influence radio development in France is the fact that that country now shelters a number of competent radio engineers who are exiles from Germany. Because employment in France is not available to these individuals they are themselves undertaking manufacture there, and although they may be limited in the matter of financial facilities at present, they are well equipped as regards technical knowledge and experience gained in the very thorough schools of German set production, especially in relation to cheap sets of just the type which the French Government will wish to encourage.

FOREIGN BROADCAST GUIDE

LAHTI

(Finland).

Geographical position: 60° 25′ 38″ N.; 28° 10′ E.

Approximate airline from London: 1,135 miles.

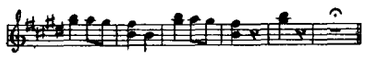
Wavelength: 1,807 m. Frequency: 166 kc/s Power: 40 kW.

Standard time: Eastern European (one hour ahead of B.S.T.).

Standard Daily Transmissions:

B.S.T.: 07.45 and 08.15 (Sun.) physical exercises; 11.00 con.; 17.59 Time Signal, weather, news (frequently in Swedish also), followed by talks, con., etc. 19.30 or 20.00 main programme.

Interval signal: Musical box melody:



Announcers: Man and woman.

Call: (in Finnish) *Huomio! Huomio! taala suomen yleisradio Helsinki-Lahti-Viipuri;* (in Swedish), *Giv akt! Giv akt! her Finlands rundradio Helsingfors-Lahti-Viborg.*

Closes down at approx. 21.00 with the words: *Toivotan Kaikille kuunteli joillemme nyrä yota,* and Swedish translation: *Jag önskar alla vara lyssnare en god natt* (we wish all our listeners a good night).

Relays: Helsinki (Helsingfors), 335.2 m. 895 kc/s. 10 kW; Viipuri (Viborg), 569.3 m. 527 kc/s. 13 kW; Oulu (Uleaborg), 696 m. 431 kc/s. 2 kW; Tampere (Tammerfors), 211.3 m. 1,420 kc/s. 1.2 kW; Turku (Abo), 201.1 m. 1,492 kc/s. 0.6 kW; Pori (Bjorneborg), 400.5 m. 749 kc/s. 0.5 kW; Pietarsaari (Jakobstad), 200 m. 1,500 kc/s. 0.25 kW.

HINTS and TIPS

Practical Aids to Better Reception

WHEN building a receiver from a published design, it is worth while to study carefully the disposition of the leads which are connected to the "live" terminals of the ganged tuning condenser. If the performance of the original set is to be duplicated, it is usually a matter of some importance that the disposition of these wires should not be altered. The leads in question are distinctly "danger points" in almost any receiver.

Wires to Watch

Occasionally it will be found that, in spite of taking all reasonable precautions, signs of undesirable interaction between these high-potential condenser leads will become evident. In such cases there is little left to do but to screen the wires; occasionally, however, it is a good plan to enclose one or more of the condenser terminals (and a certain length of the wire connected to it) in a small metal box, which, of course, projects from the side of the condenser. Auxiliary screening boxes of this type are fitted by the makers to the terminal of the centre section of one of the Utility ganged condensers.

THOSE who used diode detectors in the days before special multiple valves became available for the purpose will doubtless find it hard to recognise many of the present circuits as having any relationship with those originally used for this method of rectification. An arrangement which was in common use at one time is illustrated in Fig. 1 (*a*); here the load resistance is virtually in parallel with the tuned circuit from which H.F. energy for rectification is derived; short-circuiting of L.F. voltages developed across this resistance is prevented by the interposition of a small blocking condenser (usually of 0.0001 mfd. or less) inserted between the circuit and the diode anode.

Diode Differences

Nowadays it is more usual to employ what may be described as a "series" circuit, as shown in Fig. 1 (*b*). Here the load resistance is inserted in series with the return lead from the tuned circuit of the cathode or filament of the valve. Low-frequency voltages developed across the diode load are passed to the succeeding L.F. amplifier through some simple form of "stopping" filter, such as that shown, which consists of an H.F. choke and a pair of small by-pass condensers.

There is no great difference between the functioning of these two methods of connection, except that the second requires much less H.F. filtering; it also calls for a fully insulated tuning condenser.

These remarks apply, of course, to multiple diode valves, in which other electrodes than the diode anode are included, as well as to non-amplifying diodes.

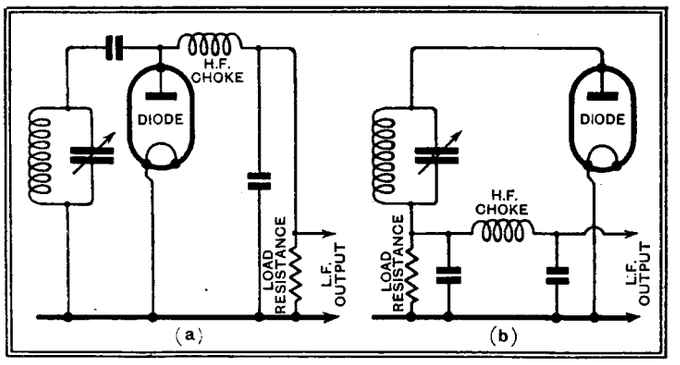


Fig. 1.—Parallel and series diode circuits: their action is similar, except with regard to the need for H.F. filtering.

AFTER working well for some months a D.C. mains set was recently noticed to be more susceptible to mains interference, and also to suffer from hum to a much greater extent than formerly. The trouble was eventually traced to the detector grid leak, which had changed in resistance value to a figure nearly three times greater than its original rating. Replacement of the leak provided a complete cure for the trouble.

Increasing Grid Leak Resistance

It is worth while remembering that when a resistor of high value misbehaves itself the change in resistance is nearly always in an upward direction. This effect was particularly marked with the older type of component, which often showed a tendency towards a gradual increase in ohmic value until at last it developed almost an "open circuit."

This applies mainly to composition resistances. It is not unknown for a wire-wound resistor which has been accidentally overloaded to *decrease* its value considerably, generally as a result of a partial internal short-circuit.

WHEN an attempt is made to obtain the highest possible degree of magnification from an H.F. stage a distinct limit to one's aspirations is usually set by instability. The usual limit of magnification can be passed by taking abnormal precautions against unwanted couplings, but usually it is impossible to go very far beyond it before the H.F. valve breaks into uncontrollable self-oscillation.

The Last Ounce

When trying to get more magnification than usual, it is worth while remembering the possibilities of neutralisation—an old friend that stood us in good stead in the days of three-electrode H.F. valves. True balancing, whereby the residual grid-anode capacity of the valve may be accurately balanced out, is almost out of the question with modern screen grid valves, but a simple balanced form of coupling, theoretically imperfect though it may be, still has its uses.

The circuit arrangement in question is shown diagrammatically in Fig. 2, which represents its application to a tuned anode coupling, though it may be employed with any other method of inter-valve linkage. From the diagram it will be seen that an extra balancing winding, in inductive relation with the tuned coupling coil, is connected back to the grid of the valve through an adjustable condenser which may actually have a capacity of some 20 mmfds., or even considerably less. From one to three turns will be ample for the balancing winding, and it is admitted that a good deal of patience is required in determining its actual size, the proper relationship with the tuned coil, and also the best setting for the balancing condenser.

As a rule one does not aim to get perfect neutralisation over both wavebands in a broadcast set, although it is possible to position the balancing winding in such a way that it acts on both sections of the tuned coil, and so increases the amount of magnification obtainable with stability on both bands.

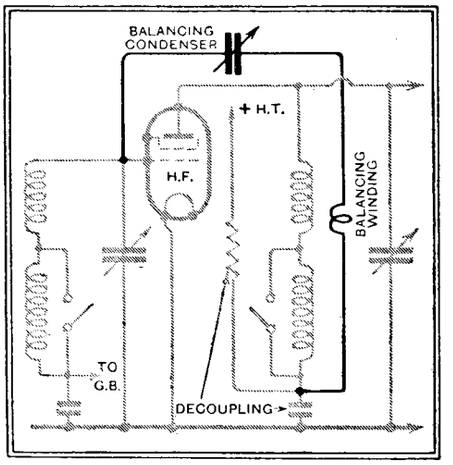
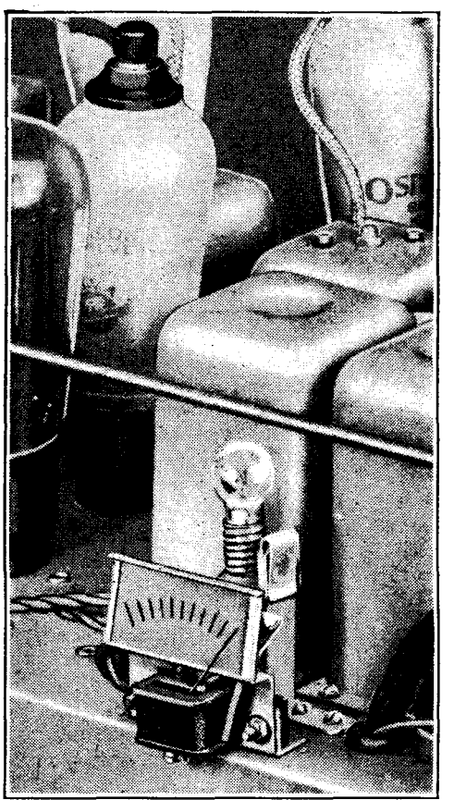


Fig. 2.—The addition of an "anti-oscillation" neutralising system to an H.F. stage.

The Art of Ganging

IV. Effects Due To A.V.C. Circuits

THE chief factors affecting the ganging of straight sets have been dealt with in the preceding articles in this series, and it only remains to indicate some often unsuspected faults which may occur through the use of automatic volume control. This article also points out some of the practical difficulties encountered in adjusting a set fitted with A.V.C. and advocates the use of a tuning meter.



This illustration shows a typical tuning meter fitted to a set incorporating A.V.C.

MODERN receivers usually include some form of automatic volume control, and a favourite method of applying the bias to the controlled stages involves the addition of a large-capacity fixed condenser to the tuned circuit. An arrangement commonly employed is shown in Fig. 1, from which it will be seen that a fixed condenser C is inserted in one tuned circuit to permit the application of bias. A usual value for such a condenser is 0.1 mfd., and as this is some 200 times the maximum capacity of the variable condenser it has a negligible effect upon the ganging. If it were not for this it would be necessary to include such condensers in series with the aerial and intervalve circuits of Fig. 1 also. It should be noted, however, that should a capacity of 0.01 mfd. be used in error, the ganging would be appreciably affected, so that where errors in ganging occur in receivers of this type it is always as well to suspect any by-pass condensers in this position.

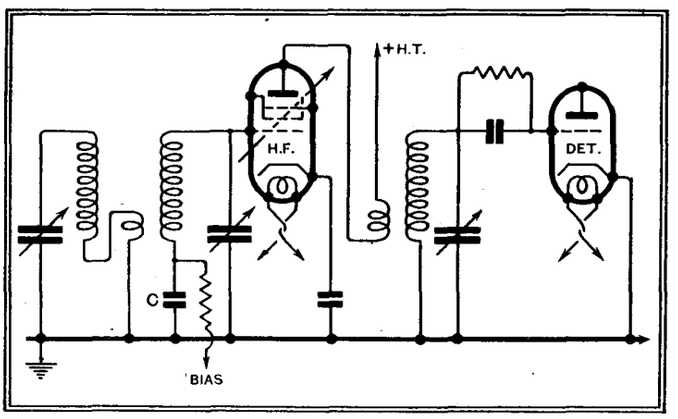


Fig. 1.—When A.V.C. is used, the bias is often applied to the grid of the H.F. valve through a resistance, and a condenser C is included in the tuned circuit.

Even the best condenser, however, is slightly inductive, and the larger the capacity chosen the greater is this inductance likely to be. The use of a large-capacity condenser in this position, therefore, may lead to difficulty in ganging, through the mis-matching of the circuit inductances which it introduces. It is becoming a common practice, therefore, to employ a different method of applying grid bias with which this risk cannot occur. This arrangement is shown in Fig. 2, and it will be seen that the tuned circuits are all closed, and consist only of the coils and variable condensers. The bias is applied to the grid of the valve through a very high resistance R1, which is effectively in parallel with the tuned circuit, and a small stopping condenser C1, which may have a capacity of from 0.0001 mfd. to 0.001 mfd. The grid leak necessarily damps the tuned circuit to some extent, but it is believed to no greater extent than the losses in the series condenser of Fig. 1, and the mis-ganging effect is avoided.

In some circuits, notably of the band-pass type, the use of a capacity similar to that of Fig. 1 becomes necessary for the filter coupling. In Fig. 3 an arrangement of this nature is shown, and as the capacity selected for C1 has usually a value of from 0.01 mfd. to 0.05 mfd., it may affect the ganging. Strictly speaking, therefore, a condenser C2 (shown dotted) should be inserted in the intervalve circuit, and this condenser should have one-half the capacity of that in the band-pass filter. In practice, however, it is often found that the other errors of ganging exceed those introduced by the filter couplings, so that it is now more often omitted than not.

The vast majority of the points which have been raised in this section are ones which concern chiefly the designer of a receiver, and which do not affect in the least the constructor. It might be thought, therefore, that this is hardly the place to discuss them, for these articles are intended to deal chiefly with the practical adjustments of ganging. Experience has shown, however, that many builders modify, intentionally or otherwise, their receivers, and it is easy to see that unless care be exercised such modifications may have untoward effects upon the accuracy of ganging. It is felt, therefore, that these brief notes upon the factors which affect the ganging of a receiver may prove service-

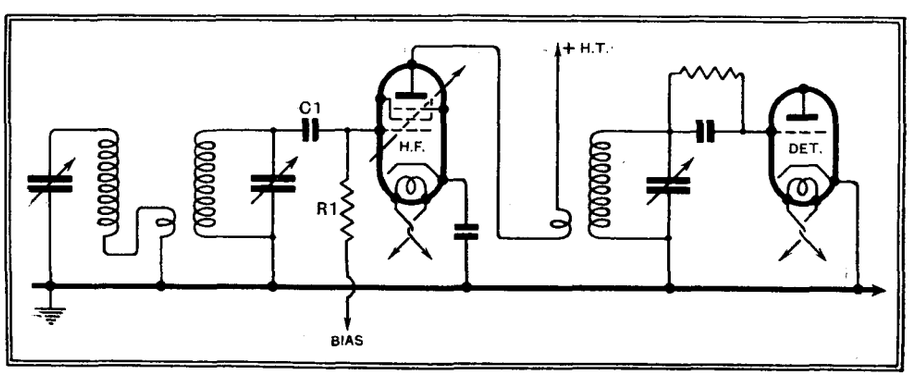


Fig. 2.—An alternative method of applying A.V.C. bias is shown here which does not necessitate the isolating condenser C1 being included in the tuned circuit.

The Art of Ganging—

able to those who have constructed a set and introduced modifications to the original design, or who find that, through some defect in construction or in a component, accurate ganging is difficult to obtain.

Before closing this section it may be as well to make some reference to tuning indicators. The ganging procedure has been described as being carried out always for maximum signal strength. Now the ear is a very unreliable indicator of changes in volume, and, moreover, many receivers are now fitted with automatic volume control, and no maximum volume point of trimming is then detectable except on the weakest signals. It is very much better, therefore, to employ some form of visual tuning indicator. This is most conveniently a milliammeter.

Tuning Meters

In the case of a receiver not fitted with A.V.C., the milliammeter is most usefully connected in the anode circuit of the detector valve. In the case of a power grid detector, the meter would normally have a maximum scale reading of some 10 mA. In the absence of a signal the current will be a maximum, and will probably be from 4 mA. to 8 mA., according to the design of the set. On tuning in a signal, however, the current will fall, and the greater the change of current the greater the signal strength. Tuning, therefore, should be carried out for a minimum current reading on the meter. Care should be taken, of course, not to overload the detector during this process, and normally the change of current should not be allowed to exceed some 25 per cent. of the no-signal standing current.

The anode bend detector is not used to any great extent now, but a tuning meter may be fitted to it in the same way as with a power grid detector. The meter should be connected in the anode circuit of the valve, and should have a maximum scale reading of some 2 mA. In the absence of a signal the current will be very small, perhaps 0.1 mA., and will increase on tuning in a station. In this case, trimming must be carried out for the maximum current indication on the meter.

The diode detector is now finding increasing favour, and although this detector also gives a change of direct current through its load resistance with increasing signal strength, it cannot be used to operate a milliammeter. The current is so small that a sensitive microammeter would be necessary, and this is an instrument which few have available. In general, however, diode detectors are combined with an automatic volume control system, in which the bias on the H.F. stages varies with signal strength, being higher the greater the strength of the signal. As a result, the anode current of the H.F. valves falls with increasing signal strength, and this may be used to operate a milliammeter as a tuning indicator. The meter should be connected in the anode or cathode circuits of one or more H.F. valves and trimming carried out for minimum current reading on the meter exactly as in the case of a power grid detector. Unlike the latter, however, the change of current will usually be much greater, and the meter is correspondingly easier to read.

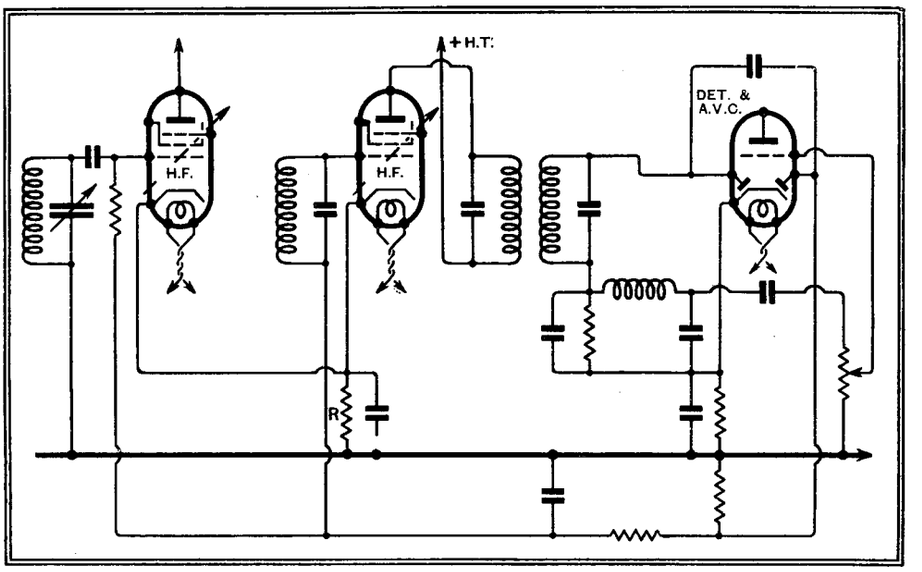


Fig. 4.—In an A.V.C. set some form of tuning indicator is often desirable, and it is usually sufficient to connect a voltmeter across the cathode biasing resistance R.

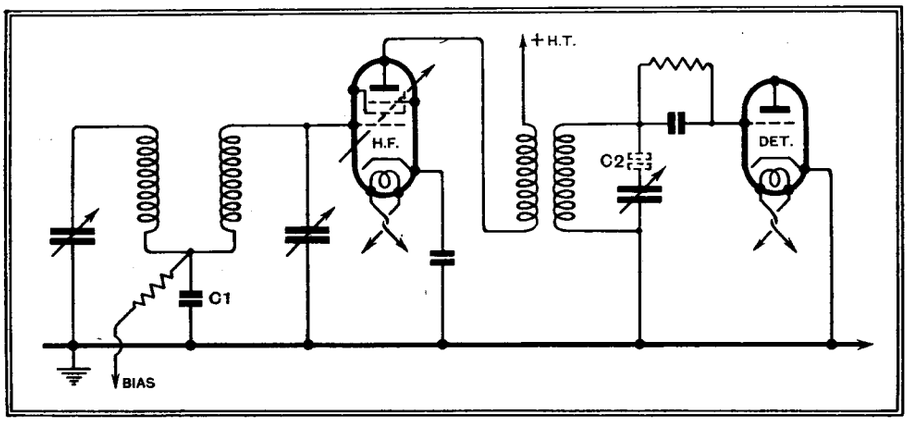
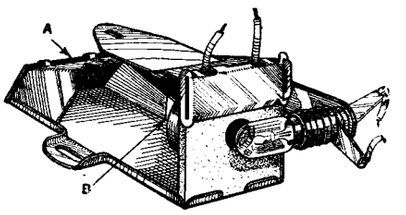


Fig. 3.—With a band-pass filter the condenser C1 is comparatively small, so it may be necessary to fit a compensating capacity C2 in the other circuit in order to maintain accurate ganging.

The use of a milliammeter is not always convenient, particularly in the case of a commercial receiver, since it involves the disconnection of wires for its insertion. It is convenient to remember, therefore, that in an A.V.C. set it is possible to use a low-range voltmeter connected across the bias resistance to one or more controlled valves. In Fig. 4 the bias resistance is shown at R, and the bias will usually be from 1.5-3 volts, so that a meter with a full-scale reading of some 4-6 volts would be quite suitable. As with current, the meter reading falls with increasing signal strength.

Commercial Tuning Indicators

In the case of commercial receivers, meters are sometimes fitted as tuning indicators, and it is then unnecessary to insert an additional meter while ganging. Other forms of tuning indicator, such as neon tubes and miniature cathode ray tubes, are also included in some cases, and these are equally suitable for use as ganging indicators. It should be emphasised that quite a cheap meter can be used, and it is unnecessary for it to be calibrated, for trimming is not carried out for any definite current reading, but merely for maximum or minimum current according to the particular circuit in which the meter is connected. With practically all modern receivers the trimming is for a minimum current reading, for anode bend detection is now rarely employed.



A shadow tuning device in which a vane B fitted to a type of milliammeter intercepts a beam of light and throws a shadow on the screen A.

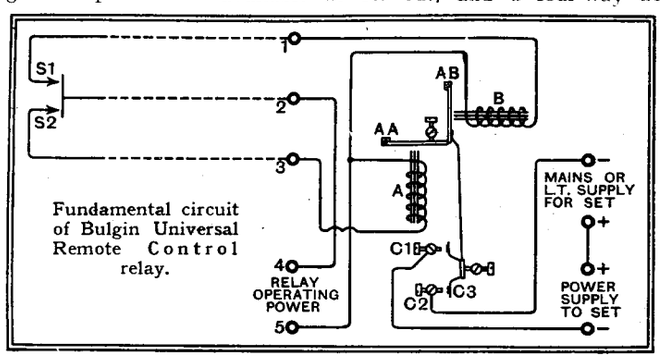
New Apparatus Reviewed

Latest Products of the Manufacturers

BULGIN UNIVERSAL REMOTE CONTROL

FOR their new Universal Remote Control system A. F. Bulgin & Co., Ltd., Abbey Road, Barking, Essex, have developed a most ingenious relay which can be operated either on A.C. or on D.C. One of its chief points of interest is that it consumes current only for the short periods necessary to move over the relay armatures, which then remain locked until the next impulse is sent along from the control to change their positions.

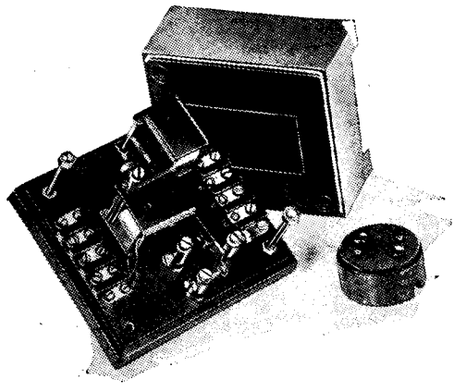
The diagram shows the essentials of the device, which consists of two relays, A and B, with their armatures arranged at right-angles so that one interlocks with the other. Contacts C1, C2, and the insulated bridge piece C3 constitute a single-pole switch which is included in the L.T. or in the A.C. supply leads to the receiver.



Fundamental circuit of Bulgin Universal Remote Control relay.

From terminals 1, 2, and 3 is taken a three-way cable to a special double push-button switch, and when S2 is pressed current flows through relay A. Its armature AA is attracted, and, in moving away from its stop, releases the tip of armature AB. Being under spring tension AB then moves to the left, locks AA in position, and at the same time takes the bridge piece C3 over to the switch contacts C1 and C2. This completes the supply circuit and switches on the set.

Now, if S1 is pressed relay B is energised, its armature is attracted, and the switch contacts open. Armature AA is released and its spring brings it back to its stop, and AB is locked in position.


Bulgin Universal Remote Control relay with cover removed and special double push-button switch.

Any number of remote-control switches can be installed, but only one relay is necessary. If an output filter is employed the "earthy" loud speaker lead can be utilised as the common return to terminal 2, so enabling a four-way cable to serve both for the loud-speaker extension and for control purposes.

The apparatus functioned perfectly on test, the relays respond instantly the push-buttons are pressed, and the switch contacts make and break without arcing. A flash-lamp battery of 4½ volts suffices to operate it, but with A.C. sets a small transformer can be used.

The relay costs 25s. and the remote-control switches 2s. each. Three-way cable is available at 8s. 6d., and a four-way at 10s. 6d. for 100 feet. A small mains transformer for operating the relay on A.C. costs 9s. 6d.

PEAK CONNECTORS

PEAK connector blocks, which are now made by W. Andrew Bryce & Co., Woodfield Works, Bury, Lancashire, are available in the six- and ten-way types only, it having been found possible to reduce the price of the former, and the five-way model has accordingly been discontinued.

The six-way measures 2¾in. long by 1 1/16in. wide by ⅝in. high, and costs 2s. 6d., while the ten-way is 4 1/16in. long, the other dimensions being the same as the six-way, and its price is 3s. 6d.

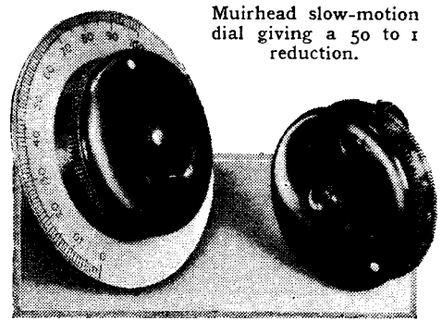
MUIRHEAD SLOW-MOTION DIAL

A SLOW-MOTION dial that has a smooth and silk-like action, in addition to being quite distinctive in appearance, will undoubtedly appeal to the discriminating experimenter and home constructor, and one that in every way justifies this claim is that made by Muirhead & Co., Ltd., Elmers End, Beckenham, Kent. Developed originally for laboratory apparatus, it gives that precision of control so essential where accuracy is demanded. For modern sets of high selectivity and for short-wave receivers a good slow-motion drive is required, and the Muirhead model would meet such cases admirably.

It embodies a friction drive arranged on the epicyclic principle and giving a reduction of fifty to one. There is not the slightest trace of slip or backlash, and the drive runs free and true.

The mechanism is enclosed in a moulded bakelite case 3in. in diameter and about 1¼in. deep, and the driving knob is approximately the same size as the casing.

There are two styles available, one has the scale engraved on the circumference of the moulding, while the other is fitted with a silver and lacquered brass dial 4½in. in diameter on which is engraved the scale, which can be divided into 100 or in 180 divisions, according to requirements.


Muirhead slow-motion dial giving a 50 to 1 reduction.

On the standard dials the zero is on the left, and although this coincides with the condenser position for maximum capacity there is less risk of errors arising in reading the actual setting with relation to a fixed pointer than with the more orthodox arrangement, yet, for those who prefer it, the dials will be supplied with the scale calibrated in the reverse direction.

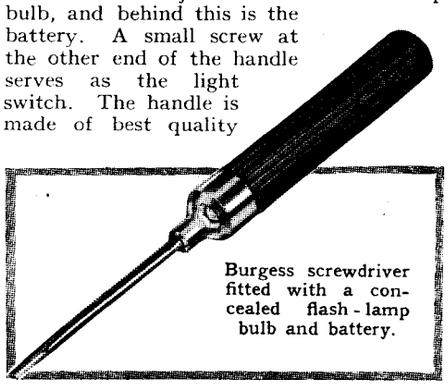
In both models the scale rotates in the same direction as the driving knob, and a panel fitment having an engraved line is supplied. The dial is fixed to the spindle by a clamp and screw, this fitting being arranged to accommodate ¼in. spindles.

The price is £1 for the model with the scale on the moulding and £1 5s. 6d. if fitted with the larger scale.

BURGESS FLASHLIGHT SCREWDRIVER

WHEN fitting a wireless chassis in its cabinet it sometimes happens that a screw has to be inserted in a rather dark corner, where it is difficult to see either the screw, its hole, or even if the blade of the screwdriver is engaged in the slot of the screw. A tool that is ideal for use on such occasions is the Burgess Flashlight screwdriver, which provides its own illumination just where it is wanted, and obviates the inconvenience of holding a lamp in one hand and directing the screwdriver with the other.

The handle of the tool is hollow, and where the blade joins it is a recessed lamp bulb, and behind this is the battery. A small screw at the other end of the handle serves as the light switch. The handle is made of best quality hard fibre capable of ensuring perfect insulation up to some 400 volts.


Burgess screwdriver fitted with a concealed flash-lamp bulb and battery.

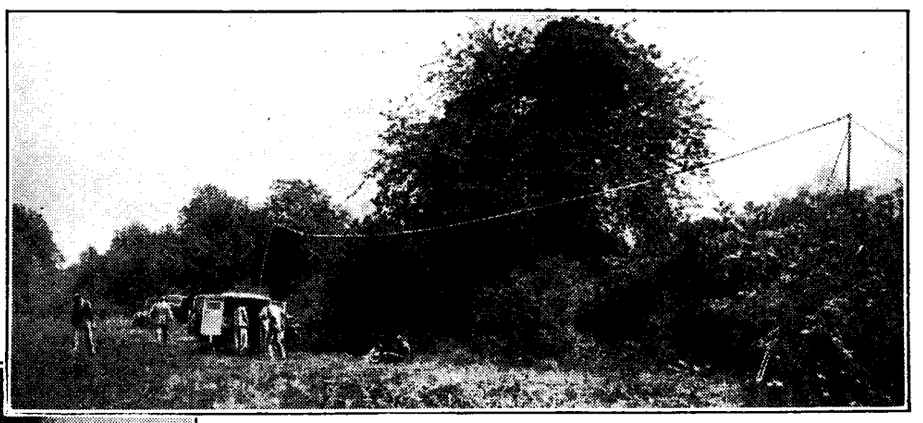
The inclusion of a flash lamp has in no way impaired the strength of the tool, for it is very robustly made and will stand up to hard wear.

It is made by the Burgess Products Company, Bush House, London, W.C.2, and the price is 4s. 6d. complete. A spare battery costs 6d. and the small bulb 4d.

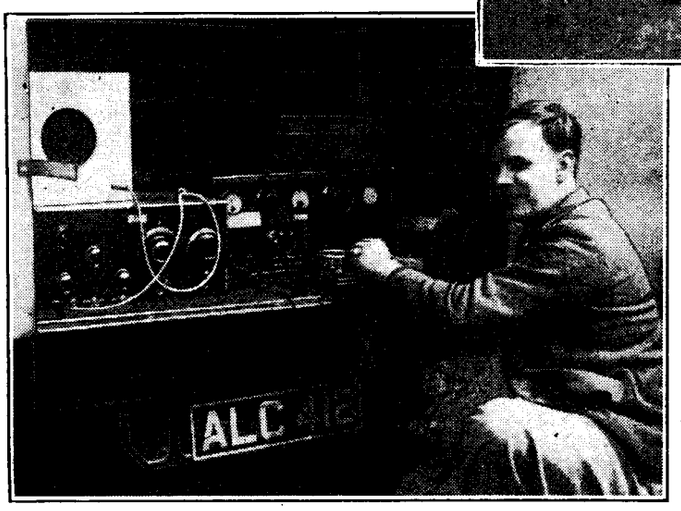
Tracking Down by D.F.

Successful Field Day in Hertfordshire

MORE than seventy enthusiasts, including members of six radio societies, took part in the hidden transmitter hunt organised by the Golders Green and Hendon Radio Scientific Society and held on Sunday, May 27th. The "hunt" ranged over an area bounded by Harrow, Mill Hill and Berkhamsted, and it speaks well for the skill with which the transmitter was concealed that only one group actually located its position, and this by accident rather than design. The transmitter (G5CD), operated by Mr. Corfield, was hidden up a faint horse track surrounded by bushes at the top of a steep hill with a number of intersecting roads at its base and several commons in the immediate vicinity.



"SOMEWHERE IN HERTS." The concealed transmitter, G5CD, in operation. Seventy amateurs with D.F. sets ranged the country in search of it, but only one group actually located the site.



Mr. Corfield at the key. Transmissions were made at regular intervals.

The site was eventually discovered by the Southall Radio Society group, which was placed third by the judges because, owing to a balancing condenser mishap, poor readings were recorded on the first transmission.

The winning group was led by Mr. Maurice Child, with an average error of only 0.7°. The group worked at an average distance of 10 miles from the transmitter.

Mr. Alexander Black's group came second with an average error of 1.5°, readings being obtained at an average distance of seven miles. The Southall Society, taking third place, had an average error of 8°. Pye Radio Society came fourth.

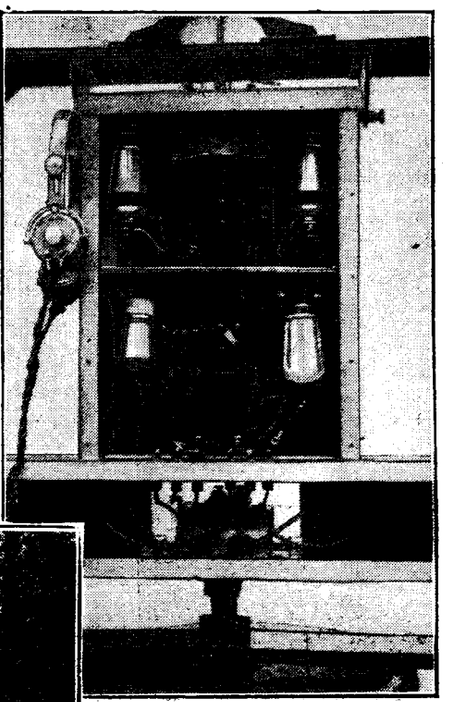
The judges included Dr. R. L. Smith-Rose, of the National Physical Laboratory, Mr. Leslie McMichael, M.I.E.E., Mr. M. Reed, M.Sc., Mr. H. B. Dent, of *The Wireless World*, Wing-Commander Marshall, and Lieut.-Col. Ashley Scarlett.

The transmitters 5RD (Kings Langley) and 2JU (Harrow) co-operated with the mobile transmitter 5CD, acting as fixed transmitting stations for checking receiving apparatus and correcting for local errors.

Dr. R. L. Smith-Rose complimented the direction-finding groups on the very high standard of the work. He strongly recommended the study of direction finding by all radio societies, pointing out that there was a large scope for experiments and development easily within the resources of the average wireless amateur.

The prize distribution will take place on July 7th at the Regal Cinema, Finchley Road, N.W.2, at 2.30 p.m.

A novel experiment will be tried on Sunday, June 17th, when the Golders Green Society will attempt 5-metre direction finding near Chipperfield. The first part of the proceedings will be devoted to set calibration and local reception. During the latter part of the day more distant operations will be attempted, the transmitters 5RD, 2JU and 6BO co-operating.



Mr. Maurice Child's directional set, which obtained the most accurate readings and won first prize. The photograph on the left was taken while judging was in progress. The winner is fourth from the right.

News of the Week

Current Events in Brief Review

New Polish Station

A NEW Polish broadcasting station of 30 kW. is to be erected at Torun, Polish Pomerania, within the next few months.

Paris Radio Show

DESPITE rumours of its cancellation, the annual Paris Wireless Show is to be held this year in the Grand Palais from September 6th to the 16th.

Valve Famine in Russia ?

RUSSIA is short of radio valves. It is stated that the number of valves required in a year is three million, and in consequence the Radio Advisory Committee is urging the Government to obtain supplementary supplies of raw material to increase production of the home article.

Programmes from Egypt

AS first reported in *The Wireless World*, Abu Zabal, near Cairo, is the location of Egypt's new Marconi-built broadcasting station. Broadcasting in Egypt was placed on an official basis on May 31st when the new service, operated by the Marconi Company on behalf of the Egyptian Government, was inaugurated. The 20-kilowatt station at Abu Zabal and the 250-watt relay transmitter at Ras el Tin, near Alexandria, are connected by land lines with a suite of studios at Radio House, Cairo. Abu Zabal works on 483.9 metres and Ras el Tin on 267.4 metres. 75 per cent. of the programme time is devoted to programmes of native interest and 25 per cent. to matters appealing to the European population. News is broadcast in Arabic, French and English. Sponsored programmes are not accepted.

KING'S BIRTHDAY HONOURS. Sir Hugo Hirst, Bt., chairman and managing director, General Electric Co., Ltd., on whom a Barony has been conferred. Sir Hugo was one of the original directors of the British Broadcasting Company.

Superhets. for Two Pounds

JAPANESE five-valve superhets. costing only two pounds each were recently landed in New Zealand. According to the *Christchurch Times*, the sets passed the Government electrical safety tests, but have not been allowed on the market owing to possible damage to local trade. It is stated that the sets were of an out-of-date pattern and equipped with obsolete valves built into an old-fashioned circuit.

Television Committee: Evidence Sought

THE committee recently appointed to consider the development of television held its first meeting on May 29th under the chairmanship of Lord Selsdon. Any society, firm or individual wishing to submit written or oral evidence to the committee should communicate with the Secretary, Mr. J. Varley Roberts, Telegraph and Telephone Department, General Post Office, London, E.C.1.

New Zealand Radio

FOR the new broadcasting station, IYA, Auckland, the New Zealand Broadcasting Board has accepted the tender of Amalgamated Wireless of Australasia, Ltd. The station, which will cost £8,000, is being built at Henderson, some ten miles from the city.

Radio in French Parliament

THE installation of a wireless receiver in the Chamber of Deputies, Paris, is being discussed as is also the question of equipping the Chamber with broadcasting gear. It is considered, however, that broadcasting might tempt Deputies to indulge in high-flown oratory which would slow up the Parliamentary machine.

Tit for Tat

WHEN should a nation relay the broadcast programmes of another? According to the French Committee of Co-Ordination which is reorganising the State broadcasting programmes no relays should be accepted from abroad unless they are superior to those which would normally occupy the French programme on the same day, and unless the country from which the programme emanates will guarantee reciprocal relays from France.

Emergency Radio in New Zealand

FOR use in emergencies, such as earthquakes, the New Zealand Post Office has established nineteen short-wave stations in various parts of the Dominion. Most of the stations are portable and battery-operated, and work on wavelengths of 53 metres in daylight and 70 metres at night with a power of only five watts.

Morse on the Beat

THAT all policemen should learn morse was the advice given by Brigadier-General Dudgeon when reviewing the Dundee police last week. Wireless for police purposes, said the General, should become increasingly prominent in view of tests by the police of Glasgow and Edinburgh, and every constable, therefore, should be able to transmit and receive in the Morse Code.

CAPTAIN IAN FRASER, C.B.E., M.P., one of the new Knights-Bachelor. Capt. Fraser is well known to our readers not only for his work at St. Dunstan's, but as a keen wireless amateur and member of the R.S.G.B.

Licences by Instalments

THE Post Office points out that facilities exist whereby the amount of 10s. required for the annual wireless licence fee can be saved in sums of sixpence.

Savings stamps, costing sixpence each, may be purchased at any post office and affixed in a stamp savings book which is provided free of charge. When 20 stamps value 10s. have been accumulated the book may be surrendered and a wireless licence obtained in exchange.

"Shadows *v.* Whispers"

A FIRST-CLASS dispute in America is developing between "the Shadows and the Whispers," otherwise the Movies and the Radio, writes our Washington correspondent. The moviemen form the aggrieved party, contending that box-office receipts are declining because radio is not only keeping the people indoors, but raiding the movie stage in search of talent.

To ascertain the degree to which radio cuts into box-office receipts, if at all, the National Recovery Administration has sent a questionnaire to 600 radio stations. One of the important questions is how many people attend studio performances and whether they pay admission fees. This question is prompted by the fact that radio audiences in America are much larger than in Britain, invitations being issued wholesale by those sponsoring the programmes.

From Bad to Worse

A WRITER in our enterprising French contemporary, *Toute la Radio*, says that it will suffice to describe the apparatus under consideration as "le lecteur phonographique." The Editor, in a footnote, hopes that in spite of this French designation, his readers will understand that the reference is to what is known in England as a "pick-up."

When will someone invent a really suitable name for this useful piece of apparatus?

British Radio for China

THE Chinese Government has recently placed a large order for radio stations with Standard Telephones and Cables, Ltd., London. It is intended that the larger towns in China shall have their own transmitting and receiving stations thus building up radio links all over China. On a smaller scale the network will be almost identical with the world telephony service between England, America Africa and Australia.

Photo-electric Cells

THE Research Committee of the Television Society has defined photo-electric (light sensitive) cells in the following way:—

1. A light sensitive cell is any device in which modification of its electrical properties occurs on illumination.

2. A photo-conducting cell is one whose electrical resistance varies with the illumination incident upon the cell.

3. A photo-electric cell is one in which electrons are emitted from a metallic surface under illumination.

4. A photo-electrolytic cell is one which depends primarily for its action upon the Becquerel effect.

5. A photo-voltaic cell is one in which difference of potential is developed across the rectifying contact between the surfaces of a semi-conductor and a metal under the influence of illumination; this potential difference gives rise to a current in an external circuit.

Still Calling

ALTHOUGH sponsored programmes from private radio stations in New Zealand were banned from March 31st last, Auckland still has four such stations. Two are supported by Listeners' Leagues. Listeners are awaiting the next move in this wireless "war."

Page 399 follows after the Programme Supplement

PRINCIPAL BROADCASTING STATIONS OF EUROPE

Arranged in Order of Wavelength

(Stations with an aerial power of 50 kW. and above in heavy type)

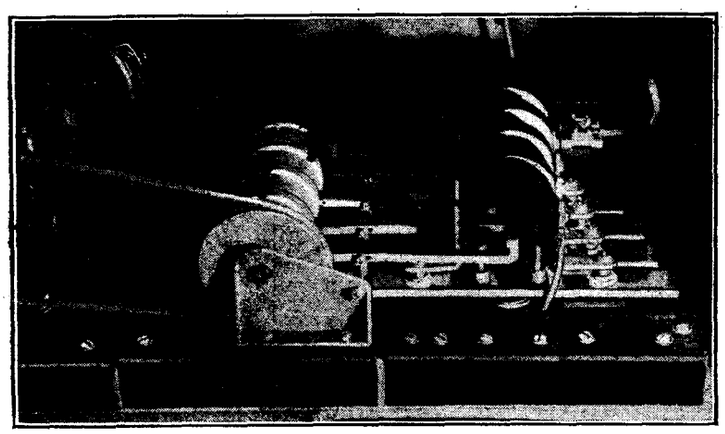
Station.	kc/s.	Tuning Positions.	Metres.	kW.
Kaunas (Lithuania)	155	.....	1935	7
Brasov (Roumania)	160	.....	1875	20
Huizen (Holland). (*Kootwijk, 50 kW. after 3.40 p.m.*) (*V.A.R.A. and A.V.R.O. Programmes.*)	160	.....	1875	7
Lahti (Finland)	166	.....	1807	40
Moscow, No. 1 (U.S.S.R.)	174	.....	1724	500
Radio Paris (France)	182	.....	1648	75
Istanbul (Turkey)	185	.....	1621	5
Königswusterhausen (Deutschlandsender) (Germany).	191	.....	1571	60
Daventry National	200	.....	1500	30
Ankara (Turkey)	200	.....	1500	7
Minsk (U.S.S.R.)	208	.....	1442	100
Reykjavik (Iceland)	208	.....	1442	16
Eiffel Tower (Paris)	215	.....	1395	13
Motala (Sweden). (*Relays Stockholm*)	216	.....	1389	30
Warsaw, No. 1 (Poland)	223	.....	1345	120
Luxembourg	230	.....	1304	150
Kalundborg (Denmark). (*Relays Copenhagen*)	238	.....	1261	75
Leningrad (U.S.S.R.)	245	.....	1224	100
Oslo (Norway)	254	.....	1181	60
Madona (Latvia)	265	.....	1132	20
Moscow, No. 2 (U.S.S.R.)	271	.....	1107	100
Geneva (Switzerland). (*Relays Sottens*)	401	.....	748	1.3
Moscow, No. 3 (U.S.S.R.)	401	.....	748	100
Boden (Sweden)	413.5	.....	726	0.6
Ostersund (Sweden)	414	.....	724.6	0.6
Oulu (Finland)	431	.....	696	2
Hamar (Norway)	519	.....	578	0.7
Innsbruck (Austria). (*Relays Vienna*)	519	.....	578	0.5
Ljubljana (Yugoslavia)	527	.....	569.3	5
Viipuri (Finland)	527	.....	569.3	13
Bolzano (Italy)	536	.....	559.7	1
Wilno (Poland)	536	.....	559.7	16
Budapest, No. 1 (Hungary)	546	.....	549.5	120
Beromunster (Switzerland) (Schweizerischer Landessender).	556	.....	539.6	60
Athlone (Irish Free State)	565	.....	531	60
Palermo (Italy)	565	.....	531	4
Mühlacker (Stuttgart) (Germany)	574	.....	522.6	100
Riga (Latvia)	583	.....	514.6	15
Agen (France)	583.3	.....	514.3	0.6
Vienna (Bisamberg) (Austria)	592	.....	506.8	120
Radio Maroc (Morocco). (*S.-w. Stn.*, 48 *m.*)	601	.....	499.2	6.5
Sundsvall (Sweden). (*Relays Stockholm*)	601	.....	499.2	10
Florence (Italy). (*Relays Turin*)	610	.....	491.8	20
Brussels, No. 1 (Belgium). (*French Programme.*)	620	.....	483.9	15
Lisbon (Portugal)	629	.....	476.9	20
Trondheim (Norway)	629	.....	476.9	1.2
Prague, No. 1 (Czechoslovakia)	638	.....	470.2	120
Lyons, PTT (France)	648	.....	463	15
Langenberg (Germany)	658	.....	455.9	60
North Regional (Slaithwaite)	668	.....	449.1	50
Sottens (Switzerland) (Radio Suisse Romande)	677	.....	443.1	25
Belgrade (Yugoslavia)	686	.....	437.3	2.5
Paris, PTT (France)	695	.....	431.7	7
Stockholm (Sweden)	704	.....	426.1	55
Rome, No. 1. (*Short-wave station, 25.4 metres*)	713	.....	420.8	50
Kiev (U.S.S.R.)	722	.....	415.5	100
Tallinn (Estonia)	731	.....	410.4	20
Seville (Spain)	731	.....	410.4	1.5
Munich (Germany)	740	.....	405.4	100
Marseilles, PTT (France)	749	.....	400.5	5
Katowice (Poland)	758	.....	395.8	12
Midland Regional (Daventry)	767	.....	391.1	25
Toulouse, PTT (France)	776	.....	386.6	2
Leipzig (Germany)	785	.....	382.2	120
Barcelona, EAJ1 (Spain)	795	.....	377.4	5
Lwow (Poland). (*Relays Warsaw*)	795	.....	377.4	16
Scottish Regional (Falkirk)	804	.....	373.1	50
Milan (Italy). (*Relays Turin*)	814	.....	368.6	50
Bucharest (Roumania)	823	.....	364.5	12
Moscow, No. 4 (U.S.S.R.)	832	.....	360.6	100
Radio, LL (Paris)	836.6	.....	358.6	2
Berlin Funkstunde. (*Short-wave Stations,*) 16.89, 19.73, 25.5, 31.38 *and* 49.83 *metres.*)	841	.....	356.7	100
Bergen (Norway)	850	.....	352.9	1
Valencia (Spain)	850	.....	352.9	1.5
Strasbourg (France)	859	.....	349.2	15
Poznan (Poland)	868	.....	345.6	16
London Regional (Brookmans Park)	877	.....	342.1	50
Graz (Austria). (*Relays Vienna*)	886	.....	338.6	7
Helsinki (Finland)	895	.....	335.2	10
Limoges, PTT (France)	895	.....	335.2	0.5
Hamburg (Germany)	904	.....	331.9	100
Radio Toulouse (France)	915.6	.....	327.7	10
Brno (Czechoslovakia)	922	.....	325.4	32
Algiers (Algeria)	931	.....	322.2	12
Brussels, No. 2. (*Flemish Programme*)	932	.....	321.9	15
Göteborg (Sweden). (*Relays Stockholm*)	941	.....	318.8	10
Breslau (Germany)	950	.....	315.8	60
Poste Parisien (France)	959	.....	312.8	100
Grenoble (France)	968	.....	309.9	20
West Regional (Washford Cross)	977	.....	307.1	50
Cracow (Poland)	986	.....	304.3	2
Genoa (Italy). (*Relays Turin*)	986	.....	304.3	10
Hilversum (Holland). (*KRO and NCRV*) (*7 kW. till 5.40 p.m.*).	995	.....	301.5	20
Bratislava (Czechoslovakia)	1004	.....	298.8	13.5
North National (Slaithwaite)	1013	.....	296.2	50
Heilsberg (Germany)	1031	.....	291	60
Parede (Portugal)	1034.5	.....	290	5
Rennes, PTT (France)	1040	.....	288.5	2.5
Scottish National (Falkirk)	1050	.....	285.7	50
Bari (Italy)	1059	.....	283.3	20
Bordeaux-Lafayette	1077	.....	278.6	12
Zagreb (Yugoslavia)	1086	.....	276.2	0.7
Falun (Sweden)	1086	.....	276.2	2
Madrid, No. 2 (EAJ7)	1095	.....	274	7
Naples (Italy). (*Relays Rome*)	1104	.....	271.7	1.5
Radio Vitus (Paris)	1112.6	.....	269.6	0.7
Kosice (Czechoslovakia). (*Relays Prague*)	1113	.....	269.5	2.6
Belfast	1122	.....	267.4	1
Nyiregyhaza (Hungary)	1122	.....	267.4	6.2
Hörby (Sweden). (*Relays Stockholm*)	1131	.....	265.3	10
Turin, No. 1 (Italy)	1140	.....	263.2	7
London National (Brookmans Park)	1149	.....	261.1	50
West National (Washford Cross)	1149	.....	261.1	50
Moravska-Ostrava (Czechoslovakia)	1158	.....	259.1	11.2
Monte Ceneri (Switzerland)	1167	.....	257.1	15
Copenhagen (Denmark). (*S.-w. Stn.*, 31.51 *m.*)	1176	.....	255.1	10
Frankfurt (Germany)	1195	.....	251	17
Trier, Cassel, Freiburg-im-Breisgau and Kaiserslautern.	1195	.....	251	—
Prague, No. 2 (Czechoslovakia)	1204	.....	249.2	5
Lille, PTT (France)	1213	.....	247.3	5
Trieste (Italy). (*Relays Turin*)	1222	.....	245.5	10
Gleiwitz (Germany). (*Relays Breslau*)	1231	.....	243.7	5
Cork (Irish Free State)	1240	.....	241.9	1
Juan-les-Pins (France)	1249	.....	240.2	2
Rome, No. 3 (Italy)	1258	.....	238.5	1
San Sebastian (Spain)	1258	.....	238.5	3
Nürnberg and Augsburg (Germany)	1267	.....	236.8	2
Bodö, Stavanger and Kristiansand (Norway)	1276	.....	235.1	0.5
Dresden (Germany)	1285	.....	233.5	1.5
Aberdeen	1285	.....	233.5	1
Linz, Klagenfurt and Salzburg (Austria)	1294	.....	231.8	0.5
Danzig. (*Relays Heilsberg*)	1303	.....	230.2	0.5
Swedish Relay Stations	1312	.....	228.7	0.25
Budapest, No. 2 (Hungary)	1321	.....	227.1	0.8
Hanover, Bremen, Flensburg, Stettin and Magdeburg.	1330	.....	225.6	1.5
Lodz (Poland)	1338.9	.....	224.1	1.7
Montpellier, PTT (France)	1339	.....	224	5
Dublin	1348	.....	222.6	1
Milan, No. 2 (Italy)	1348	.....	222.6	4
Königsberg (Germany)	1348	.....	222.6	0.5
Turin, No. 2	1357	.....	221.1	0.2
Warsaw, No. 2 (Poland)	1384	.....	216.8	2
Lyons (Radio Lyon) (France)	1393	.....	215.4	5
Tampere (Finland)	1420	.....	211.3	1.2
Newcastle	1429	.....	209.6	1
Béziers (France)	1431	.....	209.9	2
Magyarovar (Hungary)	1438	.....	208.6	1.25
Miskolc (Hungary)	1438	.....	208.6	1.25
Fécamp (Radio Normandie)	1456	.....	206	10
Pecs (Hungary)	1468.6	.....	204.2	1.25
Bournemouth	1474	.....	203.5	1
Plymouth	1474	.....	203.5	0.3
Bordeaux Sud-Ouest (France)	1492	.....	201.1	1
Nimes (France)	1492	.....	201.1	0.2

The Diary of an Ordinary Listener

RADIO TOULOUSE transmitted extracts from Puccini's "La Tosca" on May 24th, and, later in the evening, an entertaining programme of light music, with intervals devoted to the praise of goods on sale in Paris or Toulouse. Munich gave us a fine rendering of Bruckner's Sixth Symphony in A, played by the Station Orchestra, conducted by Winter, and Warsaw a programme of light music, but neither of these stations was really satisfactory during daylight. After dark I heard a good selection of records from Prague, including Tchaikowsky's "1812" Overture.

Beromünster's attractive concert of English and French songs on May 25th was somewhat sullied by a background of jazz from Athlone. There seems to be something peculiarly penetrating and far-reaching in the notes of the saxophone and Hawaiian guitar, which have a way of intruding uncomfortably into programmes on neighbouring wavelengths; the National Orchestra from Paris P.T.T. suffered in the same way the following evening. On the long waves the station orchestra of Luxembourg, conducted by Pensis, afforded substantial fare in Beethoven's "Coriolanus" overture and Haydn's 'cello concerto.

When I tuned in rather late on the following Monday I found most of the audible stations were transmitting news, so I turned for comfort to the faithful Huizen, seeing by the programme that there was an organ recital. Unfortunately, from my point of view, the organ was of the cinema variety, and as the gibbering tremulant of these instruments, even when well played (as I must admit this one was), only irritates me, I quickly switched over to Kalundborg for Rimsky-Korsakov's String Quartet in F.



INTERVALS AT MUNICH. New mechanism for playing the 4-note bell theme from Parsifal between programmes at Munich. The sound vibrations are conveyed to the amplifiers through magnetic pick-ups.

Tom-Toms from Paris

On Tuesday of last week I happened on a most intriguing programme from the Eiffel Tower, the main part consisting of what I believe to be contemporary French music; certainly the harmonies were modern, but not blatantly discordant or objectionable to ears accustomed to music which accords with Shakespeare's definition, "a concord of sweet sounds"; and I quite enjoyed a pianoforte concerto and some descriptive music scored for many unusual instruments, including two tom-toms and soprano solo. I assume that these were French compositions, because the sounds were not merely the "virile cacophony" of which musical critics write, but had that piquancy and sense of humour typical of the French nation. After Eiffel Tower had closed down I moved farther south and heard the end of an excellent military band concert from Rome, which station was coming in exceptionally clearly. The final numbers were a Spanish Rhapsody by Pinna, a dance from Borodin's "Prince Igor," and the famous "Blue Danube" waltz, which, incidentally, did not altogether suit a band composed entirely of wind instruments, and sounded somewhat heavy.

CALIBAN.

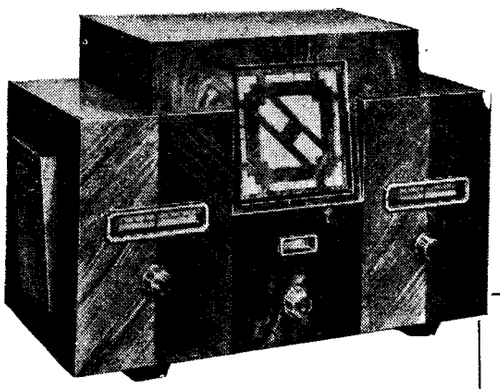
SHORT-WAVE STATIONS OF THE WORLD

(N.B.—Times of Transmission given in parentheses are approximate only and represent G.M.T.)

Metres.	kc/s.	Call Sign.	Station.	Tuning Positions.
62.56	4,795	VE9BY	London, Ont. (Canada). (*Sun.* 06.00) ...	.....
58.31	5,145	OK1MPT	Prague (Czechoslovakia). (*Tues. and Fri.* 19.30)	.....
50.26	5,970	HVJ	Vatican State, Rome. (*Daily* 19.00) ...	.....
50.0	6,000	RW59	Moscow. (*Relays No. 1 Stn.*)	.....
50.0	6,000	EAR25	Barcelona, Radio Club (Spain). (*Sat.* 20.00)	.....
49.83	6,020	DJC	Zeesen (Germany). (*Daily* 18.00 *and* 01.00)	.....
49.67	6,040	W1XAL	Boston, Mass. (U.S.A.)	.....
49.67	6,040	W4XB	Miami Beach, Florida (U.S.A.)	.....
49.58	6,050	GSA	Empire Broadcasting	.....
49.5	6,060	W3XAU	Philadelphia, Pa. (U.S.A.). (*Relays WCAU*)	.....
49.5	6,060	VQ7LO	Nairobi (Kenya Colony). (*Daily* 16.30)...	.....
49.5	6,060	W8XAL	Mason, Ohio (U.S.A.). (*Relays WLW*) ...	.....
49.43	6,069	VE9CS	Vancouver, B.C. (Canada)	.....
49.34	6,080	W9XAA	Chicago, Ill. (U.S.A.). (*Relays WCLF*)...	.....
49.22	6,095	VE9GW	Bowmanville, Ont. (Canada). (*Daily* 20.00)	.....
49.18	6,100	W3XAL	Bound Brook, N.Y. (*Relays WJZ*) ...	.....
49.18	6,100	W9XF	Downers Grove, Ill. (U.S.A.)	.....
49.1	6,110	VUC	Calcutta, India. (*Daily* 13.00)	.....
49.02	6,120	W2XE	Wayne, N.J. (U.S.A.). (*Relays WABC*)...	.....
49.0	6,122	ZTJ	Johannesburg (S. Africa). (*Weekdays* 09.00) 14.00 [*Sat.* 14.30] *and* 17.00, *Sun.* 13.00 *and* 16.30.)	.....
48.86	6,140	W8XK	East Pittsburg, Pa. (U.S.A.). (*Relays KDKA* 21.19-06.00)	.....
48.0	6,250	CN8MC	Casablanca (Morocco). (*Relays Rabat*) ...	.....
47.97	6,250	HJ3ABF	Bogota (Colombia). (*Daily* 15.00) ...	.....
47.0	6,382	HC1DR	Quito, Ecuador. (*Daily* 01.00)	.....
46.69	6,425	W3XL	Bound Brook, N.J. (U.S.A.). (*Relays WJZ*)	.....
45.38	6,610	RW72	Moscow. (*Relays Stalin Stn.*)	.....
45.0	6,667	FM8KR	Constantine (Algeria). (*Mon. and Fri.* 22.00)	.....
45.0	6,667	TGW	Guatemala City (Central America). (*Daily* 03.00)	.....
43.75	6,860	—	Radio Vitus, Paris. (*Daily* 20.30) ...	.....
43.0	6,970	EAR110	Madrid. (*Tues. and Sat.* 22.30)	.....
42.92	6,990	LCL	Jelöy (Norway). (*Relays Oslo*)	.....
41.7	7,195	VS1AB	Singapore (Malay States). (*Sun. and Wed.* 15.30)	.....
40.3	7,443	HBQ	Radio Nations, Prangins (Switzerland) (*Sun.* 22.00–22.45)	.....
38.47	7,797	HBP	Radio Nations, Prangins (Switzerland). (*Sat.* 22.30–23.15)	.....
37.33	8,936	CNR	Rabat (Morocco). (*Sun.* 20.00)	.....
37.04	8,110	HCJB	Quito (Ecuador)	.....
33.50	8,955	TGX	Guatemala City (S. America)	.....
31.58	9,500	PRBA	Rio de Janeiro (Brazil). (*Daily* 21.30) ...	.....
31.55	9,510	VK3ME	Melbourne (Australia). (*Wed. and Sat.* 10.00)	.....
31.54	9,510	GSB	Empire Broadcasting	.....
31.51	9,520	OXY	Skamlebaek (Denmark). (*Relays Copenhagen*)	.....
31.48	9,530	W2XAF	Schenectady, N.Y. (U.S.A.). (*Relays WGY*)	.....
31.38	9,560	DJA	Zeesen (Germany). (*Daily* 11.45–14.45) ...	.....
31.35	9,570	W1XAZ	East Springfield, Mass. (U.S.A.). (*Relays WBZ*)	.....
31.29	9,585	GSC	Empire Broadcasting	.....
31.28	9,590	W3XAU	Philadelphia, Pa. (U.S.A.). (*Relays WCAU*)	.....
31.28	9,590	VK2ME	Sydney (Australia). (*Sundays*)	.....
31.27	9,595	HBL	Radio Nations, Prangins (Switzerland). (*Sat.* 22.00–22.45)	.....
31.25	9,598	CT1AA	Lisbon (Portugal). (*Tues. and Fri.* 22.00–00.00)	.....
31.0	9,675	T14NRH	Heredia (Costa Rica). (*Daily* 22.00 *and* 02.00)	.....
30.0	10,000	EAQ	Aranjuez (Spain). (*Daily* 22.30, *Sat.* 18.00)	.....
28.98	10,350	LSX	Buenos Aires (Argentina). (*Daily* 20.00)	.....
26.83	11,180	CT3AQ	Funchal (Madeira). (*Tues. and Thurs.* 10.30–12.30)	.....
25.63	11,705	FYA	Pontoise (France). (*Colonial Stn. E-W, daily* 20.30)	.....
25.6	11,720	VE9JR	Winnipeg (Canada). (*Daily* 14.30) ...	.....
25.57	11,730	PHI	Eindhoven (Holland)	.....
25.53	11,750	GSD	Empire Broadcasting	.....
25.5	11,760	DJD	Zeesen (Germany) (*Daily* 01.00-04.00) ...	.....
25.45	11,790	W1XAL	Boston, Mass. (U.S.A.)	.....
25.4	11,810	2RO	Prato Smeraldo, Rome. (16.15-23.30) ...	.....
25.36	11,830	W2XE	Wayne, N.J. (U.S.A.). (*Relays WABC*)...	.....
25.36	11,830	W9XAA	Chicago, Ill. (U.S.A.). (*Relays WCFL*) ...	.....
25.28	11,865	GSE	Empire Broadcasting	.....
25.27	11,870	W8XK	East Pittsburg, Pa. (U.S.A.). (*Relays KDKA* 21.19-03.00)	.....
25.20	11,905	FYA	Pontoise (France). (*Colonial Stn. N-S*) ...	.....
25.0	12,000	RNE	Moscow. (*Relays No. 2 Stn.*)	.....
23.38	12,830	CNR	Rabat (Morocco). (*Sun.* 12.30)	.....
19.84	15,120	HVJ	Vatican State, Rome. (*Daily* 10.00) ...	.....
19.81	15,140	GSF	Empire Broadcasting	.....
19.73	15,200	DJB	Zeesen (Germany). (*Daily* 05.35 *and* 11.45)	.....
19.72	15 210	W8XK	East Pittsburg, Pa. (U.S.A.). (*Relays KDKA* 15.00-21.18)	.....
19.68	15,244	FYA	Pontoise (France). (*Colonial Stn. E-W*)...	.....
19.64	15,270	W2XE	Wayne, N.J. (U.S.A.). (*Relays WABC*)..	.....
19.57	15,330	W2XAD	South Schenectady, N.Y. (U.S.A.). (*Daily* 20.00)	.....
16.89	17,760	DJE	Zeesen (Germany)	.....
16.88	17,770	PHI	Eindhoven (Holland)	.....
16.87	17,780	W3XAL	Bound Brook, N.J. (*Relays WJZ*) ...	.....
16.87	17,780	W9XAA	Chicago, Ill. (U.S.A.). (*Relays WCFL*) ...	.....
16.87	17,780	W9XF	Downers Grove, Ill. (U.S.A.)	.....
16.86	17,790	GSG	Empire Broadcasting	.....
13.97	21,470	GSH	Empire Broadcasting	.....
13.92	21,540	W8XK	East Pittsburg. (12.00-19.00)	.....
12.30	24,380	VE9GW	Bowmanville, Ont. (Canada)	.....

Halcyon Superhet

MODEL 701

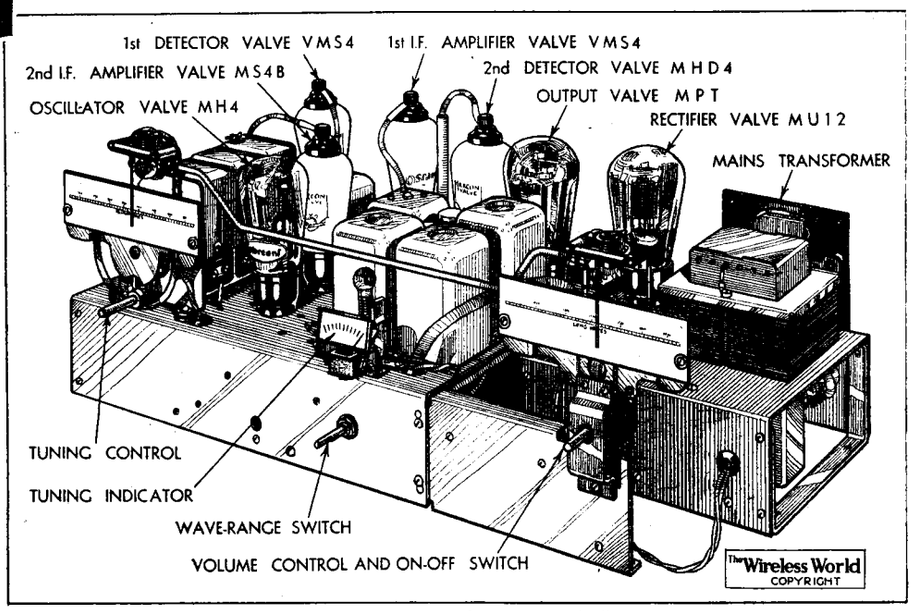


High Selectivity from Two I.F. Stages

THE imposing appearance of the cabinet is not belied when one comes to make a closer examination of the circuit and specification of this receiver. Evidently the makers have set out to give a performance in range and selectivity which will make the set attractive to those who desire a somewhat better performance in these respects than is given by the popular four-stage superhet. Actually six stages are employed, and two of these are devoted to I.F. amplification, there being no fewer than six tuned I.F. circuits. It is reasonable, therefore, to look for a high degree of selectivity, and in this respect the performance fulfilled every expectation.

FEATURES. ***Type.***—*Table-model superheterodyne for A.C. mains.* ***Circuit.***—*Var.mu first detector—triode oscillator—Var.mu I.F. amplifier—Screen-grid I.F. amplifier—duo-diode-triode detector—power pentode output valve. Full-wave indirectly heated rectifier.* ***Controls.***—*(1) Tuning with separate scales for medium and long waves. (2) Wave-range switch. (3) Manual volume control and on-off switch.* ***Price.***—*£19 19s.* ***Makers.***—*Halcyon Radio Ltd., Valetta Road, London, W.3.*

It is interesting to find, also, that a separate triode oscillator valve is used. The first stage, which makes use of a variable-mu screen grid valve, is therefore called upon to perform only the function of first detector. It is preceded by a band-pass tuner with inductive coupling to give the necessary degree of initial selectivity. Both this valve and the first of the I.F. amplifiers is subject to automatic volume control, and a visual tuner of the meter type is connected in the anode feed to the first I.F. stage.



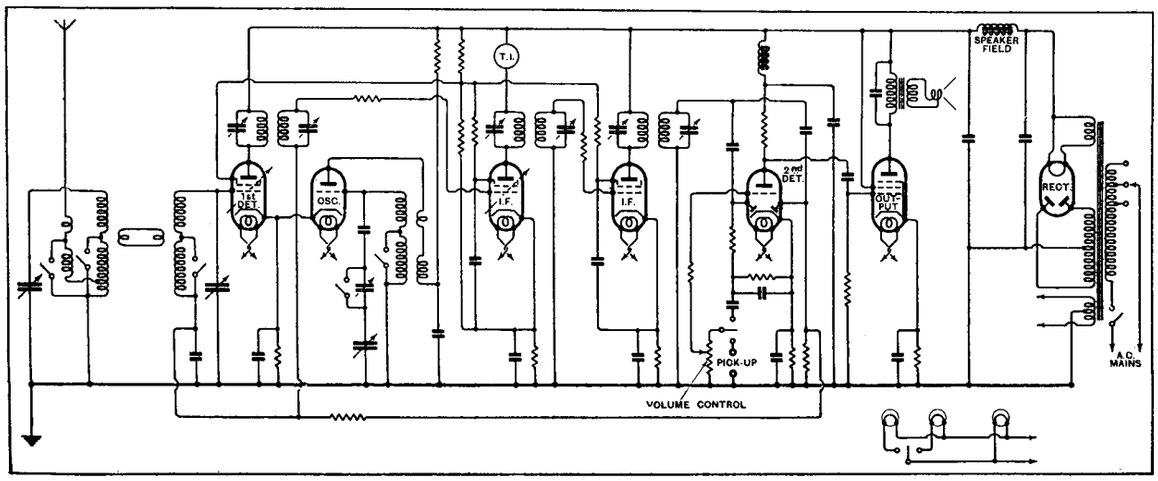
The power unit incorporating the mains transformer and indirectly-heated rectifier valve, is a separate unit connected to the main chassis by a five-pin plug.

The second I.F. amplifier is of the standard screen grid type, and its output is passed to the electrodes of the duo-diode second detector, one diode being employed for signal rectification, and the other to supply the A.V.C. bias. Resistance coupling is employed between the triode amplifying portion of the second detector and the power pentode output valve. Volume is controlled at the grid of the triode section, and the control functions on both radio and gramophone. An indirectly-heated full-wave rectifier supplies the H.T. current, and it is interesting to note that a separate smoothing choke is included in the feed to the second detector stage in addition to the loud speaker field, which is common to the remaining anode circuits.

Several points of originality are to be noted in the chassis design, which is well laid out and finished in blue cellulose enamel. Separate dials are employed for medium and long waves, the appropriate scale being illuminated by means of contacts on the waverange switch. The two pointers are connected by a link motion, and the pilot lamps travel with the pointers, thus giving maximum illumination where it is required. The scales are marked both in metres and kc/s, but the intermediate graduations are purely decorative as they do not relate to either scale.

In the particular model tested only 1½ channels were lost on either side of the National transmitter in Central London, but it was not found possible to approach closer than 2½ channels to London Regional without incurring some background from that station. On long waves the reception from Königswusterhausen was exceptionally good, and interference from Daventry and Radio-Paris was as low as one could reasonably expect, having regard to the relative powers and wavelengths of the stations concerned.

With the set accurately tuned to the local station there was perhaps a little too much loss



The circuit employs two I.F. stages, in the first of which is connected a visual tuning indicator.

Halcyon Superhet, Model 701—

of the higher frequencies, but that is the price one has to pay for the high selectivity provided. On the other hand, judicious adjustment of the tuning control, with the aid of the visual indicator, enabled the balance to be adequately restored. The magnification of the lower frequencies due to the characteristics of the tuned circuits also resulted in some overloading on powerful nearby stations. This was not amenable to correction by manual volume control, but would probably be corrected by the use of a less efficient aerial system than the one employed for our tests. There need be no fear of losing any worthwhile foreign stations as a result of this measure, for there is an ample reserve of overall magnification to bring in all stations of programme value on a small outdoor aerial.

In conclusion, the makers are to be congratulated on the solidity and well-balanced proportions of the cabinet. It is finished in quartered walnut veneer. For an extra £2 2s. the model may be supplied with an electric clock let into the loud speaker grille, and a specially designed pedestal costs an additional 45s.

Readers' Problems

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers.
Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page.

Home-made Relay

IT is a fact that a fairly satisfactory relay (for remote control purposes, etc.) can be improvised from the mechanism of an electric bell. A correspondent who proposes to try this plan asks us to suggest briefly how the bell should be modified.

An ordinary bell is so arranged that the contacts "break" when current is passed through the energising windings. In most cases this is not what we want, and accordingly the contacts must be rearranged so that they "make" when the battery circuit through the magnet windings is completed.

It will therefore be necessary to move the fixed contact (B in Fig. 1) to the opposite side of the tongue which carries the moving contact A. The new position of the contacts is shown in the sketch. This is the most important alteration, but, in order to improve the sensitivity of the device and make provision for adjustment, it is almost essential to add a back-stop screw in order to limit the movement of the armature to a suitable extent.

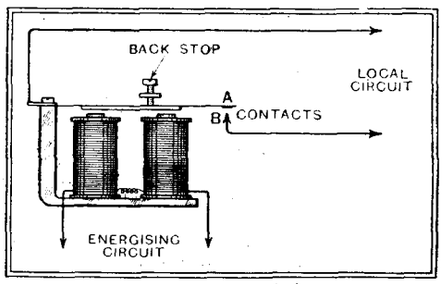


Fig. 1.—Sketch showing rearrangement of contacts and connections for converting an electric bell into a relay.

In the interests of economy and sensitivity it is often worth while to rewind the magnet coils with finer wire, but this is not always essential.

Ignoring Back-E.M.F.

A QUERIST, who proposes to charge some accumulators from D.C. mains, is in difficulties with regard to the determination of the value of the necessary limiting resistance which must be inserted in the charging circuit. He has apparently overlooked the fact that the voltage applied for charging purposes will, in effect, be reduced by the back-voltage of the battery to be charged.

The procedure is, first, to subtract the battery voltage from the voltage of the source, and then to ascertain the value of the limiting resistance (in ohms) by dividing the voltage ascertained by the previous subtraction by the desired value of charging current, expressed in amperes or fractions.

Testing for Oscillation

A BUILDER of the Single-Span Receiver (A.C. model) does not apparently realise that there is no inherent difference, except in the matter of frequency range, between the oscillator circuit of the new set and that of more conventional designs. Unless the oscillator is functioning correctly the receiver cannot work, but, fortunately, a test can be carried out very simply in the conventional way.

The procedure is to short-circuit terminals Nos. 3 and 4 (the reaction winding) of the oscillator coil assembly, after having inserted a milliammeter in the anode circuit of the oscillator section (in series with R_5). When the coil is short-circuited the current reading should be higher, and no change of current is a definite indication of non-oscillation.

The most probable cause of a failure of this nature is a reversal of connections to the oscillator reaction coil; a defect in either of the condensers C_3 or C_6 might also be responsible, and there is also the possibility of a short-circuit between the screening "can" and one or more of the internal connections of the oscillator coil assembly.

The procedure for checking the operation of the detector-oscillator valve of the battery model is similar.

Eliminator Condensers

THERE seems to be some confusion between the two high-capacity condensers used in association with a valve rectifier and its smoothing circuit. Briefly, it may be stated that the reservoir condenser which is connected directly across the rectified output, as shown in Fig. 2, is almost invariably of 4 mfds. capacity, the majority of British rectifying valves being designed to work with that value. The smoothing condenser connected on the output side of the smoothing choke is also of the same capacity as a general rule, but it is not uncommon to employ a larger capacity of some 6 or 8 microfarads.

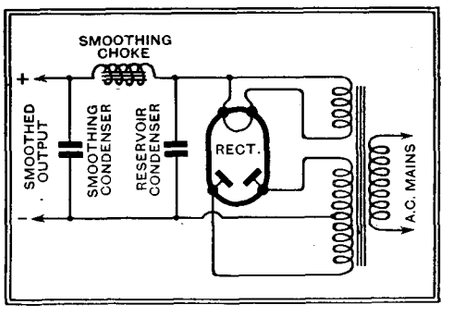


Fig. 2.—Positions of the two essential condensers in a rectifier-smoothing unit.

Low-resistance H.T. Source

WE are asked to examine the circuit diagram of a receiver originally designed for A.C. mains feed and to say to what extent it will be permissible to reduce the decoupling in the various anode circuits if anode current is derived from a battery of large H.T. accumulators.

The impedance of an accumulator battery is certain to be much lower than that of an A.C. power supply unit, and so it is reasonable to suppose that much less thorough decoupling would be required in order to prevent instability. But we fear that the matter is hardly susceptible to accurate estimation, and, in any case, is it worth while, from a practical point of view, to reduce the value of decoupling resistance?

The H.T. voltage required will be governed by the requirements of the output valve, and so there seems to be no particular point in economising in voltage for the earlier valves. These might, of course, be fed from tappings on the battery, but this would introduce complications, due to unequal discharge of the various accumulator cells; it would seem much better to play for safety and to apply the full voltage to the set through the original values of feed resistances.

The Wireless World INFORMATION BUREAU

THE service is intended primarily for readers meeting with difficulties in connection with receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

Communications should be by letter to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service.

Personal interviews are not given by the technical staff, nor can technical enquiries be dealt with by telephone.

BROADCAST BREVITIES

By Our Special Correspondent

The 24-Hour Clock

ALTHOUGH blessed with the hide of a rhinoceros the B.B.C. confesses to slight cutaneous irritation following public attacks on the 24-hour time experiment.

They are asking at Broadcasting House what would have been the public reaction if the B.B.C. had introduced Daylight Saving. Probably people would have sat up all night out of spite.

A Willing Scapegoat

To some extent the B.B.C. are the scapegoat of the Post Office, though, unlike the scapegoat of Holy Writ, the Corporation was quite pleased to shoulder the responsibility of initiating the experiment. The staff are now too busy translating normal times into abnormal to take much notice of the shouting and tumult.

The "Third Stage"

On June 15th, I understand, the experiment will reach its "third stage" with the resumption in the B.B.C. publications of 12- and 24-hour timings side by side. What will be the "fourth stage"?

A Nightingale Mystery

A CHARACTER in Bernard Shaw's "Pygmalion," having studied people's accents, could "place" anyone within a mile or two of his home after hearing him speak. I have studied nightingales the same way, with the result that, having listened last week to their song, I have come to the conclusion that it is not the Pangbourne birds that are broadcast. The trill at the end of each cadence suggests the Burghfield (Berks) variety, and I defy the B.B.C. engineers to say I am wrong.

Listen for Droitwich

WITHIN a month we may expect the first tests from Droitwich after midnight. It looks as if the new station will have a longer testing period than any of its sister stations, for I hear that the official opening will probably be deferred until September. August, apparently, is taboo, because all the best people are then on holiday.

When it does enter regular service Droitwich will have a most auspicious send-off. The ceremony may be performed by wire and wireless from the North of Scotland.

How They Listen

A MAP which showed automatically the density of listening population at any given moment would disclose interesting variations in national habits. The black or grey blobs would wobble up and down the country in well-defined shapes at different times of the day, to judge from some important conclusions arising out of a recent close study of correspondence received by the B.B.C.

Saturday Night Disclosures

In Northern England, for instance, it appears that there is very little listening on Saturdays. The claims of football, the "pictures," and the Saturday night shopping are irresistible. Sunday, too, is an off-day, and serious listening does not begin until Monday night. Yet Saturday is a most popular listening day in Scotland, except in the Clydeside area, which prefers its wireless during the early part of the week, Saturday night being sacred to other pursuits.

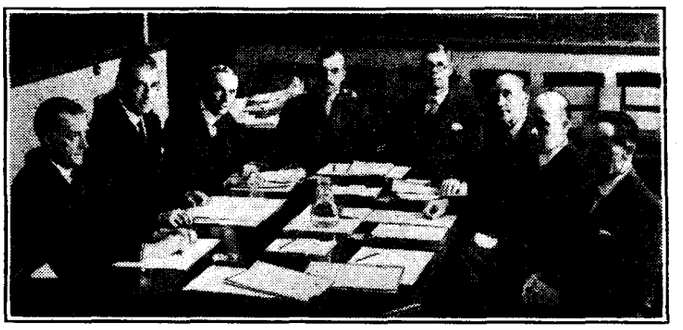
Why Wales Won't Listen on Sundays

Correspondence reveals that Midlanders are fond of their Saturday programmes. Londoners tune in "at any old time," except, apparently, early on Saturday evening when presumably they are prowling the shops. At all events it is significant that Londoners have seemed least attracted by the "In Town To-night" series, being, no doubt, "in town" themselves.

Wales is not too fond of Sunday programmes. Not, though, for the usual reason but because they interfere with chapel going.

WHITHER TELEVISION?

The P.M.G.'s Television Committee at its first sitting last week. Left to right: Sir John Cadman, Lord Selsdon (chairman), Mr. F. W. Phillips, Mr. J. Varley Roberts, Mr. O. F. Brown, Vice-Admiral Sir Charles Carpendale, Mr. Noel Ashbridge, and Col. A. S. Angwin.



Forthcoming Programme Changes

Taken as a whole correspondence reveals that the B.B.C. has the largest number of listeners in the morning and late at night throughout the week.

I wonder whether the general aspect will alter if the B.B.C. proceeds with the idea, now under discussion, of introducing almost an entire change in the programme layout next winter.

Later Evening Talks?

Two vital alterations would be the extension of the morning broadcasts so that regular programmes would start at 10.15 and the shifting of the talks period to later in the evening. This latter change, which would completely transform the average evening programme, seems desirable, for in the last year or two the programme arrangements have been stereotyped to the point of monotony. And yet, do people want a mid-evening talks period?

Shooting the B.B.C. Film

PEOPLE pacing the Broadcasting House corridors these days often find themselves peering into the lens of a movie camera, for John Grierson, of the Post Office Film Unit, is already taking experimental "shots" in connection with the B.B.C. film.

From 00.00 to 24.00

The film is to deal in hard facts only; there will be no romancing, no scandals, no sex appeal, but simply a matter-of-fact record in sound and picture of what happens from 00.00 to 24.00. There will be scenes in the wee sma' hours during the Empire broadcasts, of the staff arriving and the postbag being sorted, and of all those thousand and one other incidents which occur before the B.B.C. can "call it a day."

It will be a full-length film, running an hour or more, and should prove what the trade calls "a premier attraction."

Crystal Palace as London Regional

THE news that the Baird Company will shortly transform the Crystal Palace into a television station with several studios and facilities for giving regular entertainment for Londoners is a reminder that the B.B.C. itself considered the Crystal Palace as a possible site for the London Regional station. For London and the South of England it would have been a perfect position, but it was felt that the area between it and Daventry would have been too great to supply a good service over the intervening counties. As the Baird Company is concerned with transmission on optical waves the same considerations do not apply.

"Time to Spare"

A UNITED STATES citizen is reading through the "Encyclopædia Britannica" in the American Library, Paris, and I hear that he has reached the letter L. He is a long way behind Philip Thornton, who broadcasts the music talks on Saturday mornings. After an accident in his boyhood, which laid him up for several months, he read the Encyclopædia from A to S. Recently he achieved one of his greatest ambitions by reading it from T to Z. This explains the allusive erudition which he brings to the microphone as a "Traveller in Search of Music."

B.B.C. Loses a Musician

VICTOR HELY-HUTCHINSON'S departure from the B.B.C. is a distinct loss to broadcasting. This versatile musician has been appointed Poyton Professor of Music in the University of Birmingham, and will take up his duties on October 1st. He joined the B.B.C. as an accompanist in 1926 and soon rose to the position of conductor and assistant to Dr. Adrian Boult. Recently he was transferred to Midland Regional to act as musical director there. It surprised me then that headquarters could spare him; now the B.B.C. has lost him altogether.

The Short-Wave World

Greatly Improved Conditions : End of Eleven-year Cycle ?

A SPELL of exceptionally brilliant short-wave conditions, together with the "sighting" of a large sun-spot, seem to confirm the supposition that the trough of the notorious eleven-year cycle has been passed.

The great improvement both in receivers and transmitters that has taken place, however unobtrusively, during the past three or four years, gives one the impression that conditions at present are right up to their 1928 or 1929 level.

As an example, one day's log, on the amateur bands only, includes all continents, fifty-four countries, and most of the localities that are rarely heard at all. Hawaii and the Pacific Coast of the U.S.A. have been good in the early mornings on 20 metres; the same band provides good signals from Japan and California (the latter presumably "the long way round") at 1,700 or thereabouts; and South America comes in well between 22.00 and midnight.

On one morning the writer logged fifty-four stations in the United States' sixth district (California, etc.) between 06.00 and 07.00.

With all this activity in evidence on the amateur bands it is not surprising that some of the broadcast stations have mounted to tremendous strengths. W3XAL, on 16.87 metres, and W8XK, on 19.72 metres, have been coming across like locals for some days on end. W3XAL in the 49-metre band has also been outstandingly good.

By way of contrast, some of the Central and South Americans seem to have faded out for the time being. They have been replaced on the "Honours List" by JIAA, Tokio, KUV, Manilla, Philippine Islands; and FZR, Saigon, French Indo-China, all of which have been very difficult to receive at all during the past few months.

It is of interest to note, by the way, that observations on the previous eleven-year sunspot cycle suggest that the minimum of this one should have occurred last January or February. Presumably, we are now experiencing one of the first "peaks," which occur at irregular intervals as well as at the well-defined period of fifteen months.

It should be understood that the eleven-year cycle only represents a rough smoothing-out of what appears to be a very "peaky" curve; fortunately for us, some of the peaks, even towards the minimum of the cycle, attain quite a high amplitude.

The question that is in the minds of all amateur transmitters at the moment is, "Will 10 metres come back to its old state and be useful for long-distance work once more?" Congestion is becoming quite serious, even on the 20-metre band, which used to be a quiet retreat. Another workable band would help matters tremendously.

Another point that arises is concerned with the broadcasting stations. If all our suppositions are correct, and the shorter waves do commence to increase in effectiveness, will it be necessary or advisable to remove some of the stations from the vicinity of 50 metres and to fill up the 16- and 19-metre bands?

This is rather doubtful, as 50 metres probably represents the wavelength that is least affected by these cyclic changes. It does not improve so much as the shorter waves when conditions are really good, but, conversely, it does not depreciate so much when they are bad.

One thing seems to be certain—that the reception of American broadcast on the medium waves has fallen right off for the present. Long-distance conditions on those wavelengths are definitely "out of phase" with short-wave conditions.

MEGACYCLE.

THE RADIO INDUSTRY

A NUMBER of components, including coils, for the Single-Span Receiver are described in a leaflet issued by Ward and Goldstone, Ltd., Pendleton, Manchester.

An up-to-date radio and public address installation has been fitted by the Marconiphone Company at the new Shenley Mental Hospital, which was opened by H.M. the Queen last week.

Burne-Jones and Co., Ltd., of 296, Borough High Street, London, S.E.1, are specialising in the production of Magnum components for the battery model of the Single-Span Receiver.

The National Radio Service Co., of 15-16, Alfred Place, Tottenham Court Road, London, W.C.1, claim to have fitted more car radio sets than any other firm in the country. They do not sell receivers, but specialise in installing and repairing them.

The introduction of a new Sunbeam Midget receiver is announced. The set is of the universal mains type, embodies a superheterodyne circuit, covers both wavebands, and has automatic volume control. Three valves are employed, plus a rectifier; the combined detector-output valve is of the double-diode-pentode type.

Philips Industrial, a subsidiary of the radio and lamp concern, is carrying out the public-address work at the Runnymede Pageant, and has also installed an interesting photo-electric timing device at the Welsh Harp Greyhound Track.

Wireless is generally a valuable guide to air and sea navigators, but here is a case where it proved to be the reverse. During a flight to Leeds the speaker magnets of a load of Ekco battery sets affected the compass so seriously that an intermediate landing had to be made for re-stowage of the cargo.

MULTITONE TRANSFORMER

A MULTITONE transformer suitable for *The Wireless World* Battery Single-Span Receiver has been submitted for test.

This is the D4 1/9 model, and it is of the push-pull type with a ratio of 1-9. The primary inductance with no direct current is rated at 60 H, and at the current of 1.6 mA., at which it operates in this receiver, the inductance is over 40 H.

On test the component functioned admirably, and it can be confidently recommended for use in this set. The makers are Multitone Electric Co., Ltd., of 95-98, White Lion Street, London, N.1, and it is priced at 17s. 6d.

RADIO TALKS ON POLISH TOURS

MR. THAD ORDON, whose talks in English from the Warsaw station are enlisting a growing army of listeners in this country, recently described some interesting Polish tours for the benefit of English holiday makers. Three tours have been arranged. As an example, Tour No. 1 includes the sea voyage to and from London, railway journey from Gdynia to Poznan, Warsaw, Cracow, Zakopane and neighbouring mountain resorts, with hotel accommodation and conducted visits to all places of interest.

Vacation courses in Polish history and arts have also been arranged.

Full particulars can be obtained from the Polish Travel Office, 25, Cockspur Street, London, S.W.1, or from Mr. Thad Ordon, c/o *The Wireless World*, Dorset House, Stamford Street, S.E.1.

TRACKING A HIDDEN TRANSMITTER. Members and friends of the Golders Green and five other radio societies who took part in a direction-finding field day on May 27th. A description of the event appears on another page.

The Wireless World

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EDITORIAL COMMENT

New Set Designs

Points Which Require Attention

NOW that we may presume the manufacturers are busy completing their designs for next season's sets and components, it is an opportunity to draw attention once more to certain changes in style of receiving sets which we believe would be welcomed by the public.

There seems to be, at the present time amongst manufacturers, a decided prejudice against the separation of the speaker from the set; it is argued, we believe, that such an arrangement complicates distribution of sets, packing, and so forth; but this seems to be a matter of small importance by comparison with the advantages which the listener would enjoy. It is surely worth while to have the choice of the best position in the room for the speaker and not be obliged to accommodate it at the particular point which is most convenient for the set. Again, by separating the speaker from the set considerable scope is offered for an improvement in the quality of reproduction.

In these days when the majority of good sets leave comparatively little to choose between them, it would surely be of advantage to any manufacturer who adopted the idea of separating the set from the loud speaker to have this additional selling point.

In America manufacturers are already giving attention to this requirement, and a well-known authority there stated some time ago that "Clearly the loud speaker must be separated from the set, equipped with sufficient baffle area, and placed, inconspicuously perhaps, in some other part of the room," and that "The very advantage of tuning and adjusting volume and tone from the point in the room where the listener will sit is of great importance."

Another direction in which there is quite definitely room for ingenuity is in the design of tuning scales for the set. Some improvement has taken place recently, but we still have a long way to go before tuning a set has reached a stage of simplicity which will bring it into line with the other advances which have taken place in receiver design. The ordinary listener, we believe, attaches far more importance to the simplicity of tuning to whatever station it is desired to receive than is generally supposed.

Broadcast Transmitters

Possibilities of Single Sideband

WE have reached a point in broadcast development where the transmitting side seems to have settled down on a permanent basis as if there was little to be expected from it in the future beyond quite minor improvements.

But it may be well worth while not to abandon hope of a partial solution being arrived at by changes at the transmitting end.

Single sideband transmission, which is discussed in an article in this issue, is in practical use to-day in certain services, but it has not been adapted for broadcast purposes. We venture to think, however, that if some of the ingenuity and effort which is at present directed towards finding a solution for the selectivity problem on the receiving side were focused upon the transmitter instead, we might hope for some solution to be found at that end.

It seems to us, therefore, quite probable that in the not far distant future more will be heard concerning the single sideband system as applied to broadcast transmission.

Broadcast Transmission

What of the Future?

DESCRIBING single sideband transmission and showing how it is already possible—at any rate technically—that more transmitters might be accommodated in the allotted broadcast bands; alternatively, much higher quality would become possible if the existing number of stations were to operate on this system.

THE Lucerne Plan has now been in operation for a long time, and we are able to take stock of the position in regard to the broadcasting situation.

The new scale of wavelengths came into being in a manner which was remarkable, not only as a technical achievement, but as a wonderful example of what can be done when widely divergent interests combine to find a common solution to their difficulties. Undoubtedly, many broadcast services have had to forgo privileges for the common weal, and it is most encouraging to see the scheme now working so well.

Where We Stand

At the same time it is interesting to review the technical position in the light of experience up to date. The first point which is clearly brought out is the vital necessity for all stations to be equipped with means to ensure a very high order of stability in wavelength. Most of the high-power transmitters are already so fitted, but many of the small stations, intended for a localised service area, are working with somewhat crude controlling apparatus. Although such stations may be geographically far separated from the service using the adjacent channel, yet, owing to the extreme sensitivity of all receivers to heterodyne notes (whistles), serious interference arises at night time, when the received signal strength rises, unless the allotted wavelength is very accurately maintained. The technique for keeping the required stability is known and used on the large stations; but questions of cost and supervision limit its application in the design of small transmitters. The difficulty has been somewhat eased by the new allocation for the following two reasons:—

(1) The definite fixing of a wavelength to belong permanently to a station renders it possible to utilise transmitting circuits having a very limited range of adjustment. This allows the designer to secure a much better stability for a given cost.

(2) The fixed wavelength lends itself to the employment of single-frequency electro-mechanical oscillators such as piezo-electric crystals or tuning-forks. The crystal drive is probably the simplest and steadiest at present obtainable when the balance of cost and performance is taken into account.

Although the Plan will, on these scores, help considerably, yet the problem of controlling the wavelength emitted from a station to such an accuracy as is demanded cannot be regarded as finally solved. Research and experiment will therefore be encouraged in this direction with beneficial results to all services.

The Plan has also made it very obvious that before long a real trouble will arise in the packing of the required number of services into the available number of channels. It is quite evident that the people of Europe will not be content to remain stationary in the matter of the amenities afforded by broadcast news and entertainment. This will bring, and is now bringing, a desire for better and more services, implying the building of stations of higher power and an increase in the total number in operation.

If, as is the case, we have only a certain limited band of wavelengths available for the purpose of broadcasting, then an increase in number over and above that provided for by the Plan must be followed by a closer packing of the channels. Now any two stations (each occupying its own channel), when received simultaneously on a single receiver, interfere with each other. The interference primarily takes the form of the production of a continuous whistle in the loud speaker. The pitch of the note, or whistle, is controlled by the closeness of the channels in the wavelength band, and its strength, or intensity, by the strength of the weaker station. Fortunately for the broadcast listener, the ear is insensitive to notes of very high pitch, so that, provided the interference whistle is high enough, no serious trouble ensues. In the case of the Lucerne Plan the stations are so spaced in the wavelength scale that the pitch of the note produced by the interference of adjacent channels is about one octave above the highest note on the piano. This note is perfectly audible to the average person, but does not seriously spoil the reception of the desired programme.

Sacrifice of Quality

Receiver manufacturers also have certain dodges to prevent the whistle from being heard. It must, however, be kept in mind that use of such whistle preventers is attended by a reduction in the quality of the received speech or music. It is a fact that if full use is to be made of the real acoustical quality of the B.B.C. transmissions in this country, then the whistle produced by the interference of the adjacent channel will also be heard. This is particularly the case in the evenings, when the strength of low-power distant stations may at times rise to a high value.

An even more serious type of interference is caused by the direct encroachment of one channel on its neighbour when sounds are transmitted. Without worrying about the technical details, it is a fact that Nature has been unkind enough to ordain that when we cause a sound wave to ride on the back of a wireless wave (or carrier wave), then no matter how carefully and steadily we control the master oscillator, keeping the transmitting station on its wavelength in the middle of its correct channel, the

Broadcast Transmission—

carrier wave becomes split up into a number of secondary waves grouped around it. The more complex the jumble of sound waves comprising the speech or music superimposed upon the carrier, the more elaborate becomes this secondary system of waves travelling with it. We thus see the reason for giving each channel a width in wavelength. It is not only to allow for wanderings of the primary wave of the transmitter (caused by lack of steadiness of the master oscillator), but also to allow elbow room for the transmission of these secondary waves produced by the superimposed sounds. It also will be clear that even if the stations are accurately controlled, so that the carrier waves lie in the middle of their respective channels, the sound waves themselves may set up secondary waves which lie in the next door channel, and so cause interference. It is possible to reduce the spread of these secondary waves and so arrange matters that no wavelengths are produced outside the allotted channel, but this is accompanied by a reduction in the quality of the reproduction. The wider the spread allowed the better the quality.

Minimum Channel Width

Under the Lucerne Plan the channels have been arranged so that the quality is just being noticeably affected if the circuits (i.e., transmitter and receiver) are so designed as to confine the secondary wavelengths strictly to the allotted limits. If any further reduction of channel width were made it would be noticeable that the reproduction was definitely poor.

We therefore see that the demand for more and higher power stations cannot be met by a closer packing of the channels because such a course would lead to interference with reception caused by the secondary waves produced by the sounds superimposed upon the carrier waves of the adjacent channels. Further, any attempt to reduce these interferences can only be effective at the cost of the quality of the reproduction.

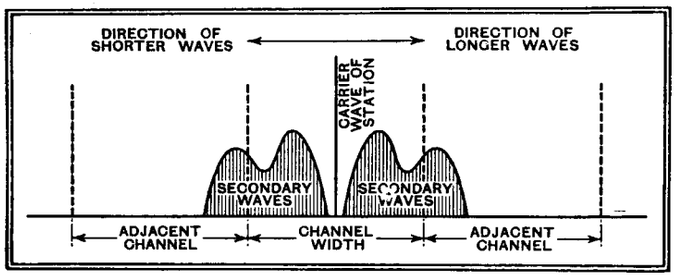


Fig. 1.—The conventional method of double sideband transmission, illustrating encroachment into both neighbouring channels.

This type of interference is undoubtedly the most serious trouble to be encountered in the immediate future; and before considering the probable line of attack on the obstacle it will be well to consider a little more closely its nature. As explained, when the carrier wave has the sound vibrations superimposed on it, secondary waves are produced. Now these waves are spread out on either side of the carrier wave, so that the station transmits its steady carrier accompanied by two similar fringes of waves; one set spreading in the longer wave direction and the other in the shorter. This can be represented pictorially in the manner of Fig. 1.

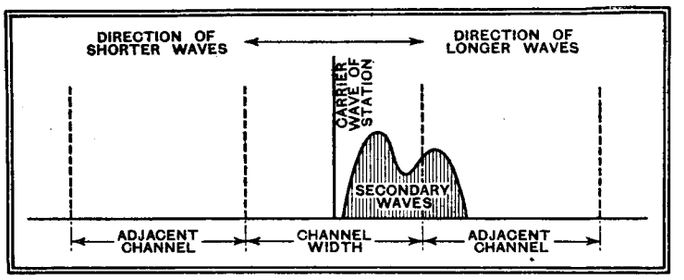


Fig. 2.—The lower sideband removed, leaving interference on the higher adjacent channel only.

The diagram is self-explanatory. If, therefore, the channels are distributed in the wavelength scale as suggested in the picture, some of the secondary waves will fall in the channels adjacent to the one under consideration, and they will be heard by receivers using those channels with resulting interference. The important thing to notice, however, is that the secondary waves are distributed perfectly symmetrically on either side of the carrier wave.

It is possible, by electrical means, to remove any portion of the band of wavelengths transmitted by a station; and, furthermore, it has been found that it is possible to receive a transmission in which one complete fringe of secondary waves has been removed, without deterioration in quality of speech and music. It is immaterial whether we leave untouched the fringe extending into the longer or the shorter wavelengths. For the sake of illustration let us remove the fringe to the left of the carrier of Fig. 1. If this is done, our picture of the transmission will appear as in Fig. 2.

It will be seen that we have eliminated the interference which existed in the next door channel on the shorter wave side. This procedure alone, if effected by any considerable number of stations, would materially reduce the total amount of jamming. We can now go a stage farther and move the carrier wave to the left-hand edge of the middle channel depicted. The remaining fringe, of course, accompanies it in this shift keeping its relationship to its carrier unaltered.

Our picture must be again modified, and now takes the form of Fig. 3.

It is now obvious that we have cleared the next channel on the longer wave side.

By these changes we have therefore completely removed the disturbances from the two adjacent channels and their transmissions are unmutilated. The exact effect on the total carrying capacity of the medium wave broadcast waveband under these new conditions is very difficult to estimate; but we may say with safety that it will be greatly increased.

Research and experiment is necessary to establish designs for both transmitters and receivers to operate in this manner, and, indeed, work has already begun in various laboratories.

It is not intended to suggest that any revolutionary changes are imminent; but rather to point out the lines upon which development is likely to occur now that the success of the Lucerne Plan has shown that a broadcast system so heterogeneous as that of Europe can be brought to a realisation of the advantages of a carefully maintained and orderly method of working.

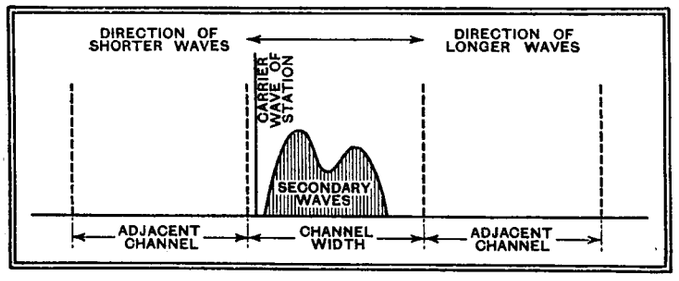


Fig. 3.—Result of re-allocation of carrier frequencies: sideband interference (or "splash") disappears entirely.

In Next Week's Issue

Single-Span A.C. Receiver and the Quality Amplifier

FULL details of the modifications necessary to the Single-Span Receiver when it is to be used to feed the Push-Pull Quality Amplifier will appear in next week's issue. The combination is outstanding in the quality of reproduction obtainable and is suitable for both local and distant reception. An illustration of the revised receiver will be found on page 417.

Turning the Record

Factors Determining Torque and Speed Regulation in Gramophone Motors

By E. C. WADLOW

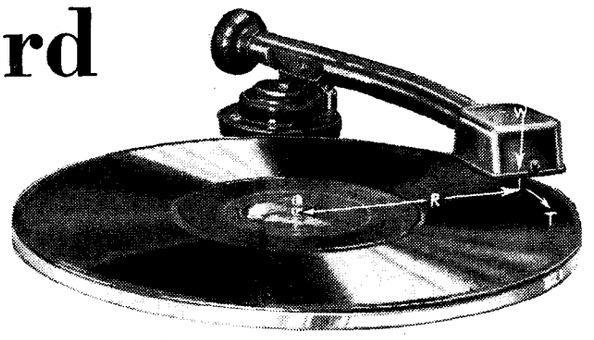


Fig. 2.—From measurements of the retarding torque T, the needle pressure W, and the radius of the groove R the coefficient of friction of the record material can be calculated.

AN important factor influencing the quality of gramophone reproduction is the variation in the motor speed caused by alterations in retarding torque at the needle point as the latter traverses the record groove. It is interesting to see how this load changes with needle and record wear, pick-up characteristics, different record materials, and so on, and to compare the different systems of gramophone motor speed control which are in use at the present time

IF the action of the needle in traversing the groove of a gramophone record is considered, it will be seen from Fig. 1 that the resultant pressure between the two may be split up into two components, one vertical and one horizontal. The former is due to the weight of the pick-up or sound box supported on the needle point, and the latter is the horizontal pressure between the needle and the groove wall, set up as the needle is forced to follow the groove contour. This horizontal component, which thus causes the needle to vibrate to and fro, is effective only in producing sound. While these

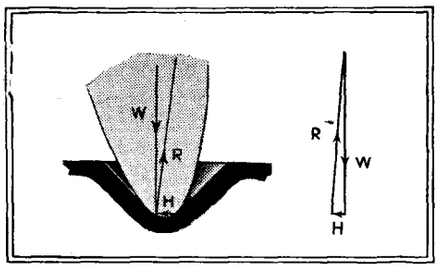


Fig. 1.—Section of needle and groove showing resultant forces but neglecting friction.

pressures are unaffected by the position of the needle point on the record, the retarding torque is proportional to its radial distance from the centre.

The effect of employing different materials, and of wear, upon the retarding torque, is best seen by making experiments with plain cut records, when the horizontal pressure is eliminated. The torque is then given by $T=\mu WR$, where μ is the coefficient of friction between the record material and the needle, W the weight on the needle point in grams, R the radial distance in centimetres of the needle from the centre of the record, and T the retarding torque in gram-centimetres. (This neglects the very small side thrust which is necessary to feed the sound box or pick-up gradually inwards towards the centre of the record as playing proceeds.)

The coefficient of friction, μ, is determined by needle and groove shapes, and by the nature of the materials in contact, and is independent of the type of pick-up or sound box used. Experiments in which the retarding torque was measured with a specially constructed dynamometer motor gave, among others, the following figures:

A new loud-tone steel needle on a new plain cut record of material used as standard by one record manufacturer gave an average value of $\mu=0.084$, which corresponds to a retarding torque of about 160 gm. cms. for an average pick-up at the periphery of a 12-inch record. Other materials with similar needles gave average values for μ of 0.081, 0.094, and 0.116 respectively, while a flexible record tested under similar conditions gave $\mu=0.140$. For comparison, it may be mentioned that the value of μ for a well-lubricated bearing is about 0.05, and for a motor car brake about 0.4. There is thus not much prospect of a reduction in the value of μ, which, if it could be achieved, would enable smaller and less costly motors to be employed, or, alternatively, make for greater constancy of speed with existing types.

Needle and Record Wear

The value of μ is, however, very easily altered by needle and record wear, and the change often takes place so rapidly that there is a doubt when testing new materials as to whether observed differences are due to actual differences between the materials or whether they are due to the states of wear not being comparable.

Fig. 3 illustrates a test where the same loud-tone steel needle was allowed to play over the same plain cut record time after time. The value of μ at the beginning was 0.10, falling to 0.067 after forty playings—a reduction of 33 per cent. If the needle is changed for every playing the effect is similar, but the reduction in value of μ is not so great. One of the most remarkable examples of the influence of wear on μ was obtained some time ago when it was found that for a new flexible record and a new loud-tone steel needle μ was 0.14, while a similar needle which had played through a record once gave a value of $\mu=0.09$ with a new record—a reduction in retarding torque of 36 per cent. Difficulty is sometimes experienced

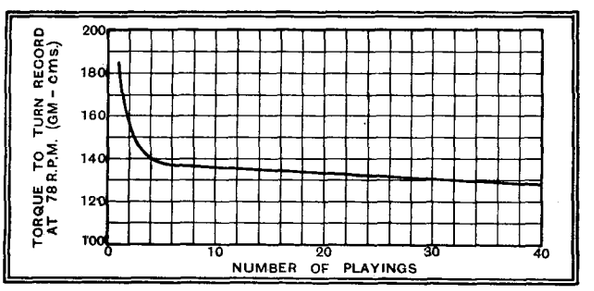


Fig. 3.—Curve showing reduction of driving torque required by the same needle with increasing number of playings.

on this account, and the makers of such records recommend that the needle should be used over and over again. Of course, the needle should never be taken out and replaced on account of the chisel edge which will almost certainly be presented to the groove wall. Measurements also show that this procedure may increase the value of μ by 20 per cent.

Similar conclusions hold for music records until the groove walls begin to show signs of wear. Then the torque required to drive the record commences to increase, and when pieces have actually been torn from the record the torque required may be up to 50 per cent. greater than for the first playing. The number of playings which may be made before the torque begins to increase is usually at least forty in bad cases, but, of course, may be much greater. When this point is reached, perfect reproduction is unattainable, however good the motor, and for this reason the data given in this article is confined to the first stage in the life of the record when a fall in torque is generally observed.

The effect of using different types of needle is therefore best shown by using plain-cut records which have been used a number of times. Tests made with a number of needles on a standard record material under comparable conditions gave the following average values:—Soft-tone steel, $\mu=0.079$; loud-tone steel, $\mu=0.09$; semi-permanent needle, $\mu=0.095$; loud-tone Tungstyle, $\mu=0.116$.

However, differences in retarding torque can be noticed even between record materials and needles supposedly identical, apart from errors of observation. Thus variations in records of the same type may amount to as much as 15 per cent., and

Turning the Record—

needles from the same box may show variations of about 5 per cent. Some of this is no doubt due to the states of wear not being really comparable.

The purpose of the groove on the record is to oscillate the needle to and fro at an amplitude and frequency proportional to that possessed by the original sound wave, and the horizontal component only of the resultant pressure between needle and record is useful in doing this. If the groove could be shaped like a rectangular trough, with vertical walls, it might be possible to make the needle follow the groove without there being any necessity for a vertical pressure component. But such a groove would be very easily damaged, and in consequence the triangular shaped groove is universally adopted. The vertical pressures which have so far been considered are necessary simply to keep the needle point in the groove, and the factors which

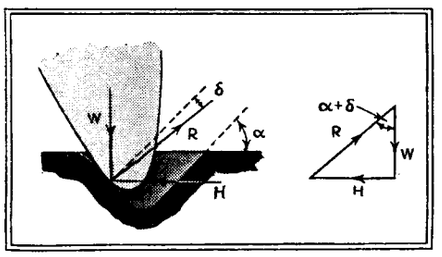


Fig. 4.—Pressures acting on record when the needle is just leaving the groove.

determine the magnitude of the horizontal component cannot be examined experimentally in a direct manner by eliminating the vertical component. If the latter is entirely removed by counterbalancing, the equilibrium of the system is unstable, as, with record groove and needle shapes universally used, no point on their surfaces exists where the resultant pressure normal to their surfaces at the point of contact may become horizontal. With zero vertical pressure, therefore, any side pressure immediately causes the neeedle to leave the groove.

Load Due to Recorded Sound Groove

However, some idea of the magnitude of the horizontal pressure may be obtained from counterbalancing experiments. Referring to Fig. 4, if α is the angle which the groove wall makes with the horizontal, the needle will stay in the bottom of the groove as long as H_{max} is less than W tan $(\alpha+\delta)$, where $\delta=\tan^{-1}\mu$, H is the horizontal pressure, and W the vertical pressure. With usual values of α and μ, H_{max} must be less than about 1.15 W or the needle will begin to travel up and down the groove walls. If this value of horizontal pressure were constant, the needle would leave the groove, but as the pressure is alternating, the time element becomes important, and the needle may not have climbed to the top of the groove wall before the pressure has fallen to a safe value, or has even reversed. There is thus a range of horizontal pressures over which the needle remains in the groove but is not following the contour accurately. This range may be determined approximately by listening to the reproduction as the weight on the needle point is reduced, or by using an oscillograph and constant-frequency records.

Vertical Pressure More Important

The effects of pick-up or soundbox characteristics upon the horizontal component of the pressure between the groove wall and the needle cannot be determined with any degree of accuracy by this method. The problems involved are very difficult of solution either experimentally or by calculation. The method outlined serves, however, to indicate approximately the magnitude of the horizontal pressure, and to show that the effects on the motor, with which we are now mainly concerned, are of a secondary nature only; for it is found that the vertical pressure may be reduced over a very wide range of frequency to about 50 grams before the needle ceases to follow the grove accurately, and to 15 or 20 grams before the needle actually leaves the groove. Thus it appears that with normal pick-ups and soundboxes having a weight from 100 to 150 grams on the needle point the vertical component of the resultant pressure between the needle and the record contributes by far the larger proportion of the retarding torque on the motor.

This is also confirmed by dynamometer experiments with constant frequency, and with music, records. With a variety of needles and vertical pressures of 100 to 150 grams, it is found that the difference in retarding torque caused by adjacent loud and soft passages on a number of music records does not often produce a variation in retarding torque upon the motor greater than about 20 per cent. Likewise, with constant-frequency records, the retarding torque does not vary more than 20 per cent. over a very wide band of frequency. The view has often been expressed that the load imposed on the motor is much less with a pick-up than with a soundbox. Experiments with different types, however, show this to be incorrect. The weight on the needle point is frequently the same for both pick-ups and soundboxes, and there is then generally very little difference in the retarding torque caused by the two types. At a number of frequencies, in fact, it may be lower with the soundbox. Again, the mica diaphragm soundbox has been accused of causing a greater load than the metal diaphragm type, but there is also very little justification for this statement.

With the small difference in retarding torque caused by the reproducer characteristics and the frequency and amplitude of the recorded sound, it is only to be expected that tracking errors are not important from this point of view. In a series of experiments the tracking was arranged to vary from 1.5 inches behind centre to 1.5 inches ahead of centre, but no difference in retarding torque could be measured.

It is clear, therefore, that a number of factors, such as the response characteristics of the pick-up or soundbox, which vitally affect the quality of reproduction have little influence on the retarding torque imposed on the motor. The major cause of variation in the latter for a given pick-up or soundbox is the gradually decreasing radius at which the weight on the needle point acts as playing proceeds. Superimposed on this are smaller irregular variations due to loud and soft passages, and smaller permanent changes due to record and needle wear. For practical purposes, therefore, with normal types of pick-up, soundbox and record, the torque required to drive the latter at 78 r.p.m. will fall approximately within the limits of the shaded areas of Fig. 5.

Minimum Audible Variation of Frequency

Before discussing some of the methods employed for maintaining the motor speed within the necessary limits of constancy under these varying loads, the degree of speed variation which can be tolerated before the reproduction begins to suffer must be considered.

The minimum differences in frequency perceptible to the human ear are difficult to determine, and as they differ from one individual to another, and vary with the conditions of test, it is not possible to fix limits with absolute precision. The most reliable numerical results are those of Knudsen[1], whose figures (extrapolated beyond 4,000 cycles by Harvey Fletcher) are given in Fig. 6. For frequencies between 500 and 4,000 cycles per second,

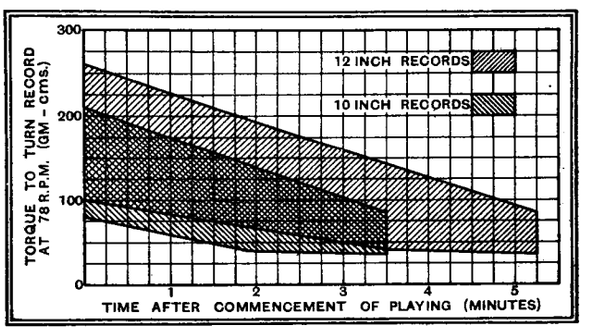


Fig. 5.—Limiting values of torque required under normal conditions to turn records at 78 r.p.m.

respectively, the minimum perceptible difference in frequency is about 0.3 per cent. The sensitiveness of the ear is reduced at both higher and lower frequencies. It also varies with the intensity of the sound being received, and, according to Harvey Fletcher, decreases as the sound intensity is lowered.

The interval of time which elapses

[1] *Physical Review* No. 22, Jan., 1923, p. 84; also *Speech and Hearing* by Harvey Fletcher, Macmillan & Co.

Turning the Record—

between the hearing of two notes which are being compared has also a considerable influence. If the interval is fairly short, say, about half a second, any difference in pitch is much more readily detected than if the interval is a minute or longer. On the other hand, it has been found that there is a minimum length of time during which a pure tone must excite the ear in order that it may be sensed as a tone having a definite pitch. This time is about one-twentieth of a second.

The sensitiveness of the method of speed control may conveniently be denoted by the torque in gram-centimetres which, when applied to the turntable spindle, causes the motor speed to fall by 1 per cent. Thus, taking the range of torques encountered during the playing of a 12-in. record as from 200 to 60 gm.-cms., the sensitiveness of the speed-controlling device should be $\frac{200-60}{0.3}=470$ gm.-cms. for a 1 per cent. change, if Knudsen's figure of 0.3 per cent. is taken as the maximum speed variation allowable.

In practice, however, the conditions are rarely as severe as assumed above. With most records, the change in torque will be less than from 200 to 60 gm.-cms., and, in any case, will take place gradually over a period of minutes. So a greater change in frequency than 0.3 per cent. between beginning and end of a record, due to the change in load, is commonly found. In fact, with several makes of motor which have enjoyed great popularity for many years, the sensitiveness is not more than a third of the figure given as a minimum, based on Knudsen's experiments. On the other hand there are motors in which the figure of 470 gm.-cms. for a 1 per cent. speed change is slightly exceeded.

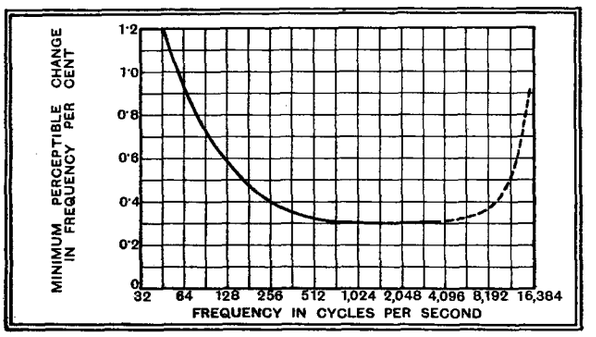


Fig. 6.—Minimum change in frequency perceptible to the ear at different frequencies.

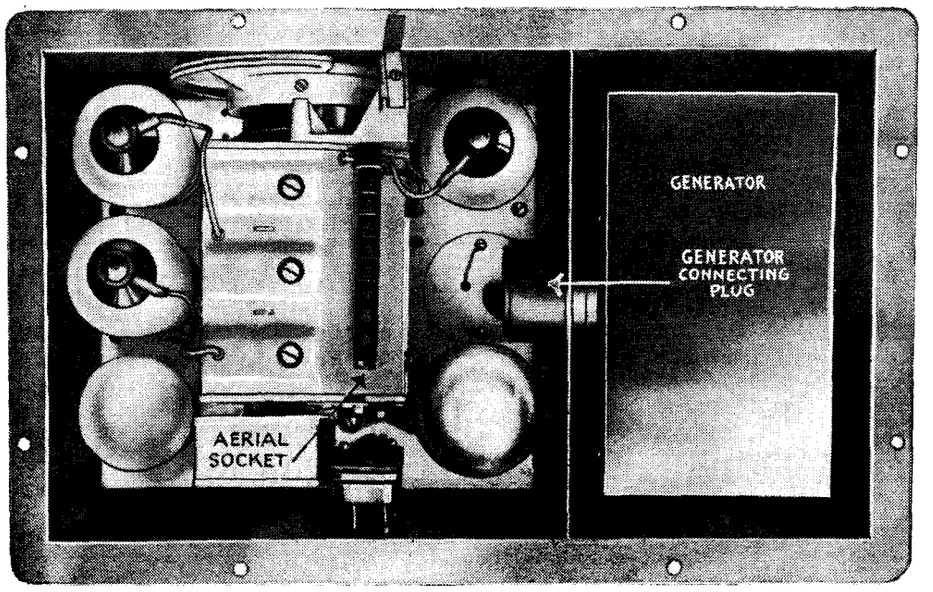
[To be concluded.]

LISSEN CAR RADIO RECEIVER

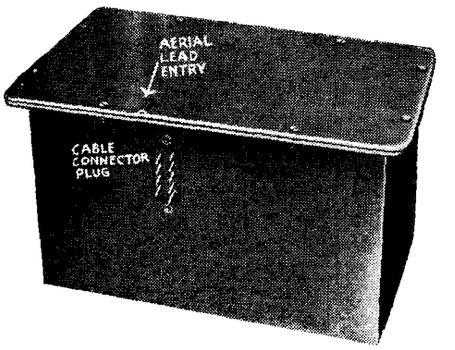
SINCE last we reviewed the Lissen car radio receiver in our issue of December 15th, 1933, further progress has been made in the development of the apparatus, and a new model operated by a D.C. generator driven by the car battery is now available. The generator and the set are both housed in the same metal container, which has been lengthened and a partition fitted for this purpose. It is watertight and intended to be sunk below the level of the floorboards in the car.

A five-valve circuit is employed with three H.F. stages, as in the battery model previously described, and the only notable change that has been made is in the output stage, which in this model employs a super-power pentode giving about two watts undistorted power output.

Although the reproduction of the battery model was undoubtedly good, it has been possible to improve on this, for a higher anode potential is available for the output valve and the pentode will handle the particularly loud passages in the transmission without a trace of distortion.



Receiver and generator unit of the Lissen car radio equipment with the cover removed.



The metal container housing the receiver and generator unit.

Sensitivity and selectivity are sensibly the same, and quite adequate for the needs of car radio; the set, of course, includes A.V.C., which, being effective on three stages, maintains constant volume under all conditions on the road.

The controls remain as before, with tuning, volume control and waveband switching embodied in a small unit attached to the steering column within easy reach of the driver's right hand. Tuning can be done by ear, but should it be necessary to glance at the dial, the scale is clearly indicated by concealed lighting, yet no dazzle effect is produced. Medium- and long-wave ranges are indicated by a change in the colour of the dial light, a diffused red illumination showing the former, while green is employed for the latter.

The price of the complete generator equipment, including all accessories and a set of suppression units for the ignition of any make of car, is twenty guineas. The total current taken from a 12-volt battery is only just over three amperes, including that required for energising the field of the moving-coil loud speaker.

It has been found possible to reduce the price of the battery model, which now costs sixteen guineas complete. The makers are Lissen, Ltd., Lissenium Works, Worple Road, Isleworth, Middlesex.

Television: To-day and To-morrow. By Sydney A. Moseley and H. J. Barton Chapple. Pp. 208+xv. 405 diagrams and illustrations. Published by Sir Isaac Pitman and Sons, Ltd., London. Price 7s. 6d.

This book is a comprehensive history of the Baird system of television. It includes a non-technical outline of the working principles of television apparatus, which, compared with many popular explanations, is commendably free from errors. The history is detailed, and describes every step of the Baird Company's successive technical exploits. The tired business man will be able to get a good bird's-eye view.

One feels, however, that a less partisan attitude would have served better the authors' purpose of lauding the oldest, and British, system of television. It is not productive of the best of impressions when one of the authors, in his introduction, remarks, for instance, that certain other authors of books on television exhibited an incomplete knowledge of their subject. J. H. O. H.

Practical HINTS and TIPS

AIDS TO BETTER RECEPTION

THE introduction of Single-Span tuning has again focused attention on the vexed question of tuning scales, and brings home to us the fact that length of scale is a highly desirable quality. In sets built to the new principle, the whole range of broadcast wavelengths is covered by a single sweep of the tuning control, and it might be thought that the scale would be crowded; actually, however, there is no very great risk of serious congestion. The medium-band stations are spread over the first 130 degrees of the scale, thus giving more than a degree per channel.

Tuning Scale Length

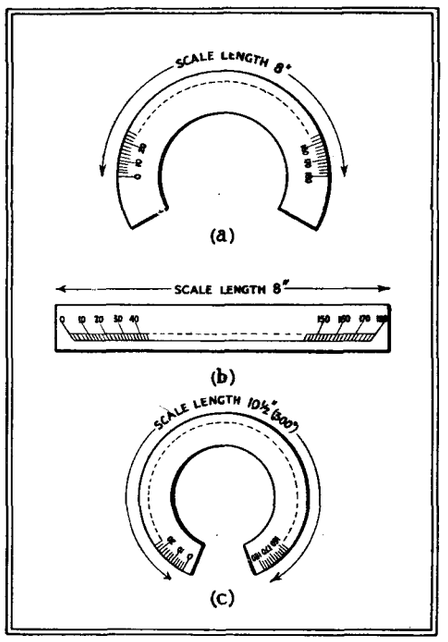


Fig. 1.—Length of scale is as important in a tuning dial as in an electrical measuring instrument.

It might, however, be difficult to "log" tuning positions with accuracy if a very short scale were used, and anything much less than that specified can hardly be considered suitable. It will be remembered that the scale used in the receiver described was of the semicircular type, 5in. in diameter; this means that the length of the scale—which from our present point of view is what really matters—amounts to nearly 8in., as is shown in Fig. 1 (a).

A straight horizontal scale, though appearing to be larger, may often have less effective length than a semicircular scale which occupies the same amount of space behind the panel. To obtain the equivalent length of the ordinary semicircular arrangement shown in diagram (a), we would need a horizontal scale 8in. in length (diagram (b)).

As a matter of interest, it is worth while considering the possibilities of a circular—or nearly circular—tuning scale of the type indicated in diagram (c). Such devices do not appear to be available commercially, but would offer the advantage of a very long scale (for example, about 10½in. length for a diameter of about 4in.) combined with compact dimensions. The difficulty, of course, is to arrange for a good non-slipping link mechanism between the condenser spindle, which rotates through 180 degrees only, and the pointer. An arrangement offering this advantage would have distinct attractions if the Single-Span principle were extended to cover a still wider band of wavelengths.

UNWANTED transference of H.F. energy from circuit to circuit takes place in many mysterious ways, and recently one or two cases have been encountered where instability is caused by stray couplings through the heater circuits of indirectly heated valves.

Stray Couplings

A cure for this trouble seems to be most easily effected by wiring a pair of 0.1-mfd. condensers in series across the heaters of one or more of the valves, and joining the junction point between these condensers to earth.

A SELF-CONTAINED frame-aerial receiver seldom works well when placed upon an old-fashioned sideboard with a mirror at the back. The reason is that the "silvering" of the mirror imposes heavy damping on the frame aerial. This damping is, of course, most pronounced when the frame is close to, and in the same plane, as the surface of the offending mirror.

The Wrong Place for a Portable

THE following experience of a battery set user may prove of value to other listeners who observe the symptoms described in their own sets.

This listener was rather puzzled because his receiver would not function unless the low-tension battery connections were reversed; i.e., positive L.T. to H.T. negative and earth.

An L.T. Battery Phenomenon

The explanation was that the high-tension battery had run down in an inordinately short period, but grid bias volts had remained unchanged. The result was that all the valves in the receiver were over-biased in relation to the anode voltage applied. When a positive L.T. connection was made, the normal negative bias was slightly neutralised, enabling the receiver to function once again. Of course, a reduction in the grid battery voltage when ordinary "negative to negative" connections were restored improved reproduction still further.

A BUILDER of the original Single-Span receiver offers the following suggestions. These are made as a result of his own experiences in constructing the new receiver, and should prove of interest to other readers.

Practical "Single-Span" Hints

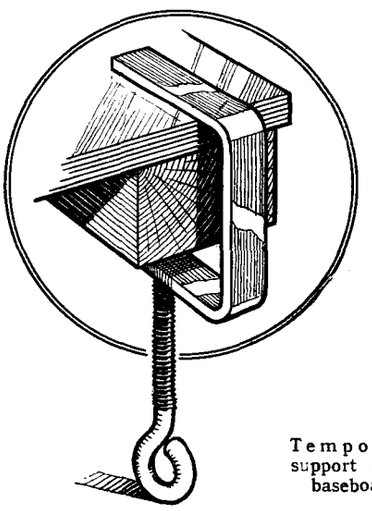
1. There is sometimes a risk that the terminal tags of the coils will touch the tops of the screening cans; this can be avoided by inserting discs of paper or of some other insulating material in the top of each can.

2. The short leads from the coils to the caps of the I.F. valve can easily be threaded through the top of the can by inserting the ends into a length of sleeving, which will act as a guide.

3. Those who take a pride in the appearance of their sets will find it worth while to apply a coat of transparent lacquer to the coil screens before they become finger-marked.

4. The tuning condenser spindle will just take certain types of dial other than that for which it is intended, but the makers might with advantage fit rather longer spindles.

5. To support the baseboard for wiring, two sets of four "G" cramps can be fixed as shown in the accompanying sketch.



Temporary support for a baseboard.

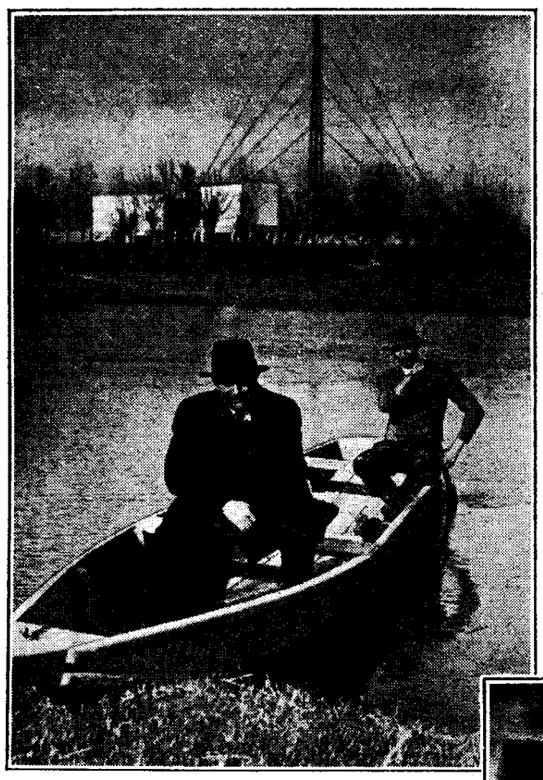
The ordinary 3in. pattern will do for fitting under the board, and the larger type made by Hobbies are suitable for the upper surface. The length of the projecting screw can be increased by inserting wooden blocks as shown.

Why the Balkans are Deaf

Thirteen Million Population : Sixty Thousand Listeners

By A. A. GULLILAND

TAKING Yugoslavia as a typical Balkan country, our contributor has visited the towns and villages to discover why the ordinary people are out of touch with the beneficent and pacificatory influences of broadcasting. His investigations, concluding with an interview with the Postmaster-General, reveal that in most cases crystal-set owners can hear only foreign stations!



BROADCASTING has become part of our lives. Statesmen talk quite seriously of it as a means to stop war. In Russia it is used to educate and raise to a higher standard a vast population which would otherwise be unattainable on such a wide basis. In Germany broadcasting forms the direct link between Government and people. But there are countries in Europe where, for some reason, broadcasting makes little or no headway. I am not thinking of those lands situated in the sunny south where the major part of the population prefer outdoors to indoors, and where broadcasting will hardly ever attain the same weight or importance as in countries less blessed by sun and climate.

I refer to that corner in south-eastern Europe, the Balkans, from where, twenty years ago, the torch of the World War was set alight. Broadcasting can only be of real use, internationally and nationally, if the larger part of the population have made a habit of listening. Without that, the most beautiful concerts, the wisest talks, and the most important political speeches find no echo.

Are Yugoslavia, Bulgaria, Greece, and Albania lost to broadcasting? Will these countries remain outside an influence which, even in vast Russia, has proved invaluable? To seek an answer, I went to Yugoslavia, this being the largest and most important country in the Balkans.

The first broadcasting station in Yugoslavia and, in fact, in the Balkans, was opened by a small band of amateurs at Zagreb on May 15th, 1926. Two years later a station was provided for Slovenia, at Ljubljana, and on March 24th, 1929, a 2.8 kW. transmitter was opened in the capital, Beograd. These stations cater for the population of the three most important towns, for the service range of a 0.7 kW, a 7 kW., and a 2.8 kW station (Zagreb, Ljubljana, Beograd) is very limited indeed. And my observations in other parts of the country prove this statement to be true; Budapest, and *not* the Yugoslavian, stations are relied on for daylight programmes in the greater part of the country, Bucarest in some parts, Graz in the north, and Bari on the Dalmatian coast.

In making out the concessions to the three broadcasting stations in terms of reception by two- and three-valve sets, the Yugoslavian Government obviously decided not to follow the example set by Poland and Hungary and provide the country with a crystal-set reception service. It would

Radio-Zagreb, on an island in the River Save, must be approached by the station boat seen in our uppermost picture. Ivica Arhanic and Prof. Srepel, announcers at Zagreb, are pictured above while broadcasting the midday advertisements. On the left is a favourite microphone "turn," a "guslar" player of Dalmatia. On the right Serbian peasants are dancing the national "Kolo."

seem that the intention was to limit broadcast listening to those persons who could afford a valve set. (A valve set costs 9,000 dinars, or as much as five horses!) This circle of people is naturally limited in a country which largely depends on agriculture for a livelihood, and where the peasant population has in the past been too busy with wars of liberation to have much time for developing its culture and education.

No Scope for Pirates

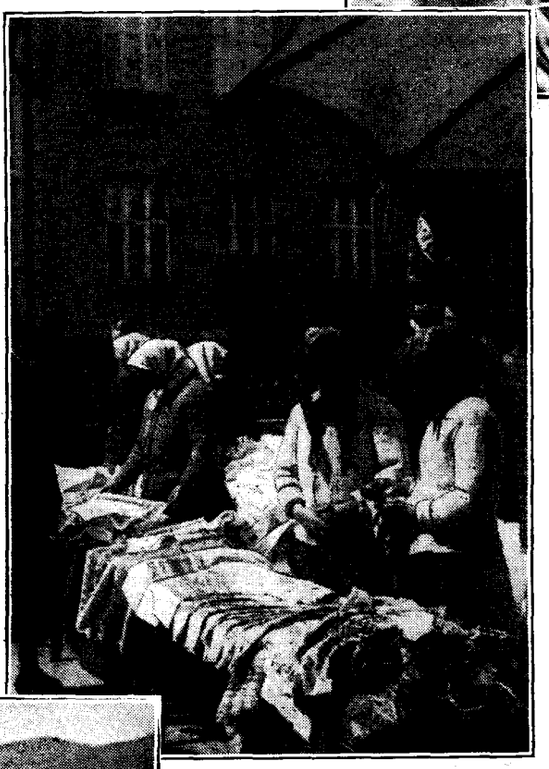
At Skoplje, until 1912 under Turkish rule and called Uesküp, I obtained valuable official statistics showing the exact occupations of listeners. In the postal district of Skoplje, which covers the entire Banovina of Morava and Vardar, i.e., the whole of Serbia proper without Beograd, there were exactly (April 1st, 1934) 2,506 listeners. It is unlikely that there are any pirates in these districts, as every sale of a receiver must be notified to the Post Office, and a licence is issued automatically. Of these 2,506 listeners there are none with crystal sets, only two use a one-valve, and only eighty-three a two-valve set. The majority, 991, use three-valvers, 897 listeners four-valvers, 315 five-valvers, and there are even six with nine-valve sets. Not one single peasant is a listener, and only forty-three schools and eighty-four teachers in that vast region have receivers. The majority of the 2,506 listeners are officers, State and private officials, priests, and business men.

The Government is aware of these facts, and intends providing a remedy by the increase of the power of the present stations and by erecting further relay stations. But lack of capital makes it necessary to depend on private initiative, which, in its turn, threatens the monopoly which the Government has so long enjoyed. This state of affairs has brought about an *impasse* which has lasted since July, 1933.

When in Beograd I had an interview with the Yugoslavian Postmaster-General, Dr. Ratajac. He pointed out that the Government fully realised that things could not be left as they were, especially in view of the fact that certain foreign stations, obviously taking advantage of their high power, were arranging special appropriate programmes and even news bulletins in Serbian for the benefit of Yugoslav listeners. The Government had now completed an extensive study of broadcasting organisation in other countries, and in all probability would very shortly take the bull by the horns by reorganising Yugoslavian broadcasting on a national basis.

Knowing the Balkans as I do, some time may yet go by before any change is made. But at least my interview with the P.M.G. defines the Government point of view.

At the present moment the three Yugoslavian stations are catering for about 60,000 to 65,000 licensed listeners, with probably a few thousand pirates to be found in the towns. The total population of this large country is over 13 millions. The majority are peasants who, for very many years to come, will not be able to afford more than a crystal set. On the other hand, there is a dire necessity for more effective educational, cultural and hygienic propaganda, especially in those regions until recently under Turkish rule. Broadcasting could do this, but Yugoslavian broadcasting, as it is to-day, cannot. Let us hope that Yugoslavia will soon give its population an adequate service.



Above is a typical radio shop in Bosnia, Yugoslavia. Window space appears to be at a premium. (Left) Peasants selling embroidery in Zagreb.

THE RADIO INDUSTRY

THE first service station dealing exclusively with the installation and maintenance of car radio receivers was opened last week by the Philco concern on the Great West Road.

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The B.T.H. Company have just installed a 10-watt gramophone amplifying equipment at the Birmingham factory of Messrs. J. B. Brooks and Co., Ltd. The purpose of this installation is to provide music for the factory operatives while at work, and it is hoped that this will help to counteract the tiring effects of mass-production repetition work accompanied by machine noises. The experiment will be watched with interest.

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The price of the Kolster-Brandes receiver, Type K.B.444, reviewed in our issue of May 25th, is 12 guineas, and not 11 guineas, as stated.

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An interesting technical pamphlet received from Marconi's Wireless Telegraph Co., Ltd., of Electra House, Victoria Embankment, London, W.C.2, describes a series of portable precision frequency meters, in which extraordinary precautions are taken to reduce the possibility of error, and to provide for accurate reading of the scales.

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CATALOGUES RECEIVED

S. Smith and Sons (M.A.), Ltd., Cricklewood Works, London, N.W.2.—Radio accumulators.

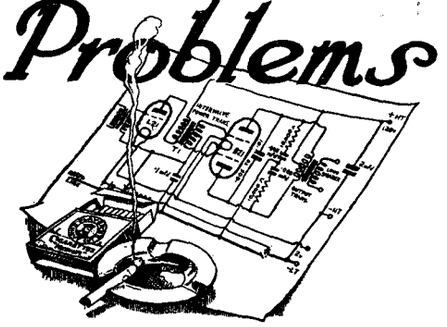
Tele-Radio Supplies, 305, King's Road, Chelsea, London, S.W.3.—List of components.

British Rola Company, Ltd., Minerva Road, Park Royal, London, N.W.10.—List of loud speakers; also leaflets describing suitable extension loud speakers for all well-known sets.

Harwell, Ltd., The Sessions House, Clerkenwell Green, London, E.C.1.—T.M.C.-Hydra condensers.

Readers' Problems

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers. Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page



Loud Speaker Position

A QUERIST, who is attempting to remove the last vestige of hum from his A.C. mains set, tells us that the background is greatly improved by removing the loud speaker from the cabinet, and asks for our comments.

This reduction of hum is probably obtained only at the expense of bass reproduction. By removing the speaker from the cabinet, its baffle area is reduced to practically zero, and so it is understandable that low-frequency notes corresponding to mains hum should be reproduced at much less strength.

Almost Everything Wrong

THERE is sometimes a veritable string of components in the anode circuit of a detector valve, and it would seem that many amateurs find it fatally easy to wire some of them in their wrong relative positions.

For instance, the circuit shown in Fig. 1 (a), which represents part of a diagram submitted for criticism, contains two errors. In the first place, the blocking condenser C through which impulses are applied to the succeeding L.F. amplifier should not be connected on the "live" side of the H.F. choke, which will thus be rendered ineffective in restricting the amount of H.F. energy applied to the L.F. amplifier.

Next, the anode by-pass condenser, which is intended to improve the efficiency of the detector circuit by reducing anti-reaction feed-back, cannot do this job properly if connected to the anode of the valve through a path of high impedance. It should be joined directly to the anode.

The correct connections of the detector anode circuit are shown in Fig. 1 (b).

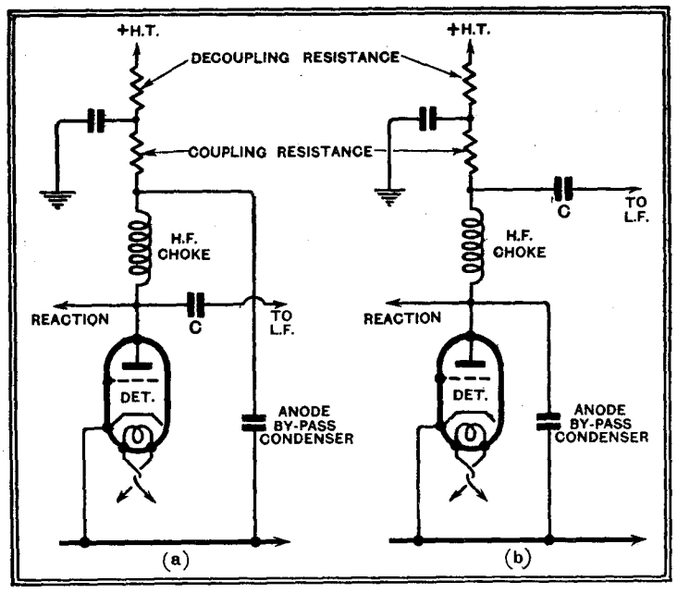


Fig. 1.—What is wrong? Diagram (a), representing the anode circuit of a detector valve linked to the succeeding amplifier by resistance coupling, contains two errors, which have been corrected in diagram (b).

No Allowance for Smoothing

WE recently published a query relating to the use of a set primarily designed for A.C. mains with an H.T. accumulator battery. Now another correspondent, writing on the same subject, asks whether it will be advisable to obtain an H.T. battery giving the same voltage as the rectifying equipment of the original set.

Actually, the accumulator voltage may be appreciably lower, for the reason that no smoothing will be required, and consequently there will be no loss of voltage in the choke. The high-tension battery should therefore have the same voltage as the smoothed output of the original set.

Carrier-borne Interference

AS most readers are aware, "modulation hum" is a peculiar form of interference which manifests itself only when the receiver is tuned to an incoming carrier wave. Disconnect the aerial, or tune the set to a "channel" in which no transmission is taking place, and the persistent background noise will disappear.

A well-known and successful method of attacking the trouble (so far as A.C. sets are concerned) is the fitting of a screened primary power transformer, in which a metal shield is interposed between the primary and the various secondary windings. A querist, who has gone to the length of making this alteration to his own receiver, is disappointed to find that the modulation hum still persists, and asks us to suggest his next step.

It is possible that the smoothing for the H.F. stages of the receiver is inadequate, but we think it more likely that the transformer screening has been virtually "short-circuited" by an incorrect arrangement of the mains connection to the receiver. If this connection is allowed to pass in close proximity to the tuned circuits or their wiring, the screen cannot be expected to have any good effects, as the interference will be induced direct into the receiver circuit.

Balanced Aerial Circuit

WE are asked to say if it is possible to devise a simple method of controlling the input from aerial to receiver from virtually zero up to maximum; it is stipulated that the method employed shall have the smallest possible effect on the tuning of the closed circuit.

We doubt if the conditions imposed can be satisfied better (at any rate, more simply),

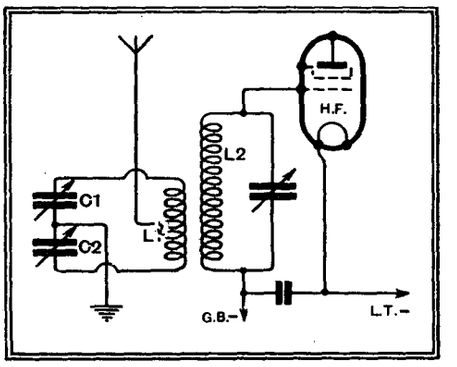


Fig. 2.—A special form of "bridge" coupling circuit.

than by the balanced input circuit shown diagrammatically in Fig. 2. This arrangement, which is fairly well known, has often been used for various purposes, and will probably meet our querist's needs.

The functioning of this system of coupling is not difficult to understand. A centre-tapped aerial coil, L1, in inductive relationship with the tuned secondary coil L2, is shunted by a pair of "balancing" condensers, C1, C2. A balance can be struck by setting the values of these condensers at the same capacity, so that currents flowing in the aerial-earth circuit divide themselves equally between the two sections of the tapped coil L1. The "sense" of these windings is such that the magnetic fields due to these currents will cancel out, and there will be no transference of energy to L2.

To increase the amount of energy transferred to the secondary, the input circuit is progressively unbalanced by altering the setting of either C1 or C2; a very small change in capacity will produce a big increase in transferred energy, and so tuning is not sensibly upset.

The difficulty in devising a practical scheme of this sort is that all coupling other than magnetic must be avoided if a good "zero" is to be obtained.

The Wireless World

INFORMATION BUREAU

THE service is intended primarily for readers meeting with difficulties in connection with receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

Communications should be by letter to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service.

Personal interviews are not given by the technical staff, nor can technical enquiries be dealt with by telephone.

BROADCAST BREVITIES

By Our Special Correspondent

Droitwich and Why

TAKE away one Diesel generating set and . . . where are you? If Mr. Noel Ashbridge had one more Diesel generating set he could open Droitwich to-morrow, but he lacks that Diesel generating set. Consequently, the Droitwich inaugural ceremony cannot take its place among those other big social events of "the Season," like Goodwood or Cowes. However, the first test signals may be expected within a month.

The I.B.U. in London

WHO would be a delegate to the Conference of the International Broadcasting Union? Perhaps I should say: Who would not? Apart from some incidental discussion on wavelengths and propaganda, the coming week seems to offer a round of pleasure for the lucky delegates.

A Midsummer Night's Dream

To-day they visit the P.O. International Trunk Exchange, and are to be fêted in the evening by the Postmaster-General at Lancaster House. To-morrow they witness a rehearsal of "A Midsummer Night's Dream" at Broadcasting House, and then proceed to the Aldershot Tattoo.

A B.B.C. Banquet

Monday will see the party at Droitwich and Washford Cross, while on Tuesday evening they will be taking the boat from Westminster to Greenwich, dropping in at the Tower of London to witness the Ceremony of the Keys. On Wednesday they will be photographed in the morning, and will finish up in the evening with a banquet given by the B.B.C. at Grosvenor House.

Not a Picnic

Actually the Conference is not such a picnic as appears at first sight, for the agenda stipulates sixty hours of solid discussion. The pleasure jaunts will, in reality, be a merciful relaxation after the tension which invariably develops at an international conference. Every delegate is conscious of a burden of responsibility as representative of, perhaps, millions of his fellow-countrymen.

Are Landladies Fair Game ?

IS the Post Office launching an attack on the seaside landlady? At all events, it is significant that the direction finding vans are spending July in a tour of the south coast towns, including Brighton, Worthing, Bexhill, Eastbourne and Hastings, where it is known that many professional hostesses add wireless to the amenities of their establishments.

A Nice Summer Job

By the way, I can think of few pleasanter summer-time jobs than that of a Post Office D.F. man on the south coast. The work is not particularly arduous. In fact, it is almost literally that of "keeping up appearances" first in one place and then in another, with a little waggling of the frame aerial to keep one's hand in and impress the natives.

A Neglected Art

ALTHOUGH the B.B.C. is busy making more programme records for sale to stations in the Dominions and Colonies, it is neglecting one form of recording which has proved effective and popular on the Continent. I refer to mobile recording in O.B. work, which the Germans have exploited so successfully that Russia is now copying them.

A Lesson from Russia

Tuning in to Moscow the other night at 11.30 I heard a vivid and realistic running commentary of a march past by the Red Army. The item was obviously recorded because, quite apart from the unlikelihood of a Red or any other colour army parading the streets at that time of night, there were helpful interpolations by the announcer in the studio, cuts in the broadcast and some skilful selection in the microphone "shots" which made the item more effective.

Scope for an "O.B." Recording Van

Why does the B.B.C. neglect the possibilities of a mobile recording van? Those O.B.s which are "canned" by Blattnerphone involve lengthy preparation and cumbrous land line arrangements, the recording plant being at headquarters. With a car installation Mr. Gerald Cock and his lieutenants could range the country for "sound snapshots," many of them done on the spur of the moment.

Sound Flashes Daily

I should like, tuning in one evening after the Second General News, to hear a Flying Squad chase up Regent Street, an author's speech at a "First Night," the arrival of the Flying Scotsman at King's Cross, a clash between speakers and audience in Hyde Park, and other sound flashes, each very short, but all serving to give a vivid impression of the day's activities.

Only a mobile recording plant could manage this cheaply and effectively. Why does the B.B.C. ignore this method?

The Pageant of Parliament

THE closing scene from the Pageant of Parliament, which is to be relayed to National programme listeners on July 2nd from the Albert Hall, will include the procession of "The People of To-day," to the accompaniment of The Knightsbridge March, by Eric Coates, played by Callender's Band. A resumé of the Pageant will be given by a B.B.C. announcer. Next follows "Assembly of Peers and Peeresses," with orchestral accompaniment. "Non Nobis Domine," a new poem by Rudyard Kipling, to music by Roger Quilter, will be sung by members of the Royal Choral Society.

AMERICAN RADIO DRAMA. This photograph, taken at a New York broadcasting station, reveals the difference between the technique of British and U.S. radio drama. Multi-studio presentation is practically unknown in America, where all the participants—actors, orchestra and "effects" staff—are concentrated before a few microphones monitored at a control panel.

Motor Cyclists' Day

TO-DAY (June 15th)—a Crimson Letter day in the calendar of the motor cyclist—sees the broadcasting of the Senior T.T. race in the Isle of Man at 12.30. This is the most important of the three Manx Tourist Trophy races, being open to engines of 500 c.c. The race to-day will be described by Major Vernon Brook from the Grand Stand, by James L. Finigan from Craig-na-Baa, and by Victor Smythe at the Ramsey hairpin bend.

A Dead Microphone

LAST week's mishap, which resulted in Lord Derby talking for some minutes by himself to a dead microphone, had a precedent some years ago at Savoy Hill. A noted singer gave a recital lasting half an hour before a microphone which had been switched off before he began. By a mistake in the control room the red light remained on.

Fortunately, the singer, who shall be nameless, is still in ignorance of what happened.

News of the Week

Current Events in Brief Review

Music with the Milk

BRESLAU now claims to be the earliest riser among European broadcasting stations. Regular gramophone recitals are now given at 5 a.m. for the benefit of farm workers who usually breakfast at that time.

Higher Power from Germany

THE high-power Langenberg transmitter is expected to resume service at the end of the month with 100 kW. in the aerial. The present transmissions are conducted with the old 17 kW. apparatus.

Breslau and Heilsberg will shortly increase their power to 100 kW., operating with anti-fading aerials.

Munich, now operating on 100 kW., will employ its new anti-fading aerial for the first time in the course of a week or two.

Solo in Unison

OUR French contemporary, *L'Antenne*, reports having seen a portrait presented by a famous radio artiste to a friend. The dedication ran: "From Mlle. X., whom you will hear singing in unison from the State stations on Tuesday, May 29th."

International Broadcasting Union

IN addition to wavelength problems and questions of radio propaganda, we understand that the International Broadcasting Union is devoting time during the present General Assembly in London to the subject of the Luxembourg station.

Despite recent attempts to boycott the station, German firms have recently bought "time on the air" at Luxembourg to a considerable extent, and this will probably lead to a raising of the ban on the printing of Luxembourg's programmes in German journals. With German, as well as French and Belgian support, Luxembourg becomes a greater power to reckon with during the coming winter, particularly as the Union may be called upon to discuss a doubling of Luxembourg's power to 500 kilowatts.

The London meeting of the Union opened on Tuesday last, June 12th, and will continue until next Wednesday, June 20th.

The Globe Circler

IT is regretted that in our recent reference to an editorial appearing in the May number of the *Globe Circler*, the organ of the International DX'ers Alliance, it was stated that criticism was directed towards amateur transmitters. As the extract showed, the writer's remarks concerned "DXers"— in other words, long-distance listeners. No reflection was intended on the transmitter fraternity.

Non-stop Broadcasting

WHAT is claimed to be a record in continuous broadcasting has been set up by the new Portuguese station at Bacarena, Lisbon, which, incidentally, is of British construction. During tests a continuous broadcast was made for 103 hours. Over 1,000 gramophone records were played, and various O.B.'s—concerts, banquets, and conferences—were relayed.

Retort to Criticism

PRESS protests in Brussels against the construction of an expensive "Radio House" have been met with the retort that it is no economy for the National broadcasting services to be run with the present inadequate accommodation for studio and staff. At present the control rooms and certain of the studios are housed in the National Radio Institute and are separated by offices. The main studio is in an old dancing hall in a neighbouring building.

The projected Radio House promises to be one of the most up-to-date of its kind in Europe.

INTERNATIONAL BROADCASTING UNION IN LONDON. Grosvenor House, Park Lane, where the delegates are now holding their Annual General Assembly.

Transmitters in the Field

OVER forty portable amateur transmitting stations participated in the R.S.G.B.'s second National Field Day last week-end. Some worked on 20 and 40 metres only, and others exclusively on 80 and 170 metres, additional points being obtained when another portable station was worked in preference to a fixed one.

Amateurs all over the world showed interest in the event, and in Switzerland particularly several portable stations operated, thus making available valuable extra points to British stations which contacted them.

Prison for Pirates

CONVICTED wireless pirates in Germany numbered 176 during the first quarter of 1934. In five cases the culprits were sent to prison for periods ranging up to three weeks.

German Broadcasting Trial

SEVERAL former German broadcasting officials are defendants in a suit to be heard before the Berlin Courts in about a week's time. It is alleged that irregularities occurred in connection with the sale of the old Broadcasting House and the construction of the present building in Berlin.

Sixteen persons have been charged, among them being Dr. Mueller, a former departmental chief of the German broadcasting organisation, and Herr Wilhelm Wagner, who still holds a position at the Reichssender, Berlin.

It will be recalled that Dr. Bredow, the Post Office Radio Commissioner, and Dr. Magnus, former managing director of the broadcasting system, have been in custody since last autumn awaiting trial on a corruption charge.

Electric Prompter at Runnymede

MANY of the spectators at the opening performance of the Runnymede Pageant, on Saturday, must have wondered how it was possible to convey cues and stage directions to the 5,000 performers taking part. Actually this was effected by means of a special arrangement of screened microphones and a dozen concealed Philips loud speakers. Some of the loud speakers were sunk in the turf 35 feet in front of the audience with their backs to the spectators' stands; in this way the voice of the "electric prompter" reached the players, but was inaudible to the audience. Amplification was also used for the Prologue and Epilogue, the only speaking parts in the pageant; a microphone was secreted in the "plumage" of the two-seater "swan" which formed the symbolical car of the "Spirit of England," played alternately by Dame Sybil Thorndike and Lady Forbes-Robertson.

Institute of Wireless Technology

DOUBLED office accommodation and the extension of library facilities reflect the progress of the Institute of Wireless Technology in the past few months. Additional space is now available for country and overseas members visiting London and wishing to make use of the Institute's facilities.

We learn that the Institute examinations for Associate Membership and Associateship, which are held bi-annually in June and November, are attracting attention from many parts of the world. Entries for the June examinations this year are double those of 1933. The headquarters of the Institute are at 4, Vernon Place, Southampton Row, London, W.C.1.

Human Generator

THE tale of the week comes from Athens, where, it is reported, a student has been found with the ability to light electric lamps and wireless valves simply by rubbing them between the palms of his hands.

He should prove an ideal companion in the country with an all-mains portable.

More Swiss Listeners

SWISS radio listeners totalled 289,135 at the end of April last, making an increase of 12,000 during the year.

Page 415 follows after the Programme Supplement

PRINCIPAL BROADCASTING STATIONS OF EUROPE

Arranged in Order of Wavelength

(Stations with an aerial power of 50 kW. and above in heavy type)

Station.	kc/s.	Tuning Positions.	Metres.	kW.
Kaunas (Lithuania)	155	.....	1935	7
Brasov (Roumania)	160	.....	1875	20
Huizen (Holland). (*Kootwijk, 50 kW. after 3.40 p.m.*) (*V.A.R.A. and A.V.R.O. Programmes.*)	160	.....	1875	7
Lahti (Finland)	166	.....	1807	40
Moscow, No. 1 (U.S.S.R.)	174	.....	1724	500
Radio Paris (France)	182	.....	1648	75
Istanbul (Turkey)	185	.....	1621	5
Königswusterhausen (Deutschlandsender) (Germany).	191	.....	1571	60
Daventry National	200	.....	1500	30
Ankara (Turkey)	200	.....	1500	7
Minsk (U.S.S.R.)	208	.....	1442	100
Reykjavik (Iceland)	208	.....	1442	16
Eiffel Tower (Paris)	215	.....	1395	13
Motala (Sweden). (*Relays Stockholm*)	216	.....	1389	30
Warsaw, No. 1 (Poland)	223	.....	1345	120
Luxembourg	230	.....	1304	150
Kalundborg (Denmark). (*Relays Copenhagen*)	238	.....	1261	75
Leningrad (U.S.S.R.)	245	.....	1224	100
Oslo (Norway)	254	.....	1181	60
Madona (Latvia)	265.6	.....	1129	20
Moscow, No. 2 (U.S.S.R.)	271	.....	1107	100
Rostov-on-Don (U.S.S.R.)	355	.....	845	20
Smolensk (U.S.S.R.)	364	.....	824	10
Geneva (Switzerland). (*Relays Sottens*)	401	.....	748	1.3
Moscow, No. 3 (U.S.S.R.)	401	.....	748	100
Boden (Sweden)	413.5	.....	726	0.6
Ostersund (Sweden)	413.5	.....	726	0.6
Oulu (Finland)	431	.....	696	2
Oufa (U.S.S.R.)	436	.....	688	10
Hamar (Norway)	519	.....	578	0.7
Innsbruck (Austria). (*Relays Vienna*)	519	.....	578	0.5
Ljubljana (Yugoslavia)	527	.....	569.3	5
Viipuri (Finland)	527	.....	569.3	13
Bolzano (Italy)	536	.....	559.7	1
Wilno (Poland)	536	.....	559.7	16
Budapest, No. 1 (Hungary)	546	.....	549.5	120
Beromunster (Switzerland) (Schweizerischer Landessender).	556	.....	539.6	60
Athlone (Irish Free State)	565	.....	531	60
Palermo (Italy)	565	.....	531	4
Mühlacker (Stuttgart) (Germany)	574	.....	522.6	100
Riga (Latvia)	583	.....	514.6	15
Agen (France)	583	.....	514.6	0.6
Vienna (Bisamberg) (Austria)	592	.....	506.8	120
Radio Maroc (Morocco). (*S.-w. Stn., 48 m.*)	601	.....	499.2	6.5
Sundsvall (Sweden). (*Relays Stockholm*)	601	.....	499.2	10
Florence (Italy). (*Relays Turin*)	610	.....	491.8	20
Brussels, No. 1 (Belgium). (*French Programme.*)	620	.....	483.9	15
Lisbon (Portugal)	629	.....	476.9	20
Trondheim (Norway)	629	.....	476.9	1.2
Prague, No. 1 (Czechoslovakia)	638	.....	470.2	120
Lyons, PTT (France)	648	.....	463	15
Cologne (Germany)	658	.....	455.9	60
North Regional (Slaithwaite)	668	.....	449.1	50
Sottens (Switzerland) (Radio Suisse Romande)	677	.....	443.1	25
Belgrade (Yugoslavia)	686	.....	437.3	2.5
Paris, PTT (France)	695	.....	431.7	7
Stockholm (Sweden)	704	.....	426.1	55
Rome, No. 1. (*Short-wave station, 25.4 metres*)	713	.....	420.8	50
Kiev (U.S.S.R.)	722	.....	415.5	100
Tallinn (Estonia)	731	.....	410.4	20
Seville (Spain)	731	.....	410.4	1.5
Munich (Germany)	740	.....	405.4	100
Marseilles, PTT (France)	749	.....	400.5	5
Katowice (Poland)	758	.....	395.8	12
Midland Regional (Daventry)	767	.....	391.1	25
Toulouse, PTT (France)	776	.....	386.6	2
Leipzig (Germany)	785	.....	382.2	120
Barcelona, EAJ1 (Spain)	795	.....	377.4	5
Lwow (Poland). (*Relays Warsaw*)	795	.....	377.4	16
Scottish Regional (Falkirk)	804	.....	373.1	50
Milan (Italy). (*Relays Turin*)	814	.....	368.6	50
Bucharest (Roumania)	823	.....	364.5	12
Radio, LL (Paris)	831.9	.....	360.5	2
Moscow, No. 4 (U.S.S.R.)	832	.....	360.6	100
Berlin Funkstunde. (*Short-wave Stations,*) 16.89, 19.73, 25.5, 31.38 *and* 49.83 *metres.*)	841	.....	356.7	100
Bergen (Norway)	850	.....	352.9	1
Valencia (Spain)	850	.....	352.9	1.5
Strasbourg (France)	859	.....	349.2	15
Poznan (Poland)	868	.....	345.6	16
London Regional (Brookmans Park)	877	.....	342.1	50
Graz (Austria). (*Relays Vienna*)	886	.....	338.6	7
Limoges, PTT (France)	894.9	.....	335.1	0.5
Helsinki (Finland)	895	.....	335.2	10
Hamburg (Germany)	904	.....	331.9	100
Radio Toulouse (France)	913	.....	328.6	10
Brno (Czechoslovakia)	922	.....	325.4	32
Brussels, No. 2. (*Flemish Programme*)	932	.....	321.9	15
Algiers (Algeria)	941	.....	318.8	12
Göteborg (Sweden). (*Relays Stockholm*)	941	.....	318.8	10
Breslau (Germany)	950	.....	315.8	60
Poste Parisien (France)	959	.....	312.8	100
Grenoble (France)	968	.....	309.9	20
West Regional (Washford Cross)	977	.....	307.1	50
Cracow (Poland)	986	.....	304.3	2
Genoa (Italy). (*Relays Turin*)	986	.....	304.3	10
Hilversum (Holland). (*KRO and NCRV*) (*7 kW. till 5.40 p.m.*).	995	.....	301.5	20
Bratislava (Czechoslovakia)	1004	.....	298.8	13.5
North National (Slaithwaite)	1013	.....	296.2	50
Königsberg (Germany)	1031	.....	291	60
Parede (Portugal)	1031	.....	291	5
Rennes, PTT (France)	1040	.....	288.5	2.5
Scottish National (Falkirk)	1050	.....	285.7	50
Bari (Italy)	1059	.....	283.3	20
Bordeaux-Lafayette	1077	.....	278.6	12
Zagreb (Yugoslavia)	1086	.....	276.2	0.7
Falun (Sweden)	1086	.....	276.2	2
Madrid, No. 2 (EAJ7)	1095	.....	274	7
Naples (Italy). (*Relays Rome*)	1104	.....	271.7	1.5
Radio Vitus (Paris)	1113	.....	269.5	2
Kosice (Czechoslovakia). (*Relays Prague*)	1113	.....	269.5	2.6
Hörby (Sweden). (*Relays Stockholm*)	1120.9	.....	237.7	10
Belfast	1122	.....	267.4	1
Nyiregyhaza (Hungary)	1122	.....	267.4	6.2
Turin, No. 1 (Italy)	1140	.....	263.2	7
London National (Brookmans Park)	1149	.....	261.1	50
West National (Washford Cross)	1149	.....	261.1	50
Moravska-Ostrava (Czechoslovakia)	1158	.....	259.1	11.2
Monte Ceneri (Switzerland)	1167	.....	257.1	15
Copenhagen (Denmark). (*S.-w. Stn., 31.51 m.*)	1176	.....	255.1	10
Frankfurt (Germany)	1195	.....	251	17
Trier, Cassel, Freiburg-im-Breisgau and Kaiserslautern.	1195	.....	251	—
Prague, No. 2 (Czechoslovakia)	1204	.....	249.2	5
Lille, PTT (France)	1213	.....	247.3	5
Trieste (Italy). (*Relays Turin*)	1222	.....	245.5	10
Gleiwitz (Germany). (*Relays Breslau*)	1231	.....	243.7	5
Cork (Irish Free State)	1240	.....	241.9	1
Juan-les-Pins (France)	1249	.....	240.2	2
Rome, No. 3 (Italy)	1258	.....	238.5	1
San Sebastian (Spain)	1258	.....	238.5	3
Nürnberg and Augsburg (Germany)	1267	.....	236.8	2
Bodö, Stavanger and Kristiansand (Norway)	1276	.....	235.1	0.5
Dresden (Germany)	1285	.....	233.5	1.5
Aberdeen	1285	.....	233.5	1
Linz, Klagenfurt and Salzburg (Austria)	1294	.....	231.8	0.5
Danzig. (*Relays Heilsberg*)	1303	.....	230.2	0.5
Swedish Relay Stations	1312	.....	228.7	0.25
Budapest, No. 2 (Hungary)	1321	.....	227.1	0.8
Hanover, Bremen, Flensburg, Stettin and Magdeburg.	1330	.....	225.6	1.5
Lodz (Poland)	1339	.....	224	1.7
Montpellier, PTT (France)	1339	.....	224	5
Bordeaux Sud-Ouest (France)	1348	.....	222.6	1
Dublin	1348	.....	222.6	1
Milan, No. 2 (Italy)	1348	.....	222.6	4
Turin, No. 2	1357	.....	221.1	0.2
Warsaw, No. 2 (Poland)	1384	.....	216.8	2
Lyons (Radio Lyon) (France)	1393	.....	215.4	5
Tampere (Finland)	1420	.....	211.3	1.2
Newcastle	1429	.....	209.6	1
Béziers (France)	1431	.....	209.9	2
Minsk (U.S.S.R.)	1438	.....	208.6	100
Fécamp (Radio Normandie)	1456	.....	206	10
Pecs (Hungary)	1465	.....	204.7	1.25
Bournemouth	1474	.....	203.5	1
Plymouth	1474	.....	203.5	0.3
Nimes (France)	1492	.....	201.1	0.2

DISTANT RECEPTION NOTES

Programmes from Japan? The Best European Stations

PORTUGAL'S new National station has been at work experimentally for some days now. One can usually pick it up from about 10 p.m. onwards, and the transmissions come in with wonderful strength and excellent quality. Portugal will eventually have three useful broadcasting stations: the long-waver for North Portugal, the Lisbon station, and Parede.

Budapest is not usually well heard just now, except at the week-ends. The reason is that the main 120-kilowatt transmitter is temporarily out of action, repainting of the great aerial masts being in progress. In the meantime the old 18-kilowatt plant is being employed, and this is not sufficiently powerful to provide good reception over here until after dark.

Japan is undertaking a recasting of her broadcasting service. When it is completed the system will include three great stations of 100 to 150 kilowatts and a number of smaller relays in various parts of the country. It is quite possible that we shall hear something of the big stations at certain times of the year.

I wonder how many readers remember an extraordinary evening six or seven years ago when Japanese stations, then using not more than 2 or 3 kilowatts apiece, were clearly and strongly received by many listeners. It was supposed at the time that the reason for this freak was that the times of dawn in the one country and dusk in the other coincided, and that conditions were otherwise particularly good. One wonders which path round the world the waves took.

Dodging the Atmospheric

Atmospherics, which were mentioned in these notes a month ago as having been a nuisance, have continued to be troublesome on two or three evenings each week on the average until the present time. I wonder how many readers possessed of sets with built-in frame aerials and automatic volume control have discovered that this kind of interference can often be dodged successfully?

Owing to the action of the A.V.C., there is little or no variation in the strength of a wanted signal when the frame is turned quite considerably from the optimum position. Atmospherics frequently come from a well-marked region, and if this is not on a prolongation of an imaginary straight line joining transmitter and receiver, it may be found that, by turning the frame to the minimum position for atmospherics, the desired transmission can be brought in with good volume and free from interference.

On the long waves conditions are a good deal better than they were. Huizen is now quite free from the background previously caused by Brasov, and other stations which are not usually interfered with are Radio-Paris, Zeesen, Motala, Luxembourg, Kalundborg, and Oslo. The Scandinavian stations, however, are not reliable at present, since they show great variations in strength from day to day.

There is certainly not the falling-off in signal strength at the top of the medium waveband that we have experienced in previous summers. Budapest's weakness has already been explained, and the only other station seriously affected is Vienna. Beromünster (which has postponed its closing-down for enlargements), Athlone, Stuttgart, Brussels No. 1, Prague, and Lyons PTT are all fine transmissions. Florence, too, is usually good.

Cologne is always worth attention, though liable to variations in strength. Söttens is not so well heard as it was. Paris PTT, Stockholm, Rome, Munich, and Leipzig all provide excellent reception. Marseilles has been very well heard of late.

Other recommended stations are Milan, Berlin, Strasbourg, Radio Toulouse, Hamburg, Brussels No. 2, Breslau, and Bordeaux.

D. EXER.

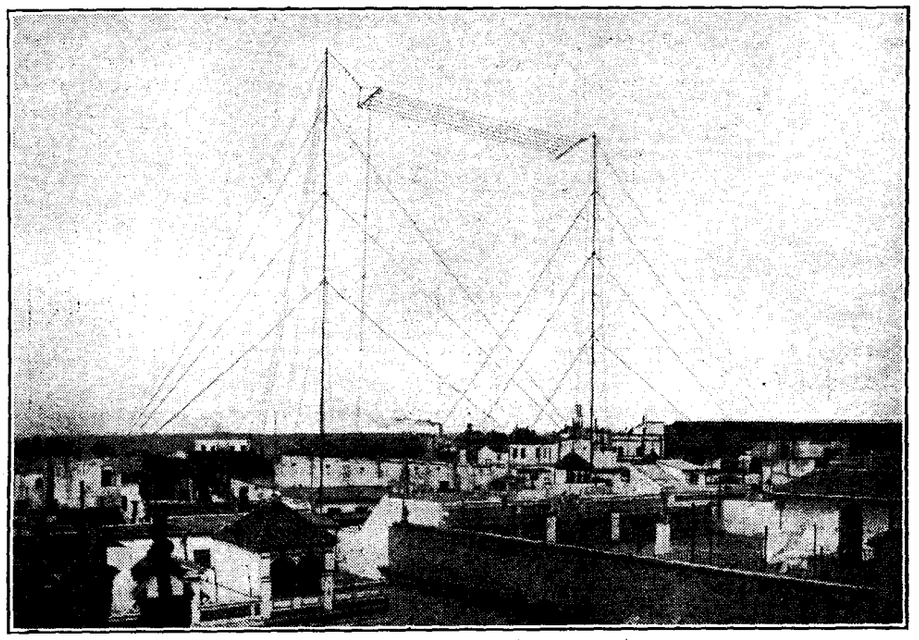
The Diary of an Ordinary Listener

The Temptation of Opera: English Music from the Continent

THE merry month of May departed amid a blaze of atmospherics.

On June 1st conditions were better, and I picked up the latter part of an interesting concert of modern music by the Station Quartet at Milan, which included an Intermezzo for harp, flute, clarinet and strings by Ravel, and three pieces for pianoforte and strings by Pick-Mangiagalli which I hope to hear again. Luxembourg was also transmitting a good concert of which I heard German's "Nell Gwyn" suite and two compositions by the conductor, Pensis, all of which came through well and proved most enjoyable. Later in the evening Rome gave a very good selection of varied records.

I sat down to listen on Saturday evening fully intending to avoid opera, but found the excellent performance of Puccini's "Turandot" from Rome was coming in so well and proving so exciting that I held on to that station for a long time, occasionally going over to Breslau, which was giving a good general orchestral concert which included a selection from Puccini's "La Bohême," Waldteufel's fine waltz "Estudiantina," and later a relay of the European concert by the Madrid Philharmonic Orchestra. On June 3rd I heard the excellent concert of English music given from Prague, in honour of the King's birthday, which included Hamish MacCunn's overture, "Land of the Mountain and Flood," and Stanford's Irish Symphony, while later on, after opera and serious music had ceased, I found I had still enthusiasm enough left to appreciate the military band music from Juan les Pins.



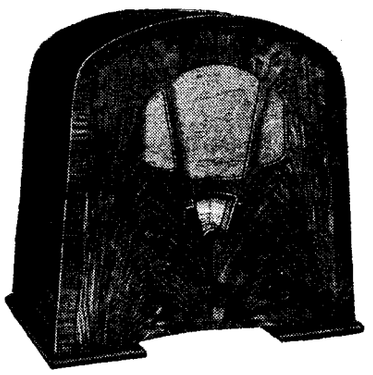
ORANGES AND RADIO. The slender antenna of the Seville broadcasting station perched high over the town's house tops. Local programmes are a special feature of this Union Radio transmitter.

When I Switched Off

I thought the Luxembourg programme very attractive on Monday evening. The station orchestra, which was, as usual, conducted by Pensis, gave us Amadei's "Invano," Liszt's Preludes, and a Suite from Delibes' "La Source." These were followed by a fine recital of Italian operatic songs by Marie-Terèse Grosfils-De Cuyper, of which I heard an aria from "La Bohême," and the ever popular soprano solo from Rossini's "Barber of Seville." I must admit that I switched off when the singer began the Intermezzo from "Cavalleria Rusticana," as I am rather prejudiced against words being set to purely instrumental music.

On Tuesday of last week I listened for a time to the Military Band concert from Rome, and was again struck with the excellent playing of Marchesini's musicians. After that I went over to Monte Ceneri, where the station orchestra were giving a most creditable performance of Mozart's Symphony in E flat, and thence to Huizen, where the K.R.O. Boys entertained us with light music, which included some of the best male voice part-singing I have heard for a long time. The jazz, too, I could listen to with the greatest pleasure.

CALIBAN



Dario Super Six

High Selectivity at a Reasonable Price

FEATURES

***Type.**—Table-model superheterodyne for A.C. Mains. **Circuit.**—H.F. pentode first detector—triode oscillator—screen-grid I.F. amplifier—single-diode-tetrode second detector—power pentode output valve. Full-wave valve rectifier. **Controls.**—(1) Tuning. (2) Volume control and on-off switch. (3) Waverange switch. (4) Tone control switch. **Price.**—£14 14s. **Makers.**—Impex Electrical Ltd., 47, Victoria Street, London, S.W.1.*

ONE of the few disadvantages of the superheterodyne principle of reception is the difficulty which designers often experience in eliminating whistles and other background noises generated within the receiver itself. It has to be admitted that, taking the class as a whole, this criticism is not without some foundation, but the designers of the set under review have clearly demonstrated that the problem can be satisfactorily solved without necessarily increasing the cost of production. A meticulous search over both wavebands failed to reveal a single self-generated second channel or harmonic whistle. It is, perhaps, significant that the functions of first detector and oscillator have been assigned to separate valves, the detector being an H.F. pentode and the oscillator a small power triode.

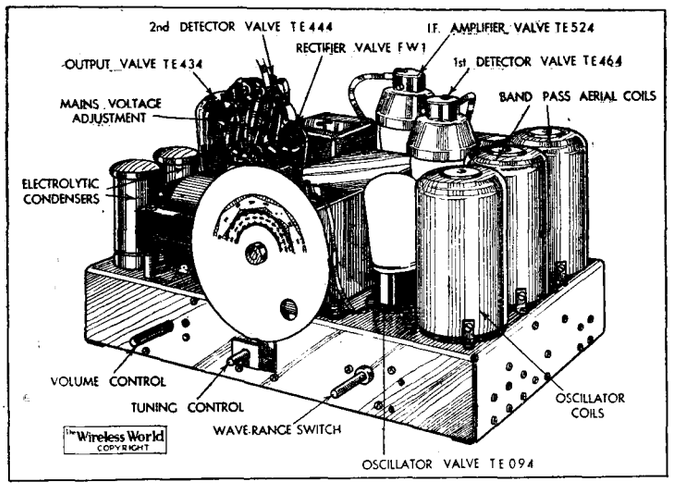
The aerial circuit comprises a band-pass filter in which the capacity coupling is automatically adjusted to the correct value on each waveband. A steep-slope screen-grid valve is employed in the I.F. stage, and, as in the case of the aerial filter, the I.F. transformers are Litz-wound. A frequency of 420 kc/s, which lies between the medium and long wavebands, has been assigned to the I.F. circuit.

The second detector is a single-diode-tetrode, and is arranged to supply A.V.C. bias to the I.F. amplifier. Pick-up terminals are connected to the amplifying portion of the valve, and the volume control operates on both radio and gramophone. The coupling between the detector-amplifier and the power pentode output valve is resistance-capacity, and the anode feed to the former stage is thoroughly smoothed and decoupled by a resistance-capacity network.

The moving-coil loud speaker is of the permanent-magnet type, and terminals are provided for an extension loud speaker. The H.T. supply is smoothed by a separate choke and two electrolytic condensers, and the rectifier is of the full-wave type.

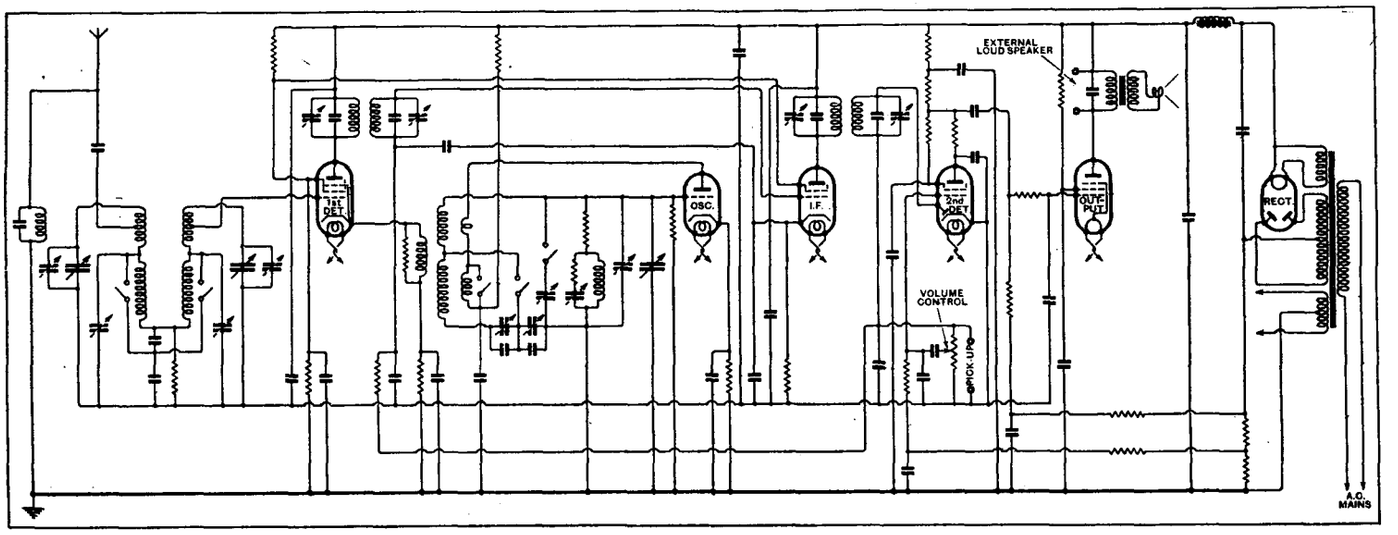
The range of the set is good, and in this respect it can hold its own with any four-stage superheterodyne (neglecting the oscillator) which we have so far tested. The sensitivity is equally good on both wavebands, and reception from the long-wave stations is notable for its clarity.

On the score of selectivity the performance is definitely above the average. In Central London the London National and Regional transmitters are completely lost at 12 kc/s off tune, and on long waves Königswusterhausen is easily tuned in clear of Daventry and Radio-Paris. In view of the fact that only a single I.F. stage is employed, this is a fine performance which can be definitely attributed to the efficiency of the coils used in the tuned circuits.



General view of the chassis. The tuning scale, although small in diameter, is accurately calibrated and easy to read.

The automatic volume control is far more effective than might be anticipated in view of the fact that it is applied only to the I.F. valve. Its extension to the first detector might conceivably overcome the tendency to overloading which was observed on very strong signals. This overloading is, of course, outside the scope of the manual volume control, which is connected after the second detector, and it is necessary to make use of the alternative aerial tapping (not shown in the circuit diagram) when receiving a nearby station. It was found with this tapping that although full volume can be obtained from London Regional, the input from the National transmitter was hardly sufficient to fully load the output valve, and some form of input volume control would seem to be desirable. However, it is only in isolated circumstances that these difficulties might be expected to arise.



The single-diode-tetrode second detector and the separate oscillator valve are interesting features of the circuit.

Dario Super Six—

In view of the high selectivity of the tuned circuits it was gratifying to find that the quality of reproduction did not suffer appreciably from side-band cutting, and with the tone control switch in the normal position an excellent balance of tone was obtained with really good bass going down to at least 70 cycles. In the "mellow" position the top cut-off appears to be in the neighbourhood of 2,500 cycles, but it is only rarely that this position will have to be used, as background noise, which alone justifies the fitting of a tone control, is in general less than one usually associates with a super-heterodyne receiver.

The tuning scale is very accurately calibrated and is easy to read, the long-wave scale being drawn on a smaller radius than the medium wave. This goes far to remove the impression of flat tuning on long waves which is experienced with a wavelength scale equal in length to the medium wave-band. The cabinet design is simple and dignified, and a safety plug for the mains is incorporated in the back panel, which is secured by quick-action fasteners instead of the usual wood screws.

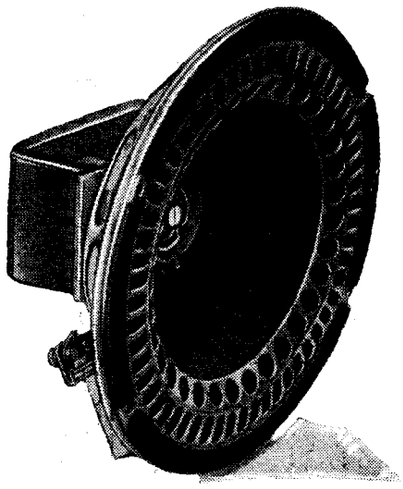
New Apparatus Reviewed

Latest Products of the Manufacturers

GOODMANS "GRILLE" LOUD SPEAKER

THE mechanical design of this unit has received more than usually careful attention. The chassis is a heavy gauge steel pressing in which a lip has been turned over at each of the perforations to give additional strength. Protection is afforded to the diaphragm by a chromium-plated grille which covers the suspension at the edge, where it is most liable to damage from mishandling. Greater freedom of movement is obtained by locating the edge of the diaphragm between resilient felt pads.

The bass response is exceptionally good for a diaphragm having an effective area of only 6½ inches, and the balance of tone would do justice to units of much larger size and price. The fundamental diaphragm resonance is at 70 cycles, and subsidiary peaks were noted at 150, 3,000, and 5,500 cycles. These are not serious enough, however, to obtrude under working conditions. In the upper register the response is good to 8,000 cycles, after which it falls gradually.



Goodmans "Grille" permanent magnet moving-coil loud speaker.

The reproduction generally is clean and crisp, with a broad bass foundation which is not usually found in permanent magnet units of this size.

The makers are Goodmans (Clerkenwell), Ltd., Broad Yard Works, Turnmill Street, London, E.C.1, and the price is 42s.

GARD AUTOMATIC LIGHTNING ARRESTER

GRAHAM-FARISH, LTD., Masons Hill, Bromley, Kent, have developed a new lightning arrester to replace the original Gard model, and although the general principles of the device are similar, in the new model greater precautions are taken to prevent surface leakage during wet weather.

New Gard Lightning Arrester; its compactness can be gauged from the one watt Ohmite resistance.

It is fitted with a dome-shaped cowl designed to throw the rainwater well clear of the lower or earth terminal, while the insulated barrel, into which are screwed the two connecting studs, is protected by a brass cup extending well up into the cowl.

As with the earlier model, this new lightning arrester should be fitted outside the building, with the top terminal joined to the downlead and the set, while the lower one is taken direct to an outside earth.

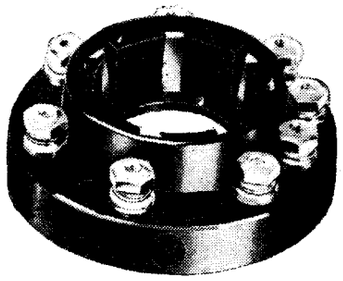
It is small and unobtrusive, measuring only 2¾in. long×1¼in. in diameter overall, and under normal conditions does not affect reception in the least. Yet it provides that measure of protection so necessary when electrical storms are in the vicinity.

Its price is 2s.

NEW W.B. VALVE HOLDER

WHITELEY ELECTRICAL RADIO CO., LTD., Radio Works, Victoria Street, Mansfield, Notts, have introduced a baseboard-type valve holder for the new Mullard AC/DC valve fitted with side contact studs on the base in place of the customary array of pins. The valve holder measures 2⅛in. in diameter, and has eight spring contacts carried in slots moulded on the inside of the recess into which the base of the valve fits.

The contact studs, and likewise the slots, are not equally spaced, so the valve cannot be inserted until they are all in correct alignment, but as a further precaution against accidental contact the springs are not carried the full length of the slots, but finish



W.B. valve holder for the new Mullard AC/DC valves with contact studs.

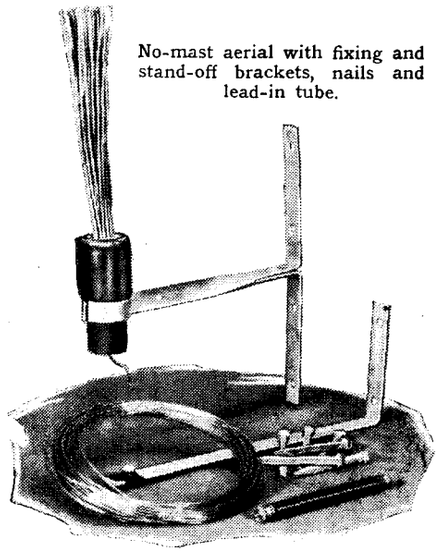
about 1/8in. down. The springs are hairpin-shaped and splay outward when the valve is inserted. They are light and strong and make a perfectly satisfactory contact throughout, yet the valve slides in smoothly and without undue pressure. It is provided with terminals, and costs 1s. 9d.

NO-MAST AERIAL EQUIPMENT

THE greatly improved sensitivity of modern receivers, coupled with the trend towards the use of high power for broadcast stations here and abroad, has made it possible to obtain good reception from all the worth-while stations with quite a short aerial. As a result, the familiar inverted L pattern having a considerable horizontal span can be replaced by a good vertical one without loss in efficiency; indeed, an improvement will often accompany the change since serious overloading is thereby avoided.

The No-Mast aerial, marketed by the Central Equipment, Ltd., 188, London Road, Liverpool, provides a satisfactory alternative to the older pattern, as it is neat, efficient, and easy to erect. It consists of a vertical portion terminating in a brush of stout copper wires embedded in a porcelain

No-mast aerial with fixing and stand-off brackets, nails and lead-in tube.



insulator supported in a galvanised wall bracket. This is fixed by four nails to the highest available point, such as a chimney stack, and a stand-off bracket with an insulated eyelet is provided to keep the downlead clear of the guttering and the wall. An ebonite lead-in tube is included in the equipment, and the price complete, including about 50 feet of stranded phosphor-bronze wire, is 10s. 6d.

Letters to the Editor

What is a Radio Engineer?

Star Items of Broadcasting : Balance and Control : A.V.C. for Superheterodynes

The Editor does not hold himself reponsible for the opinions of his correspondents

What is a Radio Engineer?

THERE has been some correspondence in your columns recently regarding "service engineers" and their capabilities, but I think we cannot even argue about technical qualifications in radio until we can answer the question, "What is a radio engineer?"

The Institution of Electrical Engineers is accepted as the representative body of the electrical profession, and recently a wireless section of the Institution was formed for the benefit of those members of the Institution who are interested in wireless.

Membership of the Institution of Electrical Engineers carries with it, however, no indication whatever of qualifications to entitle a member to describe himself as a radio engineer; in fact, a large percentage of the membership to-day would probably find it difficult to distinguish one type of valve from another!

Unfortunately, as things are at present, the Institution of Electrical Engineers is hindering rather than helping matters, for the Institution is taking no steps to define the qualifications of a radio engineer, and yet the Institution would not, I believe, be prepared to allow its members to support any other Institution which might be established for this purpose.

Perhaps the Institution still continues to regard radio as no more than a branch of electrical engineering; but it should be remembered that no radio engineer to-day could regard membership of the Institution as setting any seal upon his qualifications in his profession. RADIO ENGINEER,

London, S.W.1. Unchartered.

Star Items of Broadcasting

I WAS much interested in your editorial comment of May 25th on the need for advance notices of the B.B.C.'s best programmes.

The policy you advocate is the one which is consistently followed by the *Manchester Evening Chronicle*, which has been running a daily broadcasting feature for over ten years. A point has always been made of noting "star" turns a week or two in advance, and drawing special attention each evening to outstanding events in the Regional and National programmes, with only very occasional reviews of something that has taken place.

The same policy has been followed in connection with the *Daily Dispatch*, from the same office. F. HORN,

Radio Editor.

Manchester. Allied Newspapers, Ltd.

I READ your Editorial of May 25th with much interest, because I have long insisted that in order to do justice to B.B.C. programmes the listener must plan his listening in advance. Actually this can be done by perusing the *Radio Times* on a Friday, when, after all, two days remain before the particular week for planning commences.

Surely it shows the greatest contempt for the world's best wireless programmes, and also, of course, our receivers, if we cannot even afford the time of a quarter of an hour a week in selecting the most pleasing items. Really, just imagine the chances of picking on something pleasing, when you switch on at random! Too many listeners that I know do this very thing, and seem surprised that at the wonderful moment the B.B.C. have actually chosen to broadcast an unsuitable item for a particular listener! Why, that listener in his conceit expects that at any given moment the B.B.C. will naturally please him above any others.

E. L. CUMBERS,

Hon. Sec., The Croydon Radio Society.

Modern Sound Film Technique

THE attention of our clients, British Acoustic Films, Ltd., of Film House, Wardour Street, W.1, has been called to an article in your issue of June 1st headed "Modern Sound Film Technique. The British Acoustic Full-Range System. By A. L. M. Douglas." This article was published without our clients' knowledge, and they request us to state that they cannot accept responsibility for this description of their equipment, which was not authorised or approved by them.

FAITHFULL OWEN & FRASER,

Solicitors.

St. Michael's Alley, Cornhill,

London, E.C.3.

Balance and Control

I WAS glad to see in your issue of May 25th that there was apparently something wrong with the Command Performance" broadcast so far as "balance and control" was concerned.

Personally, I thought at the time that it was a disgrace to British broadcasting, but with typical Northern modesty was content to ascribe it to deficiencies in my receiver, feeling sure that the B.B.C. could not be at fault.

I do not quite appreciate why all the fuss should be made about the broadcasting of the B.B.C. Dance Orchestra. They are very ordinary at any time, and my reception of them did not suffer to any great extent from their normal performances. My complaint was in respect of the other turns, especially Jack Hylton's Band. We know *they* are good, but their finale with the military band was mutilated and blasted out of all recognition! LOUIS J. WOOD.

Halifax.

A.V.C. for Superheterodynes

IN connection with your articles in *The Wireless World* of May 4th and 11th on the subject of a new form of amplified A.V.C. for superheterodynes, it may be of interest to your contributor and to your readers to know that we have been using the combined detector and A.V.C. valve circuit on both our superheterodynes for the past year. This circuit gives an admirably level curve with only two controlled valves, the output level being adjustable by the size of detector anode by-pass used (up to 0.0001). We agree, however, that this circuit (or the variation employing a Westector) is entirely unusable on a straight set, the detector overloading seriously at 200 m.

We were surprised to note that your contributor bewails the absence of a valve suitable for this circuit; our type A.V.C.2 (for battery sets) and A.C./A.V.C. (for mains) have been on the market for nearly a year, and give a marked improvement (gain of some 10 d.b.) over a diode-triode owing to the reduced damping on the I.F. circuit.

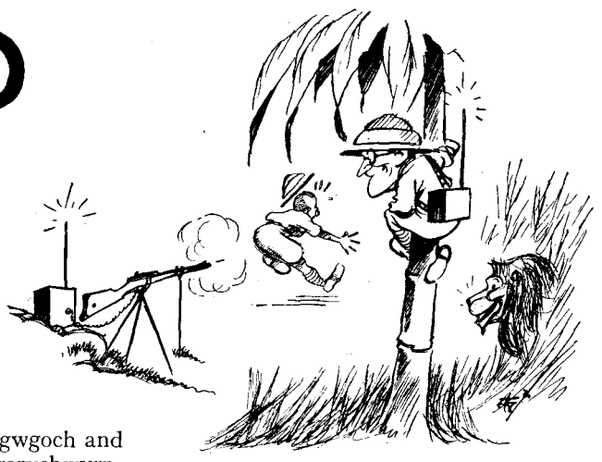
M. T. CALLENDER,

Research Department, Lissen, Ltd.

Isleworth, Middlesex.

UNBIASED

By
FREE GRID



So much the worse for the sportsman.

Is Wireless Harmful?

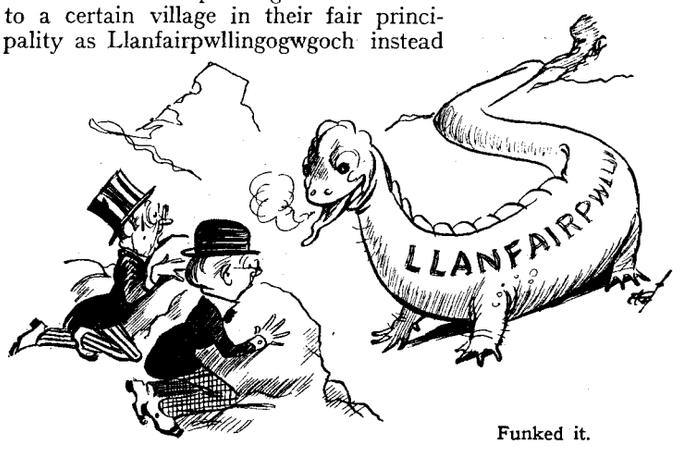
A FEW weeks ago (May 25th) I appealed to readers to assist me in the delicate case of a small boy who had been so far demoralised by the evil influence of "the wireless" that he had descended to the level of a cinema-addict. So far from obtaining help, however, I have been overwhelmed by correspondence seeking my aid and quoting other instances of cases where "the wireless" is supposed to be the source of all evil.

One good lady, for whom my heart bleeds, complains that since the gift of a long-distance receiver to her son and heir he has developed a morbid desire to go into unwholesome details about the wretched gardener's boy and his passion for pens, and has rapidly risen from an ignominious position at the bottom to the premier place in the French class. "Such an unnatural desire for learning French," says my correspondent, "can only point to one thing—namely, the desire to hear and understand the rather doubtful forms of entertainment which I feel sure must be radiated from these terrible foreign stations."

Another distracted mother is even more emphatic in her denunciations of radio, and more particularly of its offspring, television. It is clear from her letter that she knows nothing about television or, for that matter, ordinary broadcasting, for, as I have written to tell her, such things as she describes are never broadcast and, in any case, no television is radiated from Paris.

What I Meant

TEN thousand thanks to the hordes of indignant Welsh readers who have written to me complaining that I referred to a certain village in their fair principality as Llanfairpwllingogwgoch instead of Llanfairpwllgwyngyllgogerychwyrndrobwllllandisiliogogogoch.



Funked it.

Actually, of course, I did nothing of the sort. When I said Llanfairpwllingogwgoch I meant Llanfairpwllingogwgoch and not Llanfairpwllgwyngyllgogerychwyrndrobwllllandisiliogogogoch, as they seem to think. It is perfectly true that such a place as Llanfairpwllgwyngyllgogerychwyrndrobwllllandisiliogogogoch does exist and it is equally true that the B.B.C.'s precious pronunciation committee funked Llanfairpwllgwyngyllgogerychwyrndrobwllllandisiliogogogoch just as much as they funked Llanfairpwllingogwgoch, but this delinquency on the part of the committee is no reason for supposing that I was so ignorant as to write Llanfairpwllingogwgoch when I meant Llanfairpwllgwyngyllgogerychwyrndrobwllllandisiliogogogoch.

Big Game

I DO not profess to be any judge of the ethics of sportsmanship and so I can offer no opinions as to the rights and wrongs of the controversy which has recently been raging apropos the shooting of lions from moving cars.

There is, however, a certain method of shooting big game adopted by some so-called sportsmen which, in my opinion, certainly calls for severe censure, involving as it does the prostitution of wireless.

The facts were brought to my notice by an eminent photographer who has long pursued the hobby of obtaining close-ups of lions feeding their young and other examples of life in the raw. This he does by "planting" various cameras near lions' dens, birds' nests, elephants' eyries, etc., upon which they are carefully focused. The camera "triggers" are coupled up to a simple magnetic relay actuated by a short-wave receiver.

My friend then takes up a safe perch on a tall tree from which he can command a view of his "planted" cameras and, with the aid of a pair of powerful binoculars, can choose the most appropriate time for actuating each camera. I should perhaps mention that the various receivers are all attuned to slightly different wavelengths in order to avoid the simultaneous triggering off of all the cameras.

Point-Blank Range

It appears that he has not been too circumspect in imparting this information, and the result is that certain so-called "sportsmen" have pirated the whole scheme. By substituting sporting rifles for the cameras they have been able to shoot their quarry at point-blank range and thus bring home a record and very mixed bag at no danger to their wretched skins.

I feel so strongly upon the matter, as I am sure you do also, that if I can get the necessary financial assistance I shall proceed to the scene of action armed with a short-wave transmitter and take a fiendish delight in firing off all their engines of destruction from a suitable place of concealment. If it should so happen that I accidentally fire at a moment when one of the sportsmen is passing in front of a muzzle . . . well, so much the worse for the sportsman.

That Vest Pocket

A LADY signing herself "Sweet Seventeen" has written to me vigorously protesting against my frequent use of the term "vest pocket portable" to describe the small "headphones" portable which I frequently carry about with me in order not to miss the gems that the B.B.C. may be scattering at any given moment.

"Certain camera manufacturers," she writes, "make use of a similar term to describe certain of their products. This pernicious practice," she continues, "is grossly misleading, as surely men cannot have pockets of such a size in their vests? In fact," she adds, "I have always been under the impression that, as in the case of my own sex, men have no pockets at all in their vests."

I have written to her deeply deploring this looseness of expression on my part and explaining the matter fully to her, and I trust that she will allow the unfortunate incident to close.

The Wireless World

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CONTENTS

EDITORIAL COMMENT

Quality : The B.B.C. Replies

A Re-assuring Statement from the Chief Engineer

IN the correspondence columns of this issue we publish a letter from the Chief Engineer of the B.B.C., which contains statements of tremendous importance to broadcasting at the present time, and holds out real hopes for the improvement of quality of reproduction in the future. The letter is prompted by the Leader in our issue of June 1st, entitled "No Compromise with Quality." Mr. Noel Ashbridge points out "that more attention is given to high quality broadcast transmission in this country than in most others, and that the policy of the B.B.C. in this respect has never been changed."

We hope that nothing that we have said has been interpreted as a criticism of the policy of the engineering side of the B.B.C. in their efforts to put out the highest possible quality from the transmitters. We would be the first to recognise the persistent efforts of Mr. Ashbridge and his colleagues in carrying out this ideal.

We wish to take this opportunity of expressing our satisfaction at the persistent efforts of the B.B.C. in the direction of quality on the transmitting side, but this only serves to strengthen our case that something must be done on the receiving side to take advantage of what the transmitters can give us.

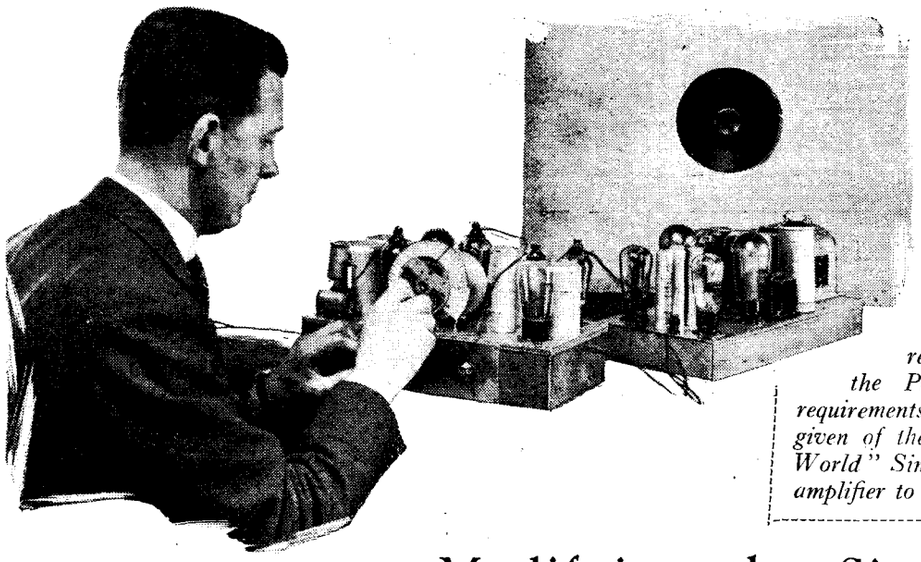
In his letter Mr. Ashbridge assures us that "all the regional transmitters, as well as the associated apparatus in control rooms, are capable of reproducing a frequency range of 50 to 9,000 cycles per second, with a loss of less than 3 decibels." We may be justified in asking the question whether this effort on the part of the B.B.C. is to be wasted, or if we can we look for some efforts by receiver manufacturers in the near future to give the public the benefit of what the B.B.C. engineers are taking so much trouble to make it possible for them to enjoy.

We do not think that we are in any way exaggerating the position if we say that the commercial receiver of to-day is up to the average standard if it reproduces frequencies from 75 to 4,500 cycles per second. A year or two ago the Bell Telephone Laboratories performed some experiments with the object of determining the frequency ranges required for the faithful reproduction of speech, music and certain noises. The result of that investigation was the discovery that the highest audio frequencies were necessary for proper reproduction of musical instruments, that even an upper cut-off at 10,000 cycles had a slight effect on the tone quality of most instruments, but that a cut-off at 5,000 cycles definitely impaired the quality of *all musical instruments except the large drums.*

Mr. Ashbridge, in his letter, vigorously supports our plea for variable selectivity in receiver design, for this enables full advantage to be taken of present transmitter quality for local station reception, whilst giving the required selectivity to avoid adjacent-channel interference where such interference is up to a strength sufficient to give trouble at the higher frequencies.

The greatest interest will be taken by many of our readers in the final paragraph of the B.B.C. letter, for here we are told that for some time past it has been intended to reconsider the question of the transmission of a range of audio frequencies when the Droitwich station becomes available for this purpose.

Radio Reception with the Push-Pull Quality Amplifier



THE attainment of the highest standard of reproduction is essential to the complete enjoyment of both broadcasting and gramophone records. So far as the latter are concerned, the Push-Pull Quality Amplifier meets all requirements, and in this article full details are given of the modifications needed to "The Wireless World" Single-Span Receiver for using it with this amplifier to provide an equal performance on radio.

Modifying the Single-Span Receiver

By W. T. COCKING

THE performance of the Push-Pull Quality Amplifier[1] reaches such a high standard that it is difficult to see in what way it could be improved. So far as the reproduction of speech and music is concerned it so nearly approaches perfection in its freedom from amplitude, frequency, and phase distortion that the ear could not detect any improvement. The amplifier, of course, is only one link in the chain, and loud speakers, gramophone pick-ups, and microphones, are so notoriously defective that it is not possible to claim even a close approach to perfection for a complete reproducing system from microphone to loud speaker.

In view of this, it is often argued that there is no point in reducing distortion to a minimum in any one portion of the apparatus, for some distortion will in any case be present. Except in the case of frequency distortion, when by luck or design the defects of one piece of apparatus may compensate for the defects of another, however, it can be seen that an improvement in any individual link in the chain will effect some improvement in the overall performance, even if it is not as great as it would be were all stages to be improved equally. The total distortion must be very great indeed, or the ear very insensitive, if even a small reduction in the distortion introduced by one piece of apparatus is not to give an audible improvement in the quality of reproduction.

Purity of Reproduction

In spite of the defects in other portions of the equipment, therefore, the use of a really distortionless amplifier leads to a very evident increase in the purity of reproduction, as those who have put the Push-Pull Quality Amplifier into action can testify. The applications of this amplifier are many and varied, but only its use for gramophone reproduction has so far been dealt with at any length. It is probable that the equipment will be more widely used for broadcast reception, and it is certain that it will then show up to most advantage, for the average broadcast programme is technically of higher quality than a recording.

Although some notes on the use of the amplifier on radio have been published, it is felt that many would welcome the description of a receiver suited to its characteristics. So far as freedom from distortion is concerned, the Single-Span Receiver[2] is ideally suited to the amplifier, and the only modifications necessary to it are connected with the attainment of push-pull output. This receiver is fitted with variable selectivity, and it is largely this which makes it so suitable for quality reception, since when the control is in the position of minimum selectivity side-band cutting reaches a very small figure. For distant reception, however, where side-band cutting is essential if interference is to be avoided, the selectivity can be greatly increased.

The circuit diagram of the modified receiver is shown in Fig. 1, and it will be seen that the early circuits have not been altered in any way. The changes occur in the second detector and A.V.C. circuits. A 50,000 ohms coupling resistance Rb is included in the anode circuit of the MHD4 valve, and a further 50,000 ohms resistance Ra is fitted to provide decoupling in conjunction with the 8-mfd. electrolytic condenser Cc. The output to one side of the push-pull amplifier is taken from the anode of the MHD4 valve. The output for the other side of the amplifier must be of equal value and of opposite phase, and is obtained by inserting a 50,000 ohms resistance in the cathode lead.

In the original design one diode was used for the detector, and the other for A.V.C. purposes. Owing to the high resistance in the cathode lead which must now be used, however, one of the diodes cannot be employed to provide A.V.C. The two diodes are connected in parallel, therefore, and act only as the detector. A Westector is used for A.V.C., and is fed through the 0.0002-mfd. condenser Cd—its load resistance R15 being returned to negative H.T. At the high frequency used in this receiver the Westector is hardly as efficient as a

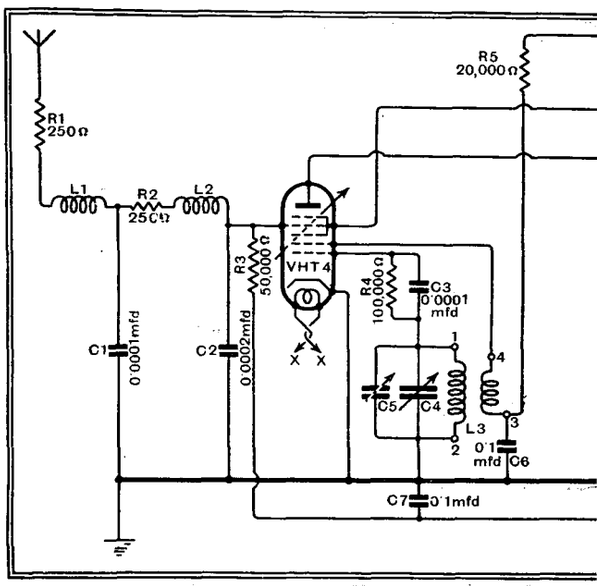


Fig. 1.—The complete circuit diagram of the modified

[1] *The Wireless World*, May 11th and 18th, 1934.

[2] *The Wireless World*, April 13th, 20th, and 27th, 1934.

thermionic rectifier. Partly because of this, and partly because the L.F. amplification is slightly higher, the delay voltage has been reduced to 3 volts. It is important to note that the low-capacity type WX Westector be used; the older type W is not suitable.

Tone-Correction

The only other major change necessary is to the H.T. feed, for the mains equipment of the amplifier provides some 245 volts for operating the receiver, which requires only 200 volts for the early stages. The MHD4 valve is fed from the full supply, but a 1,500 ohms resistance Rd is included to drop the voltage for the other stages.

It will thus be seen that the additional components required to effect the alteration are few in number. Neither the power unit of the original Single-Span Receiver, nor the feeder unit of the Push-Pull Quality Amplifier, is required, of course.

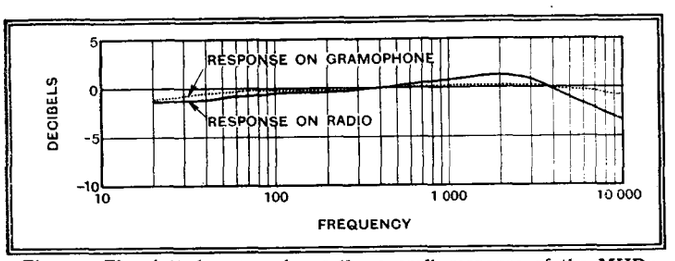


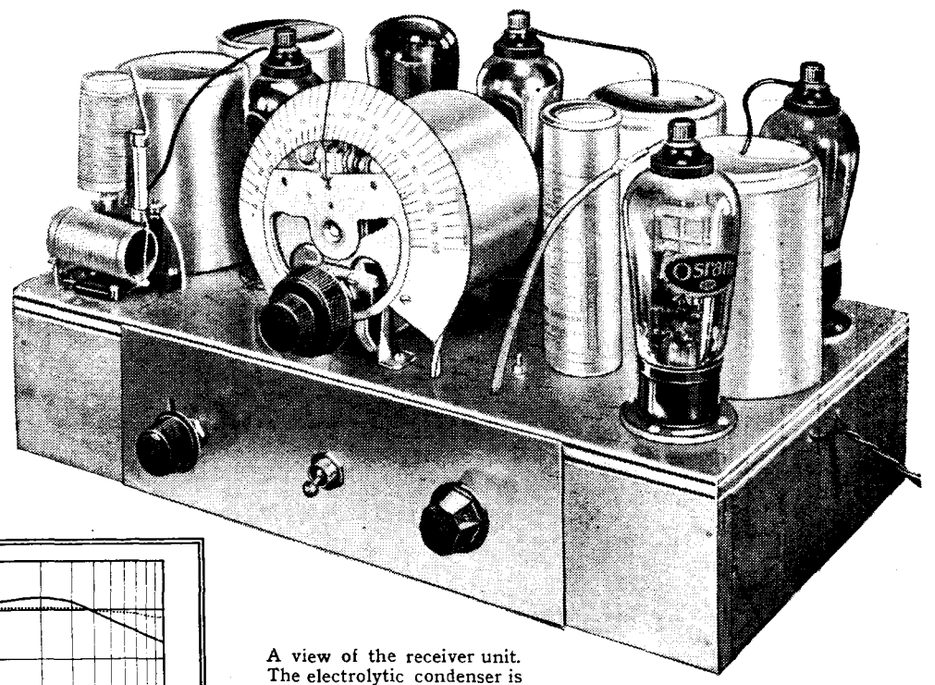
Fig. 2.—The dotted curve shows the overall response of the MHD4 valve and the amplifier for gramophone operation, while the full line curve illustrates the performance on radio. Even at 10,000 cycles the response falls by only 3.5 db.

The initial adjustments which the receiver requires are identical with those of the original set, so that it is unnecessary to repeat the trimming instructions, and those who build the modified receiver should refer to the article in *The Wireless World* for April 20th, 1934.

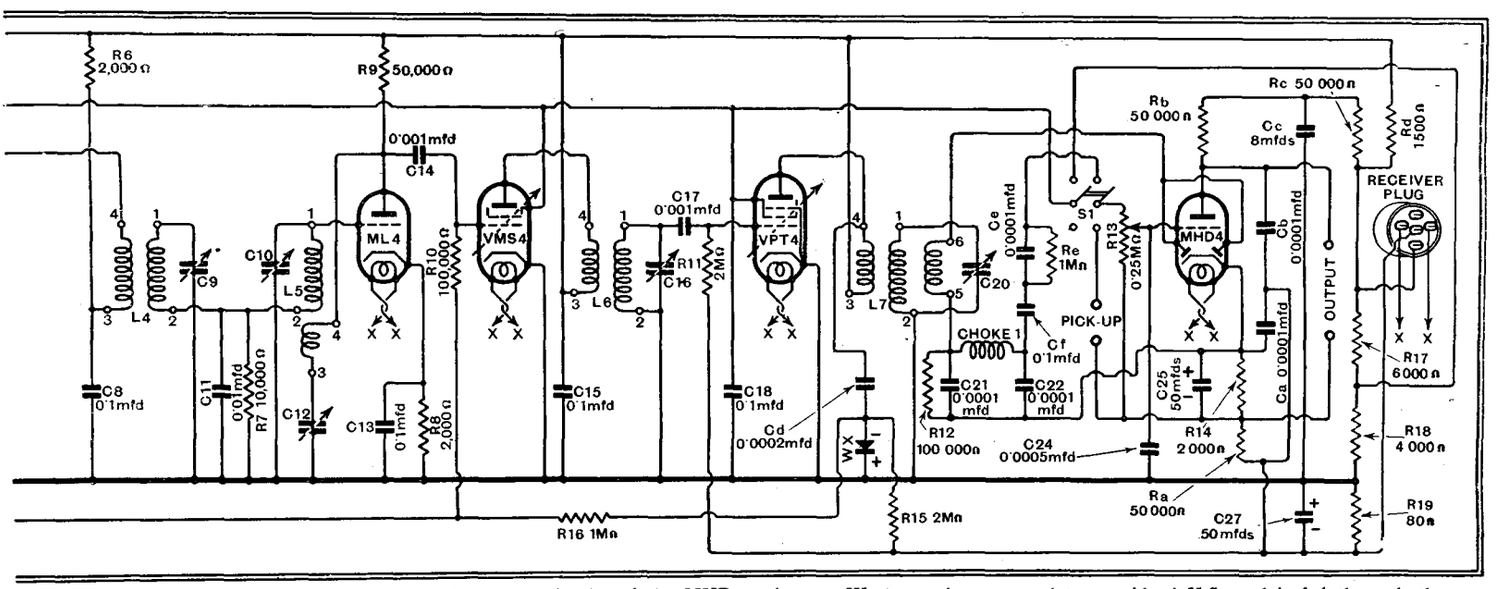
The coupling condenser Cf in the diode circuit has been increased to 0.1 mfd. in order to maintain the bass response with a negligible loss. At high frequencies the amplifier characteristic is nearly flat, and there is little in the detector circuits to produce a loss. The tuned circuits, however, introduce a certain degree of sideband cutting, in spite of the selectivity without reaction being only moderate. A small degree of tone-correction, therefore, has been introduced. This is provided by the 0.0001-mfd. condenser Ce in shunt with the 1-megohm resistance Re, in combination with the volume control resistance R13.

The action of a circuit of this nature is extremely simple, for R13 with Ce and Re form a voltage divider, the ratio of which varies with frequency. At low frequencies the reactance of Ce is very high compared with the resistance of Re. The proportion of the rectified voltage fed to the triode grid, assuming the volume control to be set at maximum, is thus governed by the ratio of R13 to the sum of Re and R13. In this case it is 250,000/1,250,000, or one-fifth.

At high frequencies the reactance of Ce is low compared with the resistance of Re, so that the resistance plays a negligible part. If the reactance of Ce is also low compared with the resistance of R13, practically the full rectified voltage is developed across R13 and applied to the triode. Actually, the loss at high frequencies is only some 10 per cent. to 20 per cent.

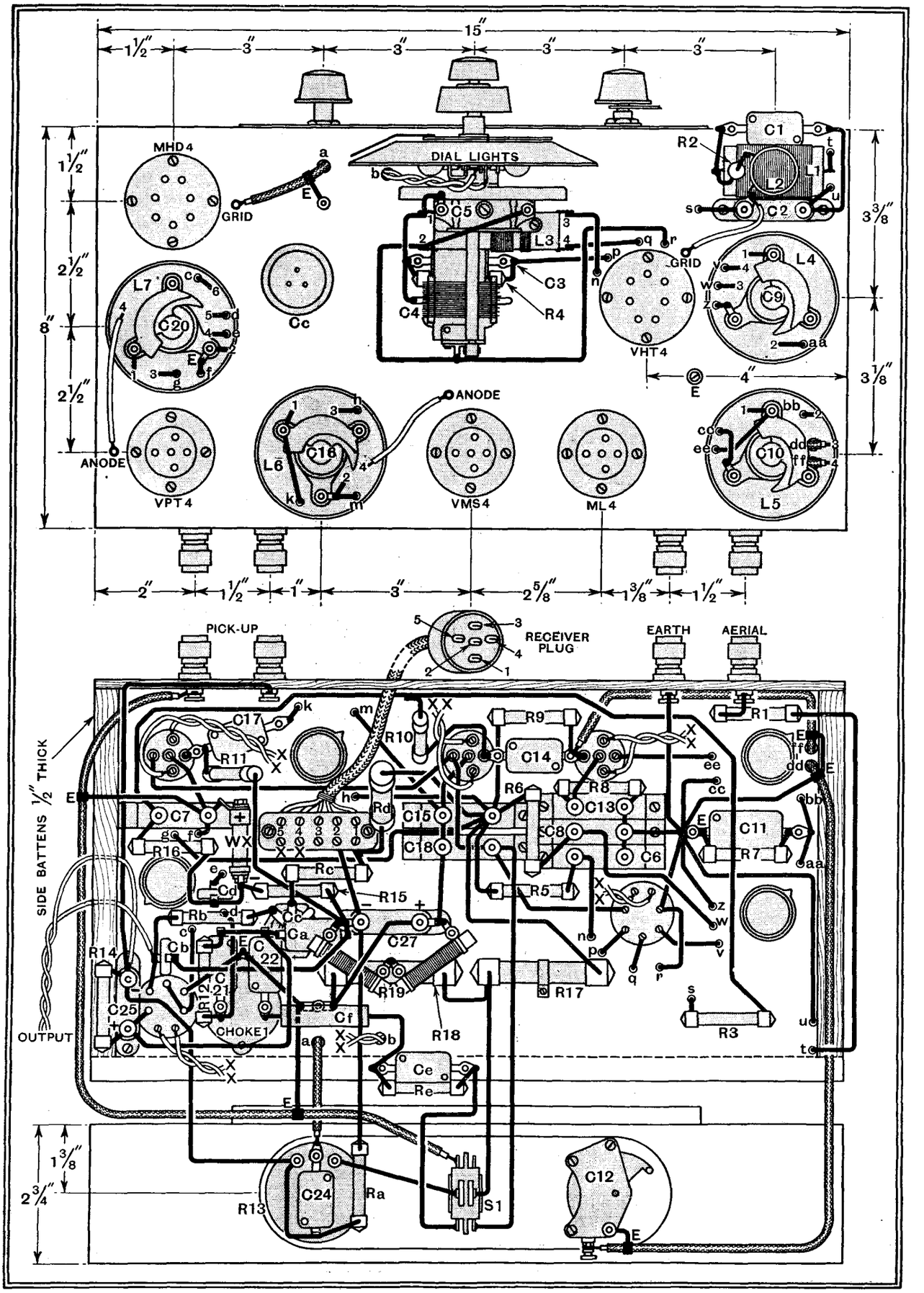


A view of the receiver unit. The electrolytic condenser is the only new component on the upper side of the base.



Single-Span Receiver. The changes are chiefly in the circuits of the MHD4 valve: a Westector is now used to provide A.V.C. and is fed through the condenser Cd. Tone-correction is introduced by the resistance Re and the condenser Ce.

PRACTICAL WIRING DIAGRAM



Full details of the modifications may readily be gleaned from these drawings. It should be noted that flexible leads are brought out for the two output connections.

Radio Reception with the Push-Pull Quality Amplifier—

This degree of tone-correction provides nearly perfect compensation for the sideband cutting, and the full line curve of Fig. 2 shows the degree of perfection obtained. The dotted curve shows the characteristics of the L.F. circuits alone, and represents the performance on gramophone; from 20 cycles to 10,000 cycles the deviations are less than 1.2 db. On radio the losses at the extremes of the frequency range are slightly greater. At 20 cycles the response falls by about 1.5 db., the slight increase being due to the losses in the additional L.F. coupling. At 10,000 cycles there is a loss of 3.5 db., while there is a rise of about 1.2 db. at 2,000 cycles. On radio, therefore, the characteristic is flat within 4.7 db. over the complete range.

The Detector

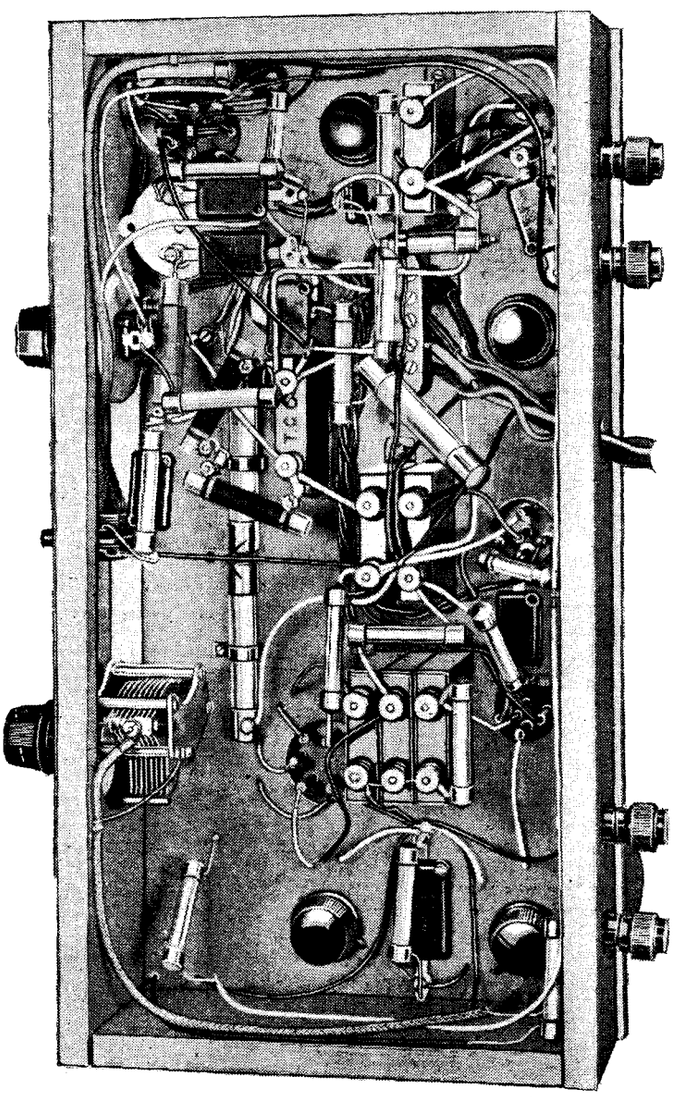
It is very doubtful whether the most critical ear can detect a change of 6 db. at the extremes of the frequency range, so that for all practical purposes the performance can be considered as satisfactory, from the quality viewpoint, on radio as on gramophone. The improvement in performance obtained with this apparatus may best be realised when it is remembered that ordinary present-day equipment may show a loss of 20 db. or more at only 5,000 cycles.

When reaction is used in order to increase either the sensitivity or the selectivity, the sideband cutting is increased, and the overall response naturally droops at the highest frequencies. This is advantageous rather than otherwise, for it is only the strongest stations which are likely to be received at sufficient strength to be free from interference from the adjacent channel with such a well-maintained high-frequency response. For weaker stations it is necessary to sacrifice quality somewhat in order to obtain freedom from sideband splash and the steady heterodyne note caused by the beating of adjacent carriers, and this is accomplished by means of the selectivity control.

A full-size blue print of the wiring diagram is available from the Publishers, Dorset House, Stamford Street, London, S.E.1. Price 1s. 6d. post free.

It may be remarked that the use of tone-correction lowers the sensitivity of the set, since about one-fifth of the detector output at low and medium frequencies is thrown away. This is inevitable with nearly all systems of tone-correction, but it does not mean that the sensitivity is any lower than with the original Single-Span Receiver, for a higher degree of L.F. amplification is now employed.

The loss, in fact, is an advantage, rather than otherwise, for the triode section of the duo-diode-triode requires an input of only 0.254 volts R.M.S. or 0.359 volts peak for an output of 4 watts to the loud speaker. With the tone-correction in circuit the detector output with 80 per cent. modulation must be $0.359 \times 5 = 1.795$ volts peak, and this will be provided by a detector input of about 1.8 volts R.M.S. Even this input is rather small for completely distortionless detection, but in practice this is unimportant, for the detector input is determined by the strength of the signal, and with a local station it is held at a high level by the A.V.C., the excess in the detector output being thrown away in the volume control. In the case of a weak signal, of course, the detector input may become smaller. Any distortion which may then occur, however, is relatively unimportant, because such signals are usually accompanied by a background of atmospherics or man-made static, and because the distortion, if audible, would occur only on the deepest modulation.



An under view of the receiver. The changes are chiefly in the upper part of this illustration.

LIST OF PARTS

Additional Components Required.

3 Metallised Resistances, 50,000 ohms 1 watt	Ra, Rb, Rc Dubilier
1 Metallised Resistance, 1,500 ohms 3 watts	Rd Dubilier
1 Metallised Resistance, 1 megohm 1 watt	Re Dubilier
1 Electrolytic Condenser, 8 mfds. 440 volts	Cc T.C.C.
2 Fixed Condensers, 0.0001 mfd.	Ca, Cb, T.C.C. Type "M"
1 Fixed Condenser, 0.1 mfd.	T.C.C. Tubular
1 Fixed Condenser, 0.0002 mfd.	Cd, T.C.C. Type "M"
1 Westector	Type "WX"

Components formerly used, but no longer required.

1 Fixed Condenser, 0.0005 mfd., C26.

On test the apparatus proved fully the theoretical points which have been discussed in this article, and the quality of reproduction was outstanding in all respects. The sensitivity and selectivity proved adequate for the reception of the stronger Continental transmissions, and mains hum was quite inaudible.

The Function of the Receiver

In conclusion, it may be remarked that the apparatus is not intended for the confirmed distant listener who wishes to receive any and every foreign station. A more selective and sensitive set giving a lower standard of reproduction will meet his requirements better. The equipment is intended for those whose aim it is to obtain the best possible quality of reproduction from a limited number of stations. The listener who will tolerate no distortion, and who relies principally upon his local station, but who wishes to receive some of the more important of distant stations when the local programmes are not to his taste, will find that the Single-Span Receiver with the Push-Pull Quality Amplifier exactly meets his requirements.

BOOK REVIEW

Elements of Radio Communication, 2nd Edition, by J. H. Morecroft. Pp. 286 + xii. Published by J. Wiley and Sons, New York, and Chapman and Hall, 11, Henrietta Street, London, W.C.2. Price 18s. 6d. net.

This book forms an introductory volume to more comprehensive works, such as the author's "Principles of Radio Communication." It is easy to read, it contains only the simplest mathematics, and in it will be found an elementary account of nearly everything of interest to workers in radio. Five years have elapsed since the first edition was published, and the advance in wireless technique is reflected in the large amount of new material added to the book, such as valves with multiple grids, analysis of speech sounds, micro waves, automatic volume control. The utility of the book has been increased by the addition of a large number of illustrative problems. R. T. B.

The Whole Spectrum

How All the Wavelengths are Allocated by Nature

WE become so accustomed to thinking of wavelengths as applied to wireless that it may be well to be reminded of the fact that radio frequencies occupy only a comparatively small part of the whole spectrum of radiating waves. The present article reviews our existing knowledge of the spectrum and its composition.

WE are all well accustomed these days to complaints about an overcrowded ether. And really it is quite true that the ether is very full—so full, indeed, that some of the natural wavelength allocations actually overlap. When we complain of the weaknesses of the Lucerne Plan, it is easy to forget that our wireless wavelengths form quite a small part of the whole field of radiation and that broadcasting waves, in particular, are a very small part indeed of the whole active spectrum.

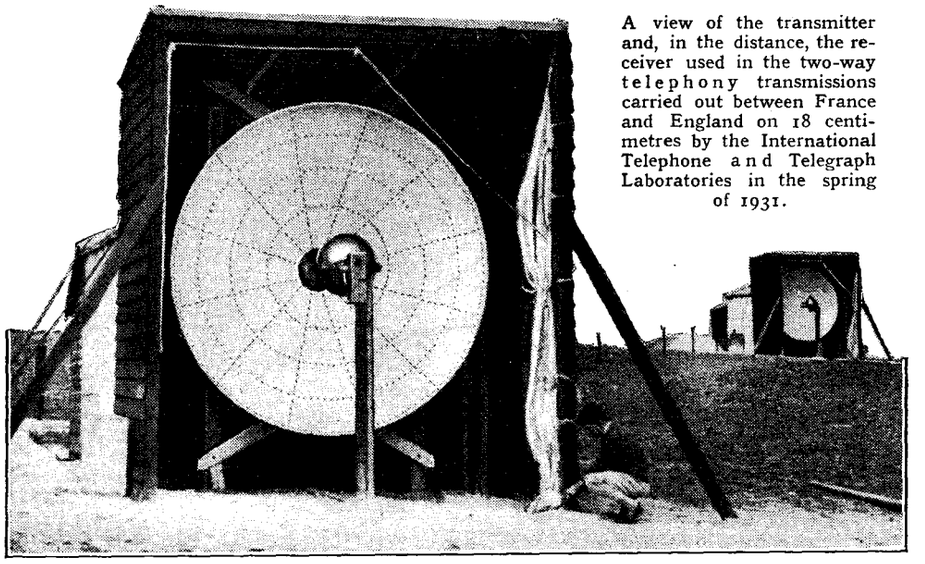
The word "spectrum" (from a Latin word meaning "to see") appears to have been used first by Newton to denote the effect which he obtained of breaking up a beam of sunlight into its constituent colours, a process which we now know to be decomposing it into its different wavelengths or frequencies. While the word is thus primarily of optical significance, it is now frequently used in relation to other phenomena which can be expressed in wavelengths or frequencies, and that is how we shall use it here.

Taking this view, a remarkable feature of the scientific progress of the past fifty years has been the increase of our knowledge of the whole spectrum of radiation. The first great contribution was that of Clerk Maxwell, who in the middle of last century published his classical theory—based chiefly on mathematical reasoning—that light was of the nature of an electromagnetic radiation. He also showed that it should be possible to create electrically waves of a similar character and travelling with the same velocity, although possibly differing in wavelength from those to which the eye responded as light. It was not till more than twenty years later that Hertz discovered the electrical method of producing these waves and established the basis on which practical wireless radiation has since been built.

At about the same time, also, as the early days of practical wireless, Röntgen discovered X-rays, and the Curies discovered radium, and gave the great impetus to the study of radio activity, to which Lord Rutherford and the Cambridge School have since contributed so much.

As a result, we now have a fairly complete picture of all the frequencies and wavelengths that go to make up the whole spectrum of ether radiation. The extent of our present knowledge is shown in Fig. 1. The frequencies and wavelengths are marked off in logarithmic scales because it would be quite impracticable to show by any other method the extraordinary width of the values to be covered. The scales, of course, conform to the general relation that:—Wavelength × Frequency = Velocity (of light) = 3×10^{10} centimetres per second.

The classification of the various types of radiation shown is based on their normal method of use or (what is really the same thing) the normal method of their detection or appreciation that is available to us. The most striking feature of the range illustrated in Fig. 1 is the relatively smooth manner in which the various types shade off into each other, just as the colours of the rainbow shade into each other within the narrow range of the visible spectrum. And yet, strangely enough, taking the spectrum as a whole, this is least true of the *boundaries* of the visible range, which are relatively well marked. This is because the human eye responds to wavelengths or frequencies falling within almost exactly a 2 to 1 range. Since this 2 to 1 range, or ratio, is that comprised within the *octave* of musical usage, the same name is usually applied in the case of the wide spectrum, and the range of the eye is frequently referred to as the "visible octave" or something of that kind.



A view of the transmitter and, in the distance, the receiver used in the two-way telephony transmissions carried out between France and England on 18 centimetres by the International Telephone and Telegraph Laboratories in the spring of 1931.

The Ether "Keyboard"

The scale of frequencies in Fig. 1 is shown throughout in cycles from $10^0 = 1$ cycle per second, and that of wavelength in centimetres, above and below the value of $10^0 = 1$ cm., since the centimetre is the unit usually employed in basic scientific measurements and calculations. As wireless readers are well aware, the waves of radio practice are usually specified in metres. It is also usual with wavelengths which are minute fractions of a centimetre to use another unit, known as the Angstrom, named after the Swedish scientist who introduced it, and equal to one-ten-millionth part of the centimetre.

As a matter of interest, also, there is added to Fig. 1 a scale of octaves with the visible octave as its zero reference. The other ranges of radiation are then shown in octaves above and below it, like the keyboard of a gigantic piano, with numerous octaves stretching above and below the familiar middle octave in which the less musically gifted among us gropingly trace out familiar melodies with one finger.

The Visible Octave

Since the visible octave forms the beginning of our knowledge of the spectrum and is, indeed, the one with which man has been longest acquainted, it is shown *in extenso* in Fig. 2. This consists of all

The Whole Spectrum—

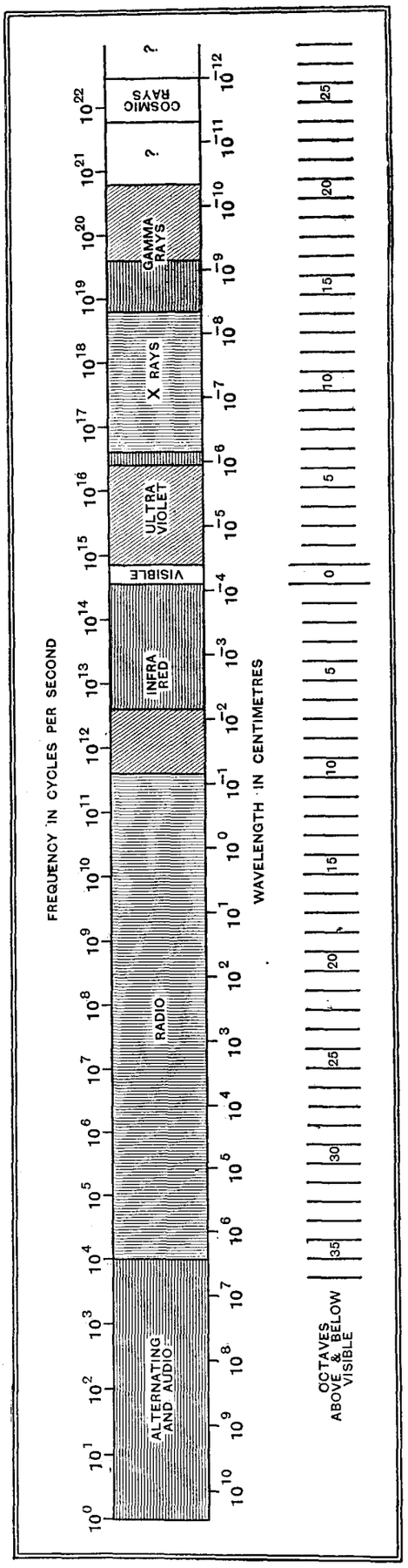


Fig. 1.—The whole spectrum as we know it to-day.

the colours of the rainbow shading off from one to the other in the manner familiar to us all since childhood, the difference between the various colours being simply that of their respective wavelengths. In Fig. 2 we see that a wavelength of just below 4,000 Angstroms (forty millionths of a centimetre) is about the limit of the shorter waves which produce on the retina of the eye the sensation of violet colour. Twice this wavelength, about 7,700 Angstroms, produces the sensation of red, with all the intermediate colours ranged in the order shown. These wavelengths correspond to frequencies of just over 750 million millions ($7{\cdot}5 \times 10^{14}$) for the violet extreme, and approximately half this value for the red limit of the octave.

Fig. 2, taken also in conjunction with Fig. 1, shows how the visible octave shades off at one end into the actinic or ultra-violet range, and at the other to the infra-red—the former concerned with chemical activity such as that of photography, and the latter with radiant heat. Incidentally, the visible octave is a good example of the division of the spectrum into groups determined more or less by the means of their utilisation or detection. The sun's radiation reaching the earth contains a large range of wavelengths running up into the "invisible light" of the ultra-violet and down into the infra-red. The eye, however, only responds to the limited range to which it is, as it were, "tuned," behaving, in fact, like a good band-pass filter passing a 2 to 1 range of frequency with fairly vertical cut-off walls at its boundaries.

Reverting to Fig. 1 for consideration of our complete spectrum, going down in wavelength (and up in frequency) from the visible octave, we pass through the ultra-violet range. This is primarily concerned with chemical effects such as those of photography and with effects on the human body which in the past few years have brought into prominence the various types of "artificial sunlight" lamps. These are designed to have a spectrum running well into the ultra-violet, and are enclosed in envelopes of quartz or other material, which freely transmits the ultra-violet wavelengths, whereas ordinary glass cuts them off. It is for this reason, also, that attention is being devoted to the special types of window glass, in order to permit the passage of as much as possible of the sun's ultra-violet rays which normal window glazing cuts off. Shorter still than the ultra-violet comes the X-ray range, actually with a slight overlap between the longest wave in the X-ray group and the shortest of the ultra-violet that have been measured. The X-ray group at the other end shades off into the "Gamma" rays of radio activity, with again a slight overlap, as shown, between the extremes that have been measured in each category. For a long time the shortest waves of the "Gamma" group represented the limit of the known spectrum. More recently, however, Prof. Millikan and others have discovered a highly penetrating type of radiation the origin of which is at present not very clearly known. With a gap between the known limits of the "Gamma" group, this type of radiation occupies the approximate position shown in Fig. 1 as "Cosmic rays." This region has not been otherwise explored, nor has the region beyond it. But that is no reason why some field for its utility may not yet be found. Certainly he would be a bold man who, in these days, would write "finis" to the present spectrum.

Again reverting to our reference point of the visible octave and continuing to longer wavelengths (lower frequencies), the next longer waves are the infra-red of radiant heat. But again the fluid state of our present scientific knowledge is illustrated by the very recent developments which have been made in the utilisation of this group in new photographic methods, allied with the fact that they have been shown to penetrate atmospheres (such as fog) which are opaque to the ordinary visible rays. Here again is an extension of invisible light.

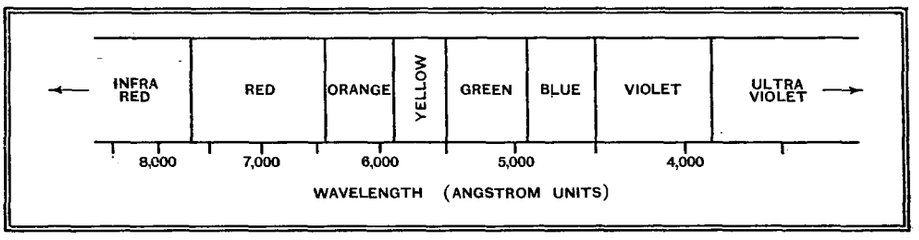


Fig. 2.—The visible spectrum, which includes all the colours of the rainbow.

The Electrical Spectrum

Up to a dozen years or so ago there was a gap between the longest waves of the infra-red family and the shortest waves set up by electrical means and, therefore, to be regarded as coming into the radio group. More recently, however, waves of eight-thousandths (8×10^{-3}) of a centimetre have been produced as damped oscillations. Although these are definitely in the category of laboratory experiments, they do run up, as shown in Fig. 1, into the region belonging normally to the infra-red.

Various other short-wave essays have also been made on a laboratory scale, but, coming to more practical radio waves, the shortest continuous waves capable of modulation that appear to have been generated bring us to the quite respectable wavelengths of 10 to 20 centimetres. For

The Whole Spectrum—

a long time reception of such waves had only been effected over a distance of six miles or so. About three years ago there was a successful demonstration of two-way telephony over the English Channel between paraboloid reflectors on the cliffs of Dover and on the cliffs about Gris Nez in France, and the apparatus used on the English side is shown in the photograph. A service on this wavelength has more recently been inaugurated between Lympne and the French coast in connection with aircraft services, while the Post Office has also a service on a somewhat similar very short wavelength across the Bristol Channel supplementing the cable service.

But more of this in connection with our more purely radio spectrum!

From the point of 18 or 20 centimetres onwards to 20,000 or 30,000 metres the wireless spectrum is effectively complete. Much of the range below 10 metres is not yet in practical use, but it represents an amazing number of working channels if it can be turned to useful purposes.

Fig. 1 carries on the spectrum into the audio range—indeed, right down to 1 cycle per second. This is not truly an ether spectrum so far as concerns useful radiation at these frequencies, but it is nevertheless a logical extension from the higher electrical frequencies and represents a natural enough *continuum*. The division between radio and audio at 10 kilocycles is quite arbitrary. Many of the higher harmonics of sounds exceed the normal 10 kc. point. Similarly, the limitation of radio at a nominal wavelength of 30,000 metres (10 kc.) does not mean that longer waves could not be radiated. It merely means that they have not, in fact, been practically used, and present tendencies make it unlikely that they will be. Nature, however, continues to use them—try tuning a receiver to 40,000 metres, and you will at least get plenty of atmospherics!

The London Conference

Behind the Scenes at the U.I.R. Meeting

By a Special Correspondent

SHOULD one expect much of an Annual General Assembly of the International Broadcasting Union? Better to expect little and avoid disappointment. As the only "outsider" to gain access to the various chambers and corridors at Grosvenor House during the actual session, I can assure readers of *The Wireless World* that any visions of bustle and despatch, of enterprises of great pith and moment, were totally illusory.

The atmosphere was that of a nursing home. It was in a carpeted corridor outside a boudoir converted into a typing office that I met Mr. Ashbridge, chief engineer of the B.B.C.

"Nothing has happened," he confided to me, "but we are waiting."

"Nothing *can* happen of very great interest to British listeners?" I ventured.

Mr. Ashbridge smiled. "Well, anything *may* happen. We are watching"—here he turned to Mr. Cecil Graves, chief of the B.B.C. Empire and Foreign Department—"we are watching, because there is no saying what an hour may bring forth."

Mr. Graves concurred, and in so doing reflected the sentiments of every member of the Conference. M. Braillard, head of the Technical Commission, was also among the "watchers and waiters."

French, I found, was the universal language. It was in French that the *Commission Juridique* was arguing through clouds of smoke on the first floor. It was in French that the Technical Commission wrangled for four hours over the question of a kilocycle change between two mid-European stations.

Consequently, I was not surprised when Mr. Arthur Burrows, the Secretary-General, declared that the sixty hours allotted for discussion were not enough.

"There is really nothing to report," he said, "but we are very busy. We shall have to sit on Sunday."

And he rushed off to dictate a memorandum to a French secretary. Mr. Burrows seemed the busiest person at the Conference.

Perhaps, however, we have expected too much. This was not a Conference to readjust wavelengths or to bring about other revolutionary changes. It was the ordinary annual assembly, the business of which was concerned mainly with the clearing up of the year's accounts, financial and other, to enable the members to assure each other of their continued reliance on international comity, and to re-elect the officers and commissioners.

In addition to the Legal and Technical Commission meetings, there were discussions of the Rapprochement and Relay Sections.

Some of the items on the agenda were left untouched, as, for example, the questions of political propaganda and copyright, and there was the comedy of the long vigil by two Luxembourg representatives eager to champion their station's wavelength. They need not have come, for Luxembourg did not enter into the picture! There was no time!

The London assembly differed from others in one respect. Of its kind, the publicity released by the B.B.C. was fairly adequate, but at best it was spoon-fed news. The B.B.C.'s proprietary attitude was unjustified, and reached such lengths that the photographs taken in the Conference rooms were reserved in this country for the Corporation's own journals, *while being free for publication abroad.*

Thus, readers of a penny paper in Portugal could get inside glimpses of the Conference denied to British listeners not subscribing to the publications of the B.B.C

Photo. "The Times."

On Friday last the delegates visited the International Telephone Exchange at Faraday Building, London, where they spoke to their respective countries. In the photograph are seen (left to right) Mr. Arthur R. Burrows, Secretary-General; Mr. L. W. Hayes, B.B.C. engineering staff; Dr. Schwaiger (Austria); Dr. von Boeckmann (Germany); M. Dovaz, of the U.I.R staff, and, wearing 'phones, Dr. Hubmann (Germany).

The Radio Industry

THE HARKEN ELECTRICAL CO., LTD., of 18a, South End, Croydon, Surrey, have sent us a leaflet describing their new type of short-wave converter, which employs a heptode frequency changer and includes several other interesting technical features.

Every broadcast receiver is likely to stand in need of internal adjustment or repair at some time during its life. Speaking on the subject of "Service" at a luncheon held in London last week, Mr. A. A. Rowse, Managing Director of Telsen Electric Company, Ltd., expressed the interesting view that it is not enough for a manufacturer to take all possible steps against breakdowns; he should definitely design his sets for easy "servicing," and his company proposed to follow this plan. Mr. Rowse's co-hosts at the Telsen luncheon were Lt.-Col. C. E. Jewels, D.S.O., M.C., Mr. Armitage, and Mr. Rupert Collins.

The newly established firm of Northern Batteries, Ltd., recently mentioned in these notes, have now started production. Elaborate precautions are being taken at each stage of manufacture to eliminate faulty material or workmanship.

The fourteenth annual Exide Battery Convention, which ended last week, was held this year at Scarborough.

The Art of Ganging

THE SUPERHETERODYNE—Adjusting the Oscillator Padding Condenser

THE problems involved in obtaining single-control tuning are rather different in the ordinary superheterodyne from those found with the straight set. Special arrangements are needed in order to keep the oscillator and signal-frequency circuits with their correct frequency displacement. Two methods are commonly employed, and in this article will be found details of the operation and adjustment of the system involving a padding condenser.

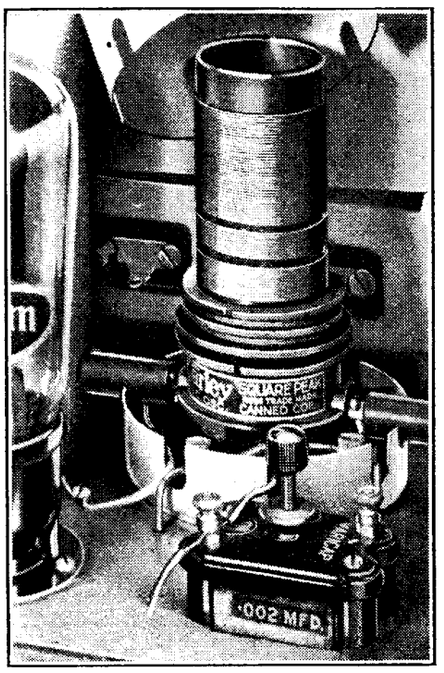
DURING the last two or three years the straight set has been very largely displaced by the superheterodyne on account of the much greater selectivity obtainable, and also because of a degree of simplification. As regards certain of the circuits employed in receivers of this type, ganging is carried out in exactly the same manner as in a straight set, and the problems involved are in no way different. In the case of the oscillator circuit, however, the problems are totally different, and both the underlying theory and the practical method of ganging have to be modified.

There are two general methods of achieving ganging in a superheterodyne—in one an ordinary gang condenser is used in conjunction with padding condensers, while in the other the gang condenser is of a special type in which one section contains specially shaped plates. This latter circuit is now the more commonly used, since greater accuracy of ganging is possible and the initial adjustments are simpler. The padding circuit, however, is still used in many commercial receivers; it would be used in constructional receivers if for any reason, such as the choice of an unusual value of intermediate frequency, a shaped plate gang condenser were inapplicable, and it is used in all superheterodynes on the long waveband. It is proposed, therefore, to deal with the padding circuit first, and to leave the shaped plate gang condenser method of ganging a superheterodyne until a later section of these articles.

The Oscillator Circuit

In a straight set the requirement is that all the tuned circuits must be tuned to the same frequency or wavelength, so that ganging is readily achieved through assigning identical values to the effective inductance and capacity of each circuit. In the superheterodyne, however, only the signal-frequency circuits require to be ganged in this manner, and the oscillator circuit must always be tuned to a frequency higher or lower than that of the others by the intermediate frequency. In practice, the oscillator is always tuned to a higher frequency.

The most common value of intermediate frequency is 110 kc/s, so that if the input circuits of the receiver are tuned to 1,500 kc/s, the oscillator must be tuned to 1,610 kc/s. Similarly, when the input circuits are tuned to 550 kc/s, the oscillator must be tuned to 660 kc/s. This brings many difficulties in its train, for it is obvious that the frequency ratio in the case of the oscillator circuit is smaller than in the case of the signal-frequency circuits. The difference between the maximum and minimum frequencies, of course, is the same, but the ratio of minimum to maximum frequency is different. It is this ratio that is important, for the frequency ratio depends upon the capacity ratio in the tuned circuit, and, since the gang condenser is assumed to have identical sections, this will be constant in all circuits.



The padding condenser of a superheterodyne is usually of the semi-variable type and is adjusted once and for all when setting up the receiver.

With a maximum frequency of 1,500 kc/s and a minimum frequency of 550 kc/s for the signal-frequency circuits, the frequency ratio is 2.73-1, so that the capacity ratio should be 7.45-1. In the oscillator circuit the maximum frequency is 1,1610 kc/s with a minimum of 660 kc/s, and the frequency ratio becomes 2.44-1, and the capacity ratio need be only 5.96-1. Since the capacity ratio is fixed by the construction of the gang condenser, it is obvious that we shall have to restrict the ratio artificially. It will be remembered that in the section dealing with the ganging of straight receivers a warning was given about the use of an excessively large value of stray capacity in a tuned circuit, since this led to a restriction of the tuning range. Such a restriction, however, is here necessary, and the obvious course seems to be to increase the stray capacity of the oscillator circuit to the requisite extent, while reducing the inductance of the oscillator coil in order to maintain the correct maximum frequency in this circuit.

Correct ganging at two points in the tuning range, one at each end of the band, is readily obtainable in this manner, but unfortunately at all other points the ganging is widely inaccurate. Some other means of restricting the range is thus necessary. Now the capacity of two series-connected condensers is less than that of the smaller, so we can try placing a suitable value of fixed condenser in series with the variable condenser of the oscillator circuit. This will obviously reduce the effective maximum capacity, and hence the capacity ratio. In general, the series condenser makes hardly any difference to the minimum capacity of the gang condenser section, so that, in order to reach the highest frequency, the oscillator inductance must be reduced to a lower value than that of the signal-frequency circuits.

The Padding Condenser

The arrangement will perhaps be clearest from the diagram of Fig. 1, in which L, C, and C1 represent the tuning coil, variable condenser, and trimmer of one of the signal-frequency circuits, the arrangement being in no way different from an ordinary straight set. In the oscillator circuit the inductance has a lower value L*o*, but the variable condenser C*o* is identical with C of the signal-frequency circuits. The correct frequency displacement of the oscillator circuit is obtained by assigning the correct values to L*o*, the padding condenser C2, and the parallel trim-

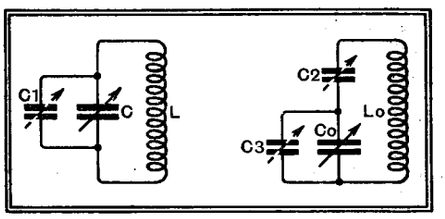
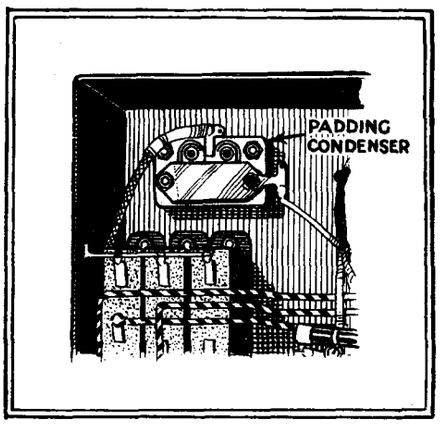


Fig. 1.—A signal-frequency circuit can be represented by the coil L and tuning condenser C, with a parallel trimmer C1. The oscillator tuning condenser Co is identical with C, but Lo is smaller than L and a padding condenser C2 is introduced.

The Art of Ganging—

ming condenser C3. Strictly speaking, completely accurate ganging is obtainable with this circuit at three points only in the tuning range, but with careful design the errors at other portions of the range can be made negligible.



Instead of using a semi-variable condenser adjustable over a fairly wide range for padding, a very small adjustable condenser is sometimes used in parallel with a fixed condenser.

The values assigned to the various components depend upon the value of the intermediate frequency employed, and are readily calculable from known formulæ. Such formulæ would be out of place in a booklet of this nature, but those interested can obtain full information from *The Wireless Engineer.** When L has the usual value of 157 mH, Lo normally becomes about 126 mH., and C2 some 0.001/0.002 mfd. for an intermediate frequency of 110 kc/s.

Although it is a matter of interest to calculate the exact values required for the components, this is of little practical value, for it is usually necessary to start with approximate values and adjust them experimentally. It is safe to assume that the coils have the correct inductance values, and that no adjusting is required here, for it will be the usual practice to employ a set of matched coils. The problem of adjusting the ganging, therefore, resolves itself into that of adjusting the signal-frequency trimmers C, the oscillator trimmer C3 and the padding condenser C2 of Fig. 1. For the moment we shall assume that the intermediate-frequency circuits are adjusted to their correct frequency, whatever this may be.

The first step is to set the padding condenser C2 at maximum, and then to adjust the trimmer C3 to a probable value, say, about one-half of its capacity. A station should then be tuned in on as low a wavelength as possible, certainly below 250 metres, or 1,200 kc/s. The trimmers on the signal-frequency circuits must next be adjusted for maximum signal strength, as determined by the loudest signals or by the maximum deflection of a visual tuning indicator, as explained in the section dealing with straight sets. Should one or more of the signal-frequency trimmers have to be fully screwed up or fully unscrewed, the oscillator trimmer is set at the wrong value. When one of the signal-frequency trimmers is fully screwed up, therefore, the oscillator trimmer should be unscrewed slightly, and the station retuned at a slightly lower dial setting, and this process should be repeated until a definite optimum setting for each trimmer is secured. Should one of the signal-frequency trimmers be fully unscrewed, of course, the process must be reversed—that is, the oscillator trimmer must be screwed up a little and the station retuned at a slightly lower dial setting. No attempt should be made to adjust the oscillator trimmer at this wavelength other than in the manner described.

The tuning dial should now be so set that a station on a wavelength of some 500 metres, or slightly less, would be received if the circuits were ganged. This will usually correspond to a dial setting of some 80° on a 100° dial, or 144° on a 180° dial. The condenser C2 should now be unscrewed until a station is heard. If no station can be received, try again with a slightly different dial setting.

In practically all superheterodynes the dial settings are determined by the constants of the oscillator circuit, so that it is useless to try and gang the set by an adjustment to the oscillator trimmer alone; whenever any adjustment is made to the oscillator trimmer or padding condenser, another adjustment must be made simultaneously. When a station has been found, therefore, the capacity of C2 should be altered with one hand, while the capacity of the variable condenser is changed in the opposite direction with the other hand, so that the station is kept in tune. Thus, C2 should be slowly reduced, while the dial setting is increased to maintain the station in resonance. If signals increase in strength, this process should be continued until a point is reached after which a further continuation reduces signal strength. The correct combination of settings is that leading to the greatest signal strength. Should the reduction in C2 initially lead to a reduction of signal strength, of course the process should be reversed, and C2 increased while reducing the dial setting.

(To be continued.)

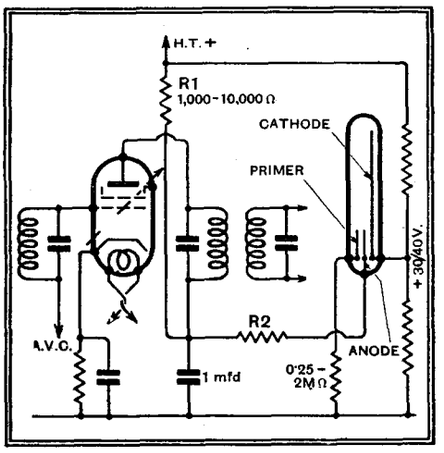
* "Ganging the Tuning Controls of a Superheterodyne Receiver," by A. L. M. Sowerby, M.Sc., *The Wireless Engineer*, February, 1932.

Visual Tuning Indicator

New Cossor Neon Tube

A TUNING indicator of the neon type has recently been placed on the market by Cossor. It consists of a narrow glass bulb about three inches long, fitted with a bayonet-type base containing three electrodes. When the correct potentials are applied to these electrodes a faint glow can be seen at the bottom of the tube, but when the anode potential increases the glow rises up the tube. Varying the anode potential of the tube, therefore, causes a column of light to rise and fall in the tube.

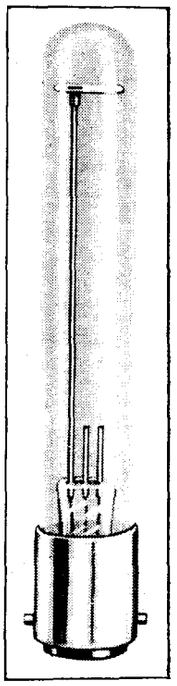
In practice, the cathode is connected to a point on a voltage divider about 30-40 volts positive with respect to negative H.T. The priming electrode is connected to negative H.T. through a resistance of some 0.25-2 megohms. The neon tube anode is joined either directly or through a resistance R2 to the H.T. end of the intervalve coupling of one of the valves controlled from the A.V.C. system. Decoupling must be included in the anode circuit of this valve, and the resistance will usually be as high as possible, consistent with other requirements.



Circuit arrangement for incorporating the tuning indicator.

On tuning in a signal the A.V.C. system applies a negative bias to the controlled valve, with the result that the anode current falls. Owing to the inclusion of the decoupling resistance R1 in the anode circuit, however, the anode voltage rises, and the anode potential of the neon tube also rises. The net result of tuning in a signal is that the column of light rises by an amount which is greater the greater the signal strength. Tuning, therefore, is carried out for maximum height of the column of light.

In some cases the resistance R2 may not be needed, but if it be found that the light fills the tube on a weak signal, it should be given a value of some 10,000-30,000 ohms. The tube normally passes a current of 3 mA., and it requires a potential of at least 160 volts for its operation. The tube is priced at 4s. 6d., and it fits a two-contact bayonet holder of motor car type.



Cossor neon-type tuning indicator.

IT is hardly an exaggeration to say that a few years ago it was only a question of time before the primary winding of an L.F. transformer developed an intermittent lack of continuity. Since then the technique of transformer manufacture has developed enormously, and faults are comparatively few and far between. But sometimes they do still develop, and so it is worth while to draw attention to a method of testing which is efficacious in locating

Tracing Transformer Faults

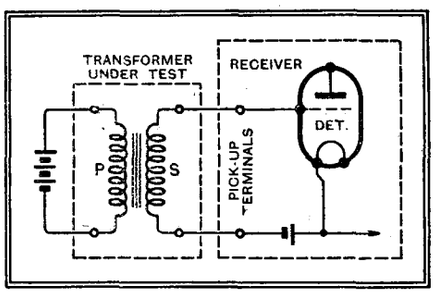


Fig. 1.—Sensitive test for transformer primary defects.

a defect in its early stages—while there is only a minute break in the wire, which causes intermittent cracklings, but not a total failure of signals.

For the test to be described, one needs an accommodating friend with a set fitted with pick-up terminals and known to be in good working order. The procedure is to remove the suspected transformer from one's own receiver, and to join it to the pick-up terminals of the testing set in the manner shown in Fig. 1. A dry-cell battery—a $4\frac{1}{2}$-volt flash-lamp battery will generally do—is joined across the primary terminals, and if everything is in order no sound should be heard in the loud speaker beyond the initial click on completing the primary battery circuit. If, however, the primary winding be defective, even slightly, minute variations in the battery current flowing through it will take place, voltages will be introduced into the secondary, applied to the amplifier, and magnified to such an extent that they will become audible as loud cracklings in the loud speaker.

It is sometimes worth while going to the length of applying to the primary terminals such a voltage that will drive through the winding the same value of current as it passes in normal service; by doing so, the test is made more conclusive.

Simplified Aids to Better Reception

FROM more points of view than one, the grid circuit of a detector valve is a danger point; it is, in effect, the first link in the chain of L.F. amplification, and any spurious voltages applied at this point will be amplified to the fullest extent, and so are likely to cause interference. It is, for example, highly desirable that the radio-gramophone change-over switch (which is, of course, in the detector grid circuit) should be kept as far away as possible from wiring which carries mains current. It would be highly injudicious to combine this switch with the mains on-off switch unless very special precautions were taken.

A Vital Point

IT has already been pointed out that a resistance of quite a small fraction of an ohm cannot be tolerated in wiring that is common to the heater circuits of a number of A.C. valves; the current flowing in such a circuit is very much greater than in any other section of a wireless receiver, and the loss of voltage will be considerable unless care be taken.

Wiring the Heaters

In two-unit receivers, where the power transformer is mounted at some little distance from the receiver valves, it is a good plan to use, for the inter-connecting lead, ordinary "15-amp. flex," which is sold by most electrical dealers for wiring heavy-current domestic appliances.

IN the "Hints and Tips" section of *The Wireless World* for June 8th it was stated that a series-connected diode circuit offers the advantage of needing less filtering in order to prevent the application of H.F. energy to the L.F. amplifier which succeeds it. Unfortunately, however, one cannot always avail oneself of this advantage; for instance, in a "straight" set with ganged tuning it is hardly practicable, for the reason that the ganged condenser which tunes the circuit feeding the diode must normally be earthed, and thus the load resistance would be short-circuited.

Diodes and H.F. Filtration

A satisfactory way of overcoming this difficulty is indicated in Fig. 2. Instead of feeding the diode direct from the preceding tuned circuit, it is connected to an aperiodic secondary winding, the tuned coil being inserted in series with the anode of the preceding valve.

An ordinary H.F. transformer turned "back to front" (*i.e.*, with the tuned secondary used as a primary) is quite suitable for this purpose. The average commercial transformer designed to have a step-up ratio of about 1 : 2 will then have a step-down ratio of 2 : 1; this is about right for a diode connected in the usual manner, and, apart from other advantages, results may actually be better from the point of view of energy transference than the normal direct connection.

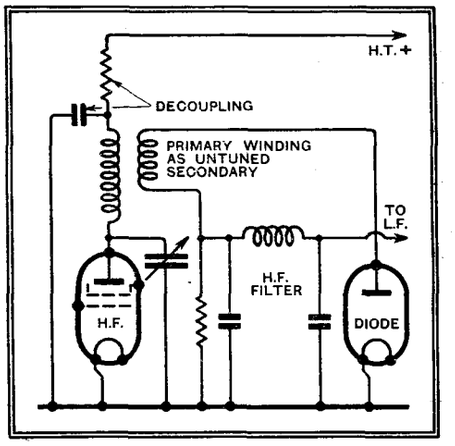


Fig. 2.—Feeding a diode from a "reversed" H.F. transformer, the secondary of which is used as a tuned-anode coil.

As an alternative to this scheme, it is practicable to employ an ordinary H.F. transformer in a tuned grid circuit, fed from an H.F. choke inserted in series with the anode of the preceding H.F. valve. The normal primary winding is again used as a secondary in the manner described.

IT has often been advised that, when building an "H.F." receiver, the ganged tuning condenser should be carefully earthed at more than one point. The same principle may often be applied with advantage when using commercial coil-and-condenser tuning units or packs, especially if the units are to be employed in circuits differing appreciably from those customarily recommended by their manufacturers.

Ready-made Tuning Units

These units are generally assembled on a metal chassis, to which the extra earthing connections should be made at any convenient points, in addition to the connection to the "earth" terminal.

News of the Week

Current Events in Brief Review

Receiver in a Lift

LIFTS are so frequently accused of causing interference with wireless reception that it is pleasant to learn that a receiver has been installed in a lift of a big building in Brussels. According to a Paris correspondent, reception is excellent both when the lift is in motion and in repose.

150kW for Deutschlandsender

AN order has been placed with the Telefunken Company for a new 150-kW. long-wave station to replace the existing 60-kW. plant of the Deutschlandsender, Berlin. Post Office engineers are now searching for a new site in the Berlin suburbs.

Ultra-short Waves in Flying School

ULTRA-SHORT waves are being used to teach air pilots at the Orly Flying School, France. The 'planes are equipped with transmitter-receivers and permanent aerials consisting of duralumin tubes. Pupils in flight can communicate by telephony with the ground or with other 'planes without any manipulation of the wireless apparatus. The range varies from 15 to 50 miles, according to the height of the 'plane. During the concluding stages of a flying course the instructor remains on the ground while directing his pupil with a running commentary of advice by wireless.

A Belgian "Warning"

THE Brussels journal *Peuple* has issued a warning against the alleged "danger" that the National Broadcasting Institute may lose its independence as the result of "certain Ministerial projects." According to the paper, the Post Office envisages the complete annexation of the broadcasting service. Moreover, it is alleged that certain of the moneys received from wireless licences is devoted to non-wireless activities, and readers are warned that it is proposed to utilise some of the cash to subsidise the Theâtré de la Monnaie, Brussels, and the Antwerp Opera.

The Belgian public might note that British listeners have long helped to subsidise opera in this country besides consenting to the use of some of the licence fees for purposes far divorced from radio.

Japanese 5-year Plan

THREE 150-kilowatt broadcasting stations at Tokio, Osaka and Kyosho are the latest projects of the Japanese Broadcasting Company, and already State credits have been granted amounting to approximately £1,623,000. From ten to fifteen Regional stations on lower power are included in the scheme, and according to the contracts the work will take approximately five years.

The Silent City

ACCORDING to a new "anti-noise" law drafted by the Turkish Ministry of the Interior, gramophones and wireless sets in Constantinople must not be used unless the window is shut. The police are empowered to levy fines on the spot.

Blow for Esperanto?

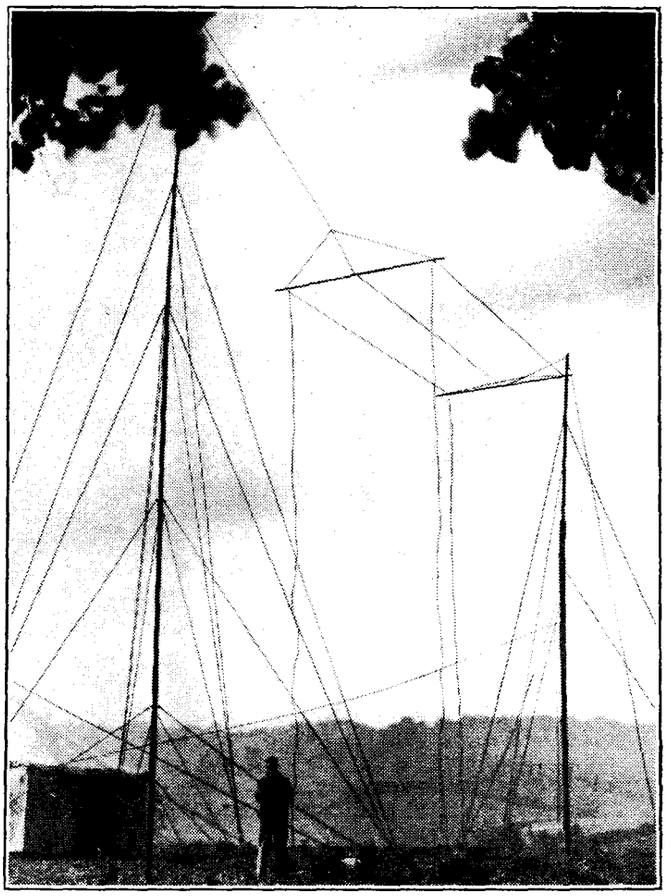
THE E.I.A.R.—the Italian broadcasting organisation—is credited with a scheme for regular broadcasting in Latin. It is believed that such transmissions would have an international appeal, as Latin is intelligible to scholars in all parts of the world.

Madrid Calls the World

THE International Short Wave Club has arranged a special world broadcast for short-wave listeners from EAQ Madrid from 00.00 to 00.30 B.S.T. on Monday, July 2nd, the wavelength being 30.40 metres. Reports of reception will be welcomed by the Club's European and Colonial representative, Mr. Arthur E. Bear, 10, St. Mary's Place, Rotherhithe, London, S.E.16.

Broadcast Advertisements Condemned

A RESOLUTION condemning broadcast advertising was put before the 20th International Congress of Press Associations at Brussels last week. The resolution ran: "This Congress is of the opinion that advertisements are the legitimate sphere of newspapers, and urges newspapermen, whether proprietors or journalists, to use their influence to prevent the dissemination of advertisements over the air."



CALLING THE WORLD ON SHORT WAVES. The radio camp of G5CV and G6YK, near Amersham, Bucks, on the recent National Field Day of the Radio Society of Great Britain. Amateurs all over the world participated by reporting the signals of the forty or more British portable stations taking part.

"Honest" Pirates in Russia

JUNE 1ST marked the opening of a campaign against Russian radio pirates. The scheme arose out of the discovery that, whereas 6,200,000 roubles should have been received from radio licences on May 15th, only 911,111 roubles, or 15 per cent., had come in. An army of young Communists is now being mobilised to ferret out the dishonest listeners and "to advise the honest ones, who are numerous, to pay *now*."

Slow Morse on Atlantic Flight

ALL short-wave listeners who can read Morse should keep watch when Mr. John Grierson makes a flight during July from London to Ottawa via Iceland, Greenland and Hudson's Bay. A short-wave transmitter, operating on about 40 and 20 metres, will give the machine's position every thirty minutes. Morse will be transmitted at six words per minute.

Those hearing the plane should telephone details to the Air Ministry in London.

R.S.G.B. Comes of Age

TO MARK the twenty-first anniversary of the formation of the Incorporated Radio Society of Great Britain, which occurs on July 5th next, the T. and R. Bulletin for June takes the form of a special birthday number. It includes a congratulatory message from the Society's patron, H.R.H. the Prince of Wales, besides contributions from many past presidents and other prominent members such as Sir Oliver Lodge, Senatore Marconi, Brig.-General Sir Capel Holden, Sir Ian Fraser, Dr. W. H. Eccles, Mr. Rene Klein, Mr. Leslie McMichael, and Mr. Gerald Marcuse.

Reference is made to the announcement in *The Wireless World* of August, 1913, of the birth of this now flourishing organisation. The original title was "The London Wireless Club."

Radio Messages to Yachts

TO enable yacht owners who are cruising to receive telegrams by radio telephony, the General Post Office has introduced a new Radio Telegraph Service. The yacht owner whose vessel is equipped with a sensitive wireless receiver and special alarm clock, can receive messages handed in or telephoned to a postal telegraph office. The message is sent out from the coast station on a wavelength of 177.5 metres. It is broadcast twice during the first five minutes of the scheduled period of watch keeping. The service will be available to all Post Office coast stations except Rugby and Portishead. Messages to coast stations are charged at the ordinary inland telegraph rate. The charge for the transmission by the coast station will be 6d. a word for a double transmission in any scheduled period.

No Sponsored Programmes for Czechs

DESPITE several recent efforts to introduce advertising into the Prague broadcasting programmes, the Czecho-Slovakian Broadcasting Company has reaffirmed its belief in the complete prohibition of trade propaganda at the microphone.

Page 431 follows after the Programme Supplement

PRINCIPAL BROADCASTING STATIONS OF EUROPE

Arranged in Order of Wavelength

(Stations with an aerial power of 50 kW. and above in heavy type)

Station.	Kc/s.	Tuning Positions.	Metres.	kW.
Kaunas (Lithuania)	155	.....	1935	7
Brasov (Roumania)	160	.....	1875	20
Huizen (Holland). (*Kootwijk, 50 kW. after 3.40 p.m.*) (*V.A.R.A. and A.V.R.O. Programmes.*)	160	.....	1875	7
Lahti (Finland)	166	.....	1807	40
Moscow, No. 1 (U.S.S.R.)	174	.....	1724	500
Radio Paris (France)	182	.....	1648	75
Istanbul (Turkey)	185	.....	1621	5
Königswusterhausen (Deutschlandsender) (Germany).	191	.....	1571	60
Daventry National	200	.....	1500	30
Ankara (Turkey)	200	.....	1500	7
Minsk (U.S.S.R.)	208	.....	1442	100
Reykjavik (Iceland)	208	.....	1442	16
Eiffel Tower (Paris)	215	.....	1395	13
Motala (Sweden). (*Relays Stockholm*)	216	.....	1389	30
Warsaw, No. 1 (Poland)	223	.....	1345	120
Luxembourg	230	.....	1304	150
Kalundborg (Denmark). (*Relays Copenhagen*)	238	.....	1261	75
Leningrad (U.S.S.R.)	245	.....	1224	100
Oslo (Norway)	260	.....	1154	60
Moscow, No. 2 (U.S.S.R.)	271	.....	1107	100
Rostov-on-Don (U.S.S.R.)	355	.....	845	20
Smolensk (U.S.S.R.)	364	.....	824	10
Geneva (Switzerland). (*Relays Sottens*)	401	.....	748	1.3
Moscow, No. 3 (U.S.S.R.)	401	.....	748	100
Boden (Sweden)	413.5	.....	726	0.6
Ostersund (Sweden)	413.5	.....	726	0.6
Oulu (Finland)	431	.....	696	2
Oufa (U.S.S.R.)	436	.....	688	10
Hamar (Norway)	519	.....	578	0.7
Innsbruck (Austria). (*Relays Vienna*)	519	.....	578	0.5
Ljubljana (Yugoslavia)	527	.....	569.3	5
Viipuri (Finland)	527	.....	569.3	13
Bolzano (Italy)	536	.....	559.7	1
Wilno (Poland)	536	.....	559.7	16
Budapest, No. 1 (Hungary)	546	.....	549.5	120
Beromunster (Switzerland) (Schweizerischer Landessender).	556	.....	539.6	60
Athlone (Irish Free State)	565	.....	531	60
Palermo (Italy)	565	.....	531	4
Mühlacker (Stuttgart) (Germany)	574	.....	522.6	100
Riga (Latvia)	583	.....	514.6	15
Agen (France)	583	.....	514.6	0.6
Vienna (Bisamberg) (Austria)	592	.....	506.8	120
Radio Maroc (Morocco). (*S.-w. Stn., 48 m.*)	601	.....	499.2	6.5
Sundsvall (Sweden). (*Relays Stockholm*)	601	.....	499.2	10
Florence (Italy). (*Relays Turin*)	610	.....	491.8	20
Brussels, No. 1 (Belgium). (*French Programme.*)	620	.....	483.9	15
Lisbon (Portugal)	629	.....	476.9	20
Trondheim (Norway)	629	.....	476.9	1.2
Prague, No. 1 (Czechoslovakia)	638	.....	470.2	120
Lyons, PTT (France)	648	.....	463	15
Cologne (Germany)	658	.....	455.9	60
North Regional (Slaithwaite)	668	.....	449.1	50
Sottens (Switzerland) (Radio Suisse Romande)	677	.....	443.1	25
Belgrade (Yugoslavia)	686	.....	437.3	2.5
Paris, PTT (France)	695	.....	431.7	7
Stockholm (Sweden)	704	.....	426.1	55
Rome, No. 1. (*Short-wave station, 25.4 metres*)	713	.....	420.8	50
Kiev (U.S.S.R.)	722	.....	415.5	100
Tallinn (Estonia)	731	.....	410.4	20
Seville (Spain)	731	.....	410.4	1.5
Munich (Germany)	740	.....	405.4	100
Marseilles, PTT (France)	749	.....	400.5	5
Katowice (Poland)	758	.....	395.8	12
Midland Regional (Daventry)	767	.....	391.1	25
Toulouse, PTT (France)	776	.....	386.6	2
Leipzig (Germany)	785	.....	382.2	120
Barcelona, EAJ1 (Spain)	789.8	.....	379.8	5
Lwow (Poland). (*Relays Warsaw*)	795	.....	377.4	16
Scottish Regional (Falkirk)	804	.....	373.1	50
Milan (Italy). (*Relays Turin*)	814	.....	368.6	50
Bucharest (Roumania)	823	.....	364.5	12
Moscow, No. 4 (U.S.S.R.)	832	.....	360.6	100
Berlin Funkstunde. (*Short-wave Stations,*) 16.89, 19.73, 25.5, 31.38 *and* 49.83 *metres.*)	841	.....	356.7	100
Bergen (Norway)	850	.....	352.9	1
Valencia (Spain)	850	.....	352.9	1.5
Strasbourg (France)	859	.....	349.2	15
Poznan (Poland)	868	.....	345.6	16
London Regional (Brookmans Park)	877	.....	342.1	50
Graz (Austria). (*Relays Vienna*)	886	.....	338.6	7
Limoges, PTT (France)	895	.....	335.2	0.5
Helsinki (Finland)	895	.....	335.2	10
Hamburg (Germany)	904	.....	331.9	100
Radio Toulouse (France)	913	.....	328.6	10
Brno (Czechoslovakia)	922	.....	325.4	32
Brussels, No. 2. (*Flemish Programme*)	932	.....	321.9	15
Algiers (Algeria)	941	.....	318.8	12
Göteborg (Sweden). (*Relays Stockholm*)	941	.....	318.8	10
Breslau (Germany)	950	.....	315.8	60
Poste Parisien (France)	959	.....	312.8	100
Grenoble (France)	968	.....	309.9	20
West Regional (Washford Cross)	977	.....	307.1	50
Cracow (Poland)	986	.....	304.3	2
Genoa (Italy). (*Relays Turin*)	986	.....	304.3	10
Hilversum (Holland). (*KRO and NCRV*) (*7 kW. till 5.40 p.m.*).	995	.....	301.5	20
Bratislava (Czechoslovakia)	1004	.....	298.8	13.5
North National (Slaithwaite)	1013	.....	296.2	50
Königsberg (Germany)	1031	.....	291	60
Parede (Portugal)	1031	.....	291	5
Rennes, PTT (France)	1040	.....	288.5	2.5
Scottish National (Falkirk)	1050	.....	285.7	50
Bari (Italy)	1059	.....	283.3	20
Bordeaux-Lafayette	1077	.....	278.6	12
Zagreb (Yugoslavia)	1086	.....	276.2	0.7
Falun (Sweden)	1086	.....	276.2	2
Madrid, No. 2 (EAJ7)	1095	.....	274	7
Naples (Italy). (*Relays Rome*)	1104	.....	271.7	1.5
Madona (Latvia)	1104	.....	271.7	20
Radio Vitus (Paris)	1113	.....	269.5	2
Kosice (Czechoslovakia). (*Relays Prague*)	1113	.....	269.5	2.6
Belfast	1122	.....	267.4	1
Nyiregyhaza (Hungary)	1122	.....	267.4	6.2
Hörby (Sweden). (*Relays Stockholm*)	1131	.....	265.3	10
Turin, No. 1 (Italy)	1140	.....	263.2	7
London National (Brookmans Park)	1149	.....	261.1	50
West National (Washford Cross)	1149	.....	261.1	50
Moravska-Ostrava (Czechoslovakia)	1158	.....	259.1	11.2
Monte Ceneri (Switzerland)	1167	.....	257.1	15
Copenhagen (Denmark). (*S.-w. Stn., 31.51 m.*)	1176	.....	255.1	10
Frankfurt (Germany)	1195	.....	251	17
Trier, Cassel, Freiburg-im-Breisgau and Kaiserslautern.	1195	.....	251	—
Prague, No. 2 (Czechoslovakia)	1204	.....	249.2	5
Lille, PTT (France)	1213	.....	247.3	5
Trieste (Italy). (*Relays Turin*)	1222	.....	245.5	10
Gleiwitz (Germany). (*Relays Breslau*)	1231	.....	243.7	5
Cork (Irish Free State)	1240	.....	241.9	1
Juan-les-Pins (France)	1249	.....	240.2	2
Rome, No. 3 (Italy)	1258	.....	238.5	1
San Sebastian (Spain)	1258	.....	238.5	3
Nürnberg and Augsburg (Germany)	1267	.....	236.8	2
Bodö, Stavanger and Kristiansand (Norway)	1276	.....	235.1	0.5
Dresden (Germany)	1285	.....	233.5	1.5
Aberdeen	1285	.....	233.5	1
Linz, Klagenfurt and Salzburg (Austria)	1294	.....	231.8	0.5
Danzig. (*Relays Heilsberg*)	1303	.....	230.2	0.5
Swedish Relay Stations	1312	.....	228.7	0.25
Budapest, No. 2 (Hungary)	1321	.....	227.1	0.8
Hanover, Bremen, Flensburg, Stettin and Magdeburg.	1330	.....	225.6	1.5
Montpellier, PTT (France)	1339	.....	224	5
Lodz (Poland)	1348	.....	222.6	1.7
Bordeaux Sud-Ouest (France)	1348	.....	222.6	1
Dublin	1348	.....	222.6	1
Milan, No. 2 (Italy)	1356.5	.....	221.2	4
Turin, No. 2	1365	.....	219.8	0.2
Warsaw, No. 2 (Poland)	1384	.....	216.8	2
Lyons (Radio Lyon) (France)	1393	.....	215.4	5
Tampere (Finland)	1420	.....	211.3	1.2
Newcastle	1429	.....	209.6	1
Béziers (France)	1429	.....	209.9	2
Radio, LL (Paris)	1435	.....	209	2
Minsk (U.S.S.R.)	1438	.....	208.6	100
Fécamp (Radio Normandie)	1456	.....	206	10
Pecs (Hungary)	1465	.....	204.7	1.25
Bournemouth	1474	.....	203.5	1
Plymouth	1474	.....	203.5	0.3
Nimes (France)	1492	.....	201.1	0.2

The Short-Wave World

THE spell of good conditions that was reported in the last instalment of these notes proved to be rather short-lived. It was unfortunate for the National Field Day organised by R.S.G.B. on June 9th and 10th that most American signals were conspicuous by their absence. Some very good contacts were established, however, on the 80- and 160-metre bands, one of the Surrey stations working a Newfoundland amateur on 80 metres.

A prophecy made in these notes last autumn would appear to have come true—that, when conditions generally are bad, 80 metres or thereabouts appears to be the "optimum" wavelength. This will only hold good for a limited period. Probably by this time next year 40 metres will be the brightest spot in the short-wave spectrum.

Reverting to National Field Day, it may be noted, in passing, that the average amateur transmitter takes to "Field" work like a fish to water! Some of the spectacles seen at the various impromptu stations suggest a degree of ingenuity and audacity not usually suspected among "hams."

One of the principal ingredients of a field station appears to be a motor car which is gradually stripped of its electrical equipment. In one such case the car batteries were being used for running a generator; the head lamps were used throughout the night suspended at various angles over the transmitter, and the electric horn was used next morning for broadcasting the latest news to visitors!

Quite apart from this, the dynamo was pressed into service for recharging the accumulators, and at meal times the general aspect of the car resembled that of a very large dumb-waiter.

It should be understood that the derogatory remarks about conditions apply chiefly to the amateur bands, which naturally suffer more changes than do the short-wave broadcast bands. On the latter most of the better-known stations continue to come in well.

The outstanding transmission from the U.S.A. during the past fortnight has been W1XAZ (Springfield, Mass.) on 31.35 metres. The best station on the 31-metre band always used to be the famous W2XAF at Schenectady, but the use of aerial systems directional for the Byrd expedition has naturally reduced their strength in this country by such an amount that they are hardly worth listening to.

On the 49-metre band, atmospherics have been very troublesome of late, but W8XK (Pittsburgh) and W8XAL (Cincinnati) have both been reliable and strong. The tremendous list of Colombian broadcasting stations continues to grow, but just at present conditions are better for the U.S.A. than for South America.

Two of the Venezuelans, YV1BC on 49.08 and YV5BMO on 49.42 metres, have been received once or twice, and sometimes reach quite a good strength.

Letters from a reader in South Africa are rather enlightening. In this country it is somewhat natural for us to think of short waves in terms of "America." In South Africa they think first of Europe, and receive European stations that most of us in England have never bothered to listen to.

The particular reader referred to finds Zeesen and Radio Coloniale (Pontoise) both stronger than Daventry, but he comments very unfavourably upon their programmes.

It is interesting to note that the Empire station has set them quite a new standard of quality and announcing. A ballot recently held in Durban resulted in an overwhelming vote for the Daventry announcer as the best on the air.

MEGACYCLE.

The Diary of an Ordinary Listener

DESPITE the prevalent sunspots and, perhaps, the drought, atmospherics have recently been in less evidence, and listening to distant stations has been really worth while. After listening the other evening to Moscow, where the aims and objects of the forthcoming Geological Expeditions to the Arctic Regions were being set forth, I met with an unexpected treat from Radio Paris, where—if I understood the announcer aright—the orchestra, conducted by Toscanini, were giving a splendid rendering of Bach's music. This may have been a gramophone record, but it certainly sounded well.

Poste Parisien gave a very varied programme on Friday, June 8th, which began, as far as I was concerned, with Oscar Strauss's "Waltz Dream," relayed from the Porte-Saint-Martin Theatre, followed by a well-chosen programme arranged for English listeners by the International Broadcasting Company. Rome was also coming in clearly with a Bizet concert by the Station orchestra. Juan-les-Pins, which entertained us later in the evening with an excellent programme of light music, comes in so clearly that I am inclined to think it must have increased its power beyond the modest 2 kW. with which it is credited in both French and English technical journals.

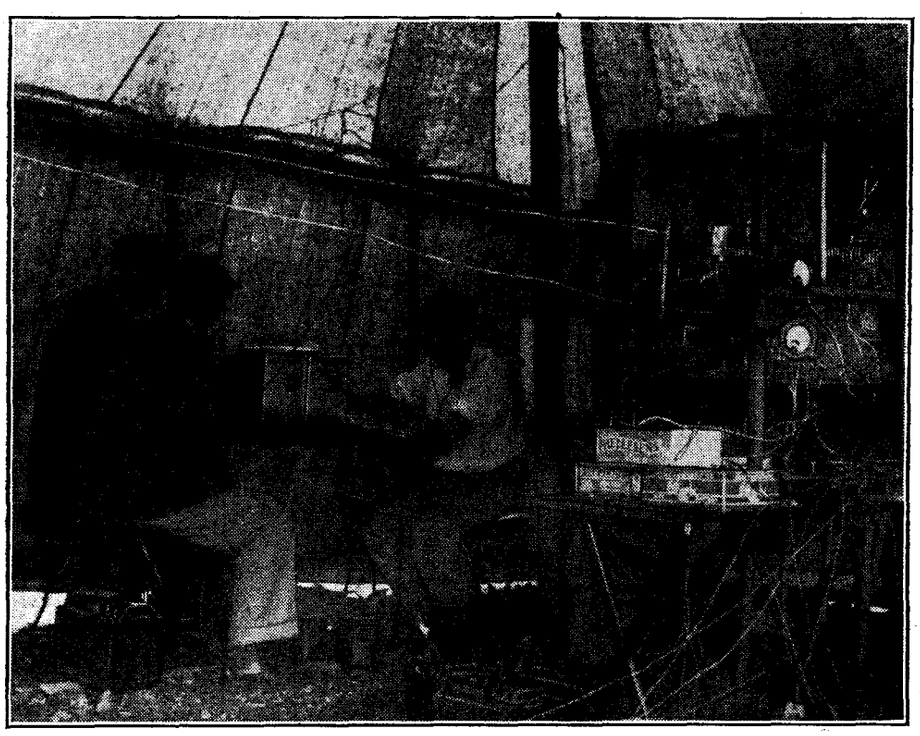
On Saturday the Dresden Philharmonic orchestra gave a very interesting concert of selections from operettas by Johann Strauss, Suppé, Dellinger, and other composers, which was relayed by Leipzig; while Deutschlandsender transmitted a good programme from Brandenburg, in which the musical reputation of that town was fully maintained.

Monday of last week was mainly given up to commemorating the seventieth birthday of that famous composer and conductor, Richard Strauss, the German stations transmitting a performance of "Der Rosenkavalier" from the Dresden State Opera House, while both Warsaw and Kalundborg devoted their evening concert to his music. Turning to somewhat lighter fare I found the programme for English listeners from the Poste Parisien quite entertaining, especially a potpourri entitled "Fifty Years of Song," wherein my pre-war memory was refreshed with such old favourites as "Ta-ra-ra-boom-de-ay" and "After the Ball."

French Music from Germany

The German stations revelled on Tuesday evening in French music performed by the Berlin Philharmonic orchestra, conducted by Henri Busser, which included Gounod's Symphony in E flat minor, and Debussy's "Petite Suite," arranged by the conductor. I was greatly struck with the fine singing of Germaine Hoerner, whose clear voice came out well in her selection of French songs. During the latter part of the Berlin concert I found that the penetrating notes of jazz (to which I have before alluded) were creeping in from London Regional, so switched over to Radio Paris, where I found dance music in full swing. Somehow there seems more life and piquancy in the French than in the Anglo-American variety of jazz. Their "crooners" are not afraid to *sing*, in marked contrast to the emasculated wailings with which our ears are so often assailed.

CALIBAN.



R.S.G.B. NATIONAL FIELD DAY G5CV and G6YK are seen in action with the West London District portable transmitter near Amersham during the competition referred to above.

BROADCAST BREVITIES

By Our Special Correspondent

Sir John Reith's Guests

SUNDAY last was the only day on which the delegates to the U.I.R. meeting in London were "free." Some of them took the opportunity, piloted by Mr. Arthur Burrows, the Secretary, to visit Sir John Reith at "Harrias," the "D.G.'s" Beaconsfield home.

The gathering was pleasantly informal, and the only official touch came at eventide, when, as the party drove out from the lodge gateway, the village policeman stood at the salute.

Last Days of "No. 10"

"DEFINITELY the last appearance" of the old No.10 studio under Waterloo Bridge may be expected in the next few weeks. Although the B.B.C. is fondly clinging to this acoustically ideal building, it is to be doubted whether with the coming demolition of Waterloo Bridge it will be possible to continue concerts in the warehouse.

Pneumatic drills and falling masonry will make daytime rehearsals impossible, and if, as seems likely, the bridge breakers carry on into the night, No.10 will have to be restricted to recitals of modern music, to which such interruptions add realism and presumably charm.

Maida Vale Marvels

Meanwhile, the Maida Vale skating-rink is being rapidly transformed into a Palace of Broadcasting. The new studio is actually a building within a building, for the original walls serve simply as a shell. The new studio, equipped with the latest type of sound-proof walls, will be the last word in broadcasting architecture.

Green Rooms and a Restaurant

There will be a restaurant and green rooms attached to the studio, besides a number of offices, so that the new establishment promises to be a Broadcasting House in miniature.

It will not, however, replace St. George's Hall in the matter of variety performances.

Flagging Enterprise

THE flag department at Broadcasting House was badly stumped last week on the occasion of the sudden visit of Their Majesties the King and Queen of Siam. Happening to be in the building at the time, I rushed into the street to witness the solemn unfurling of the Siamese standard; judge of my disappointment on seeing only the B.B.C. house flag, flippantly referred to as the "Star and Garter."

Gunfire ?

By the way, I suggest that distinguished visitors should be greeted by gunfire reproduced by gramophone records on the loud speaker over the clock.

Touring the Building

During his tour of the building the King of Siam showed particular interest in the light signals communicating between studios and control room. Sir John Reith delighted in showing the Queen the mysteries of electrical recording, and Her Majesty, after speaking a few words into the microphone, listened to a reproduced version on the loud speaker

A Programme from Canada

AN interesting radio debut occurs on July 1st, Dominion Day, when the Canadian Broadcasting Commission transmits to Great Britain for the first time. National programme listeners will hear a programme comprising a recital by Percival Price, the Dominion carillonneur, at Ottawa, selections by the Canadian Grenadier Guards' Band at Montreal, and the Mendelssohn Choir of 1,000 voices, relayed from Toronto. It is hoped that Mr. R. B. Bennett, Prime Minister of Canada, will go to the Ottawa microphone to broadcast a message to British and Canadian listeners.

"EFFECTS" IN A FILM STUDIO. The kinship between broadcasting and film technique is shown in this photograph, taken in the studios of British International Pictures, Elstree. With the aid of shoes and plywood, the "effects" men are grafting the sound of dancers' feet on to a silent film which they are watching on the screen.

That Stratosphere Broadcast

WHY has the B.B.C. decided not to relay to-day's stratosphere broadcast? Major William Kepner and Captain Albert Stevens, ascending in the world's largest balloon, are going to the trouble of taking a midget transmitter, and their messages are to be relayed all over the American continent by the medium- and short-wave stations, including 2XAF, Schenectady.

No doubt many *Wireless World* readers need no help from the B.B.C. in picking up such a transmission, but there are many folk in this country who could only experience the thrill of hearing a voice fifteen miles above the earth by means of their ordinary broadcast receivers.

Wanted: Originality

The "O.B." department of the B.B.C., who must take the responsibility of rejecting this broadcast, appear to be suffering from a sports complex. They will go to any length, or, at least, as far the cable will stretch, to give us those prearranged sporting and military events which do not call for very much originality and imagination. Yet, when something really unusual offers itself for a relay, the "O.B." people appear to be elsewhere.

A Man of the World

CHRISTOPHER STONE, who celebrates on July 7th the seventh anniversary of his first weekly broadcast of gramophone records, is to give a recital for children on July 21st in the Children's Hour.

Mr. Stone claims, among other things, a peculiar acquaintance with the racecourse, for when he enlisted in 1914 he was sent to Kempton Park, where for some time he lived in a horse-box. His military experiences, too, seem to be unique, for, during the War, he commanded his battalion for a fortnight, "at the end of which" (to quote his own words) "it was hurriedly disbanded by the War Office."

A Band of Champions

ON July 16th National programme listeners are to hear the Vancouver Kitsilano Boys' Band. This broadcast takes place a few days after the band arrives in England from Vancouver. The band, which consists of forty boys whose ages range from twelve to eighteen, during its six weeks' stay will tour the principal South Coast resorts and fulfil other engagements. It has a splendid reputation behind it, having scored such notable achievements as the Eastern Canadian Championship (1931), Pacific, North-West and British Columbian Championship (1931, 1932, 1933), and the World Championship at Chicago (1933).

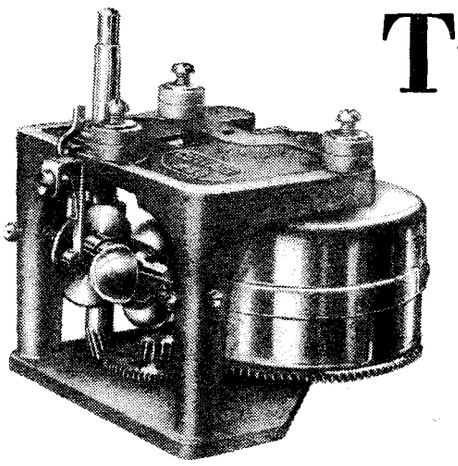
Discovered in a Bookshop

"BEAUTY and the Jacobin," which is to be heard by Regional listeners on July 5th and by National listeners on July 6th, is not so well known as that other play, "Monsieur Beaucaire," also by Booth Tarkington. John Inglis, who will produce the play, discovered it in a bookshop some years ago, and, by his instigation, it was produced by amateurs. Mr. Inglis played the part of Louis. He found it somewhat difficult to get hold of a copy as the play is now apparently out of print, but eventually, with the aid of the publishers, a copy was procured. Mr. Inglis, who joined the production staff of the B.B.C. last January, has already produced the broadcast of "The Dorsetshire Labourers" and "The Sheffield Outrages."

Vacancy for a Loud Speaker

NEW settees in the Broadcasting House entrance hall on the side remote from the enquiry desk make it necessary for the receptionists to bawl like toast-masters, especially when the caller is somnolent after a long wait.

A public address system seems indicated.



Collaro governor-controlled double spring motor.

Turning the Record

Methods of Speed Control in Gramophone Motors of Different Types

By E. C. WADLOW, Ph.D., B.Sc.

(Concluded from page 408 of the previous issue)

IN the first part of this article the forces contributing to the retarding torque on the turntable were discussed and figures given for values met with in practice. The concluding instalment deals with the methods of speed control in current use and discusses their relative advantages and disadvantages.

USING the figures quoted at the end of the first part of this article as a basis, and neglecting the effects of accidental mechanical imperfections, it will be interesting to compare the different systems of speed control which are commonly used. These comprise the mechanical centrifugal governor which is used on both spring and electric motors, and systems of electrical control depending on the supply frequency and employed in synchronous motors.

The centrifugal governor,[1] which until a few years ago was almost universally used for controlling the speed of gramophone motors, is shown in Fig. 7. Its use dates back to the earliest days of the gramophone, for it was introduced in 1877 by Stroh when he made a copy—but incorporating a spring motor—of the original phonograph invented by Edison in America earlier the same year.

Its action is briefly as follows. Imagine a record to be placed on the turntable and that the motor is allowed to gather speed. The governor weights fly outwards and through the springs, which are anchored at one end, draw the disc and sleeve along the spindle. In due course the rotating disc comes into contact with the fixed pad, but the speed still increases until the pressure between the disc and the pad reaches a value where the energy being wasted in friction at this point is equal to the energy output of the motor. When the pick-up is lowered on to the record a certain amount of energy is required to drive the latter against the needle load, and the speed falls slightly until there is a reduction of a corresponding amount in the power dissipation at the governor pad. The power output of the motor is utilised partly at the needle point and partly at the governor disc, the former taking as much as it requires and the latter having to deal with the excess. The motor speed is thus dependent upon the torque required to drive the record, the motor torque and the sensitiveness of the governor employed.

This state of affairs is illustrated for both spring and electric motors, respectively, in Fig. 8. In this diagram the motor torque is shown by the lines (A) and the torque necessary to turn the record by the line (B).

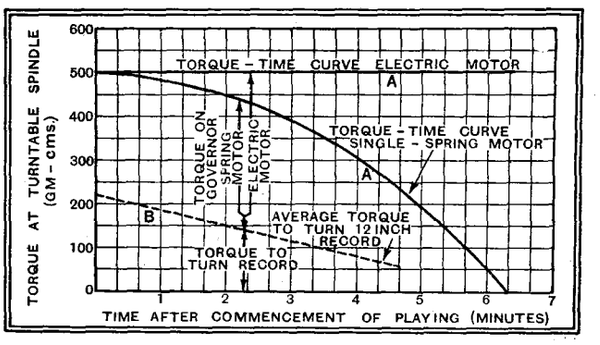


Fig. 8.—Comparison of torque distribution in spring and electric motors controlled by governors.

It should be realised, of course, that the position of the lines (A) and (B) relative to one another, and also their shapes, are not in any way fixed. Records differ considerably in physical dimensions, although of the same nominal size, i.e., 12-inch, 10-inch, etc. Some idea of the range encountered will be obtained from Table I. These are not extremes but are, perhaps, exceptional cases.

Torque Distribution

The shape of the "torque-time" curve for the spring motor will also vary, depending chiefly on whether it has been designed to play one, two, or more records.

In the case of the electric motor it is assumed that the torque is constant. In practice this is never so. A slight ripple is always present. Other changes occur in unison with fluctuations in mains voltage, and with the temperature changes in the coils of the motor, which gradually heat up in use. However, these effects are small and of secondary importance, and, while being worthy of mention, cannot be dealt with in detail.

Returning to Fig. 8, the amount of power with which the governor has to deal is given at any instant by the difference between the ordinates of the curves (A) and (B): For a spring motor it may be

[1] *The Engineer*, February 9th, 1934, p. 142.

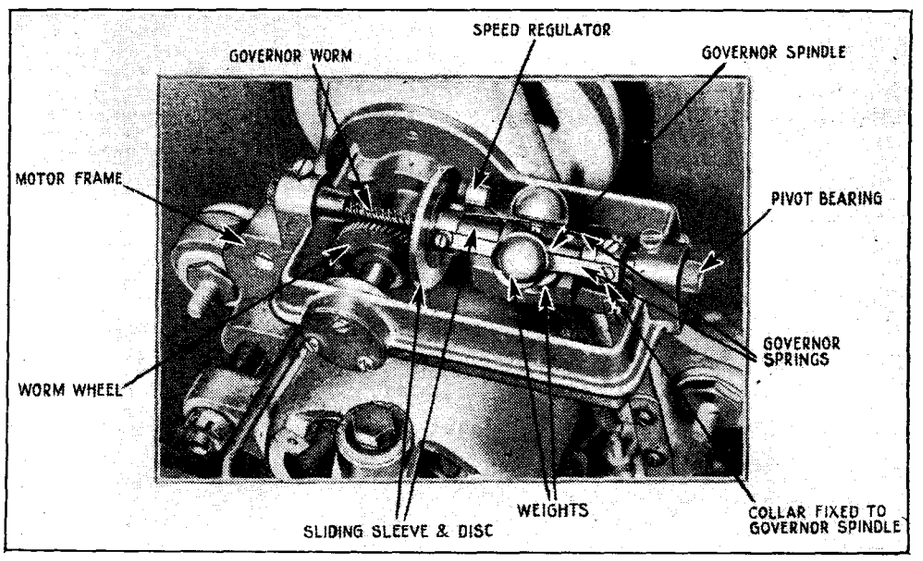


Fig. 7.—Constructional details of a typical centrifugal governor.

Turning the Record—

almost constant in amount as the two curves may be arranged to fall away together, but with the electric motor the power to be dissipated at the governor disc increases as playing proceeds. This will

TABLE I.

RANGE OF RECORD SIZES.

Nominal Size.		Total Playing Revolutions.	Max. Playing Radius. Cms.	Min. Playing Radius. Cms.
12-inch	(a)	408	14.7	4.7
	(b)	275	14.5	7.5
10-inch	(a)	270	12.0	4.7
	(b)	150	12.0	6.7

be accompanied by an increase in motor speed.

The importance of using a sensitive governor may be illustrated by taking actual figures, and it will be assumed that the speed has been initially adjusted exactly to 78 r.p.m. with the needle tracking the grooves at the periphery of a 12-inch record, that the initial motor torque is 500 gm.-cms. in both cases, and that the torque to drive the record is 220 gm.-cms. at the periphery and 60 gm.-cms. at the inside. The speeds under various conditions will then be somewhat as shown in Table II.

TABLE II.

EFFECT OF GOVERNOR SENSITIVENESS ON SPEED.

Type of Motor.	Condition of Running.	Variation in Speed. Per cent. Governor A. Sensitiveness, 500 gm.-cms. for 1 per cent. Speed Change.	Governor B. Sensitiveness, 125 gm.-cms. for 1 per cent. Speed Change.
Single-spring	Before lowering needle.	+0.44 (fast)	+1.76 (fast)
	Start of record	Correct	Correct
	End of record	−0.20 (slow)	−1.00 (slow)
Electric	Before lowering needle.	+0.44 (fast)	+1.76 (fast)
	Start of record	Correct	Correct
	End of record	+0.32 (fast)	+1.28 (fast)

These figures are also interesting as showing the spring motor in a favourable light. Properly designed and used it is capable of giving better results in respect of speed than are obtainable with a governor-controlled electric motor, but if the spring is weak or is insufficiently wound the results may be decidedly inferior.

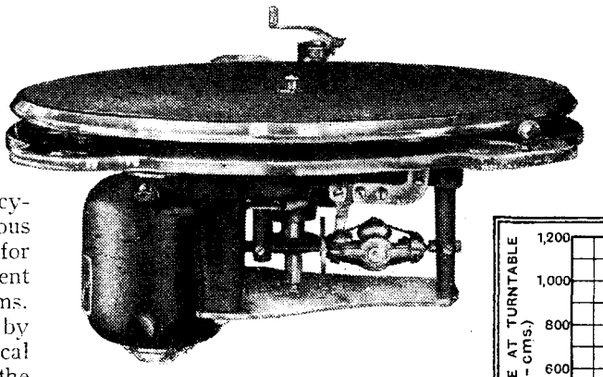
With the advent of frequency-controlled mains, synchronous motors have been introduced for record driving, and they present new and interesting problems. While they have to be started by hand they need no mechanical governor, which simplifies the construction of the motor by eliminating one of its most delicate components. The speed is now determined by the frequency of the alternating current supply. If this rises the speed increases, and vice versa. But the frequency variation on controlled supplies is very small indeed, as measurements show. For instance, Nancarrow[2] found that the variation over a period of hours for a London supply was between −0.182 per cent. and +0.146 per cent.

This by itself, however, has been found insufficient to guarantee good reproduction with synchronous motors, as imperfections in rotor and stator tooth spacings, air gap variations, and so on, still gave rise to small, but very objectionable, speed variations.

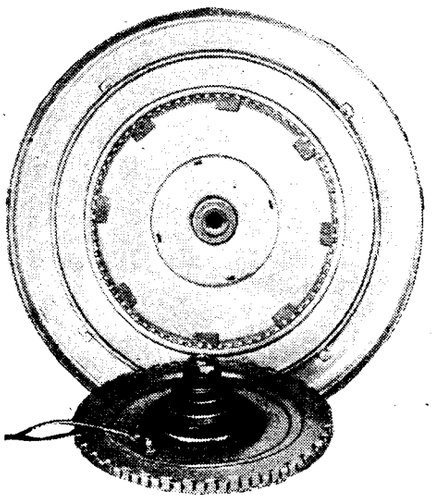
Fluctuations in Synchronous Motors

It may be mentioned also that even without these imperfections, and with a perfectly constant supply frequency, the speed of a normal synchronous motor is constant only as long as the load is constant. Suppose this mechanically perfect motor to be running unloaded. If a retarding torque is applied, for instance, by placing the pick-up on the record, the turntable will momentarily slow down and then continue to rotate at normal speed again. If the load is removed the turntable momentarily speeds up, and then continues to rotate at normal speed. When loaded, therefore, the turntable is continually lagging behind the position it would occupy if unloaded, a change in load being accompanied by a change in the angle of lag. The maximum angle by which the turntable may lag behind the no-load position is determined by the number of poles on the rotor and stator of the motor, being equal to half the pole pitch. Turntable speed motors have either 76 or 77 poles for 50 cycle supplies[3] so that the maximum angle of lag in both cases is between 2.3 and 2.4 degrees. If this is exceeded the motor stalls and comes to rest. The relationship between applied torque and angle of lag for a particular motor is given in Fig. 9.

The effects of this lag, and also of imperfect tooth spacing and varying frequency, have been almost completely overcome by the simple expedient[4] of arranging the stator of the motor so that it can rotate through a small angle about the axis of the motor, and by making the moment of inertia of the turntable many times that of the stator. When this is done any speed variations due to varying loads, varying supply frequency, or to inaccurate tooth spacing are taken up mainly by movement of the stator, which oscillates to and fro under the control of felt stops or springs while the heavy turntable continues to run at an extremely constant speed.



Garrard "Universal" motor—an example of governor-controlled electric type.



Simpson's turntable-speed synchronous motor.

Hysteresis Motors

The remaining system is similar in many respects to the previous one. In fact, the two are often grouped together, and the term "synchronous" applied indiscriminately to both types of motor. In this second type there are no definite shaped poles on the rotor, which consists simply of a ring of magnet steel. Under suitable conditions this ring can be made to rotate exactly in step with the supply frequency and the motor is self-starting. A stroboscope test shows that the load on this type of motor may be increased up to a certain amount without altering the speed of the

[2] *The Electrician*, July 29th, 1932.

[3] Synchronous motors employing permanent magnets must have an even number of poles and 76 poles gives the nearest possible speed to 78 r.p.m. This is 78.95 r.p.m. and is roughly 1.2 per cent. fast. When an odd number of poles may be used, 77 is preferable, giving 77.92 r.p.m. which is about 0.1 per cent. slow. This error is, of course, quite negligible.

[4] British Patent No. 379,065. Hammond Clock Co.

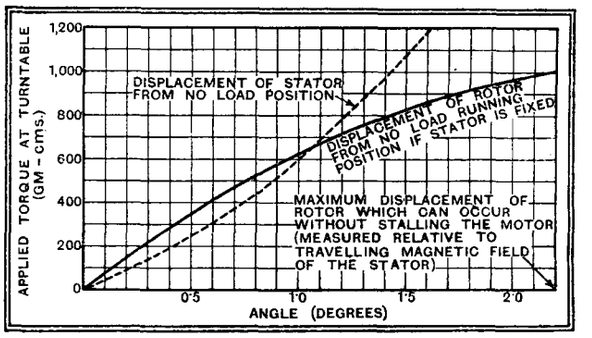


Fig. 9.—Curves showing angle of lag of a synchronous turntable motor for various retarding torques.

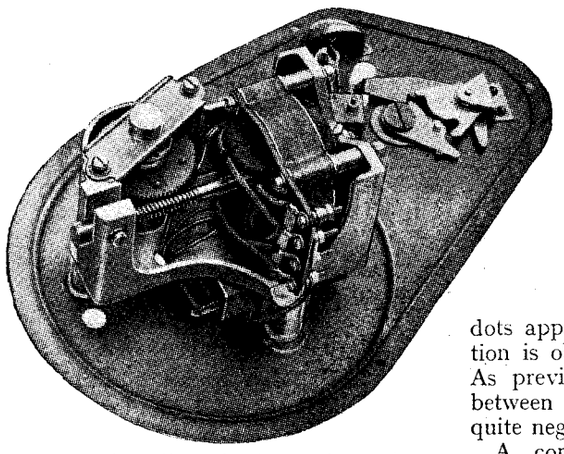
Turning the Record—

rotor. If loaded beyond this critical value the motor does not stop, as would a synchronous motor with salient poles, but it continues to run at a lower speed. This, however, is merely of passing interest, as the motor will be designed so that during normal operation the critical load is never reached, and the speed of the rotor is then quite constant as long as the frequency is unchanged.

This type of motor is essentially a high-speed one, and has to drive the turntable spindle through gearing. The most suitable gear ratio for a 50-cycle supply will give a speed of 77.92 r.p.m. as with the 77-pole synchronous motor to which reference has already been made. The necessity for gearing is, however, unfortunate, as indifferent or damaged gears may spoil the performance of an otherwise excellent constant speed and self-starting motor.

Governor Troubles

Several other methods of controlling speed have been employed commercially from time to time. In one, for instance, a centrifugal device was used to make and break the electrical circuit to the motor in an attempt to keep the speed at a mean value. Others have employed motors with almost constant speed characteristics. These systems, however, have been unsuccessful, and are not now in use.



A successful self-starting hysteresis motor—the B.T.H. "Truspeed."

Minor troubles are liable to occur with the systems of speed control which have been described, and one which is common to both is sufficiently interesting to warrant brief mention.

In order to make the centrifugal governor responsive to very small changes in speed the friction between its moving parts is reduced to a minimum. A mechanism results which is very easily excited by a periodic force having a frequency near that of its natural frequency, for frictional damping is practically absent. Should such governor oscillations set in, the speed naturally becomes very variable, and the motor is useless for playing. Several factors determine the susceptibility of a governor to such oscillations. They may usually be cured by oiling and softening the governor pad, and by making sure that the disc is smooth and polished.

A similar kind of trouble may occur with non-self-starting synchronous motors, such as have been described. The stator of this type likewise has a natural period of oscillation. It is sometimes found that if the turntable and rotor is not brought quite up to the correct synchronous speed the stator will commence to oscillate and the turntable to run in a jerky manner at a speed below its correct speed. The actual speed is determined by the amplitude and frequency of the stator oscillation. The remedy is always to rotate the turntable at starting up to, or just above, 78 r.p.m., and to wait a few seconds before lowering the pick-up on to the record. This allows the motor to fall into synchronism while free from external disturbing factors.

A hysteresis synchronous motor also constitutes a self-oscillating system under certain conditions. If a periodic disturbing force, such as may be caused by a damaged gear, a bent spindle, or, perhaps, a damaged record, is present, persistent "hunting," or periodic speed variation, may set in.

Finally, the question of measurement of the effectiveness of the speed-controlling system of any type of motor may be touched upon. As the user is not likely to have any means of measuring torque, reliance will generally have to be placed on simple, comparative tests. For these a stop-watch and a stroboscope, operated if possible from frequency controlled mains, are really essential. A stroboscope having seventy-seven dots will indicate 77.92 r.p.m. when the dots appear stationary and the illumination is obtained from a 50-cycle supply. As previously mentioned, the difference between this and the recording speed is quite negligible.

A comparison between two motors having mechanical governors may be made by playing over the same record on each, and noting the speeds at the beginning and end of the record. If possible the same pick-up or sound box and its associated arm should be used, and the precautions which follow from the earlier sections of this article should be adopted.

Alternately, a simple test is to measure and compare the reductions in speed which occur when the needle is placed in a groove near the periphery of the same 12-inch record driven by each motor in turn. Other similar comparative methods are available, and may easily be improvised.

With turntable-speed synchronous motors in good mechanical condition nothing will be learnt from stroboscopic tests as above described, for the speed variations are quite negligible. Likewise, with hysteresis motors the gradual drift in speed between beginning and end of a record is absent. With both types any variation shown by a stroboscope will generally indicate some mechanical imperfection.

As previously mentioned, damaged parts, absence of or unsuitable lubricants, and similar factors, may also cause speed variations, and such defects are possible in all types of motor. They are, however, unlikely to be present in new motors. Speed variations due to them are often more readily detected by careful listening tests with suitable records.

SUMMARY

Recapitulating, it will be evident that the variation in torque required to turn the record while playing may vary within very wide limits.

Faithful reproduction necessitates great constancy of speed considered over both long and short time intervals.

The necessary requirements are met successfully by spring and electric motors fitted with centrifugal governors, and by types of synchronous electric motors which have been developed specially for the purpose.

Motors having centrifugal governors generally show a drift in speed as playing of the record proceeds, the amount depending to a very great extent on the sensitiveness of the governor. This drift is not as a rule objectionable, and is inaudible if less than 0.3 per cent.

Turntable-speed synchronous motors show no drift in speed when running from frequency-controlled mains. Their speed remains very constant over long time intervals; it is very free from rapid fluctuations owing to the absence of gears, to the employment of a heavy turntable, and to their general mechanical simplicity. If the permanent-magnet rotor type of motor is used the speed will be 1.2 per cent. fast. This may be of importance where the absolute pitch is required to be correct.

Hysteresis motors likewise show no drift in speed due to varying loads. They do not possess quite the mechanical simplicity of the preceding type.

An impartial consideration of the two principal methods of speed control leads, therefore, to the conclusion that both are capable of giving very good results, and that both have a number of advantages which prevents either from claiming a marked supremacy. This is confirmed by the availability of both types for the same field of use. Actually, of course, the synchronous type of motor can only be used where there are 50-cycle alternating current supplies, so that its field of application is limited though increasing, whereas governor-controlled motors are available for alternating current supplies of all frequencies and for direct current supplies. When spring-driven, the latter type cater for battery and portable instruments as well.

Finally, although accuracy of speed is most important, no generalised recommendation as to which is the best motor can be made on this basis alone. Many other factors, such as appearance, size, available power supply, power consumption, silence and cost, will have some influence on the choice, but these are points which are outside the scope of this article.

Letters to the Editor :—

Quality : The B.B.C. Replies

The Editor does not hold himself responsible for the opinions of his correspondents

No Compromise with Quality

I HAVE read with interest the "Editorial Comment" appearing in your issue dated June 1st entitled "No Compromise with Quality." Evidently there is some misunderstanding as to the attitude of the B.B.C. on this question.

It is fairly well known, I think, that more attention is given to high-quality broadcast transmission in this country than in most others, and that the policy of the B.B.C. in this respect has never been changed, although certain international developments have made it impossible for all listeners to take advantage of the whole frequency band transmitted. All the regional transmitters, as well as the associated apparatus in control rooms, are capable of reproducing a frequency range of from 50 to 9,000 cycles per second with a loss of less than about 3 decibels. There are, however, a few microphones still in use which fall a little short of this, but these are being replaced as rapidly as possible. The only other exceptions are Daventry 5XX and the low-powered stations, all of which are of comparatively old design, and are also due to be superseded in the near future.

So far as the transmission is concerned, this performance may be reduced somewhat by the line between the studios and the transmitter, but all these lines are now excellent, in many cases giving a cut-off at the low-feequency end of the spectrum at approximately 50 cycles per second, and at the high-frequency end at approximately 8,000 cycles per second. Lines between regional transmitters and local studios are better than this.

The misunderstanding probably arises in connection with remarks which have been made concerning the international separation between channels. With a separation of 9,000 cycles per second between stations using high power it is seldom possible to obtain faithful reproduction at the receiving end up to frequencies higher than 5,000 cycles per second during the hours of darkness, unless a considerable amount of interference from the neighbour stations is tolerated. In the vast majority of cases this does not apply to daylight reception, and it also does not apply where the field strength of the wanted station is high. Due mainly to the fact that a very large number of listeners all over the country live in areas of strong field strength, it is still worth while sending out high-quality transmissions, and for this reason we have no intention, at present, of depreciating the quality.

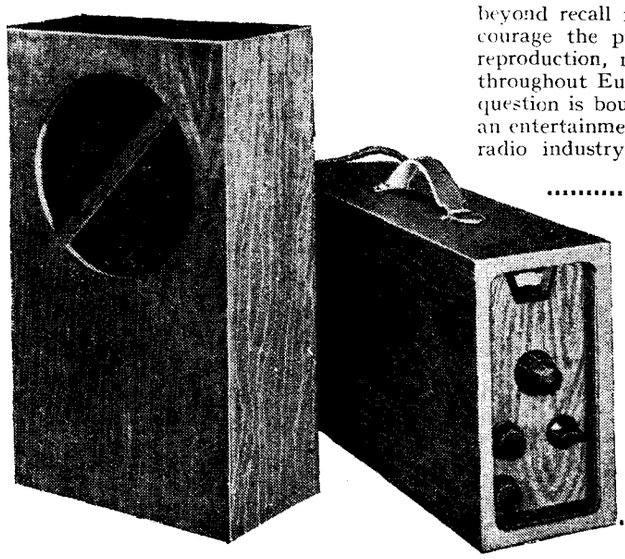
It will be clear, therefore, that if it is not possible for every listener to obtain the highest quality of broadcasting, it is not the fault of the B.B.C. policy or plant, but is due to the fact that it has become necessary to adopt an international separation between stations which, from a high-quality point of view, must be regarded as insufficient.

With regard to the receiving end, it has frequently been pointed out that high-grade receivers should possess good audio-frequency performance, with variable selectivity. The latter will allow the best possible reception in areas where it is not necessary to adjust the receiver to a condition of high selectivity.

Finally, with regard to the transmission of a range of audio-frequencies, we have for some time past intended to reconsider this question when the Droitwich station is available.

N. ASHBRIDGE,
Chief Engineer,
The British Broadcasting Corporation.

AS manufacturers who, during the past ten years, have assiduously and consistently directed their endeavours towards the attainment of realism in reproduction, we have noted with considerable interest your recent leaders on the question of good quality reproduction in radio receivers, and your comments on the attitude of manufacturers and the B.B.C. towards this question.



FOR THE HOLIDAYS.

The Two-Unit Portable, described in *The Wireless World* of June 23rd, 1933, is an interesting variant to the conventional type of self-contained set. Extreme portability and ease of stowage is secured by subdividing the receiver into two interconnected units.

Unfortunately, quality of reproduction in a receiver and its price are interdependent. The greater the realism the greater the cost of the receiver. In this may be found the prime reason for the attitude of the B.B.C. and the majority of manufacturers towards quality. There are other factors which have influenced quality—American design and heterodyne interference, to mention two—but increasing revenue to the B.B.C. and an expanding market for the manufacturer are the essential considerations, and their attainment has been secured by cheapening the commodity and placing it within the reach of the mass of the community at the expense of good reproduction.

In the light of present-day publicity, one might be forgiven for thinking that some tacit agreement existed between the B.B.C. and manufacturers for the avoidance of all mention of fidelity in connection with radio receivers. Knife-edge selectivity—shadow tuning—50 stations for 9 guineas—bring the world to your own fireside—this is the burden of publicity to-day. This is what, at a cost of some millions of pounds, the public have been taught to expect from a receiver to-day. That the receiver should reproduce the original sound with some degree of fidelity is apparently of no importance.

The public have been taught to judge the merits of a receiver upon a basis, which, to the majority of them, is fundamentally and instinctively wrong. Some proof of this may be adduced from the behaviour of an average owner of a radio receiver. In showing the wonderful receiver to his friends, the number of stations, and all the noises that go with them, is the criterion of performance. But in the quiet of the evening, with only himself or the family to please, it is the local station or one of a half-dozen of the more worth-while Continental transmissions, to receive which neither knife-edge selectivity, shadow tuning, nor the ability to drag in fifty stations is necessary.

We do not think that the time has passed beyond recall for steps to be taken to encourage the public to demand realism in reproduction, not only in this country but throughout Europe, as we feel that in this question is bound up the future of radio as an entertainment medium, the future of the radio industry, its financial security and stability, and a future means to end the international scramble for channels.

May your efforts to arouse public interest in this matter proceed with unabated vigour.

R. D. HENDERSON-DAVY,
Director, London Radio
Development Services, Ltd.

A Broadcast Frequency Scale

WITH reference to Mr. J. F. Marshall's letter in your May 4th issue commending the suggestion that the B.B.C. should radiate a "frequency scale" so as to enable listeners to check the frequency response of their sets, I beg to say that I am entirely in accord with Mr. Marshall on this point. I would suggest that the broadcast should take place during the evening programme, say, at weekly intervals.

West Hartlepool. H. V. BROWN.

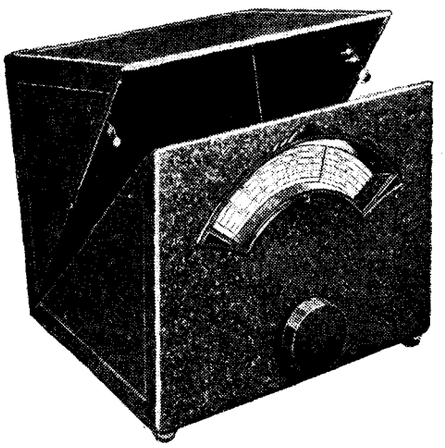
Correspondence, which should be as brief as possible, should be addressed to the Editor, "The Wireless World," Dorset House, Stamford Street, S.E.1, and must be accompanied by the writer's name and address.

NEW APPARATUS REVIEWED

Latest Products of the Manufacturers

EDDYSTONE SCREENING CABINET

AS it is advisable to completely enclose a short-wave receiver in a metal screening box, mainly with the view to the avoidance of hand-capacity effects on the tuning, short-wave listeners will doubtlessly be interested to learn that a metal cabinet for this purpose can be obtained from Stratton & Co., Ltd., Bromsgrove Street, Birmingham.



Eddystone die-cast metal cabinet for short-wave receivers shown fitted with a slow-motion dial and calibrated scale.

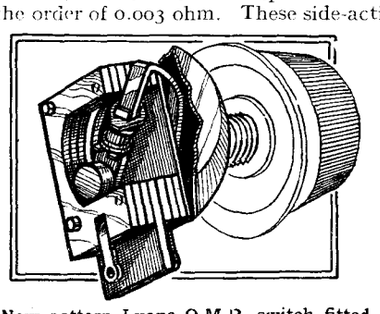
It measures 9¾in.×8in.×8in., and is die-cast in two halves from an aluminium-copper alloy. The two pieces are hinged at the back, and the two diagonal side joints interlock when closed to give efficient screening.

The cabinet is of adequate size to accommodate an average short-wave receiver or an adaptor unit, and it can be obtained with an escutcheon gap cut in the front for an Eddystone dial or as a plain undrilled cabinet. In either form the price is 27s. 6d.

LYONS B.A.T. SIDE-ACTION Q.M.B. SWITCHES

CLAUDE LYONS, LTD., 40, Buckingham Gate, London, S.W.1, have introduced a new version of their Q.M.B. switches, in which the lever mechanism is replaced by a rotary action, the spindle passing through the side of the switch casing. The internal construction of the new type is identical with that of the other style, and our measurements show that there is practically no difference in the self-capacity of the two types. This was found to be about 1.5 micro-mfds. for the on-off pattern.

These switches have a very low contact resistance, that of the above specimen being of the order of 0.003 ohm. These side-action rotary models are available as on-off, single-pole double-throw, double-pole on-off and double-pole change-over styles, the prices being 1s. 9d., 2s. 6d., 3s. 6d., and 4s. respectively, including a bakelite knob one inch in diameter.



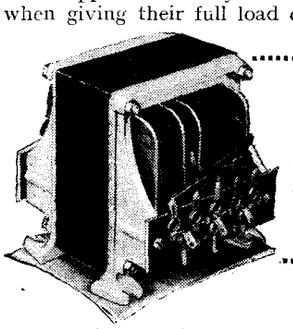
New pattern Lyons Q.M.B. switch fitted with side spindle and knob.

EVERYMAN A.C. SUPER MAIN TRANSFORMER

A MAINS transformer for the above *Wireless World* receiver has been sent in for test by All-Power Transformers, Ltd., 8a, Gladstone Road, Wimbledon, London, S.W.19. This model is slightly wider at the base than the one used in the original set, but it can be accommodated quite easily in the space available by mounting it with the terminal battens at right angles to the back of the set.

The All-Power model has a generous iron core and the insulation is particularly good throughout. Examination of a specimen bobbin reveals that each coil is layer-wound and interleaved with thin non-hygroscopic paper, and where it has been necessary to wind two coils on one bobbin these are separated by a fibre ring and the second winding further insulated by binding tape.

On test this transformer gave the correct H.T. voltage after smoothing, and both L.T. supplies were only a shade over 4 volts when giving their full load currents.



All-Power Transformer Co.'s mains transformer for Everyman A.C. Super.

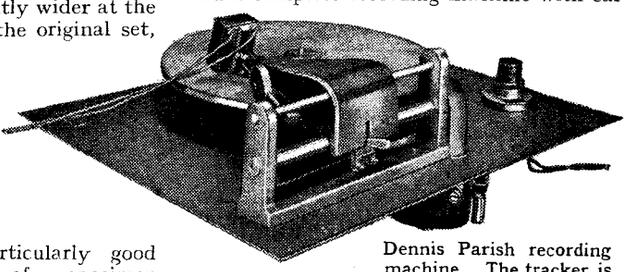
The primary winding is tapped for A.C. mains of from 200 to 250 volts, and provision is made to adjust the input in 10-volt steps. This winding is electrostatically screened. The transformer is satisfactory in all respects; it runs perfectly cool, there is no audible hum due to looseness in the assembly, and the price is 12s. 6d.

DENNIS PARISH RECORDERS

THESE machines, which are now passing from the experimental stage into commercial production, are notable for their robust simplicity. The tracking device and cutter arm are built up of heavy castings and the lead screw is enclosed to protect it from dust and record shavings. The turntable is driven by a motor of considerably larger size than the usual electric gramophone motor and the drive is taken through rubber belts. It is claimed that these, in conjunction with the inertia of the turntable itself, give freedom from speed fluctuations. A centrifugal governor is fitted on the spindle of the intermediate driving pulley.

The recording head used is of exceptionally good quality, judging from the results obtained from a test of the apparatus with the firm's own electrostatic microphone. Some records were made of speech and pianoforte playing—the latter always a stringent test of recording apparatus—and we can confirm that the standard reached is much above that usually associated with home-recording outfits. The cutter supplied requires 2 watts, and a 5-watt type is also available for commercial work.

The skeleton recorder shown in the photograph costs 15 guineas, including the cutter, and a complete recording machine with carbon microphone, A.C. mains amplifier, M.C. loud speaker and play-back pick-up is available for £30.



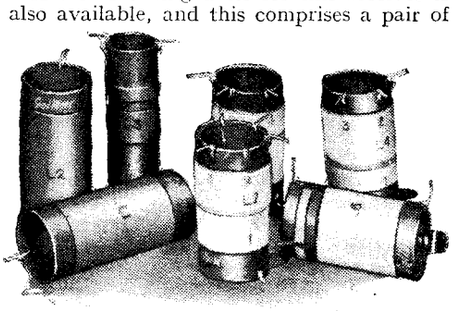
Dennis Parish recording machine. The tracker is solidly built and the lead screw is enclosed.

Several alternative types of record blanks are available and most of the component parts of the machine may be purchased separately. The makers are The Dennis Parish Recording Studios, 49, Church Lane, Hornsey, London, N.8.

SINGLE-SPAN COILS

THE Goltone coils for the Single-Span Receiver are available in a kit of seven, comprising the two coils for the aerial filter, the oscillator coil, and the four I.F. coils. They are wound to the specification published in *The Wireless World*, and are well finished; the oscillator coil former is drilled for attachment to the tuning condenser, and the I.F. coils are provided with mounting brackets. Soldering tags are fitted for the connections, and both coils and tags are clearly marked. The set of seven coils is available at 10s. 6d.

A set of tuning units for this receiver is also available, and this comprises a pair of aerial coils, an oscillator coil with screening can, tuning condenser, and slow-motion dial, and four I.F. transformers, each consisting of the appropriate coil, air-dielectric trimming condenser, and screen. This kit is priced at 55s.



Goltone kit of Single-Span coils.

The makers are Ward and Goldstone, Ltd., of Frederick Road, Salford, 6, Lancs.

The Wireless World

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24th Year of Publication

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CONTENTS

EDITORIAL COMMENT

Repairs and Adjustments

How Manufacturers Might Help

IT is quite safe to prophesy that broadcast receivers will always stand in need of occasional repair and adjustment, but equally it may reasonably be expected that, as technique improves, the need for "service" will become less frequent. Until the time arrives when a breakdown becomes such a rare occurrence that it will be considered economically preferable to discard the set or unit in which it occurs rather than to repair it, problems of maintenance are likely to present difficulties.

In a recent public speech, the Managing Director of the Telsen Electric Company put forward a point of view (briefly reported in last week's *Wireless World*) to which we think attention should be drawn. He expressed the opinion that a manufacturer of receivers should not only take all possible precautions against the incidence of faults, but that he should definitely plan the layout of his sets with an eye to the convenience of those who may have to repair and adjust them in the future. It was stated that the new season's sets to be produced by the speaker's firm were to be definitely designed on this plan.

If this attitude were to become general among set manufacturers, we cannot help thinking that the average standard of broadcast reception would improve. A vast number of sets are certainly operated in a chronic state of maladjustment, if not worse, mainly because the simplest operation can be carried out only with the greatest difficulty. The checking of anode currents alone, to mention one item of maintenance that will periodically be necessary, or at any rate highly desirable, during the life of every mains receiver, is a task that often necessitates the removal of the chassis from the cabinet and the unsoldering of a number of connections. It is appreciated that in many cases such measurements can be carried out with the help of anode adaptors, but the present diversity of valve bases militates against the popularity of this method, and the use of an adaptor sometimes prevents the receiver from functioning in an entirely normal condition.

It would be neither difficult nor expensive to arrange accessible break-in points in series with each anode circuit, where a meter could be inserted without waste of time. Similarly, adjustments to the almost universal type of self-contained receiver would be facilitated if the loud speaker were wired with longer leads than usual, and preferably with leads fitted with plug-and-socket connections rather than with soldered joints. Accessible points for the measurement of H.T. voltage might also be provided.

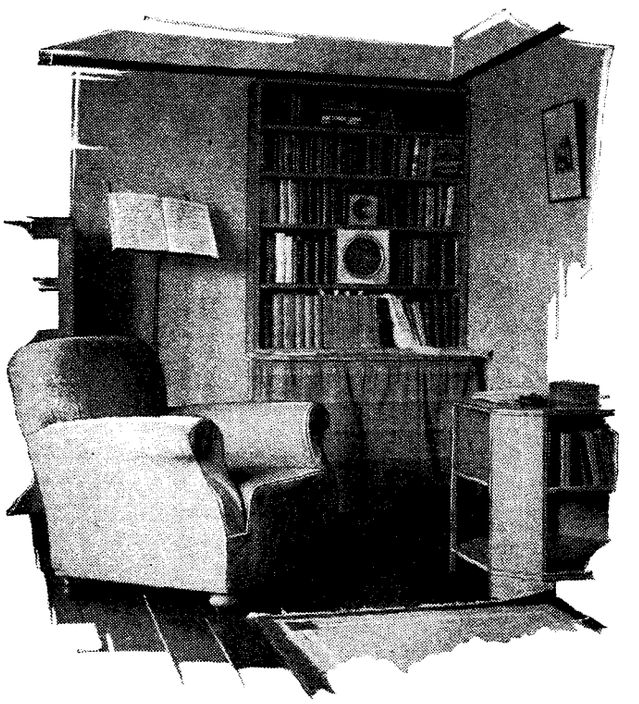
Re-trimming Made Easy

Another point to which attention might be directed is the accessibility of the trimming condenser of the aerial input circuit. The capacity of the aerial with which a manufactured set will ultimately be used may differ considerably from the arbitrary standard chosen when making initial adjustments in the factory. It is common knowledge that the performance of most ready-made sets can be improved to a worth-while extent by retrimming the aerial circuit when they are installed, but it is safe to say that very seldom is this adjustment carried out—either because the trimmer is not get-at-able, or because it is sealed up.

My Home Set-1

Local Stations Only : Separate Output Valves and Loud Speakers for High and Low Audio Frequencies

By F. L. DEVEREUX, B.Sc.



THE sets described in this series are not put forward as complete constructional designs, as their individuality must of necessity restrict their general appeal. At the same time it is felt that readers who are accustomed to evolving their own designs will find ideas which are well worth incorporating in their sets.

AN interest in the possibilities of high-quality reproduction of instrumental music, and the fact that Brookmans Park is less than five miles away, were the two main factors influencing the design of this set. The most rudimentary of aerials gives an input capable of loading a power grid detector without H.F. amplification or even reaction, so that one's efforts could be given entirely to the design of the L.F. circuits and the sound reproducers.

A frequency range of 50 to 10,000 cycles was decided upon and a volume level of 1 to 2 watts was deemed to be sufficient for the 19ft. by 12ft. room in which the set was to be used. Instead of using a push-pull output stage, it was decided to accept the very small degree of harmonic distortion which a single 5-watt Mazda PP5/400 valve would give when run with an input well within its rated capacity. The real difficulty arose when it came to finding a loud speaker capable of reproducing the range specified at a price which would leave a sufficient margin in the funds available for the purchase of other components required for the set. The only solution appeared to be to use two units, one for the lower and middle registers and one for the top. Accordingly, for the lower frequencies an old type of energised B.T.H. moving-coil R.K. with a plain paper diaphragm was acquired through the medium of the "Smalls" column, the object being to experiment with new diaphragms, as the field magnet has not undergone much change in more recent models. A preliminary test, however, showed that the output was remarkably uniform between 200 and 3,000 cycles, but that the bass resonance at 115 cycles was too high and that there was a shrieking resonance at 4,200. The latter could be dealt with when the problem arose of dove-tailing the frequency ranges of the two units, and the middle register was so good that it was worth the effort of trying to lower the bass resonance before thinking of scrapping the original diaphragm.

A Rejuvenated Loud Speaker

The obvious thing to try first was the effect of reducing the restoring force due to the rather stiff suspension. In the first place, it was noticed that while the leather in the surround was quite supple, the glued joints of the four segments were responsible for a good deal of stiffness. Small holes were, therefore, punched at these points to weaken the material. The diaphragm was, of course, removed from the chassis for this operation and an ordinary hollow punch was used with the end grain of a block of wood as a foundation. Before replacing the diaphragm the three arms of the fibre centring spider were cut away and replaced by thread treated with rubber solution. On reassembling it was found that the fundamental resonance had fallen to 40 cycles—just enough to give a little rise in the bass at 50 cycles where the output transformer might be expected to tail off slightly. In other respects the performance remained unaltered, so that, provided the 4,200-cycle resonance could be dealt with, the foundations of a substan-

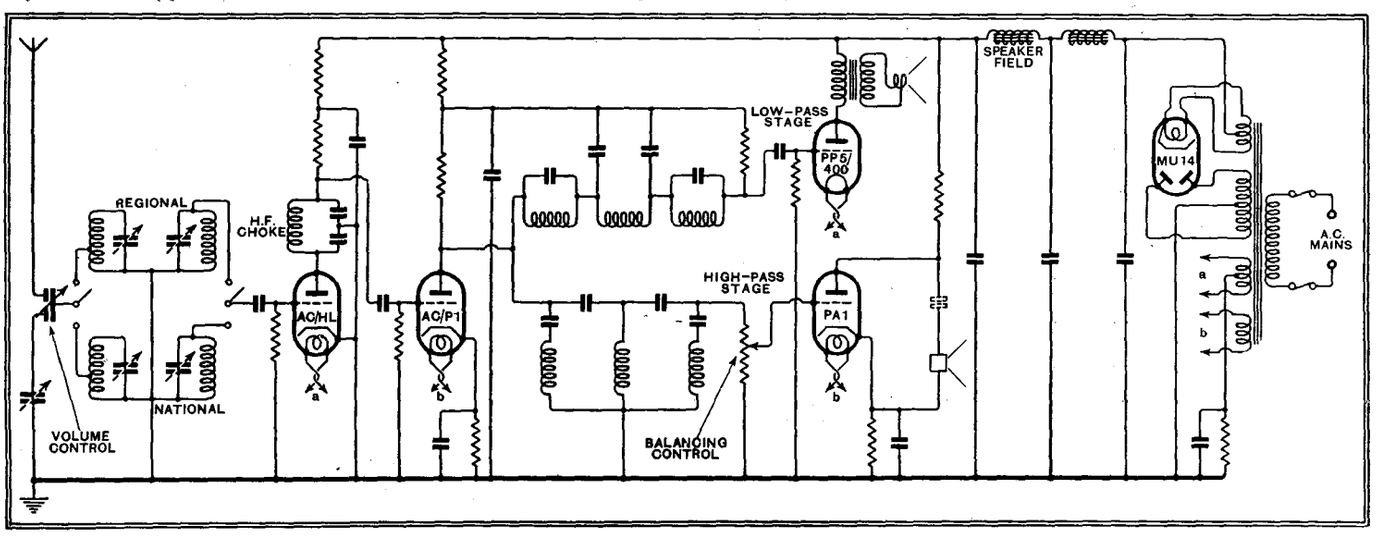
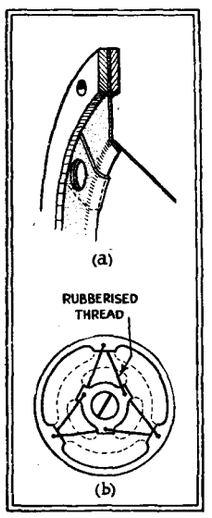


Fig 1.—Complete circuit diagram. Standard values were assigned to all components other than the filters, particulars of which are given in Fig. 2.

My Home Set—

tially uniform loud speaker frequency response were well and truly laid.

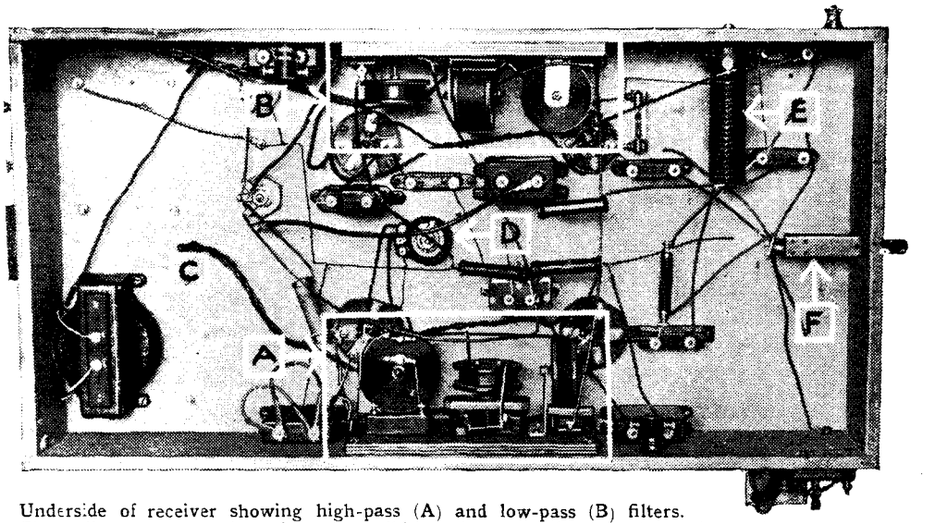
It was the desire not to disturb these foundations that led to the adoption of separate output valves for the two loud speaker units. While it is quite possible to design suitable circuits to work two units from a single output valve, there is always the possibility at the back of one's mind of mutual reaction between the electrical characteristics of each unit, not to mention the establishment of local resonant circuits if the "top" loud speaker happens to be of the "capacity" type, such as an electrostatic or piezo-electric unit. With separate output valves one loud speaker can be actually short-circuited without affecting the performance of the other, and it is most instructive to do this under working conditions and hear the relative amounts of power in the top and bottom registers.



The fundamental resonance of the moving-coil unit was reduced from 115 to 40 cycles by cutting away the overlapping seams of the leather surround and by replacing the fibre centring spider by rubberised thread.

The small-power amplifier following the detector has for its load a resistance which is the common terminating impedance for the low-pass and high-pass filters leading to the grids of the two output valves. By first taking curves of each filter separately under ideal conditions, it was proved that the characteristics were not affected by using a common input load; neither was the shape of the curves appreciably altered by the reduction of the input load by the A.C. resistance of the valve, provided the output load of each filter was maintained at its correct value.

The resistance terminating the high-pass filter may be made a volume control potentiometer to compensate for differences in the electro-acoustic efficiency of the loud speakers and to ensure a smooth change-over at the frequency of intersection of the two filters. If the low-frequency output valve and loud speaker happen to be the more sensitive, the grid leak in the resistance capacity coupling to this stage should be arranged as the volume control potentiometer. Incidentally, the absolute sound output at the cut-off point cannot be estimated by inspection of the curves, which are on a decibel scale. Calculation shows, however, that there will be a dip of about 3 db. in total sound energy at 3,500 cycles, assuming the residual outputs from both units at that frequency to be in phase.



Underside of receiver showing high-pass (A) and low-pass (B) filters. The coils are arranged as far as possible to be mutually at right-angles and screening is unnecessary. C is the smoothing choke; D, the compensating volume control; E, the H.F. choke, and F, the programme switch.

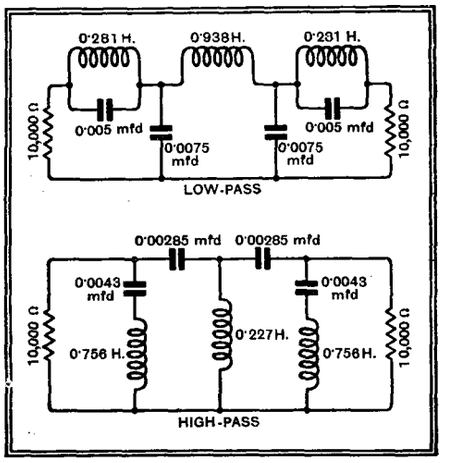
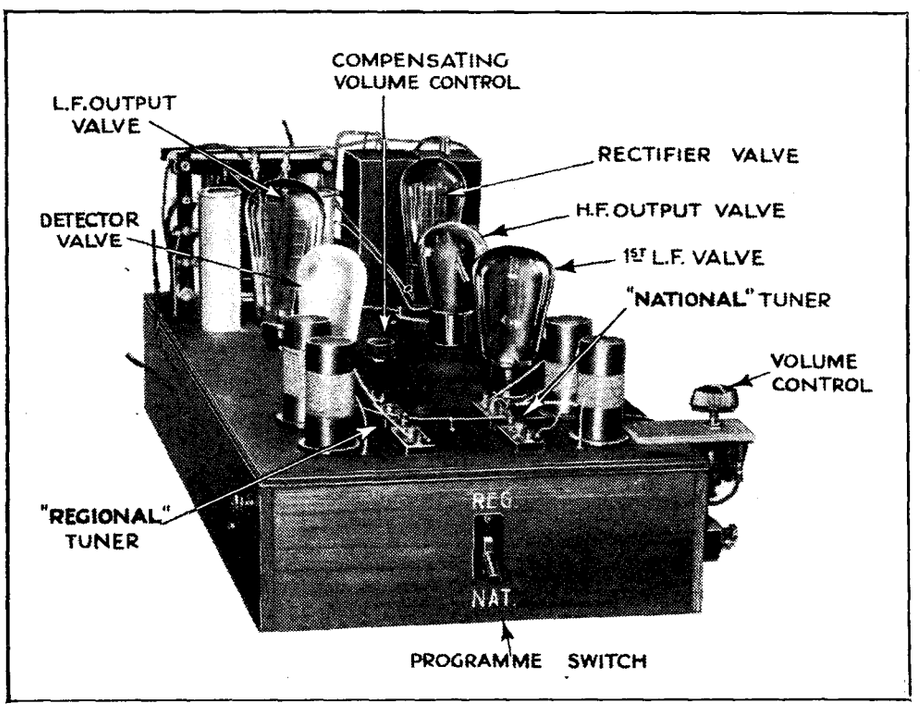


Fig. 2.—Electrical constants of high-pass and low-pass filters designed for a cut-off at 3,500 cycles.



General view of the receiver chassis. The separate band-pass filters are tuned by pre-set condensers and the coupling is fixed.

The cut-off was made at 3,500 cycles, to ensure the elimination of the 4,200-c/s resonance in the moving coil and, as a matter of interest, to keep the fundamental frequencies of the various instruments of the orchestra on the one unit and the higher harmonics on the other. Actually, the low-pass filter is the same as that described in the issue of this journal for November 10th, 1933, and it is understood that complete filters to this specification are obtainable from Messrs. Wright and Weaire, Ltd. As the energy in the high frequencies is low, a smaller output valve may be used to feed the "top" loud speaker and a Standard Telephones PA1 was chosen on account of its high mutual conductance and low

My Home Set—

A.C. resistance, the latter being important when a "capacity" type of unit is employed.

Experiments are still proceeding with a view to improving the high-note reproduction, but excellent results have been obtained with the "Primustatic" unit and a hybrid piezo-electric-driven small free-edged cone. The quality with the high-frequency loud speaker switched off is

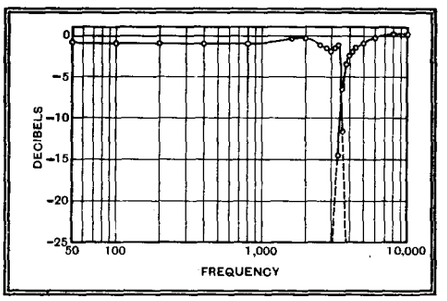


Fig. 3.—Characteristics of high-pass and low-pass filters taken *in situ* in the circuit.

quite intolerably muffled, yet the individual contribution to the total effect sounds like little more than a faint twittering reminiscent of side-band splash.

The tuning arrangements could hardly be simplified. Band-pass circuits are necessary not only to ensure a good frequency response, but to separate the stations at so short a range. Pre-set condensers are used to tune each element, and as each filter is required to work only at one frequency, direct magnetic coupling is employed, the correct separation between the coils having been found by trial and error. A key switch of the telephone type, which happened to be at hand, is used to switch from one programme to the other, and the volume control is a differential condenser arranged, in conjunction with a pre-set condenser, to maintain a constant capacity across the aerial coil tapping.

The dual loud speaker units are installed in a bookshelf baffle.

The loud speakers are installed in a bookshelf, which when filled forms an acoustically "dead" baffle of considerable effective area. This is only required by the low-frequency loud speaker which is enclosed in a small box, open at the back. The book shelves are backed with plywood and stand away from the wall an inch or two. Experiments have been made with sound-absorbing material between the wall and the case, but no noticeable improvement was evident.

The results afford convincing proof of the high standard of quality radiated by the B.B.C., and when one of the older types of microphone is used, say, in an outside broadcast, the fact is at once evident. At all events, the work involved in designing the necessary filters has been well worth while, and one can now sit back and really enjoy the programmes—at least until the possibility of some better solution presents itself.

New Mazda Valves

Recent Development in Battery Valves

A NUMBER of interesting new valves of particular appeal to the battery user will shortly be marketed by Mazda. The first of these is the T.P.22, a combination of an H.F. pentode and a triode valve in the same bulb. This valve is intended to act as a frequency-changer, and it is fitted with a 9-pin base. It consumes 0.25 amp. at 2 volts for its filament, and is rated for 150 volts on both anode and screen.

Under normal conditions, however, the valve is recommended for use with an anode potential of 120 volts, and with 60 volts applied to the screen. The pentode anode current is then 1.0 mA., and the oscillator consumes a further 0.6 mA., the conversion conductance reaching the figure of 0.5 mA./v. The price is 18s. 6d.

The next valve in the series is a variable-mu H.F. pentode, the VP.215, and this also is rated for 150 volts on both anode and screen. It is fitted with a 7-pin base, and its filament consumes 0.15 amp. At an anode potential of 120 volts, the anode current is only 1.1. mA., when 60 volts are applied to the screen and a negative grid bias of 1.5 volts is used. The mutual conductance is rated at 1.8 mA./v.

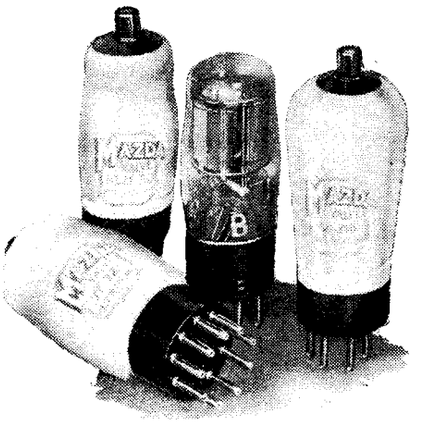
The SP.215 is a non-variable-mu H.F. pentode with similar voltage ratings. This valve also has a 7-pin base, and it is intended to act chiefly as a frequency-changer with cathode injection, in which case the heterodyne volts should be 2.5 volts peak for a conversion conductance of 0.65 mA./v. It may, of course, be used as an H.F. or I.F. amplifier in sets in which volume control is not obtained by a variation of grid bias. Both the H.F. pentodes are listed at 15s. 6d.

The Duo-diode-triodes

A duo-diode-triode, the HL.21.DD, is included in the range, and separate filaments are used for the diodes and the triode. The total filament current is 0.15 amp., and the triode is rated for 150 volts maximum anode potential. It has a mutual conductance of 1.5 mA./v. with an A.C. resistance of 21,000 ohms.

The characteristics of the two diodes are not the same, and one starts to pass current at a negative potential of about 0.6 volt, whereas the other does not become conductive until a positive potential of about 0.4 volt is applied. The first diode is consequently intended to act as a detector, while the second is used for A.V.C. purposes. Additional bias can be applied to increase the delay, but with the diode load returned to negative L.T. a delay of 0.4 volt is obtained automatically. A second duo-diode-triode, the L.21.DD, is also available; the only difference is in the triode characteristics which are suitable for a driver valve in Class "B" operation. The A.C. resistance is 10,000 ohms, and the mutual conductance 1.8 mA./v. The price of both these valves is the same, 9s.

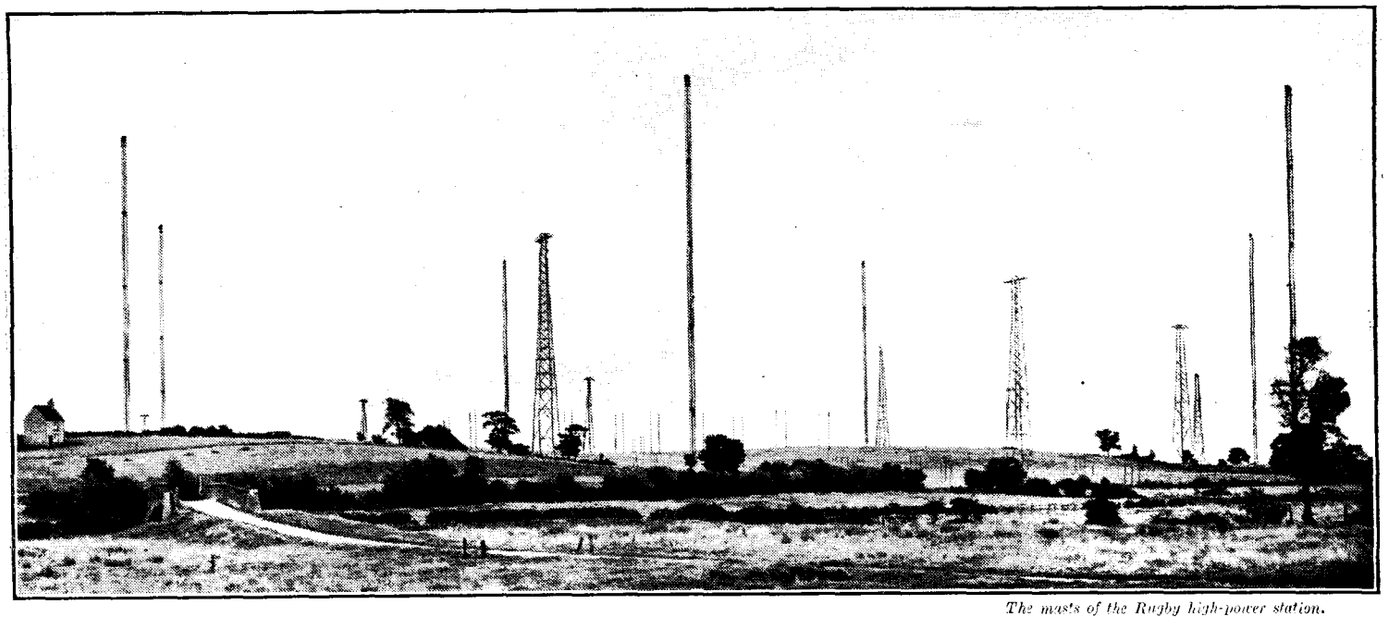
The last valve in this range is the QP.240, a double-pentode output valve of the quiescent push-pull type, fitted with a 9-pin base. The filament consumption is 0.4 amp., and the valve is rated for screen and anode potentials of 150 volts. The screens are brought out to separate pins in the base, so that the pentodes can be matched by applying different screen voltages to the two valves.



Latest additions to the Mazda range of battery valves.

A system of grading is adopted in manufacture, and letters indicating the recommended operating voltages for that particular valve are marked on the bulb. The valve is used normally with an anode supply of 135 volts and a grid bias of −10.3 volts. The letter "P" on the bulb then indicates that 103.5 volts should be applied to the particular screen to which it refers: Q indicates 111 volts; R, 118.5 volts; S, 126 volts; and T, 133.5 volts.

Under these conditions the anode-to-anode load impedance should be 20,000 ohms, and the total quiescent anode current is 3.8 mA. The power output is about 1,300 milliwatts, and the value is priced at 22s. 6d.



The masts of the Rugby high-power station.

More About the Spectrum

The Wireless Octaves

THE position of the wireless spectrum in relation to other forms of wave radiation was discussed in last week's issue. This article deals exclusively with frequencies used in radio communication, and contains much useful and practical information on the behaviour of different wavelengths under day and night conditions

A RECENT issue discussed the whole spectrum of known radiation and showed the complete ether "keyboard," with our "visible octave" as its reference. The range of wireless waves was shown as being from 30,000 metres down to 8 thousandths of a centimetre (10 kilocycles to nearly 4 mega-megacycles). At the same time it was also pointed out that the shortest waves of this group were primarily of interest as laboratory experiments and had not yet entered the field of effective radio communication. The spectrum of waves in actual wireless use, therefore, begins in the region of 10 or 20 centimetres. This accounts for the difference in scope between our wireless spectrum in Fig. 3* and that of Fig. 1 of the previous article.

* The figures in this article are numbered consecutively from those in "The Whole Spectrum," in *The Wireless World* of last week.

In Fig. 3 an attempt is made to show the various ranges of waves now in practical wireless use and their approximate classification. The scale of frequencies and wavelengths is again in the decades of logarithmic practice, and even so it is extremely difficult to detail, in the course of a single diagram, all the uses to which the various bands of wavelengths are put in practice. An approximate indication of their various utilisations is,

THE RADIO SPECTRUM AND ITS CHIEF "LANDMARKS"

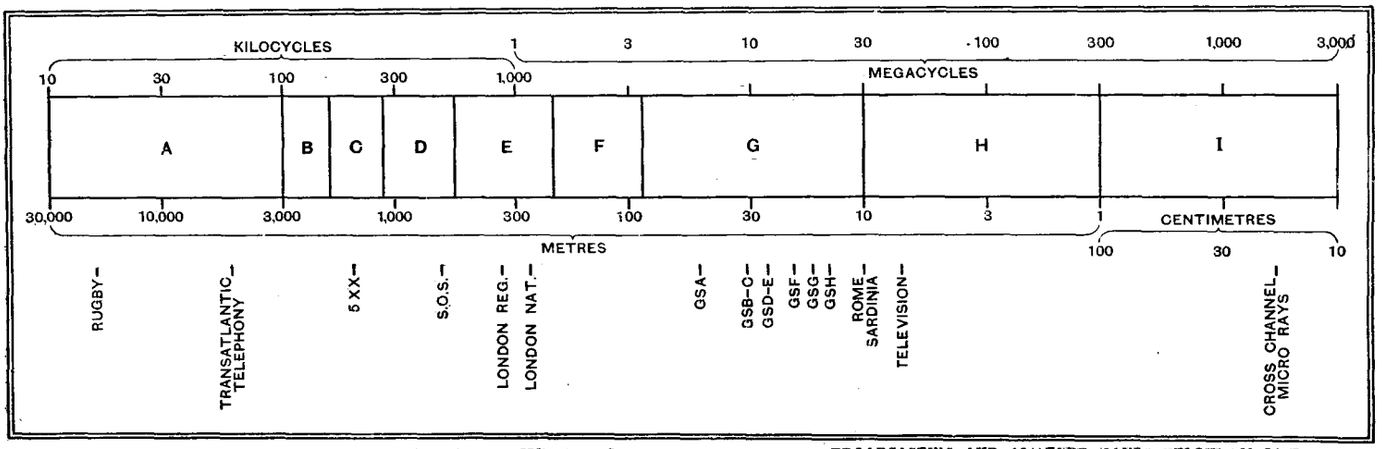


Fig. 3.—Positions of stations and services in the Wireless Spectrum.

A—Very long and long waves, fixed commercial communication services.

B—Long-wave ship-shore traffic.

C—Long-wave European broadcasting band.

D—Beacon, aviation and ship services—600 metres distress and emergency.

E—Medium-wave broadcast band.

F—Medium short waves, various fixed and mobile services.

G—Short waves, mostly point-to-point communications (broadcasting and amateur bands as shown in Table).

H—Ultra-short waves, not reflected from ionosphere.

I—Centimetre waves: special methods of generation.

BROADCASTING AND AMATEUR BANDS BELOW 200 METRES.

Broadcasting.		Amateur.		
Megacycles.	Metres.	Megacycles.	Metres.	Remarks.
6.0 - 6.15	50.0 -48.78	1.715- 2.0	174.9 -150.0	Not in Europe.
9.5 - 9.6	31.58-31.25	3.5 - 4.0	85.71 - 75.0	Not exclusive.
11.7 -11.9	25.64-25.21	3.52 - 3.73	85.23 - 80.43	British allocation.
15.1 -15.35	19.87-19.54	7.0 - 7.3	42.86 - 41.10	Exclusive.
21.45-21.55	13.99-13.92	14.0 -14.4	21.43 - 20.83	Do.
—	—	28.0 -30.0	10.71 - 10.0	Do.
—	—	56.0 -60.0	5.357- 5.0	Do.

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however, given in the lettering associated with the diagram. Some of the best-known stations or services in the various groups are also shown in their relative positions.

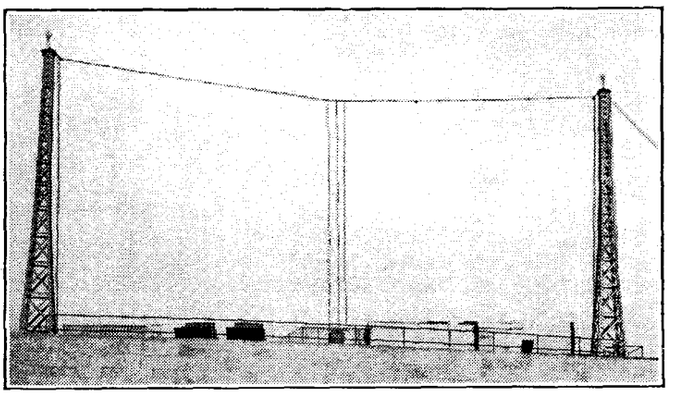
Fig. 3 shows how completely the radio spectrum is now filled up. The very longest waves, perhaps, are not in use, but wavelength allocations of 23,000 metres do appear in the list. Quite a number of other highly powered stations are also located in the 18,000 metre region along with the Rugby (telegraphy) station marked in Fig. 3, and from this wavelength downwards to about 13 metres the allocations are practically continuous.

Characteristics of the Different Wavelengths

Besides being distinguished by the type of service for which they are used, the various ranges of wavelengths are also distinguished by their physical characteristics. Thus the long and very long-wave group are characterised by their low rate of attenuation, making them suitable for reliable long-distance communication particularly, with the greatest uniformity by day or by night. (The long-wave Rugby station is receivable by British ships in any part of the world.) These characteristics still persist in the long-wave broadcast band, as is familiar knowledge to all wireless listeners. Going downwards in wavelength, below 1,000 metres, the ground-ray signal becomes more heavily attenuated and the signal returned from the ionosphere becomes of greater importance. By the time we are at the medium-wave broadcasting band the attenuation of the ground-ray is such as to give even a powerful broadcasting station a useful daylight range of only about 300 miles (dependent largely on one's personal interpretation of "useful" in relation to programme value). Little or no reflection occurs from the Heaviside layer in the daytime, but develops strongly at night, and the vagaries of the indirect or "sky" wave are the cause of the fading of distant stations.

Going still further down in wavelengths, the increased attenuation of the ground-ray gives a still more restricted daylight range, and reflection from one or the other of the ionospheric layers becomes of greater importance. The region marked in Fig. 3 as medium-short waves (from about 200 to 85 metres) is one of little use to amateurs and is devoted to the various services stated, for which its properties make it suitable. This division of "medium-short" is a somewhat arbitrary one as a step leading us to the range below 85 metres or so which can definitely be called short waves. The ground-ray falls off rapidly and the "skip distance" comes into effect. The rôle of the ionosphere is then the important thing and signals returned (presumably from the Appleton layer) begin to reappear at greater distances. Here, then, we get a re-appearance of long-distance services, with, however, the erratic behaviour associated with short waves. The whole band from 85 to about 13 metres is, broadly, devoted to various long-distance purposes, including amateur communication.

The difference between the behaviour of long and short waves is, perhaps, best illustrated by the transatlantic telephony services between this country and America. The position marked in Fig. 3 at 60 kilocycles is the original one on which the service was opened in 1927. Since then various short-wave channels have been added and are used whenever possible because of their lower power costs. The long-wave system still remains the backbone of reliable communication, and a wavelength allocation for another long-wave channel has actually been made. Roughly, five short-wave channels appear (from published lists) to exist, i.e., about 16, 20, 30, 44 and 60 metres respectively, to be used simply according to whichever is found most effective at different times of the day and different seasons of the year. The services have now been in operation for sufficient time for an approximate schedule to be made up and the 20-metre channel appears to be used for the greater part of the day.



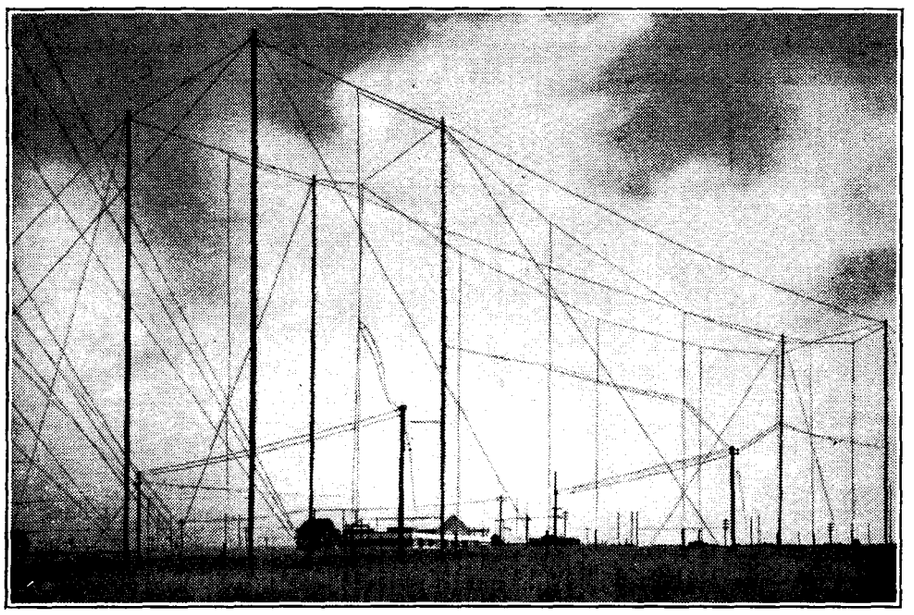
The ultra-short-wave television aerial on Broadcasting House.

The various short-wave stations of the Empire broadcasting system are also marked in Fig. 3. GSB-C indicates two allocations in the 31-metre band, 31.55 and 31.3 metres, and GSD-E two in the 25-metre band, 25.53 and 25.28 metres. GSH is the shortest of the system in the 13-metre region on 13.97 metres.

Where the Ether is Not Crowded

The region between 13 and 10 metres is still thinly populated, and that below 10 metres is definitely a block of the ether with a good many vacancies. This is, however, easily explained. At or about these wavelengths definite changes occur in the physical characteristics of the waves. Some doubt appears still to exist as to the exact point of change, but the facts are fairly definite. They are that below 10 metres the waves do not appear to be reflected from the ionosphere and that the transmitter and receiver require to have an *optically clear path* between them. A regular telephony service between Rome and Sardinia is conducted on about 10 metres, but below this wavelength there is little regular communication except over short distances.

The region of 7 metres is the one to which attention is being devoted for the exploitation of high-definition television. This, of course, is due to the fact that the width of side-bands necessary for high-quality television cannot possibly be accommodated on longer waves. The severe restriction to an optical-path range is a definite disadvantage of this region,



The short-wave aerial "arrays" at Daventry, from which the British Empire Service is radiated on a multiplicity of wavelengths.

More About the Spectrum—

but there seems no early possibility of a good-quality television service except on these limited local channels. Incidentally, one advantage of this region in relation to this purpose is not generally realised. While range is undoubtedly restricted, there is no echo from the ionosphere and, therefore, no blurring of the image which these echoes of short-duration impulses would certainly produce. Perhaps this is one of the sweet uses of adversity!

The general restriction to a clear optical path appears still to hold in the case of the very short waves of below 1 metre—the so-called "centimetre-wave" group. A further physical difference is, however, to be noted—not in the propagation of the waves, but in their method of generation. The ordinary type of reaction circuit for a valve oscillator no longer functions, and special types of oscillator have to be developed. These are the so-called "electronic" oscillators, depending for their action on the path of the electrons within the valve, which chiefly govern the frequency generated.

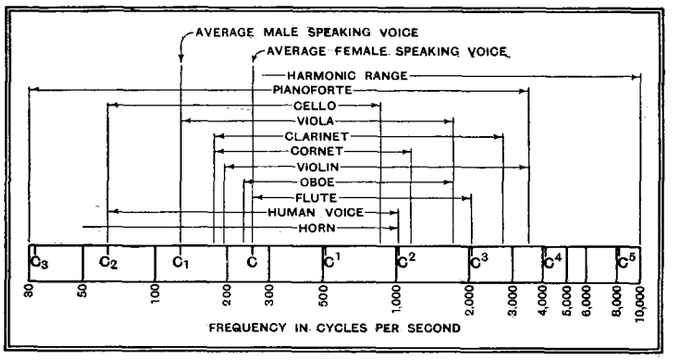
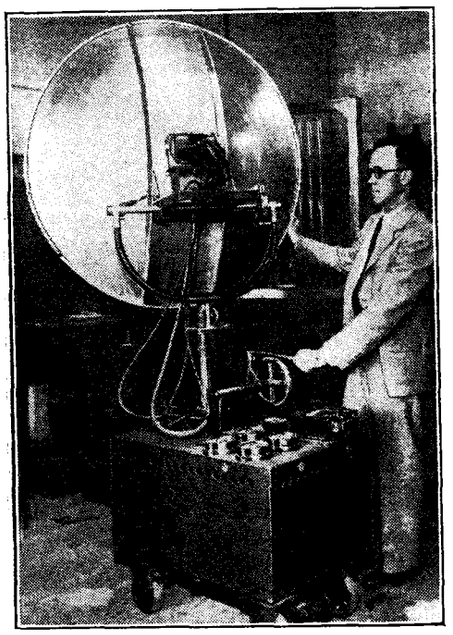


Fig. 4.—The gamut of audible frequencies.



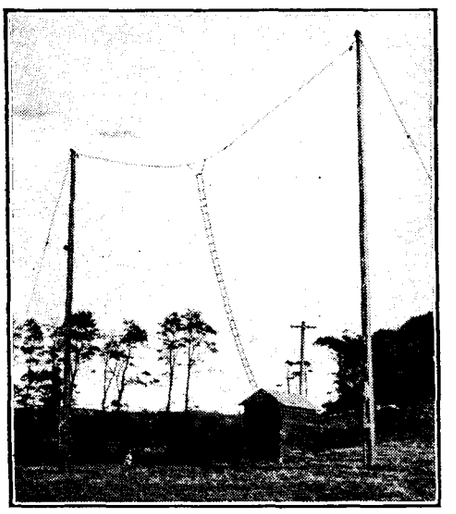
STILL SHORTER WAVELENGTHS. A new American "micro-ray" telephony transmitter operating on a wavelength of about 10 c.m. (only 4 inches!).

A valuable future field for waves of this group appears to be in short-distance communication, for example, over water channels where the cost of cable becomes serious. Transmission can be effected on very little power, utilising reflectors of reasonable size, and, so long as the path is optically clear, fading appears to be completely absent. The recent service on about 18 centimetres inaugurated between Lympne and the French coast is an example of this use, as is also the use of a similar service over the Bristol Channel. Waves of about 10 centimetres are thus the shortest now in any form of use, but—as was suggested in the former article on the whole spectrum—he would be a bold man who would cry finis to a steadily increasing spectrum.

In concluding a review of the whole spectrum it is permissible to refer just briefly to the audio range. As was stated in the previous article, although this is not truly an ether spectrum, so far as concerns useful ether radiation at these frequencies, it is still a logical extension from the higher frequencies, and represents a natural enough *continuum*. It is quite arbitrary to place the upper audio limit at 10 kilocycles, since many of the higher harmonics (contained especially in some of the more transient "noises") run into values well above this limit. Nevertheless, the range of frequencies which is considered desirable for the perfect reproduction of all speech and music and *most* transients is between 30 and 10,000 cycles—a wider range than we can hope to get without interference with the present separation between broadcasting stations.

The distribution within these limits of most of the things to which we normally listen is shown in the audio spectrum of Fig. 4, and need not be further considered here.

It is worth noticing, however, that while the eye only responds to one octave (a 2 to 1 range of frequency) the ear responds to eight or nine octaves of air waves. It is also to be noted that although most of the activity appears to lie between 300 and 1,000 cycles, it has been stated that the greatest *peak* values are amongst the higher frequencies of the thousands. This explains the need for all the audio range we can get.



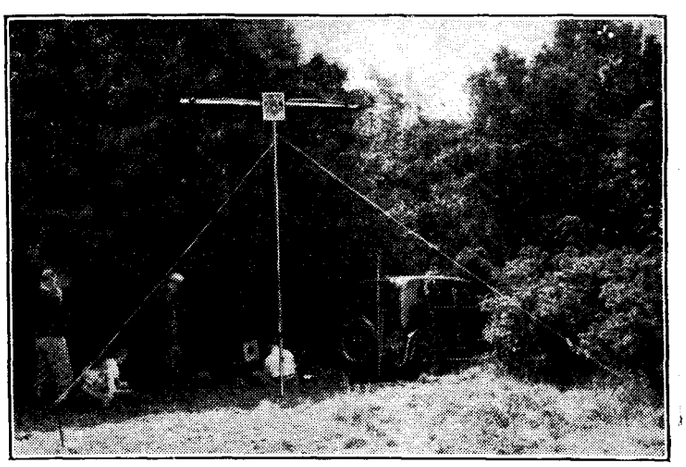
Ultra-short waves for point-to-point services: Aerial for G.P.O. telephony link across the Bristol Channel.

And what more of the spectrum? Does thought-transference come within its scope? Does spirit communication? Does foretelling the future? Fortunately, perhaps, they do not at present come within the scope of wireless engineering!

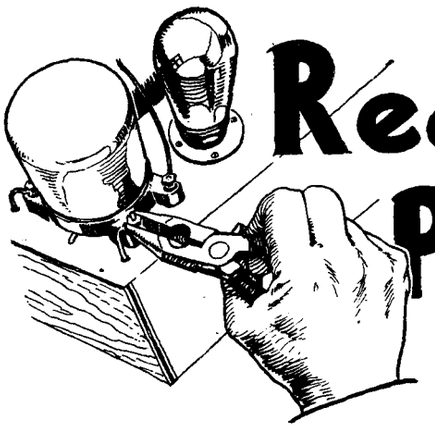
D.F. ON FIVE METRES

Direction finding on five metres provided an interesting innovation when the Golders Green and Hendon Radio Society held their Field Day on Sunday, June 17th. The sphere of operations was Chipperfield Common, Hertfordshire. After a morning spent by members in familiarising themselves with the operation of ultra-short wave receivers, tests were carried out in direction finding at various distances from the transmitter.

The experiments showed that much work has still to be done before 5-metre sets can be regarded as trustworthy direction finders. Both super-regenerative and detector L.F. sets were employed. It is proposed to hold another 5-metre field day in September.



Mr. Corfield operating the 5-metre directional transmitter on Chipperfield Common on June 17th. Good reception was maintained up to 3 miles.



Readers' Problems

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers. Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page

Vibration and Interference

A CORRESPONDENT tells us that his reception is normally free from electrical interference, but a noisy background of cracklings becomes evident when a heavy motor vehicle passes his house.

As no mention is made of ultra short-wave reception (which might be affected by direct radiation from the ignition system of the motor), we think it fair to assume that a defect in the household electrical system is responsible. Very probably there is a loose connection in a switch distribution box or fuse, and the effect of vibration is to produce arcing at the faulty contact.

Transferred Aerial Capacity

THOSE who have followed the present series of articles on "The Art of Ganging" hardly need to be reminded that it is not quite sufficient that the inductance values of all the tuned coils in the set should be identical. For instance, the question of capacity transfer from one circuit to another is a matter of some importance; in particular, circuit alignment cannot be properly maintained on both medium and long wavebands unless care be taken to ensure that the proportion of aerial capacity transferred to the tuned input circuit is the same on each band.

This condition is generally satisfied by employing an aerial transformer (or auto-transformer) which gives the same ratio of

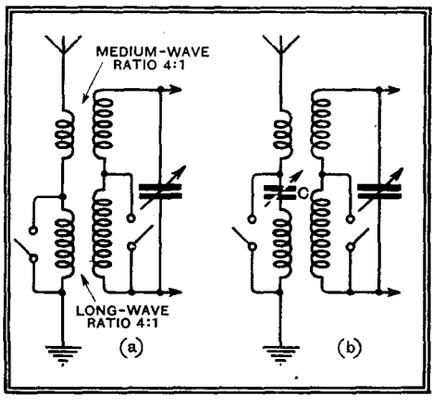


Fig. 1.—(a) Conditions for the maintenance of circuit alignment on both wavebands, and (b) the addition of a padding condenser C to compensate for a discrepancy in the transformation ratio on the long band only.

transformation on both bands, as shown in Fig. 1 (*a*). Incidentally, when estimating the number of aerial-circuit turns, it must not be forgotten that the medium-wave primary is in series with the long-wave winding for reception on the latter band.

These remarks are prompted by a letter from a correspondent whose "straight" receiver appears to be perfectly ganged on the medium band, but gives signs of mis-alignment when switched over to long waves. It has been found that better long-wave reception is obtained by making a slight decrease in the value of the trimmer which controls the input circuit. Of course, it would be hopelessly inconvenient to make this adjustment whenever long waves are being received, and we are asked to suggest how matters may be put right.

It would seem that a larger proportion of the aerial capacity is being transferred to the tuned circuit on the long than on the medium band, and this would suggest that the long-wave primary winding has too many turns. It may be possible to readjust this winding, and to do so will afford the best solution of the problem. But if this is inconvenient, we suggest as an alternative the fitting of a semi-variable condenser (of about 0.0005-mfd. maximum) in the position shown in Fig. 1 (*b*). This extra capacity should need only an initial adjustment, and will probably improve circuit alignment to a more than acceptable extent without introducing appreciable loss in other directions.

The Water Shortage

A READER who has just installed a stationary petrol engine for working a domestic water-pumping system finds that interference is produced in his receiver while the engine is running. He asks whether any unforeseen difficulties are likely to arise in suppressing this interference.

In general, a small single-cylinder engine responds to the same form of preventive treatment as a car engine, and we suggest the use of the same types of resistance and condenser suppressors as are available for that purpose. As the engine is being used for water pumping, we assume that it will be well earthed; cases have arisen where unearthed stationary engines cause an excessive amount of interference.

Mention of water-pumping apparatus reminds us that, during the present spell of dry weather, receiver earthing systems are likely to benefit from occasional watering. Accusations of inciting to waste water may be evaded by saying that, electrically speaking, there is no objection to using water that is too dirty for other purposes!

"Diode Differences"

REFERRING to a recent paragraph under this heading in the "Hints and Tips" section, a querist asks us to explain why the series-connected diode rectifier passes less H.F. energy to the succeeding L.F. amplifier, and so requires less H.F. filtering, than the alternative parallel-connected system.

This question may best be answered briefly by reference to the skeleton diagrams given in Fig. 2. In diagram (*a*) the basic circuit has been redrawn to show that the valve and its condenser-shunted load resistance may be considered as forming two limbs of a potentiometer joined across the source of H.F. voltage. So far as unrectified H.F. energy is concerned, the valve has a very much higher resistance than the by-pass condenser, and so the major part of the applied H.F. voltage is developed across the points A, B, where it can do no harm. The proportion of this voltage which is developed across B, C, and is applied to the L.F. amplifier, is comparatively small.

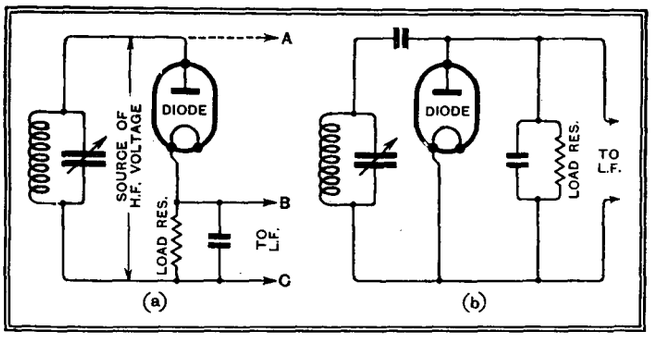


Fig. 2.—Explaining why the parallel-connected diode needs elaborate H.F. filtering.

With the "parallel" system as shown in diagram (*b*), the L.F. circuit is virtually connected right across the source of H.F. voltage, and so it is not hard to see why much more filtering is required.

Ordinarily, the series method can only be used in superhets, for the reason that neither side of the tuning condenser can be earthed. However, this difficulty can be overcome, and the matter was discussed in the "Hints and Tips" section last week.

The Wireless World INFORMATION BUREAU

THE service is intended primarily for readers meeting with difficulties in connection with receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

Communications should be by letter to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service.

Personal interviews are not given by the technical staff, nor can technical enquiries be dealt with by telephone.

The Art of Ganging

VI.—Some Common Oscillator Tracking Difficulties

THE adjustment of the padding condenser of a superheterodyne was discussed in detail last week, and this article deals chiefly with some of the more common difficulties encountered in practice. It is shown that these are usually due to the stray capacities being unduly high

THE adjustment of the padding condenser C2 of Fig. 1 was dealt with in last week's issue, but it must be remembered that any adjustment at the low-frequency (high-wavelength) end of the tuning range must affect slightly the adjustments at the other end of the range, and vice versa. It is, therefore, necessary to go back to the low wavelengths and to readjust the preselector trimmers. The long wavelength station should then be tuned in again, and C2 readjusted. It should now be found that the ganging holds well over the whole of the waveband, and the only remaining point is to check the minimum wavelength. If it be found that this is too high, the oscillator trimmer must have its capacity reduced, and the whole process of ganging must be gone through again. This process of adjusting the wavelength range is really the same as in the case of a straight set, and any difficulties are likely to be due to the same causes, with the addition that the wavelength range will be affected if the intermediate-frequency circuits have been set at the wrong frequency. Little need be said about this here, therefore.

It should be pointed out that the ganging process described above, instead of giving accurate ganging, may lead to ganging which is accurate at two points only, and very widely out at all others. This will inevitably occur if the stray capacities in the oscillator circuit are too high, and it may occur if the oscillator trimmer has an unusually wide-capacity range. In these circumstances, the adjustments may lead to a condition in which the oscillator circuit is operating at a lower frequency than the signal-frequency circuits at a low wavelength, and at a higher

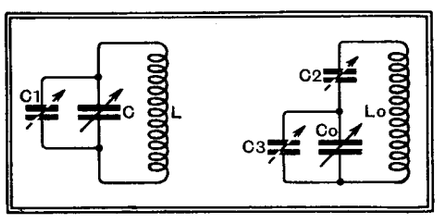


Fig. 1.—This diagram illustrating the differences between the signal-frequency and oscillator circuits is repeated for easy reference.

frequency at a high wavelength, whereas, of course, it should always be at a higher frequency. This condition is readily detectable by the marked effect upon the performance of the receiver. The greatest ganging errors will usually occur around 300 metres, and if it be found that in this region the sensitivity of the set is very low, and that the reception of practically every station is accompanied by a whistle, the note of which changes with the setting

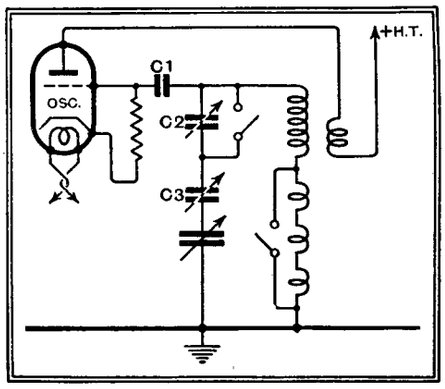


Fig. 2.—The usual arrangement of the padding condensers for two wavebands. C2 is in circuit only on the long waverange.

of the tuning dial, it may safely be assumed that the ganging is very seriously at fault.

The oscillator trimmer, therefore, should be practically fully unscrewed, and the process of ganging gone through again. If the defect is merely due to the oscillator trimmer having an unusually large-capacity range, and the original bad ganging thus caused by having inadvertently started ganging on the wrong oscillator beat, the re-ganging will lead to an accurate condition. Should it be found, however, that little better results are secured, it may be taken for granted that the stray capacities in the oscillator circuit are excessive, and that some constructional defect is preventing correct ganging from being secured. The additional capacity necessary for bringing about this state of affairs is quite large, and it has been the writer's experience that it is usually to be attributed to the mounting of one or more components connected to the high potential side of the oscillator-tuned circuit too closely to a metal baseplate.

A typical oscillator circuit is shown in Fig. 2, the long wave coil and padding condenser being distinguishable by the switches connected across them. Now, if C1, C2, or C3 is of a type having only a thin layer of insulation between its plates and the outside of its case, and it be screwed flat against a metal base, there will be a very appreciable capacity between the condenser and the base; and, owing to its position in the circuit, this capacity will appear in parallel with the tuning coil, and so greatly increase its stray capacity. This trouble does not usually occur with C1, since it is the common practice to use a postage-stamp-type condenser suspended in the wiring for this component; it is often found with padding condensers, however, and in all but one or two types it is essential for the condenser to be mounted in such a way that it is spaced from the chassis by $\frac{1}{8}$in. or so.

Stray Capacities

Another arrangement which may lead to the same trouble is shown in Fig. 3. The coupling between the oscillator and first detector valves is here arranged by making the tuned anode circuit of the oscillator common to the first detector; and, in order that the I.F. transformer shall not be unduly damped, it is connected between the anodes of the two valves. Now, most I.F. transformers are screened, and in many the I.F. trimmers are so arranged that they have quite a large capacity to the screen. This does not affect their normal operation, but in this particular circuit the capacity of the I.F. transformer will appear in parallel with the oscillator-tuned circuit, and greatly affect the ganging. It has been the writer's experience that this particular circuit is normally unsuitable for use in any ganged receiver on account of the high stray capacities which exist across the oscillator-tuned circuit. It usually requires a little care to reduce the oscillator stray capacities to a sufficiently low value for accurate ganging, and in this arrangement there are, in addition to the normal capacities, the grid-anode capacity of the first detector valve and the I.F. transformer capacity. The only case in which satisfactory results might be secured is in a battery set, for there the valve capacities are likely to be appreciably lower than in

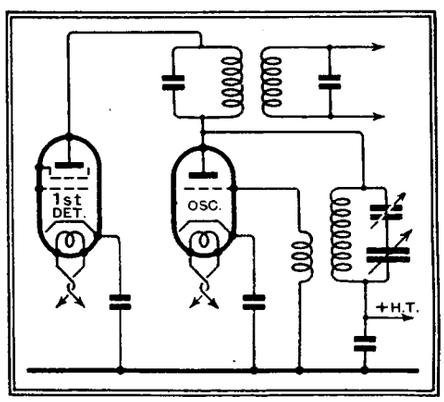


Fig. 3.—A type of frequency-changer with which ganging may be difficult on account of the high stray capacities across the oscillator circuit.

The Art of Ganging—

a mains set. The circuit, however, is not much used now.

Another arrangement in which the same difficulty through I.F. transformer capacity may occur is shown in Fig. 4, and is a single-valve frequency changer, now usually employed with an H.F. pentode. At first glance, the circuit may appear a little peculiar, but it is essentially simple. A signal-frequency circuit L_5C_5 is connected between the control grid and the earth line, and the reaction coil of the oscillator system is joined between the cathode and the earth line, so that it is effectively in the grid-cathode circuit of the valve. The I.F. transformer primary is provided with separate terminals for the condenser C1 and coil L1, and the I.F. tuned circuit is completed through the oscillator-tuned circuit L3, C3, C4, which offers a negligible impedance to currents of the intermediate frequency. At the oscillator frequency, however, C1 offers a low reactance, and L1 a high impedance, so that the oscillator circuit is shunt-fed from the valve anode circuit, the condenser C1 acting as a coupling condenser, and the I.F. transformer primary L1 acting as an H.F. choke. The point of immediate importance, however, is that any capacity to earth of the I.F. transformer appears in shunt with the oscillator-tuned circuit, and will so affect

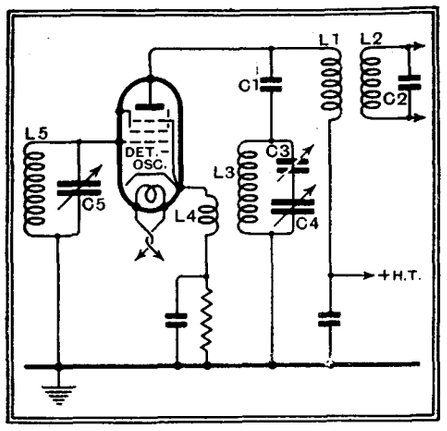


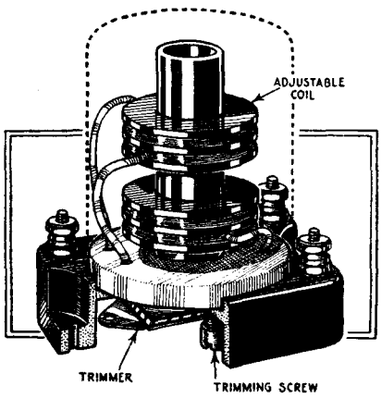
Fig. 4.—A frequency-changer in which ganging may be complicated by interaction between the signal-frequency and oscillator circuits.

the ganging of this circuit. The case is not so bad as that of the circuit of Fig. 3, of course, for there is the capacity of only one valve across the circuit instead of two, but it may be serious if an unsuitable type of I.F. transformer be selected.

Interaction

These points about stray capacity across the oscillator-tuned circuit may appear to have been unduly emphasised. They have been dealt with at some considerable length, however, because it is the writer's experience that, more than any other factor, they are responsible for poor ganging in a superheterodyne, and they are all too often overlooked, or introduced by apparently very minor modifications to a design.

It will normally be found while adjusting the trimmers of a superheterodyne that the oscillator circuit is extremely critical, and that the slightest movement is sufficient for the signal to disappear unless the setting of the tuning dial be simultaneously altered. This is because this circuit has really the selectivity of the whole of the I.F. circuits behind it. By comparison, the trimming of the signal



The construction of a typical I.F. transformer. The trimmers are built into the base, and the upper coil slides up and down the pillar to provide variable coupling.

frequency circuits is quite flat, and they are no more critical than those of a straight set. Occasionally, however, it is found that the trimmer immediately preceding the first detector behaves more like the oscillator trimmer, and that a station will disappear after quite a small alteration in its setting. This may usually be taken for a sign of interaction between the signal frequency and oscillator circuits—the circuits are coupled together so that an alteration to either affects the oscillator frequency. A defect of this nature rarely occurs with a two-valve frequency-changer or with a single-valve type using the Heptode or Pentagrid type of valve; it is not uncommon with earlier single-valve frequency-changers, however, and it occurs quite often with the arrangement of Fig. 4.

Such interaction between the circuits makes ganging very difficult. It may prove impossible to eliminate the effect entirely, but it may usually be reduced to small proportions by the careful disposition of the components of the receiver and of the wiring. Using the arrangement of Fig. 4, the reaction coil should contain as few turns of wire as possible consistent with satisfactory oscillation.

So far no mention has been made of the process of ganging on the long waveband. This has been because it is essential to obtain satisfactory medium waveband ganging before proceeding to the longer wavelengths, and it was deemed advisable to indicate the most likely troubles with the former before proceeding to a fresh set of problems. Long waveband ganging is usually quite easy, and the normal arrangement is for an additional inductance coil to be inserted in the circuit as well as a further padding condenser C2 of Fig. 2. On the long waveband none of the trimmers or padding condensers adjusted on the medium waveband must be touched, and the only adjustment is to the new padding condenser C2. This is carried out exactly as in the case of C3 on the medium waveband, but on a station at the upper end of the long waveband. Such a station should be tuned in and C2 adjusted with one hand while rocking the tuning dial backwards and forwards over a few degrees until the optimum combination of settings be found.

In a few receivers it may occur that long wave trimming condensers are included in addition. In this case, ganging is carried out exactly as on the medium waveband, but using the appropriate set of condensers. A station at the lower end of the long waveband is tuned in and the trimmers adjusted; and then a station at the upper end, and the padding condenser adjusted. The whole process should then be repeated to obtain accurate results.

In all superheterodyne adjustments it should be remembered that the trimmers must be adjusted only at the lower end of the waveband and never at the upper, and the padding condenser only at the upper end of the waveband. If this procedure be borne in mind the process of ganging will be found quite easy to carry out in practice, and if the receiver be carefully constructed to a good design and all the components be suitable and in good condition no difficulties should be found.

(To be continued.)

The Radio Industry

DURING the present year 28,000 square feet of floor space have been added to the G.E.C. wireless works at Coventry in order to cope with the bigger manufacturing programme which has been decided upon for the current season. The first of the new G.E.C. sets is a compact three-valve detector-L.F. receiver for battery operation.

The new Marconiphone battery set (Model 284) is fitted with a tone-compensating volume control.

The latest Ferranti receivers are described in a new catalogue which has just been received, and of which copies are available for readers.

In the first number of *The Pylot*, a "house journal" issued by Pye Radio, Ltd., there appears an interesting article on the importance of high-quality reproduction; the need for educating the public to appreciate high-note response is emphasised.

The British Institute of Engineering Technology, of which Professor A. M. Low is principal, proposes to establish branch colleges in Australasia, China, Japan, etc.

In our issue of June 15th we referred to a standard Graham-Farish Ohmite resistance as being of the 1-watt type. This was misleading; the standard resistances are rated at 1½ watts, and the heavy-duty type at 3 watts.

Although no official statement has yet been made as to the opening date of the new North London Tungsram valve factory, it is understood that work is proceeding smoothly in installing the necessary equipment, all of which is made by Tungsram themselves.

BROADCAST BREVITIES

By Our Special Correspondent

Government Committee on 24-hour Time ?

THE appointment of a Government committee to discuss 24-hour timing is now being seriously considered.

It is certain that the B.B.C. will continue the experiment till September or October, and, as complaints have now fallen almost to zero, the Corporation is likely to pronounce the experiment a success.

The Post Office Next

If, as is likely, the proposed Government committee receives a satisfactory report from the B.B.C., the 24-hour system may be adopted by the Post Office and other Government departments.

The committee would be appointed by the Postmaster-General.

Sir Charles Carpendale

ONCE again Vice-Admiral Sir Charles Carpendale, C.B., has been elected President of the International Broadcasting Union. It is possible that this may be Sir Charles' last term of office in view of his rumoured resignation from the B.B.C. next year.

A French Candidate

M. Marcel Pellenc (Inspector-General of French broadcasting) is generally considered the "runner-up" in the race for the coveted honour, and it is no secret that he is a strong favourite with the German delegation as a result of friendly intercourse during the Conference just closed.

The swing of the political pendulum has upset the chances of Dr. Bredow, the German Post Office radio commissioner, who was very nearly elected President last year. Dr. Bredow is now in custody awaiting trial on a corruption charge.

The Only Inspector

M. Pellenc made a strong impression on the delegates in his vigorous and entertaining speech at the B.B.C. banquet last week. Incidentally, he is Europe's only official "Inspector of State Broadcasting."

Real American

I BRING you the first news of Mrs. Curtis B. Railing. Mrs. Railing has just arrived from South Carolina accompanied by several students of her dramatic school, and, according to news from a friend of mine in Washington, will "do sketches of Southern life on the British network."

Mrs. Railing's date with the B.B.C. is Monday, July 9th, in the Entertainment Hour. She specialises in vivid interpretations of negro life, and it is her intention, I understand, to put it across in "real American style."

To-morrow's Air Display

THAT experienced commentator, Squadron Leader W. Helmore, will describe to-morrow's Royal Air Force display at Hendon. The excerpts to be included in the broadcast are the seventh and eighth events —"Air Skittles" and "Low Flying Attack."

Val Gielgud, Screen Star

SHALL we have Greta Garbo at the B.B.C. microphone? At all events, Val Gielgud, the B.B.C.'s Drama Director, will shortly appear on the silver screen. He is to make his début as a film actor in "Murder at Broadcasting House," which Venture Films are adapting as a film play from the novel. Filming begins on July 16th.

It is quite likely that the film will include some exterior, if not interior, shots of the "Big House" itself.

"Copyright House"

MANY a prospering musician will lift his hat reverently in days to come as he passes a certain building in Margaret Street, Cavendish Square, which Sir Edward German is to christen "Copyright House" on July 16th. This is the new headquarters of the Performing Right Society, the work of which has greatly expanded since the introduction of broadcasting. Not only does the Society collect, on behalf of its members, a large sum from the B.B.C. in respect of musical compositions broadcast; it also obtains moneys from

"RIBBON" MICROPHONE FOR COAT LAPELS. It is claimed for this "personal microphone," a product of the R.C.A. Victor Company, Camden, N.J., that it sacrifices none of the technical qualities of the large studio instrument seen on the left.

hotel and restaurant proprietors who use loud speakers for the delectation of their guests.

The Society represents over twenty-six thousand British and foreign composers, authors and music publishers, and controls the public performances of approximately two million pieces of music.

No Death Rays

"IT has nothing to do with death-rays or secret formulæ," explains the B.B.C. in heralding a revival of "The Fantastic Battle," Leslie Baily's microphone version of the story by C. R. Burns. It is to be broadcast on July 10th (National) and 12th (Regional).

The story is of the future, dealing with a surprising way of making war impossible. The discovery is made by a small nation under the rule of an idealist.

Learning to Fly

CORRESPONDENCE courses in swimming are rarely successful, but it is just possible that broadcasting may teach us how to fly. At all events, listeners to the series of six talks entitled "Growing Wings," starting in the National programme on July 12th and continuing on subsequent Thursdays, have a chance of getting some valuable hints. The talks director of the B.B.C. has invited Filson Young to take his courage in both hands and enrol as a flying student. He will take two lessons a week and describe his experiences in detail.

Sir Henry Wood's Celebration

I UNDERSTAND that the B.B.C. has suggested a very happy method of celebrating Sir Henry Wood's fortieth year as conductor of the "Proms" in August next. Just before Sir Henry left London on his present American tour officials from Broadcasting House discussed with him what form this recognition should take.

Five Crowded Days

The famous conductor returns a day or two before August Bank Holiday, with only five days for preliminary rehearsals for the opening of the Promenade season. Yet so seasoned a musician, directing so seasoned an orchestra, could probably offer us a satisfactory First Night performance after only a day or two of rehearsing.

How They Rehearse the "Proms."

Rehearsals, of course, continue throughout the series of concerts. Usually on these occasions actual conducting is performed by the leader, Charles Woodhouse, Sir Henry Wood being seated at a strategic point in the hall so that he can assess the general effect. Occasionally he checks the orchestra with the aid of a handbell which secures immediate silence. The tale is told that, on the first day that Sir Henry introduced this method, the ensuing silence after the ringing of the bell was broken by a double-bass player, who exclaimed "Hot water for No. 10!"

Even Sir Henry laughed.

A Movable Wooden Chalet

ALTHOUGH the May licence figures show a falling off in the monthly increase as compared with 1933, the B.B.C. is not yet considering introducing a competition on the lines of one now being run by the Italian radio organisation, E.A.I.R. Every licensed listener who secures another subscriber is presented with a lottery ticket which gives him an opportunity of winning such prizes as a four-seater Fiat car, a motor cycle or a movable wooden chalet.

The last-named should be useful to listeners whose neighbours are loud-speaker fiends.

News of the Week

Current Events in Brief Review

The Need for Television

THE running commentary on the recent Franco-Italian football match called for thirteen radio reporters, speaking in as many languages.

Have You Heard Egypt?

CAIRO, which now has a modern broadcasting station working on 484 metres, with 20 kilowatts in the aerial, is putting out daily programmes from 11 a.m. to 1.30 p.m. and 5 p.m. to 10.30 p.m., B.S.T.

We should welcome reports from readers who have picked up a direct transmission.

German Licence Drop

DURING May the number of German licence-holders decreased by 38,611, the total on June 1st being 5,401,420.

The decrease is officially attributed to the effects of the summer and holiday season, but surprise is expressed that the strong Nazi propaganda for broadcasting has not counteracted this seasonal deficiency. German radio licences are taken out monthly.

Anti-Interference Conference

THE B.B.C. and the radio authorities of seven other countries are represented at the Conference on Electrical Interference with Broadcasting, which opened in Paris yesterday (June 28th).

A major object of the Conference is to induce manufacturers of electrical equipment all over the world to include anti-interference devices in all appliances put on the market.

R.A.F. Display

WIRELESS will play an invaluable part in the Royal Air Force Display at Hendon to-morrow (Saturday), and several of the events will depend for their success on the co-ordination of units in the air by means of radio telephony.

His Royal Highness the Prince of Wales will represent His Majesty the King. Nearly all the members of the Diplomatic Corps will be present, besides several members of the Cabinet. Tickets for the display are on sale at all theatre agencies and libraries, and the proceeds are devoted to service charities, including the R.A.F. Benevolent Fund.

Listen for Bombay

SPECIAL short-wave tests from the Bombay broadcasting station have been arranged for the summer months in the hope that European listeners will send in reports. The station transmits to-morrow (June 30th) from 1600 to 1730 G.M.T. on a wavelength of 31.36 metres with a power of 4.5 kilowatts in the aerial. The call-sign is VUB.

Reports may be addressed to the Director, Bombay Broadcasting Station, c/o *The Wireless World*.

What They Want

ASKED which programmes they preferred, grave or gay, 98 per cent of listeners to the Paris PTT station have voted for "gay." No fewer than 54 per cent. asked for more "O.B.'s" and 86 per cent. voted for more theatrical programmes.

Sir Ambrose Fleming : A Speaking Portrait

THE great value which would have attached to a talking film of Faraday and other electrical pioneers was recently discussed by the Council of the Institution of Electrical Engineers,

SIX YEARS IN SEA, BUT IT WORKS! This inductance coil, clockwork mechanism and Philips miniwatt valve, were fished up in the Bristol Channel by a trawler. The valve, which was made in France in 1925, still functions.

and it was suggested that, while such priceless records were impossible in the past, no time should be lost in securing "speaking portraits" of eminent electricians of to-day. Unfortunately, the Institution has no funds available for such a purpose, but Dr. V. Z. de Ferranti, chairman of Ferranti, Ltd., proposed that the cost of such films be deferred by individual members. His offer to pay for the first one was accepted by the Institution, and it is fitting that the inaugural film is to feature Sir Ambrose Fleming, the inventor of the thermionic valve.

It is hoped to build up for the Institution a library of speaking portraits so that future generations may have the opportunity not only of studying the works of electrical authorities but of seeing and hearing them in real life.

Poste Parisien En Fête

A RADIO GALA which Poste Parisien is staging to-morrow (Saturday) and Sunday, July 1st, will take the form of broadcasting in public.

The spacious *Portiques* near the studios in the Champs Elysees, will include an exhibition hall with a glass-walled studio, in which visitors will see programmes as they are actually performed and also have an opportunity of studying transmission methods in the control room.

New Form of Static

DURING a recent broadcast from Noyon (France) listeners had a curious experience. The engineers had installed their amplifiers beneath a tree. Suddenly, while listening on 'phones, they heard a roar as of an approaching air squadron which threatened to ruin the transmission. Hasty search of the sky revealed no sign of aircraft, yet the sounds in the headphones suggested the most daring aerobatics. At last one of the operators remembered a microphone which had been left in circuit as a spare, and when this was examined it was found that a swarm of bees had mistaken it for a hive.

500,000 Cycles Without Distortion?

A NEW high-frequency cable which would possess a frequency band of from zero to 500,000 cycles without distortion was referred to at a recent meeting of the German Television Society. It was stated that a well-known German firm had produced such a cable, which was capable of functioning without intermediate amplification over a distance of some 70 kilometres. It is believed that the cable will be ideal for linking ultra-short-wave television transmitters at distances of fifty or more miles.

Germany's Radio School

GERMAN National Socialist radio officers are now required to attend the courses of the Radio School organised to provide a body of trained "Funkwarte" by the end of the year. Classes in the Berlin division take place twice a week in the evenings from 2000 to 2200 o'clock. The syllabus comprises lectures by sixty experts, including Herr Eugen Hadamovsky, radio chief in the Ministry of Propaganda, and the subjects range from the elements of electricity to the problems of radio transmission and programme technique.

If it is not possible to open similar radio schools in other parts of the country, provincial students will travel to Berlin for their training.

A Visit to Rugby

MEMBERS of the Midland section of the Institute of Wireless Technology are visiting the Rugby radio station at Hillmorton to-morrow (June 30th).

Short Waves from the Arctic

A POLISH Arctic Expedition to Spitzbergen is attempting to communicate with the whole world on short waves between 40 and 60 metres. We learn that the expedition was expected to reach its camp on June 22nd. That test calls are made during the first five minutes in each quarter of an hour between 0000 and 0100, 0600 and 0700, 1200 and 1300, 1800 and 1900, B.S.T., the call-signs being SOB and SOE. Any reports will be welcomed by the Polski Zwiazek Krotkofslowcow, Warszawa, Poland, Nowy Swiat 21.

"Ultra Shorts" at Horse Show

A MARCONI ultra-short wave transmitter is being used at the International Horse Show at Olympia this year to communicate between the judges in the arena and offices behind the crowded stands.

In previous years runners have carried the necessary messages. This year the judges are accompanied by an official with a hand microphone and a small haversack carrying a 3-foot flexible-rod aerial.

The transmitter, which is worked on a wavelength of 5.75 metres, incorporates one Type D.V.C. valve working on an anode voltage of 120, the power to the anode being 0.35 watts, less than that consumed by an ordinary pocket lamp.

Empire's Leading Amateur

THE Blue Riband of Amateur Radio is still held by a New Zealand amateur transmitter, Mr. Jack Callender, ZL4BT, of Dunedin. He has secured first place in the British Empire Radio Union's contest—regarded by all Empire amateurs as the most important event of the radio year. Last year Mr. G. G. Samson, a near neighbour of Mr. Callender, won the trophy presented by the B.E.R.U. to the champion.

This B.E.R.U. contest is divided into Senior (for high-power stations) and Junior (for low power) categories. In the latter division Mr. G. H. Todd, VS7GT, of Ceylon, repeated his feat of last year by coming first.

Cheap Travel to Radio Show

GERMAN State railways are arranging a service of special trains at reduced fares to and from the forthcoming Berlin Radio Show.

Page 449 follows after the Programme Supplement

PRINCIPAL BROADCASTING STATIONS OF EUROPE

Arranged in Order of Wavelength

(Stations with an aerial power of 50 kW. and above in heavy type)

Station.	kc/s.	Tuning Positions.	Metres.	kW.
Kaunas (Lithuania)	155	.....	1935	7
Brasov (Roumania)	160	.....	1875	20
Huizen (Holland). (*Kootwijk, 50 kW. after 3.40 p.m.*) (*V.A.R.A. and A.V.R.O. Programmes.*)	160	.....	1875	7
Lahti (Finland)	166	.....	1807	40
Moscow, No. 1 (U.S.S.R.)	174	.....	1724	500
Radio Paris (France)	182	.....	1648	75
Istanbul (Turkey)	185	.....	1621	5
Königswusterhausen (Deutschlandsender) (Germany).	191	.....	1571	60
Daventry National	200	.....	1500	30
Ankara (Turkey)	200	.....	1500	7
Minsk (U.S.S.R.)	208	.....	1442	100
Reykjavik (Iceland)	208	.....	1442	16
Eiffel Tower (Paris)	215	.....	1395	13
Motala (Sweden). (*Relays Stockholm*)	216	.....	1389	30
Warsaw, No. 1 (Poland)	223	.....	1345	120
Luxembourg	230	.....	1304	150
Kalundborg (Denmark). (*Relays Copenhagen*)	238	.....	1261	75
Leningrad (U.S.S.R.)	245	.....	1224	100
Oslo (Norway)	260	.....	1154	60
Madona (Latvia)	262	.....	1145	20
Moscow, No. 2 (U.S.S.R.)	271	.....	1107	100
Rostov-on-Don (U.S.S.R.)	355	.....	845	20
Smolensk (U.S.S.R.)	364	.....	824	10
Geneva (Switzerland). (*Relays Sottens*)	401	.....	748	1.3
Moscow, No. 3 (U.S.S.R.)	401	.....	748	100
Boden (Sweden)	413.5	.....	726	0.6
Ostersund (Sweden)	413.5	.....	726	0.6
Oulu (Finland)	431	.....	696	2
Oufa (U.S.S.R.)	436	.....	688	10
Hamar (Norway)	519	.....	578	0.7
Innsbruck (Austria). (*Relays Vienna*)	519	.....	578	0.5
Ljubljana (Yugoslavia)	527	.....	569.3	5
Viipuri (Finland)	527	.....	569.3	13
Bolzano (Italy)	536	.....	559.7	1
Wilno (Poland)	536	.....	559.7	16
Budapest, No. 1 (Hungary)	546	.....	549.5	120
Beromunster (Switzerland) (Schweizerischer Landessender).	556	.....	539.6	60
Athlone (Irish Free State)	565	.....	531	60
Palermo (Italy)	565	.....	531	4
Mühlacker (Stuttgart) (Germany)	574	.....	522.6	100
Riga (Latvia)	583	.....	514.6	15
Agen (France)	583	.....	514.6	0.6
Vienna (Bisamberg) (Austria)	592	.....	506.8	120
Radio Maroc (Morocco). (*S.-w. Stn., 48 m.*)	601	.....	499.2	6.5
Sundsvall (Sweden). (*Relays Stockholm*)	601	.....	499.2	10
Florence (Italy). (*Relays Turin*)	610	.....	491.8	20
Brussels, No. 1 (Belgium). (*French Programme.*)	620	.....	483.9	15
Lisbon (Portugal)	629	.....	476.9	20
Trondheim (Norway)	629	.....	476.9	1.2
Prague, No. 1 (Czechoslovakia)	638	.....	470.2	120
Lyons, PTT (France)	648	.....	463	15
Cologne (Germany)	658	.....	455.9	60
North Regional (Slaithwaite)	668	.....	449.1	50
Sottens (Switzerland) (Radio Suisse Romande)	677	.....	443.1	25
Belgrade (Yugoslavia)	686	.....	437.3	2.5
Paris, PTT (France)	695	.....	431.7	7
Stockholm (Sweden)	704	.....	426.1	55
Rome, No. 1. (*Short-wave station, 25.4 metres*)	713	.....	420.8	50
Kiev (U.S.S.R.)	722	.....	415.5	100
Tallinn (Estonia)	731	.....	410.4	20
Seville (Spain)	731	.....	410.4	1.5
Munich (Germany)	740	.....	405.4	100
Marseilles, PTT (France)	749	.....	400.5	5
Katowice (Poland)	758	.....	395.8	12
Midland Regional (Daventry)	767	.....	391.1	25
Toulouse, PTT (France)	776	.....	386.6	2
Leipzig (Germany)	785	.....	382.2	120
Barcelona, EAJ1 (Spain)	793	.....	378.3	5
Lwow (Poland). (*Relays Warsaw*)	795	.....	377.4	16
Scottish Regional (Falkirk)	804	.....	373.1	50
Milan (Italy). (*Relays Turin*)	814	.....	368.6	50
Bucharest (Roumania)	823	.....	364.5	12
Moscow, No. 4 (U.S.S.R.)	832	.....	360.6	100
Berlin Funkstunde. (*Short-wave Stations,*) 16.89, 19.73, 25.5, 31.38 *and* 49.83 *metres.*)	841	.....	356.7	100
Bergen (Norway)	850	.....	352.9	1
Valencia (Spain)	850	.....	352.9	1.5
Strasbourg (France)	859	.....	349.2	15
Poznan (Poland)	868	.....	345.6	16
London Regional (Brookmans Park)	877	.....	342.1	50
Graz (Austria). (*Relays Vienna*)	886	.....	338.6	7
Limoges, PTT (France)	895	.....	335.2	0.5
Helsinki (Finland)	895	.....	335.2	10
Hamburg (Germany)	904	.....	331.9	100
Radio Toulouse (France)	913	.....	328.6	10
Brno (Czechoslovakia)	922	.....	325.4	32
Brussels, No. 2. (*Flemish Programme*)	932	.....	321.9	15
Algiers (Algeria)	941	.....	318.8	12
Göteborg (Sweden). (*Relays Stockholm*)	941	.....	318.8	10
Breslau (Germany)	950	.....	315.8	60
Poste Parisien (France)	959	.....	312.8	100
Grenoble (France)	968	.....	309.9	20
West Regional (Washford Cross)	977	.....	307.1	50
Cracow (Poland)	986	.....	304.3	2
Genoa (Italy). (*Relays Turin*)	986	.....	304.3	10
Hilversum (Holland). (*KRO and NCRV*) (*7 kW. till 5.40 p.m.*).	995	.....	301.5	20
Bratislava (Czechoslovakia)	1004	.....	298.8	13.5
North National (Slaithwaite)	1013	.....	296.2	50
Königsberg (Germany)	1031	.....	291	60
Parede (Portugal)	1031	.....	291	5
Rennes, PTT (France)	1040	.....	288.5	2.5
Scottish National (Falkirk)	1050	.....	285.7	50
Bari (Italy)	1059	.....	283.3	20
Bordeaux-Lafayette	1077	.....	278.6	12
Zagreb (Yugoslavia)	1086	.....	276.2	0.7
Falun (Sweden)	1086	.....	276.2	2
Madrid, No. 2 (EAJ7)	1095	.....	274	7
Naples (Italy). (*Relays Rome*)	1104	.....	271.7	1.5
Radio Vitus (Paris)	1113	.....	269.5	2
Kosice (Czechoslovakia). (*Relays Prague*)	1113	.....	269.5	2.6
Belfast	1122	.....	267.4	1
Nyiregyhaza (Hungary)	1122	.....	267.4	6.2
Hörby (Sweden). (*Relays Stockholm*)	1131	.....	265.3	10
Turin, No. 1 (Italy)	1140	.....	263.2	7
London National (Brookmans Park)	1149	.....	261.1	50
West National (Washford Cross)	1149	.....	261.1	50
Moravska-Ostrava (Czechoslovakia)	1158	.....	259.1	11.2
Monte Ceneri (Switzerland)	1167	.....	257.1	15
Copenhagen (Denmark). (*S.-w. Stn., 31.51 m.*)	1176	.....	255.1	10
Frankfurt (Germany)	1195	.....	251	17
Trier, Cassel, Freiburg-im-Breisgau and Kaiserslautern.	1195	.....	251	—
Prague, No. 2 (Czechoslovakia)	1204	.....	249.2	5
Lille, PTT (France)	1213	.....	247.3	5
Trieste (Italy). (*Relays Turin*)	1222	.....	245.5	10
Gleiwitz (Germany). (*Relays Breslau*)	1231	.....	243.7	5
Cork (Irish Free State)	1240	.....	241.9	1
Juan-les-Pins (France)	1249	.....	240.2	2
Rome, No. 3 (Italy)	1258	.....	238.5	1
San Sebastian (Spain)	1258	.....	238.5	3
Nürnberg and Augsburg (Germany)	1267	.....	236.8	2
Bodö, Stavanger and Kristiansand (Norway)	1276	.....	235.1	0.5
Drosden (Germany)	1285	.....	233.5	1.5
Aberdeen	1285	.....	233.5	1
Linz, Klagenfurt and Salzburg (Austria)	1294	.....	231.8	0.5
Danzig. (*Relays Heilsberg*)	1303	.....	230.2	0.5
Swedish Relay Stations	1312	.....	228.7	0.25
Budapest, No. 2 (Hungary)	1321	.....	227.1	0.8
Hanover, Bremen, Flensburg, Stettin and Magdeburg.	1330	.....	225.6	1.5
Montpellier, PTT (France)	1339	.....	224	5
Lodz (Poland)	1339	.....	224	1.7
Bordeaux Sud-Ouest (France)	1348	.....	222.6	1
Dublin	1348	.....	222.6	1
Milan, No. 2 (Italy)	1356.5	.....	221.2	4
Turin, No. 2	1365	.....	219.8	0.2
Warsaw, No. 2 (Poland)	1384	.....	216.8	2
Lyons (Radio Lyon) (France)	1393	.....	215.4	5
Tampere (Finland)	1420	.....	211.3	1.2
Newcastle	1429	.....	209.6	1
Béziers (France)	1429	.....	209.9	2
Minsk (U.S.S.R.)	1438	.....	208.6	100
Radio, LL (Paris)	1439	.....	208.5	2
Fécamp (Radio Normandie)	1456	.....	206	10
Pecs (Hungary)	1465	.....	204.7	1.25
Bournemouth	1474	.....	203.5	1
Plymouth	1474	.....	203.5	0.3
Nimes (France)	1492	.....	201.1	0.2

SHORT-WAVE STATIONS OF THE WORLD

(N.B.—Times of Transmission given in parentheses are approximate only and represent G.M.T.)

Metres.	kc/s.	Call Sign.	Station.	Tuning Positions.
62.56	4,795	VE9BY	London, Ont. (Canada). (*Sun.* 06.00) ...	.....
58.31	5,145	OK1MPT	Prague (Czechoslovakia). (*Tues. and Fri.* 19.30)	.....
50.26	5,970	HVJ	Vatican State, Rome. (*Daily* 19.00) ...	.....
50.0	6,000	RW59	Moscow. (*Relays No. 1 Stn.*)	.....
50.0	6,000	EAR25	Barcelona, Radio Club (Spain). (*Sat.* 20.00)	.....
49.83	6,020	DJC	Zeesen (Germany). (*Daily* 18.00 *and* 01.00)	.....
49.67	6,040	W1XAL	Boston, Mass. (U.S.A.)	.....
49.67	6,040	W4XB	Miami Beach, Florida (U.S.A.)	.....
49.58	6,050	GSA	Empire Broadcasting	.....
49.5	6,060	W3XAU	Philadelphia, Pa. (U.S.A.). (*Relays WCAU*)	.....
49.5	6,060	VQ7LO	Nairobi (Kenya Colony). (*Daily* 15.30)...	.....
49.5	6,060	W8XAL	Mason, Ohio (U.S.A.). (*Relays WLW*) ...	.....
49.43	6,069	VE9GS	Vancouver, B.C. (Canada) ...	.....
49.34	6,080	W9XAA	Chicago, Ill. (U.S.A.). (*Relays WCLF*)...	.....
49.22	6,095	VE9GW	Bowmanville, Ont. (Canada). (*Daily* 20.00)	.....
49.18	6,100	W3XAL	Bound Brook, N.Y. (*Relays WJZ*) ...	.....
49.18	6,100	W9XF	Downers Grove, Ill. (U.S.A.)	.....
49.1	6,110	VUC	Calcutta, India. (*Daily* 13.00)	.....
49.02	6,120	W2XE	Wayne, N.J. (U.S.A.). (*Relays WABC*)...	.....
49.0	6,122	ZTJ	Johannesburg (S. Africa). (*Weekdays* 09.00) 14.00 [*Sat.* 14.30] *and* 17.00, *Sun.* 13.00 *and* 16.30.)	.....
48.86	6,140	W8XK	East Pittsburg, Pa. (U.S.A.). (*Relays KDKA* 21.19-06.00)	.....
48.0	6,250	CN8MC	Casablanca (Morocco). (*Relays Rabat*) ...	.....
47.97	6,250	HJ3ABF	Bogota (Colombia). (*Daily* 15.00) ...	.....
47.0	6,382	HC1DR	Quito, Ecuador. (*Daily* 01.00)	.....
46.69	6,425	W3XL	Bound Brook, N.J. (U.S.A.). (*Relays WJZ*)	.....
45.38	6,610	RW72	Moscow. (*Relays Stalin Stn.*)	.....
45.0	6,667	FM8KR	Constantine (Algeria). (*Mon. and Fri.* 22.00)	.....
45.0	6,667	TGW	Guatemala City (Central America). (*Daily* 03.00)	.....
43.75	6,860	—	Radio Vitus, Paris. (*Daily* 20.30) ...	.....
43.0	6,970	EAR110	Madrid. (*Tues. and Sat.* 22.30)	.....
42.92	6,990	LCL	Jelöy (Norway). (*Relays Oslo*)	.....
41.7	7,195	VS1AB	Singapore (Malay States). (*Sun. and Wed.* 15.30)	.....
40.3	7,443	HBC	Radio Nations, Prangins (Switzerland) (*Sun.* 22.00–22.45)	.....
38.47	7,797	HBP	Radio Nations, Prangins (Switzerland). (*Sat.* 22.30–23.15)	.....
37.33	8,936	CNR	Rabat (Morocco). (*Sun.* 20.00)	.....
37.04	8,110	HCJB	Quito (Ecuador)	.....
33.50	8,955	TGX	Guatemala City (S. America)	.....
31.58	9,500	PRBA	Rio de Janeiro (Brazil). (*Daily* 21.30) ...	.....
31.55	9,510	VK3ME	Melbourne (Australia). (*Wed. and Sat.* 10.00)	.....
31.54	9,510	GSB	Empire Broadcasting	.....
31.51	9,520	OXY	Skamlebaek (Denmark). (*Relays Copenhagen*)	.....
31.48	9,530	W2XAF	Schenectady, N.Y. (U.S.A.). (*Relays WGY*)	.....
31.38	9,560	DJA	Zeesen (Germany). (*Daily* 11.45–14.45) ...	.....
31.35	9,570	W1XAZ	East Springfield, Mass. (U.S.A.). (*Relays WBZ*)	.....
31.29	9,585	GSC	Empire Broadcasting	.....
31.28	9,590	W3XAU	Philadelphia, Pa. (U.S.A.). (*Relays WCAU*)	.....
31.28	9,590	VK2ME	Sydney (Australia). (*Sundays*)	.....
31.27	9,595	HBL	Radio Nations, Prangins (Switzerland). (*Sat.* 22.00–22.45)	.....
31.25	9,598	CT1AA	Lisbon (Portugal). (*Tues. and Fri.* 22.00–00.00)	.....
31.0	9,675	T14NRH	Heredia (Costa Rica). (*Daily* 22.00 *and* 02.00)	.....
30.0	10,000	EAQ	Aranjuez (Spain). (*Daily* 22.30, *Sat.* 18.00)	.....
28.98	10,350	LSX	Buenos Aires (Argentina). (*Daily* 20.00)	.....
26.83	11,180	CT3AQ	Funchal (Madeira). (*Tues. and Thurs.* 10.30–12.30)	.....
25.63	11,705	FYA	Pontoise (France). (*Colonial Stn. E-W, daily* 20.30)	.....
25.6	11,720	VE9JR	Winnipeg (Canada). (*Daily* 14.30) ...	.....
25.57	11,730	PHI	Eindhoven (Holland)	.....
25.53	11,750	GSD	Empire Broadcasting	.....
25.5	11,760	DJD	Zeesen (Germany) (*Daily* 01.00–04.00) ...	.....
25.45	11,790	W1XAL	Boston, Mass. (U.S.A.)	.....
25.4	11,810	2RO	Prato Smeraldo, Rome. (16.15–23.30) ...	.....
25.36	11,830	W2XE	Wayne, N.J. (U.S.A.). (*Relays WABC*)...	.....
25.36	11,830	W9XAA	Chicago, Ill. (U.S.A.). (*Relays WCFL*) ...	.....
25.28	11,865	GSE	Empire Broadcasting	.....
25.27	11,870	W8XK	East Pittsburg, Pa. (U.S.A.). (*Relays KDKA* 21.19–03.00)	.....
25.20	11,905	FYA	Pontoise (France). (*Colonial Stn. N-S*) ...	.....
25.0	12,000	RNE	Moscow. (*Relays No. 2 Stn.*)	.....
23.38	12,830	CNR	Rabat (Morocco). (*Sun.* 12.30)	.....
19.84	15,120	HVJ	Vatican State, Rome. (*Daily* 10.00) ...	.....
19.81	15,140	GSF	Empire Broadcasting	.....
19.73	15,200	DJB	Zeesen (Germany). (*Daily* 05.35 *and* 11.45)	.....
19.72	15 210	W8XK	East Pittsburg, Pa. (U.S.A.). (*Relays KDKA* 15.00–21.18)	.....
19.68	15,244	FYA	Pontoise (France). (*Colonial Stn. E-W*)...	.....
19.64	15,270	W2XE	Wayne, N.J. (U.S.A.). (*Relays WABC*)...	.....
19.57	15,330	W2XAD	South Schenectady, N.Y. (U.S.A.). (*Daily* 20.00)	.....
16.89	17,760	DJE	Zeesen (Germany)	.....
16.88	17,770	PHI	Eindhoven (Holland)	.....
16.87	17,780	W3XAL	Bound Brook, N.J. (*Relays WJZ*) ...	.....
16.87	17,780	W9XAA	Chicago, Ill. (U.S.A.). (*Relays WCFL*) ...	.....
16.87	17,780	W9XF	Downers Grove, Ill. (U.S.A.)	.....
16.86	17,790	GSG	Empire Broadcasting	.....
13.97	21,470	GSH	Empire Broadcasting	.....
13.92	21,540	W8XK	East Pittsburg. (12.00–19.00)	.....
12.30	24,380	VE9GW	Bowmanville, Ont. (Canada)	.....

The Diary of an Ordinary Listener

THE reciprocal concert of German music from Radio Paris on Thursday, June 14th, proved as good as, if not better than the previous Berlin concert of French music. The National orchestra under the able conductorship of Hermann Abendroth were really splendid, and the singing of Margarete Klose was of that distinctive quality to be expected from a leading soprano of the Berlin State Opera. The programme included the Overture to the "Flying Dutchman," the Prelude to "Parsifal," an extract from "Rhinegold" and a Beethoven Symphony, while more modern music was represented by Richard Strauss' Symphonica Domestica and Reger's "An die Hoffnung" (rather a dismal type of "Hope" to my mind, but nevertheless, very interesting music).

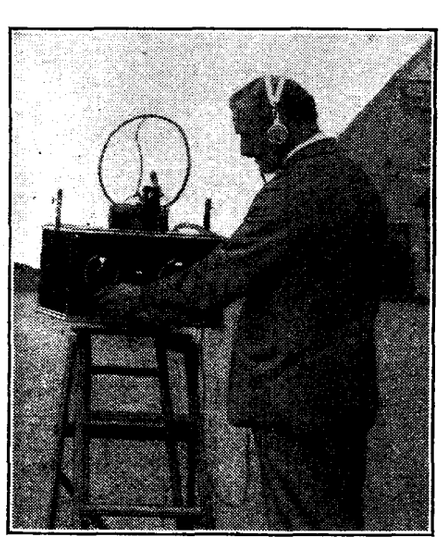
On Friday I enjoyed the excellent programme of Russian Music from Poste Parisien by the Station orchestra conducted by Mathieu which mainly consisted of works of Rimsky-Korsakov, Borodin and Mussorgsky, and, later in the evening, a varied selection of light music arranged by the I.B.C. in which many old favourites figured.

On the next evening I turned to Luxembourg for the Musical Medley by the Station orchestra and soloists which, as was only to be expected in a concert conducted by Henri Pensis, was decidedly good.

On Saturday I heard the end of a performance from Frankfurt of "The Geisha"; my lamentable ignorance of the German language did not enable me to judge of the merits of the translation of the well-known English words, but certainly the singing of them was entirely satisfactory.

The most attractive Sunday programme I thought, was the concert of English and American music by the Kalundborg Station orchestra in which America was represented by Coleridge-Taylor, with selections from "Hiawatha," and England by Vaughan Williams' "Wasps" overture.

Early last week I listened for a while to the Carillon recital relayed by Huizen.



Lt.-Col. Ashley Scarlett tuning in 5-metre signals during recent ultra-short wave direction finding tests carried out by the Golders Green and Hendon Radio Scientific Society.

I think, however, that bells never come through really well by radio, which seems to pick up too readily some of the undesired overtones.

Radio Paris transmitted a good concert from the Opéra, beginning with Ravel's "D'Heure Espagnole." I must admit, with shame, that much of Ravel's music is beyond my musical comprehension. His orchestral colouring is so vivid that I "can't see the wood for the trees."

Strasbourg gave us a concert of French music from the Casino, Vichy, which I found easiest to pick up as relayed from Monte Ceneri; even then the concluding number—Schmitt's Psalm 47 for choir, organ, orchestra and soprano solo—was somewhat marred by the intrusion of neighbouring jazz.

CALIBAN.

BOOKS RECEIVED

Television Theory and Practice, by J. H. Reyner, B.Sc., A.C.G.I., A.M.I.E.E., M.Inst. R.E. An exposition of the fundamentals of television together with practical data concerning certain systems. Pp. 196 + x., with 100 diagrams and illustrations. Published by Chapman and Hall, Ltd., 11, Henrietta Street, London, W.C.2. Price 12s. 6d. net.

Theory of Radio Communication. Post Office Engineering Department Technical Instructions. Technical instructions prepared primarily for use in connection with Workmen's Correspondence Classes. Pp. 79 with 173 diagrams. Published by H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2. Price 7s. net.

Modern Acoustics, by A. H. Davis, D.Sc. An account of modern developments in acoustics due principally to the development of electrical apparatus and methods. Pp. 345 + xi., with 102 diagrams. Published by G. Bell and Sons, Ltd., York House, Portugal Street, London, W.C.2. Price 26s. net.

German Wireless

A Note on Recent Developments

By J. H. OWEN HARRIES

AS the result of recent personal investigation of receiver design in Germany, the author of this article reaches the conclusion that technique in that country has much in common with current British practice, though receivers in general would appear to be less ambitious

WIRELESS receivers produced by German firms of standing, such as Telefunken, Lorenz, and others, are designed in accordance with the latest principle, but both valves and circuit arrangements differ in detail from British practice. For example, different types of hexode valve are largely used for frequency changing and for amplification in conjunction with A.V.C. Whereas in America the gramophone as an adjunct to radio has almost died out, possibly because the Americans have no time to put on or take off records, many of the German receivers now incorporate gramophone attachments. Incidentally, it may be remembered that in England the demise of the gramophone was freely prophesied when broadcasting arrived; but notwithstanding the prophets the

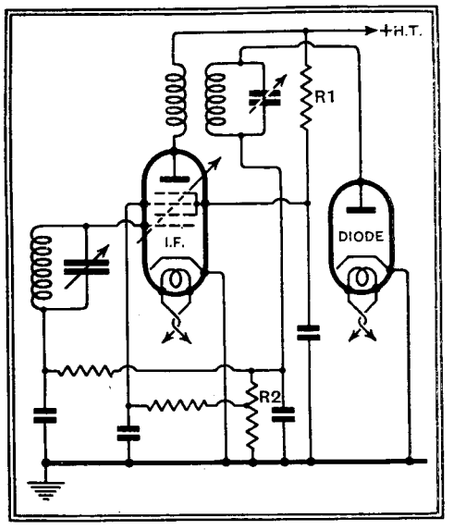


Fig. 1.—German "fading hexode" A.V.C. circuit. Both the first (control) and the third grids are biased from the A.V.C. voltage developed across the diode load resistance R2.

gramophone industry actually benefited. In America, however, the prophecy appears to have been fulfilled.

German technique seems to be more closely akin to British than to American practice. There is no tendency towards over-compact arrangements, or to over-cheapening of receivers.

Several different types of hexode valve are to be found, and similarly, there is a good deal of diversity in the circuits in which they are employed. In the "fading hexode" circuit shown in Fig. 1, control of amplification is obtained through a very wide range by applying the controlling voltage to both the inner (control) grid and to the third grid. Negative A.V.C. voltages applied to the third grid cut off the anode current and deflect it to the second and screening grid. Also the first grid is of the variable-mu type, and the negative control voltage, also applied to this grid, further reduces magnification. The combination of these effects and the reduction of the screened voltage (due to the increased drop across the series feed resistance R1 as the screen current is increased) reduces magnification with a very much smaller negative A.V.C. voltage than is the case with the methods commonly used in Great Britain and America.

The hexode is also used in Germany in much the same way as the pentagrid as a converter in superheterodynes; indeed, these valves are generally very popular on the Continent.

In another variation of the "fading hexode" circuit, the A.V.C. voltage is applied to the first grid, the third grid being used as the control electrode This system, shown in Fig. 2, avoids cross-modulation difficulties, which are sometimes encountered with ordinary variable-mu valves.

Broadcast Propaganda

The present German Government is obviously anxious to make broadcast receivers available to practically the entire population of the country, and realises that to attain its objects very cheap receivers must be available. Reproduction of good quality is needed, but long-range reception is not required. A short-range set capable of giving fair volume and clear reception from one or two stations enables the listener to get good entertainment and to hear the Government messages.

The Heinrich Hertz Institute in Berlin, a research organisation which is largely backed by the Government, was given the task of developing designs for simple and cheap local-station sets. These designs are supplied to selected wireless manufacturing firms, who then make and sell the receivers at controlled prices. There are a large number of firms engaged in this work, and already hundreds of thousands of the little sets have been sold at a price

There is now a battery model of the Nazi "People's Set": this photograph was taken at the official "launching" ceremony.

of about £6 each for mains models, the cost of the battery version being about £1 less.

The mains receiver comprises a conventional detector valve with reaction, coupled by an L.F. transformer to the output valve. The usual wave-change switching is employed, and the loud speaker is of the balanced-armature type. Indeed, the circuit is entirely conventional, except that H.T. is supplied through a half-wave rectifier in the case of the A.C. model. Quality of reproduction is as good as can be expected of any balanced-armature speaker, and ample volume is obtained for all normal purposes from the local station.

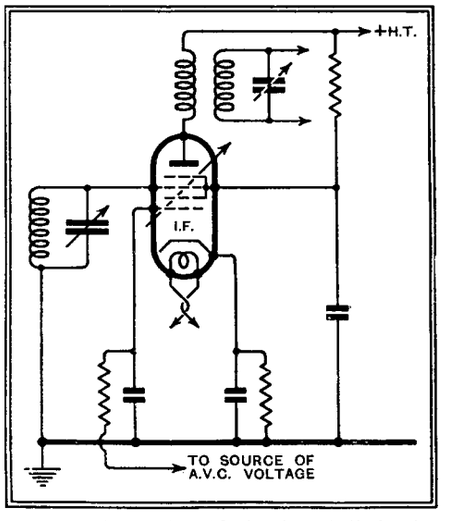


Fig. 2.—In another "fading hexode" circuit the A.V.C. voltage is applied to the first grid and the signal input to the third.

An intermediate stage of L.F. amplification is provided in the battery model, which is otherwise similar. Filament supply may be obtained from either an

German Wireless—

accumulator or from primary batteries. The special dry L.T. battery unit used with these sets is interesting; it gives an initial voltage of 3 volts, a resistance, with tappings connected to plug-sockets, being mounted in the battery case in order that the voltage actually applied to the valves may be adjusted to the rated value of 2 volts. As the battery runs down, the plug is progressively transferred to sockets corresponding to lower values of series resistance.

The obvious disadvantage of this scheme is that the valves are quickly ruined if the plug be inserted in the wrong socket; further, with such a rough voltage adjustment it is not possible to obtain the full output of the battery.

The supply of valve filaments which need a constant voltage from a primary battery which inevitably gives a varying

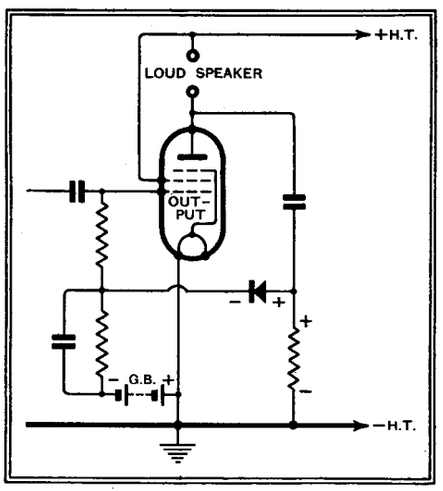


Fig. 3.—The battery economy device employed in the Government-sponsored "People's Receiver."

voltage is always an awkward problem. The better scheme is, of course, to use an accumulator, but where charging facilities are not available a more expensive but very satisfactory solution has been found in Germany; a similar arrangement is in use in the U.S.A. Current is derived from a new type of air-depolarised L.T. primary battery of the "wet" type, which is replaced entirely after some months use. Voltage is substantially constant during the life of the battery, and damage to valves and fluctuating strength of reception are avoided entirely.

Judged by the standard of the more expensive British sets, the German battery receiver does not give a very great power output. Class "B" or Q.P.P. output systems are not used, but instead automatic bias for the power valve is derived through a metal rectifier, as shown in Fig. 3. In the absence of signals, the grid is over-biased to such an extent that only about 2 milliamps of anode current flows. On the reception of a signal, the rectifier produces a positive voltage, which partly counteracts the negative grid bias, and anode current then rises to about 6 milliamps.

Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents

"What is a Radio Engineer?"

I HAVE read with interest the letter under the title "What is a Radio Engineer?" in your current issue.

It would appear that the definition of a "radio engineer" is at present an elastic term, and I feel it may be a trifle unwise to confuse the issue by referring to the suggested shortcomings of the Institution of Electrical Engineers.

The Institution by its very nature includes all kinds and conditions of men who are occupied in the many diverse branches of what is generically known as electrical engineering.

It must be realised that the Institution of Electrical Engineers is the oldest and most respected body meeting the requirements of the electrical profession in the world, and it must not be forgotten that the I.E.E. in its original form was the Society of Telegraph Engineers. As such it includes telegraph, telephone, illuminating, designing, constructional, railway, and last, but by no means least, wireless engineers; and, in addition, a whole host of physicists whose work lies in electrical laboratories, works, and in schemes scattered throughout the world.

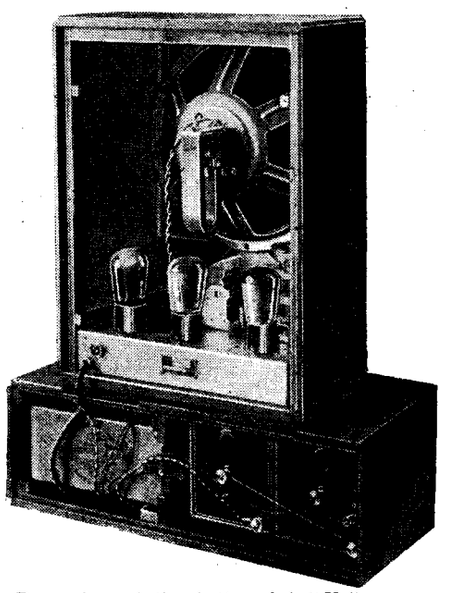
Membership in the technical sections implies a general knowledge of the fundamental principles of electrical technology, after which a man naturally branches out into his own particular or peculiar speciality.

I feel that your correspondent is in error in stating that the Institution of Electrical Engineers would not be prepared to permit its members to support any purely wireless institution which might be formed.

I, of course, am not in the confidence of the I.E.E.; but I know that some of the founder members and most of the senior members of the Institute of Wireless Technology are corporate members of the Institution of Electrical Engineers, and to the best of my knowledge the I.E.E. have in no way penalised them.

The Institute of Wireless Technology holds periodical examinations in order, if possible, to determine what is a radio engineer; and your correspondent will realise that even this branch of applied physics is broken up into many specialised subsections. We have been in existence for nearly ten years, and shall always be glad to hear from genuine aspirants in the field of technical radio engineering.

HARRIE J. KING
Hon. Sec., The Institute of Wireless Technology.



Rear view of the battery-fed "Volksempfänger," which is stated to operate 3 hours daily for 250 days without renewal of L.T. batteries.

Magnetic Screening of Gramophone Motors

IN connection with Mr. Gilbert Packman's letter in your issue of May 25th, it may be of general interest to your readers to be reminded of the superior properties of nickel iron alloys as screening materials. Extraordinary results can be obtained by the use of relatively small quantities of "Mumetal," and in one recent test a sheet of this material only 0.01in. thick reduced the 1,000-cycle pick-up by 30 db. more than that obtained with 0.25in. of cast-iron.

"Mumetal" in the form of welded boxes or pressed shrouds is utilised to a considerable extent for shielding input, intervalve and output transformers, and is invaluable for screening in high-gain amplifiers. A 40 db. reduction in 50-cycle hum due to direct pick-up by a transformer can very easily be achieved.

Where interference is not intense, or the equipment to be shielded is of fair dimensions, it is customary to use "Radiometal." This is a cheaper nickel iron alloy than "Mumetal" with somewhat less striking screening properties, but it is many times more effective than ordinary sheet iron.

Both these alloys can be obtained in the usual thicknesses, but where extremely thin sheets are required it is the practice to employ them backed with plywood, and a commercial product of this type, known as "Telcon-Plymax," is available.

London, S.E.7. GEO. A. V. SOWTER.

Transients

IN view of the interest which is being excited at the moment by the question of the importance of the phases of the various components in sound transients, the following brief summary of some work by Chapin and Firestone, on "The Influence of Phase on Tone Quality" (Journal of the Acoustical Society of America, Vol. V, No. 3) may be of interest. I quote from their paper, p. 175.

In the first experiment an observer was given the 108-cycle note at a pressure level of 104 db. Having noted its loudness and quality he was asked to introduce enough of one of the harmonics, say the second, so that its presence could be detected in the combined tone. He was then required to change the phase of the harmonic and report any changes in the quality and loudness of the combination. If he wished he was permitted to change the sound pressure of the harmonic and try the effect of the phase shift again. Out of about a dozen observers who made this attempt not one failed to report a change both in loudness and in quality with phase shift, whenever the har-

monic had a certain pressure level. The universal report also was that the minimum loudness condition was obtained with a definite setting of the phase shifter, and that a different but still definite position of the phase shifter produced a maximum loudness of the combined tone. The observers also reported a change in the quality with change in phase, the minimum loudness condition being characterised by smoothness, whereas the maximum loudness condition was characterised by a rough or dissonant element which somewhat resembled the chirp of a cricket. . . . Similar though less marked results were obtained with the combinations of the fundamental with the third, fourth and fifth harmonics.

They explain these results in terms of the non-linear properties of the ear, and develop a simple theory which seems to be in quantitative agreement with their measurements, and they finally conclude that "The data of this experiment indicate that there is a perceptible change in the loudness and quality of two harmonic tones of low frequency and high sensation level when the phase relation of the tones is changed. With proper relation of the two harmonic tones it is possible to combine them in such phase relation that the loudness of the combination is less than that of the lower frequency component alone. The phase settings of the low-frequency paired harmonics in the minimum loudness condition are found to be in agreement with the assumption that the subjective harmonics are related as cosine functions without epoch angles." The authors add that further measurements along these lines are in progress.

"A CONSTANT READER OF
'THE WIRELESS WORLD.'"

Cambridge.

High Definition Television

IF all those responsible for broadcasting were to curtail the medium- and long-wave transmissions and erect a chain of ultra-short wave transmitters there would be an outcry. Yet this is the trend of high definition television. Long-distance looking-in will have an even greater appeal than long-distance listening. By all means use the 6-metre transmissions for a purely local service of high definition, but at the same time we must have transmissions on the medium and long wavelength. Why is it that the B.B.C. have not erected a single-sideband modulated 60-line television transmitter? Do the B.B.C. intend to test the method of direct radiation on 1,000 metres of high-definition television as suggested by G. W. Walton? No; the B.B.C. are going to provide us with only ultra-short wave transmission. H. RICHARDSON.

Buxton, Derbyshire.

In Next Week's Issue:—

The Universal Single-Span Receiver

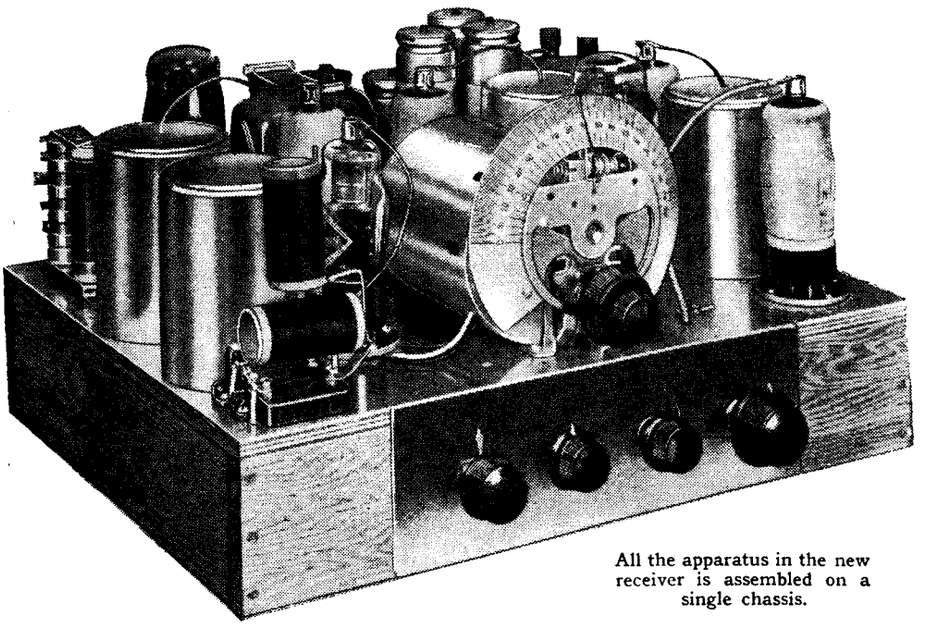
A Receiver for A.C. or D.C. Mains Without Waveband Switching or Ganging

THE single-span principle of tuning has so far only been applied to A.C. and battery receivers, but a model designed for operation from either A.C. or D.C. mains at will is to be described next week. The new Universal type valves are employed, and are arranged as a heptode frequency-changer followed by a triode buffer valve providing variable selectivity. Two I.F. stages with variable-mu H.F. pentodes are incorporated, and a duo-diode-triode feeds the output pentode with resistance-coupling and provides delayed automatic volume control.

The aerial system is substantially aperiodic, and all tuning is carried out by means of the oscillator variable condenser, thus eliminating all ganging. This is made possible by the use of a high intermediate frequency, actually 1,600 kc/s.

The sensitivity is adequate for all normal reception with an outdoor aerial, and the selectivity is sufficiently high to give interference-free reception of the worth-while Continental transmissions. The inclusion of variable selectivity, moreover, enables it to be varied to suit the requirements of any particular station, and so permits the highest quality of reproduction to be obtained under all circumstances.

The power output is adequate for most domestic purposes, and is under complete control by the manual volume control, which is operative on both radio and gramophone. The quality of reproduction reaches a very high standard, and mains hum proved negligible in all the tests.



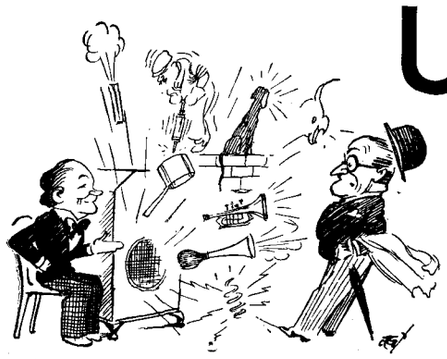
All the apparatus in the new receiver is assembled on a single chassis.

LIST OF PARTS

1 Variable condenser, 0.00016 mfd. **Polar Type "E"**
1 Dial, Slow-motion type **Polar Micro-drive semi-circular**
2 Bulbs, 0.06 amp. **Bulgin Type "H"**
1 H.F. choke **Bulgin H.F.8**
(Kinva, Wearite)
4 Microdensers, 100 mmfds. **Eddystone 900**
1 Compression condenser, 100 mmfds. **Colvern**
1 Electrolytic condenser, 4 mfds. **Peak Type "W"**
3 Electrolytic condensers, 8 mfds. **Peak Type "W"**
1 Electrolytic condenser, 50 mfds. 15 volts **Peak Type D.54**
1 Electrolytic condenser, 50 mfds. 25 volts **Peak Type D.52**
8 Fixed condensers, 0.1 mfd. **Peak Type "M"**
3 Fixed condensers, 0.01 mfd. **Peak Type "M"**
1 Fixed condenser, 0.005 mfd. **Peak Type "M"**
2 Fixed condensers, 0.002 mfd. **Peak Type "M"**
2 Fixed condensers, 0.001 mfd. **Peak Type "M"**
1 Fixed condenser, 0.0005 mfd. **Peak Type "M"**
4 Fixed condensers, 0.0001 mfd. **Peak Type "M"**
1 Fixed condenser, 0.0001 mfd. **Graham-Farish Bakelite Case Type**
1 Fixed condenser, 0.0002 mfd. **Graham-Farish Bakelite Case Type**
(Dubilier, Graham-Farish, T.C.C., T.M.C.Hydra, Telsen)
1 Resistance, 80 ohms **Watmel Hy-watt**
1 Resistance, 165 ohms **Watmel Hy-watt**
2 Resistances, 250 ohms **Watmel Hy-watt**
1 Resistance, 2,000 ohms **Watmel Hy-watt**
3 Resistances, 10,000 ohms **Watmel Hy-watt**
1 Resistance, 20,000 ohms **Watmel Hy-watt**
3 Resistances, 50,000 ohms **Watmel Hy-watt**
3 Resistances, 100,000 ohms **Seradex**
1 Resistance, 250,000 ohms **Seradex**
1 Resistance, 1 megohm **Seradex**
2 Resistances, 2 megohms **Seradex**
(Dubilier, Erie, Ferranti, Graham-Farish, Claude Lyons, Seradex)
1 Mains resistance, 300 ohms, plus 250 ohms, tapped every 50 ohms **Watmel P25**
1 Resistor, 25 ohms **Claude Lyons F.W.25**
1 L.F. choke **Wearite H.T.11**
1 L.F. choke, 32 henrys **Bulgin L.F.15**
(Bulgin, Davenset, Ferranti, Sound Sales, Varley, Wearite)
1 Tapered volume control potentiometer, 250,000 ohms **Claude Lyons Type 250 M-T**
(Ferranti, Magnum, Rothermel)
2 Valve holders, 5-pin **Clix Chassis Mounting Standard Type**
6 Valve holders, 7-pin **Clix Chassis Mounting Type**
1 Rotary Q.M.B. D.P.D.T. Switch **Claude Lyons 2163**
1 Rotary Q.M.B. D.P.S.T. Switch **Claude Lyons 2161**
1 Reaction condenser, slow-motion, 0.0002 mfd. **Polar Type QJ**
(Eddystone)
4 Coil screens, 3¾ x 2½in. diam. **Mains Power Radio Type CS1**
1 Coil screen, 4 x 3½in. diam. **Colvern**
Materials for Coils:
12in. Paxolin tube, 1in. diam. **Wright & Weaire**
2½in. Paxolin tube, ¾in. diam. **Wright & Weaire**
Quantity No. 32, 36 and 38 D.S.C. wire,
or 1 Set of Coils.
4 Knobs **Bulgin K6**
1 5-pin Plug **Bulgin P.3**
(British Radio Gramophone Co.)
1 Baseboard twin fuseholder with 1 amp. fuses **Bulgin F.11**
(Belling-Lee)
4 Ebonite shrouded terminals, A, E, Pick-up (2) **Belling-Lee Type B**
5 Valve cap connectors, thimble type **Clix**
2 Lengths screened sleeving **Harbros**
4 ozs. No. 20 tinned copper wire, 8 lengths Systoflex, wood, flex, etc.
Plymax baseboard, 12 x 15 x ⅜in. **Peto-Scott**
Screws:—
44 ⅜in. No. 4 R/hd.; 18 ½in. No. 4 R/hd.
3 ½in. No. 6B.A., with metal threads and nuts and washers.
Loudspeaker, with transformer to give primary impedance of 4,400 ohms **Rola F7-PM29**
Valves:—Mazda, 1 HL.1320, 1 HL.DD.1320, 2 VP.1321, 1 Pen.3520, 1 U.4020; **Micromesh**, 1 15.D.1.

UNBIASED

By FREE GRID



One of Bach's best.

A New Idea

AS my readers well know, I am no musical highbrow.

Therefore, when paying a visit the other afternoon to the home of a well-known musical virtuoso, now alas! afflicted with partial deafness, I was fully prepared to be pained by the strains of chamber music as I turned into his street, for, as I must explain, owing to his unfortunate affliction he always has to listen with the volume control full on.

My horror can be imagined, then, as I hove within earshot of his house, when my eardrums were nearly split by the raucous rhythm of red-hot jazz. Wondering whether he had become bereft of his senses as a result of a recent visit to America, I hastened to his domicile and found him sitting in front of his loud-speaker.

He instantly motioned me to be silent, and so I remained until the last sound of the uproar had died away. He then astonished me by remarking: "One of Bach's best, don't you think? But, of course, I forgot, you do not appreciate chamber music." Naturally, I enquired if he felt unwell and thought it best to try to humour him, having heard that this is the proper procedure in cases of this kind. I was about to make a tactful withdrawal when I suddenly observed the receiver—a new one of American make.

Explanations followed, and I learned that it was a Custom-built instrument which he had brought back from America where he had been specially "fitted" for it. It appears that partial deafness usually takes the form of uneven sensitivity of the ear to various parts of the musical spectrum, and the latest practice "over there" is to plot a curve of a patient's hearing, and from this to design a receiver fitted with suitable filter circuits which will accentuate the troughs and subdue the peaks in the curve. It appears that no two deaf people have similar curves, and so separate instruments have to be "made-to-measure" for each patient. At any rate, the net result of this tone-correcting business is to make ordinary music sound like a Kilkenny cats' chorus so far as persons of normal hearing are concerned.

A similar process of curve-taking is conducted in this country for the "made-to-measure" type of deaf-aid, but it has apparently remained for the Americans to apply the idea to a wireless receiver. There is, however, only one snag as far as I can see. Although the set I saw was fitted with a switch enabling the special tone-adjusting circuits to be cut out and everything restored to normal when other people desired to use it, what happens when the family of a partially deaf person desires to listen at the same time as himself?

Noise Consumption Device

IT has so far been my fate to live out my little life unhonoured and unhung, as the poet puts it, but as the result of a simple invention which I have just perfected I trust that my name will be writ large in the halls of fame.

There must, I suppose, be tens of thousands of people who have gone to an early grave through the efforts of their progeny to emulate Paderewski; the mere sound of the "Turkish Patrol" is sufficient to send the average paterfamilias completely berserk. Human endurance has its limitations, however, and recently it was reached in my case, resulting in the complete disembowelment of the old family silk-fronted monstrosity and the instalment of one of the "Neo-Bechstein" type of electrical pianos as recently described in *The Wireless World*, with the important modification that the output was led not to amplifier and loud speaker but to two pairs of headphones for pupil and maestro.

Consuming their own noise.

Those who possess a neighbour with a musically inclined child could do worse than present it with a piano of this type.

Wave Cancelling

THE impetus which the introduction of broadcasting has given to scientific invention of all kinds is truly marvellous, but all too frequently inventors forget to acknowledge the source of their inspiration. I am pleased to record that this is not so in the case of the latest brain-wave from America. The inventor even goes so far as to admit that it was by the study of technical articles in the various radio periodicals that he learned all about ether waves and so was indirectly led to the conception of his great idea to which, in the fullness of time, he has now given birth.

The invention is so staggering in its utter simplicity that I cannot imagine why I, or even one of you, did not think of it before. As we all know, ether waves, like those in air, are pressure waves; but for ease of explanation it will be convenient to consider them as surface waves such as we get at the seaside and to illustrate them in our mind's eye by the familiar sine-wave wiggle.

Now, as we are all aware, heat and light waves are merely short ether waves, and our hero proposes to nullify the effects of the heat of the New York summer by producing heat waves which are exactly 180 degrees out of phase with those coming

A beam of darkness.

from the sun. To put it more simply, he proposes to produce waves which will fit in nicely with the peaks and troughs of the sun's efforts and so cancel them out.

His proposals in the case of light waves are similar, and he has already produced a pocket "torch" which, when switched on in broad daylight, will produce a beam of darkness just as an ordinary torch produces a beam of light when switched on at night. The applications of this invention are bewildering in their number. He proposes, for instance, that a city should protect itself from daylight raids by hostile aircraft by the simple expedient of erecting powerful floodlights (or flood darknesses) and so wrap itself in sepulchral gloom, thus securing the same natural protection that is enjoyed by Manchester.

There is, however a very important and beneficial side of the whole business which, so far as I can see, the inventor has overlooked. Surely if these wonders can be performed in the case of the short waves of light and heat, they can also be accomplished in the case of ordinary wireless waves. Thus, if the government of one country doesn't like the broadcast propaganda of another, it will merely have to build a powerful transmitter and cancel out the carrier waves of the interfering station. This will be far more effective than jamming, as it will give peace in the ether for legitimate transmissions instead of a hideous jumble of sound.