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The Wireless World

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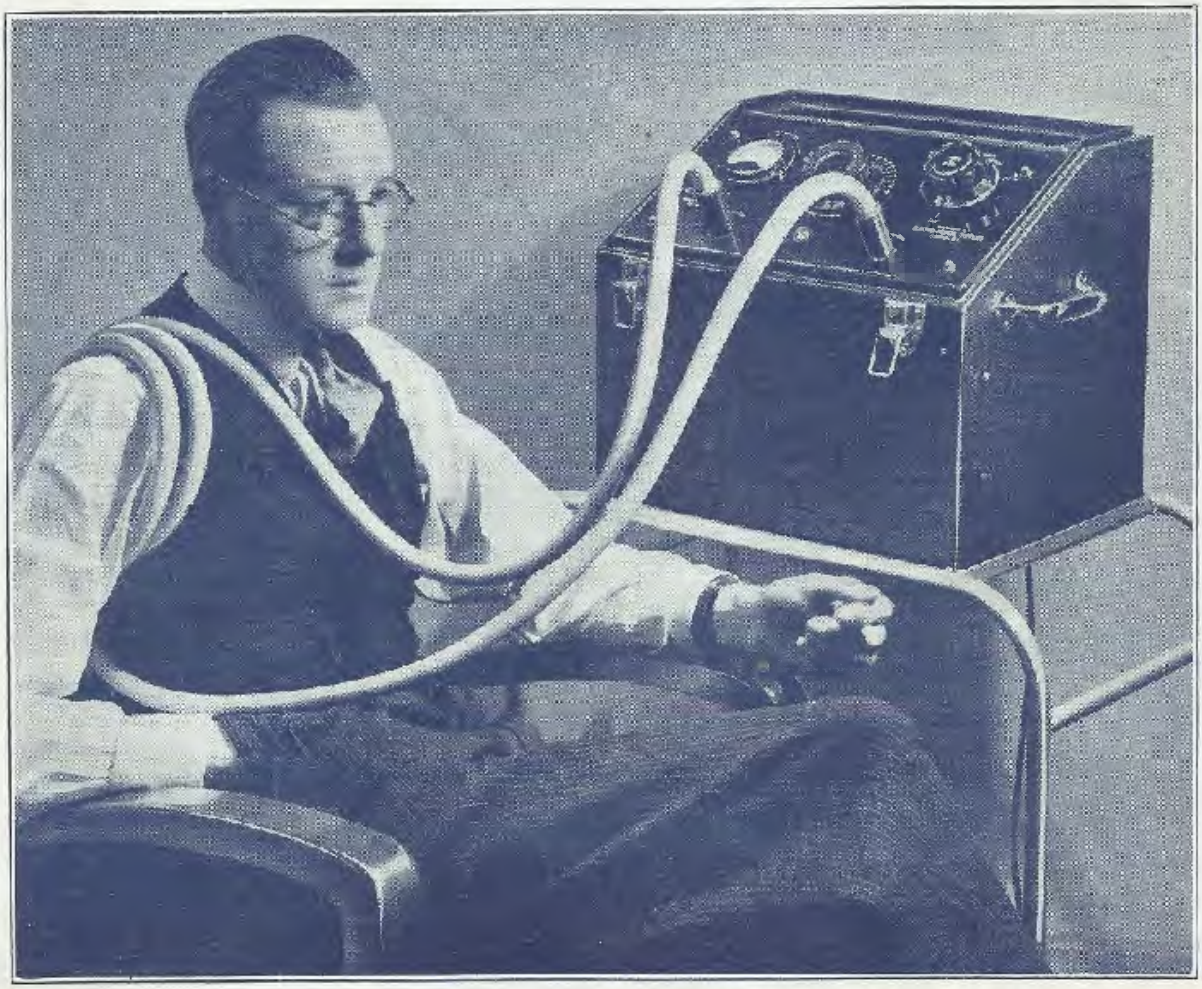
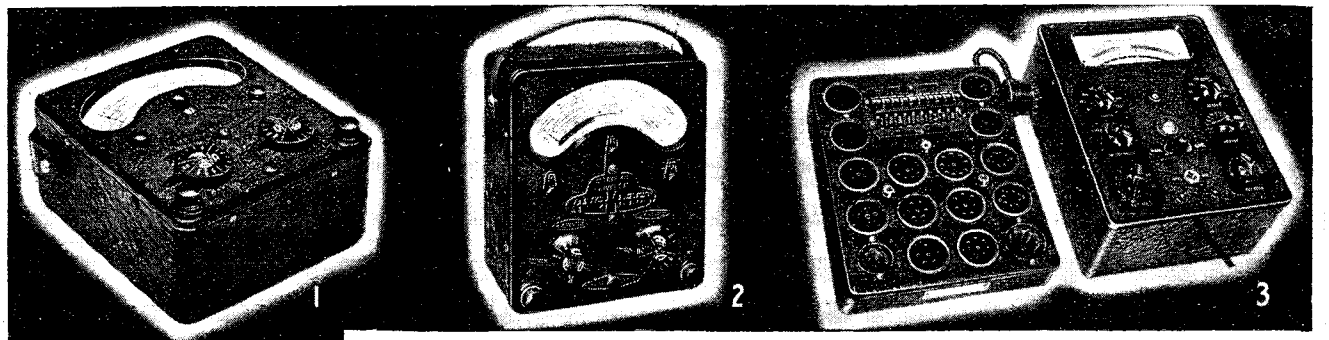
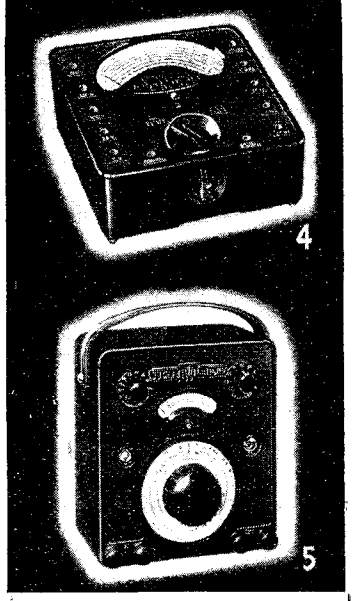
OCTOBER, 1940



WIRELESS IN THE SERVICE OF MEDICINE

No. 1060 Vol. XLVI No. 12





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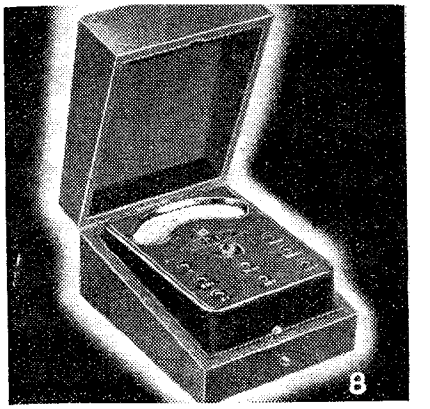

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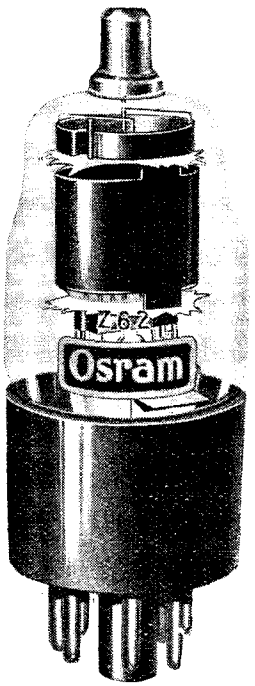

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Wireless World

COVERING EVERY WIRELESS INTEREST

30th Year of Publication

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Contents

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COVERING EVERY WIRELESS INTEREST

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Editorial Comment

Compulsory Interference Suppression

IN last month's *Wireless World* we expressed the opinion—perhaps rather pessimistically—that it was now too late to do anything to abate the nuisance of man-made interference with wireless reception, adding that the most that can be hoped for is that its increase may be curbed after the war. Now comes the news, reported elsewhere in this issue, that the Home Office has decided to restrict the use of several classes of high-frequency appliances, the most important of which is apparatus used in radio-therapy. One of the conditions attaching to the granting of permits by the Postmaster-General for the use of such gear is that " the room in which it is installed has been electrically screened in accordance with specifications laid down by the Post Office."

According to an official statement, the new restrictions are imposed in order to reduce the danger of interference with vital wireless communications of the Services. It is stated that apparatus covered by the Order—especially electro-medical apparatus—has been found to interfere with wireless reception on the ground at distances exceeding 10 miles and with aircraft flying at 10,000 feet up to 50 miles or more. Incidentally, we think that estimate tends towards understatement, as there have been fairly well-authenticated cases of the radiation of short-wave diathermy apparatus originating on the other side of the Atlantic having been detected in this country. As proof of this, it is stated that the superimposed mains hum is at a frequency widely used in America but not commercially employed in this country. Without going too deeply into the matter, however, it may be stated definitely that electro-medical apparatus does constitute a very serious source of interference with short-wave reception; in some otherwise favoured areas it is the only form that cannot be mitigated by taking such reasonably simple precautions as may be successfully applied at the receiving end.

It is a sad reflection on the official outlook that it has needed the major upheaval of a war to bring about a measure of compulsory interference suppression. If a law covering this matter had been already in force, it is likely that the present restrictions would have been unnecessary, or at least that they would have imposed very much less hardship on private users of high-frequency apparatus, who are now unable to continue using it under any conditions.

The fact remains, however, that the ice has now been broken, and that the idea of compulsion has been introduced, though admittedly by an Order made under the Defence Regulations and not by an Act of Parliament. Those adversely affected will certainly accept any hardship imposed on them by the new restrictions as part of their contribution to the National effort, and, when the time comes for their apparatus to be put into use again, will, we imagine, be more ready than hitherto to accept the principle that the radiation of avoidable interference should be illegal.

Chance for Legislation

The Order requires that high-frequency apparatus in the hands of private individuals and private nursing homes must be prepared for collection by Post Office officials, who will presumably retain it till the end of the war. We would express the hope that, before the apparatus is returned, measures will be in force to make its suppression compulsory by law.

Radio-Therapy

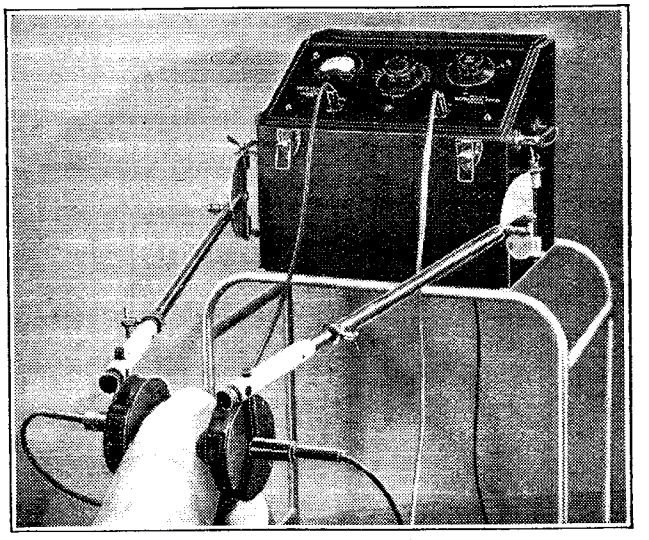
WIRELESS IN THE SERVICE OF MEDICINE

In spite of the fact that the employment of RF technique in medicine is probably more important than in any other non-communication application, wireless technicians know surprisingly little about the effect of RF currents on the tissues of the human body. Probably the information published here will clear up many misconceptions concerning this subject

IT is a far cry from the days of Dr. Bodie to modern short-wave therapy, and yet it is an unfortunate fact that in the minds of many of the public the use of short waves to alleviate and cure certain of the ills to which the flesh is heir is apt to be regarded in the same light as the music-hall demonstrations given by the exceedingly enterprising "doctor" who used to amaze and bewilder our grandparents. Even usually well-informed people, not excluding some members of the medical profession, are apt to smile indulgently when the subject is mentioned in their presence.

We must not be too hard on them, however; there has in the past been enough quackery associated with all kinds of electro-medical treatment to provide ample justification for an attitude of suspicion, and medical men, like all men of science, are apt to fight shy of, and even to oppose, new ideas which seek to carry them up the ladder of progress more than one step at a time.

Much was done to dispel these mistaken ideas concerning modern radio therapy by Dr. P. P. Dalton, who recently read a paper on the subject before a meeting of the British Institution of Radio Engineers, at which several medical men were present. Dr. Dalton first touched briefly on the historical aspect of his subject, and explained that about 1924, at a time when ships' wireless transmitters began to go up in power and down in wavelength, some operators started to complain of peculiar disturbances of health. That it was ships' operators and not land station operators who complained could be accounted for by the fact that the former worked in very close proximity to their transmitters, whereas the latter might be—and usually were—many miles from it.



In this case the ultra-short-wave energy is being conveyed capacitatively to the knee which does not merely form the dielectric between the two electrodes of the machine but is itself a complicated series-parallel network of condensers.

About the same period workers in the vicinity of a very powerful transmitter in the U.S.A., who had previously suffered from neuritis, sciatica and the like, found that they were apt to get a return of their complaints in a somewhat milder form, and a certain amount of speculation commenced in the scientific world as to whether these strange effects could be put to any practical use. The first really important work on the subject was done by d'Arsonval, but it was left to Erwin Schliephake, of the University of Jena, to put ultra-short-wave therapy "on the map" in the medical world. Once started, it spread very rapidly throughout Europe to America, where, as might be expected, it became exceptionally popular.

In order to appreciate properly the *modus operandi* of ultra-short-waves, on the human body, it was advisable to mention a few facts concerning the effects produced by ordinary direct currents, by low (infra-radio) frequency currents, and by low radio-frequency currents, or, in other words, long waves. Ultra-short-wave treatment lay in the region below 30 metres, and was rapidly descending the wavelength scale; it was likely to invade the centimetre and even millimetre wave bands as our knowledge increased.

Direct current had marked bio-chemical and bio-physical effects on the human body. Voltages up to 100 were used, and currents varying from half a milliamp. to 200 milliamps., according to the size of the electrodes and the part of the body being treated. The current caused a movement of ions in both directions through the bodily tissues which produced bio-chemical changes, and, in extreme cases, severe burning effects.

Physiological Effects of Electric Currents

If a flow of ions were suddenly started or stopped on a large scale intense chemico-physical effects such as violent and painful muscular contractions and stimulation of the sensory organs of the skin took place. If the flow were in the region of the brain, more especially near the "bulb" or lower part of the brain, bulbar palsy resulted, or, in other words, paralysis of the brain, with cessation of respiration and apparent death. It was important to recollect that in its initial stages it *was* only a palsy, and in the event of anybody being apparently killed by a high-voltage shock, artificial respiration should be continued for eight or even twelve hours; in fact, no case was hopeless until obvious signs of death had forced themselves upon the attention.

Now if instead of merely switching on or off the current it were very frequently reversed in direction—alternating current—the time during which the ions flowed in one direction might be so short that they were sent back on their path before they had had time to exert a bio-chemical effect. We

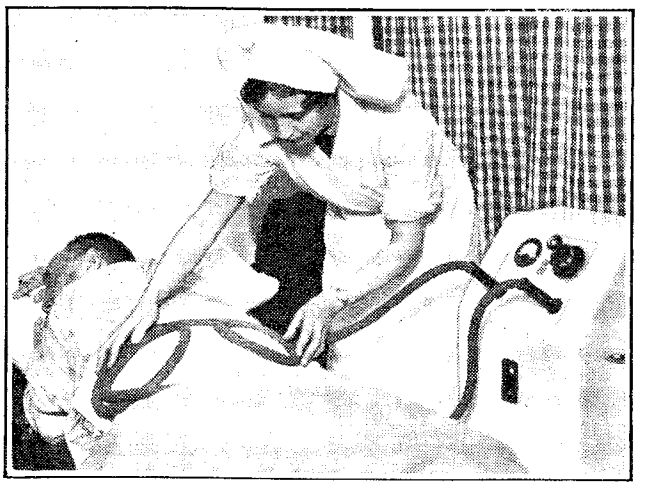
then obtained a bio-physical effect. Owing to the ohmic resistance of the body, the energy of the current became converted into heat. If the volume of the current were increased the painful contractions of the muscles and the stimulation of the sensory organs of the skin previously noted reappeared. If, however, the *frequency* were increased, these effects disappeared, and more heat was generated. When we got to frequencies of 500 kc/s to 1,500 kc/s, or, in other words, wavelengths of 600 to 150 metres, we could use pressures of 60,000 volts and currents of 4 to 6 amperes, and obtain only heat production.

These wavelengths were used for long-wave or formal diathermy, and, in accordance with Ohm's law, produced the most heat in the most resistant tissues. These tissues were, unfortunately, the more superficial ones, subcutaneous fat, for instance, being heated most. Although some degree of heating did take place in the deeper and less resistant tissues, it was not very great. As a matter of interest, it might be mentioned that the impedance of the body, and, therefore, the heating effect, ranged from 19.4 in the case of fat, down to a little more than 1 in the case of blood, unity being the impedance of a 0.5 per cent. salt solution at a temperature of 18 deg. C. Ignoring fat, the highest figure was given by the brain, which ranged between 5.5 and 6.8.

Modus Operandi of USW

In diathermy the current was conveyed into the body via electrodes closely applied to it. If the electrodes were withdrawn a small distance, sparking followed by obstinate burning took placed. A still greater withdrawal of electrodes resulted in cessation of current. If, however, use were made of very much greater frequencies—very much shorter wavelengths—we could withdraw the electrodes a considerable distance from the body, the energy being conveyed to it capacitatively.

The human body was, however, far from being a homogeneous substance, and it was found that each tiny part of the body formed a condenser on its own, and heat was generated in it. For instance, a red blood corpuscle of relatively good conductive material surrounded by a cell membrane of relatively poor conductivity and floating in serum, which is a relatively good conductor, will form a condenser. It should be noted that the dielectric constant of materials changed with increasing frequency. Another instance of this effect was the peculiar results obtained by placing a bowl of goldfish in a USW field. It was found that the goldfish could be caused to have an appreciable temperature rise without the surrounding water being affected.



When applying treatment to the hips to deal with osteo-arthritis, as in the case illustrated here, use is made of inductive coupling between the apparatus and the body.

By the judicious use of long-wave diathermy and medium and ultra-short wave therapy, it was possible to heat selectively any particular tissue of the body desired, but it must not for a moment be thought that the sole object of ultra-short-wave therapy was to produce heat; in fact, the specific effects of ultra-short-waves were athermic. It was here, however, that there came a great cleavage of opinion between the physician and the physicist. The view that specific athermic effects were produced by ultra-short-waves was generally accepted on the Continent, but was much contested in this country. The physicists had produced whole pages of mathematical miasmata to prove that these athermic effects were not athermic at all, but were due to point-heating, or, in other words, that heat was created at multiple points in tissues, but that the temperature of the mass as a whole was not increased.

Dr. Dalton pointed out that he profoundly disagreed with them; if they were correct this heat of which they talked was certainly not heat as the word is used by any ordinary person, as heating at multiple points in tissues would assuredly be conducted almost at once to the surrounding tissues and so heat the whole, and this it certainly did not. Apart from this negative argument, however, the lecturer pointed out that he had successfully carried out a good deal of work both in the laboratory and clinically, to demonstrate the reality of these specific athermic effects, which physicists in this country regarded as non-existent. In particular he had demonstrated the profound effect produced on the functioning of the kidneys by irradiating the pituitary gland by ultra-short-wave generators of insignificant output.

He furthermore explained that having arrived at the conclusion that the point-heating explanation was merely a hypothesis which was being put forward by the physicists, he had set out to formulate one of his own, which was more in keeping with the observed facts, and he had arrived at the following conclusions.

Non-conducting liquids, as everybody knew, were composed of dipoles which consisted of a negative and a positive charge of electricity separated from each other by a minute space and fixed in relationship to all their fellows in the neighbourhood. If electrolyte were added to the non-conducting fluid, then there would be free charges of ions as well as dipoles, and the mixture would approximate more nearly to bodily tissues. If the liquid were now subjected to an RF field the ions would move backwards and forwards and the dipoles would readjust themselves, the whole process being analogous to the movement of molecules of iron under the influence of an alternating magnetic field. Now, the time taken by the oscillating or swinging process was very brief, but nevertheless occupied a measurable period. This time was known as the relaxation period of the dipole, and until readjustment had been completed it was not ready to swing back in the next movement.

A New Hypothesis

If the frequency were increased, one arrived at the point where the dipoles had not completed their movement before they were called upon to reverse. The result was that they were

Radio-Therapy—

held transfixed in the manner of a dancer who was endeavouring to accommodate the rhythmic swinging of his body to music of an ever-increasing tempo and finally arrived at the point where he was able to move neither one way nor the other.

Like the dancer, the dipoles were not merely passively motionless, but were in a state of considerable stress, and it was this state of stress which the lecturer advanced as the possible cause of the undoubted specific effects which ultra-short-waves produced on the human body. The horror-stricken physicist, said Dr. Dalton, might say that he could not imagine a dipole in a state of stress, but this was because such a state existed nowhere else but in a field of sufficiently high frequency, which, said the lecturer, complied with his definition of the specific effects of ultra-short-waves, which was that: "The specific effects of ultra-short-waves are those athermic effects which are produced by ultra-short waves and by nothing else."

From the foregoing definition one might argue that the higher the frequency the greater the specific medical effects, and this, in actual fact, fitted in well with clinical observations, so that it was not unlikely that the most marked specific effects would be obtained when we got down to centimetre and even millimetre wavelengths. As a matter of interest, it might be mentioned that specific effects appeared more evident when low intensities were used than when high intensities were employed. This might be because the heating effect of the higher intensities obscured the specific effects, but this point was at present far from clear. Yet another interesting clinical observation was that a patient whose pain or other complaint was aggravated by high-intensity ultra-short waves was almost certain to be relieved by low intensity or athermic ultra-short-wave therapy.

After dealing with the question of the shape of electrodes which it was desirable to use to treat various parts of the body, Dr. Dalton passed on to the important question of measuring the output of the apparaus used. Up to the present, the methods employed had not been entirely satisfactory, he said. Of course, the actual amount of energy used was a varying factor depending upon the position of the body lying between the electrodes.

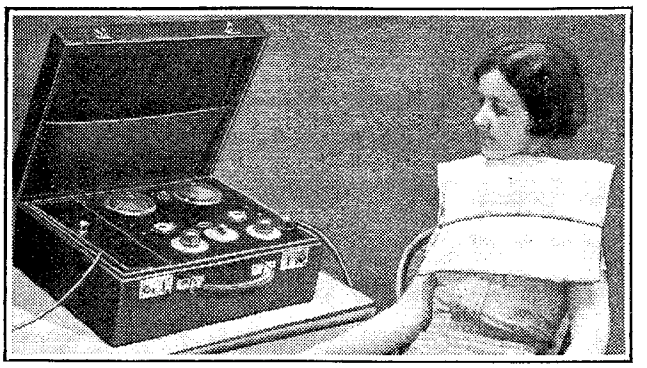
Measuring Energy Output

One method of measuring the output which gave rough-and-ready results was to connect a bank of lamps to plates which were in capacitative relationship to the output electrodes of the apparatus. This could be improved upon by the use of a light-meter employing a photocell and a galvanometer.

The foregoing method was, of course, a measure of the output of the apparatus, but bore little relationship to the amount of energy taken up by the patient. This latter figure could be ascertained in two ways, the first being by the use of a calorimeter. This was a standard phantom of normal saline in which the temperature rise was measured. The other method, which was the best so far devised, was based on the fact that the intake of energy by the portion of the patient under treatment was a product of the square of the current and the resistance. The current could easily be measured, and the resistance calculated from the damping effects of the body on the circuit. A method had now been devised of reading this figure direct from a dial while the patient was under treatment.

With regard to short-wave therapy in general, Dr. Dalton pointed out that it provided the physician with a weapon wherewith he could attack certain human ailments in a manner entirely different to that which was customary. It was, therefore, a pity that apparatus was so dear, for which, in view of the limited demand, manufacturers could not be blamed. British manufacturers were, in fact, worthy of praise, since their apparatus was, in general, somewhat better than German and very much better than American instruments of similar rated power. He had often wondered, however, whether, for experimental purposes, we could not be furnished with simpler and cheaper apparatus, and he had therefore got into touch with Mr. F. H. Clark, of the Institution, who had made for him some simple but effective apparatus from odd parts he had at home, and had definitely convinced him that it was possible to obtain a satisfactory output on the lower wavelengths at a very reasonable cost. This meant that further fields of investigation were open on the higher and, in all probability, medically more efficacious frequencies to anybody who desired to explore them, but had hitherto been prevented by considerations of cost from so doing.

Finally, Dr. Dalton asked Mr. Clark to say a few words concerning the design and construction of the apparatus which he had made for him.



It is customary, as in this case, to keep the cable electrode well away from the skin by interposing some form of pad, several thicknesses of blanket being used in some cases for this purpose.

Book Review

Television. By V. K. Zworykin, E.E., Ph.D., and G. A. Morton, Ph.D. Pp. 646+xi. Published by John Wiley and Sons, Inc., New York, U.S.A. Obtainable from Chapman & Hall, Ltd., 11, Henrietta Street, Covent Garden, London, W.C.2. Price 36s.

THIS book is an exceedingly long one and covers both reception and transmission in a comprehensive manner, although stress is laid on transmission rather than reception, and principle rather than design. It starts off with a discussion of fundamental physical principles, and in this section are included electron optics and vacuum technique.

The principles of television are then dealt with and after this comes the turn of the various elements which make up a television system. The book concludes with a description of the RCA-NBC Television Project.

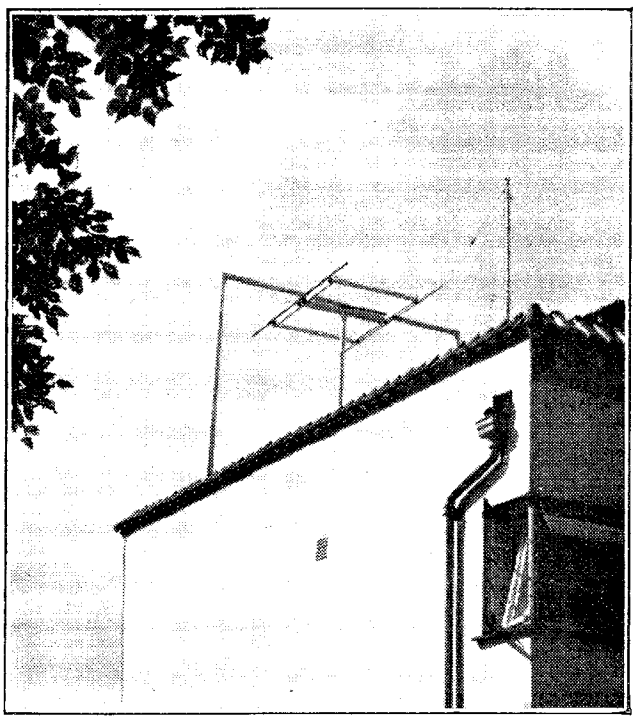
The treatment is mathematical and the book is unquestionably one for the serious worker. Errors are remarkably few and the discussions of single *v.* double sideband operation and of the principles of scanning are particularly good.

Receiving apparatus is given rather less attention and there are many omissions in the realm of time-base and deflection systems. W. T. C.

Aerial Reflectors

SOME MEASUREMENTS ON THEIR EFFECTS

By
E. L. GARDINER,
B.Sc.



The use of reflectors is here discussed more particularly from the point of view of improving signal/noise ratio in short-wave reception.

AT the present time many users of radio find themselves increasingly concerned with ultra-high frequency reception in some form or other. A peculiarity of this field is the need for specially designed aerial systems which are resonant to the wavelength in use, the well-known and widely used dipole being the simplest example of these. In the reception of wavelengths in the neighbourhood of seven metres, for example, a long-wire aerial of the kind commonly used for lower frequencies is seldom found to give strong signals unless it is situated within a few miles of the transmitter, though it will be an excellent collector of interference such as that caused by the ignition systems of passing cars, or by domestic electrical equipment. A resonant aerial, on the other hand, is fully effective only at the frequency for which it has been designed, and will be less able to receive interference of an untuned nature. Stronger signals accompanied by less interference thus result, and the vital signal-to-noise ratio is improved.

The above applies generally to reception at wavelengths below, say, 10 metres. Except perhaps for occasions when atmospheric conditions are abnormally favourable, the reception of such signals at great distances is largely determined by the local noise level, and only careful attention to the aerial system will make it possible.

There are three principal factors to be considered in the design of a dipole aerial for reception purposes. These are, first, that its length shall be suitable to the wavelength in use, secondly, that the polarisation of the waves shall be that for which the aerial is intended, and thirdly that its directional properties shall be such as to receive the desired waves effectively, whilst being unfavourable towards local interference.

In the case of television reception the first requirement should be extended to include the provision of a flatly tuned aerial system, able to respond fairly evenly over the four-megacycle band involved, and also to pick up the adjacent sound transmission. This compromise is often assisted by choosing the length of the aerial to resonate at a frequency intermediate between that of the sound and vision transmissions. The polarisation of the waves to be received was vertical in the case of the now suspended London service, and therefore a vertical dipole was used. Such an aerial has no response to waves arriving from the "end-on" direction, provided that it is connected to the receiver by a perfectly screened or field-less cable, as will be assumed throughout this article. It will therefore pick up little interference from sources below it when erected on top of a high building, and this fact is of the greatest assistance when receiving television in the heart of a large town. Much can be done however to render the aerial directional in the horizontal plane, thus avoiding interference from sources in approximately the opposite direction to the incoming signals.

In amateur working it is more usual to employ horizontal polarisation than vertical, although both are common. It is found that five-metre signals travel better for moderate distances over hilly country when the aerials used are horizontal, whilst it is also generally considered that very distant signals are more nearly horizontally than vertically polarised. The horizontal dipole is inherently directional, being most effective for waves arriving in the "broadside" direction and dead for those arriving "end-on." This effect is usually represented in the form of a polar diagram such as Fig. 1, in which the radius of the curve from the centre C of the aerial represents the relative response in any given direction. This sketch will be true for waves arriving parallel to the surface of the earth, as from a local broadcast-

ing station, but it is not strictly correct in the case of very distant signals, for here the waves may be expected to arrive from a downcoming direction. They are thus not truly "end-on" even when they arrive from the direction AB, and the aerial behaves less directionally than its locally measured polar diagram would suggest.

Reflectors

In all cases the directional properties of a dipole can be improved out of all recognition by the addition of a simple reflector. This course would be equally useful at longer wavelengths, where it is sometimes employed, but under domestic conditions the size of the reflector prevents its general adoption at long wavelengths. At a wavelength of 10 metres the reflector and dipole are approximately 16 feet in length, and separated by a maximum spacing of 8 feet. Considerably greater dimensions than these are difficult to erect and handle, but for any shorter wavelength the dimensions are proportionately reduced, and become highly convenient. It is usual to discuss aerial or reflector dimensions in terms of wavelength, for then the whole system can be designed for any desired wavelength without specifying the actual sizes of the parts in feet or inches. Thus a dipole will be very nearly 16 feet long for a wavelength of 10 metres. For 5-metre working the dipole length is very near to 8 feet. For the present no useful purpose will be served by studying these lengths more closely, and the writer has found that very little practical advantage can be detected by adjusting this length to within better than 2 per cent. of its theoretical value, whilst a variation of 5 per cent. is seldom serious. The general position is summed up by stating that a dipole should be approximately 0.48 of a wavelength long, whilst realising that this figure is modified somewhat by the presence of surrounding objects and by the conductors used, and is not extremely critical.

A reflector in its simplest form comprises merely a length of wire or other conductor stretched parallel to the dipole, on the side farthest away from the incoming signals. It must, however, be slightly longer than a half-wavelength, and therefore than the dipole, the typical figure being 0.54 of a wavelength. The foregoing remarks concerning accuracy also apply to the reflector, which must be as carefully insulated as the dipole, particularly at its free ends, and should be of low electrical resistance. Whilst it is possible to connect the reflector to the feeder cable or transmission line, the usual type now being studied is entirely unconnected to anything, and is termed a "parasitic reflector." Its behaviour is critically dependent upon the spacing between reflector and dipole, which in the simplest case should be one-quarter wavelength, when radiation from the reflector should exactly reinforce that from the dipole in the forward direction.

The explanation of this effect is as follows. Radiation from the dipole travels both forward and backward. In the latter direction it

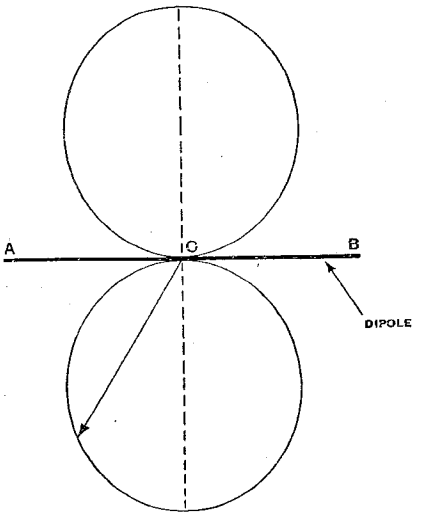


Fig. 1.—Typical polar curve of a dipole aerial without reflector.

reaches the reflector, and induces a current in it. Since the radiation has travelled a quarter-wavelength on its way to the reflector, it will reach it 90° lagging in phase relative to that from the dipole where it originated. A current of this phase lag is therefore set up in the reflector, which in turn radiates. By the time this secondary radiation has returned to the dipole it is a further 90° late in phase, making a total phase lag of 180°. But the oscillations in the dipole will have progressed through a half-cycle during this half-wave time interval, and will be 180° ahead of the initial condition, when the radiation left on its way to the reflector. That is to say, the radiation from the dipole will be a half-cycle ahead of the reference point, whilst that returning from the reflector will be a half-cycle late, bringing the two to the same point in the period of an oscillation. Being in identical phase, the radiations from the dipole and reflector reinforce each other in the forward direction, whilst an extension of the same argument will show that they tend to cancel in the backward direction.

If the current induced into a reflector was as great as that flowing in the dipole, each would produce the same radiated field strength. The forward radiation would therefore be doubled, whilst that to the rear would be exactly cancelled, giving zero backward radiation. Since the problem of radiation and absorption by an aerial system are strictly reversible in all ordinary conditions, these directional effects, which are most easily explained when the aerial is regarded as a transmitter, will be exactly similar when it is used for reception, provided, of course, that waves arrive in the plane in which dipole and reflector are situated.

Practical Limitations

In practice the resistance of a reflector will never be zero, and whilst the current in it can be made equal to that in the radiator if both are connected to a feeder, the current in a parasitic reflector must always be less than that in the dipole which gave rise to it. The forward radiation is therefore never exactly doubled, or the backward radiation fully prevented. To check this factor the writer made tests upon a five-metre dipole excited from a stable transmitter. The field strength at a certain distance from the dipole alone was measured. A reflector was then added, and adjusted to give the maximum increase in field strength. It was found that when this reflector con-

Aerial Reflectors—

sisted of brass-coated iron rod, of the type sold as curtain rods, the increased field strength was in the order of from 70 to 75 per cent. The substitution of half-inch diameter copper tube for the reflector increased the field strength to approximately 85 per cent.

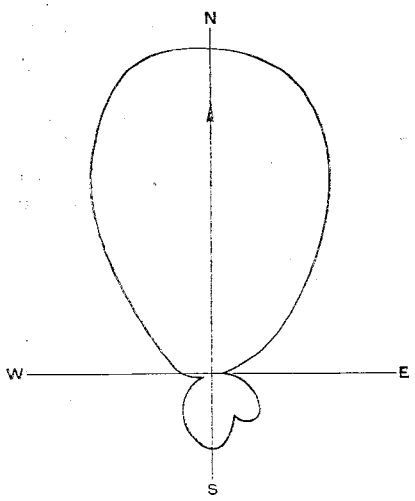


Fig. 2.—Measured polar diagram of a half-wave horizontal aerial and reflector.

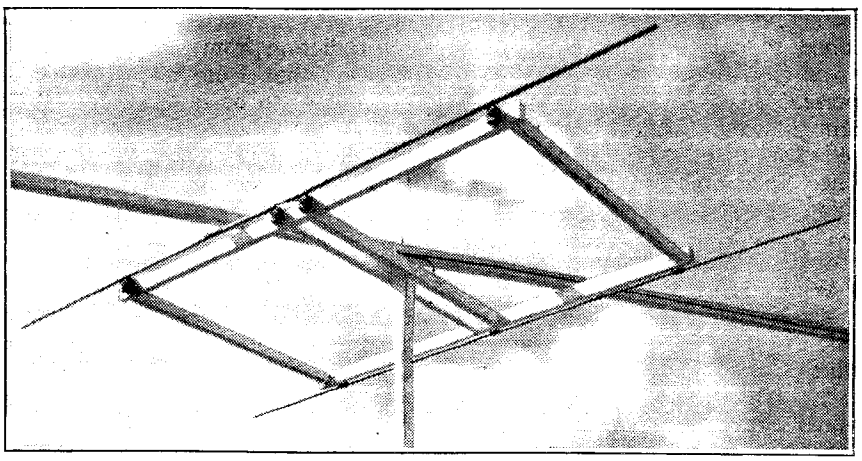
For certain purposes an increased efficiency from an aerial system in the forward direction is very valuable, whilst for others it is much more important to achieve the lowest possible backward response, or the best possible ratio of forward to backward effects. Examples of the latter occur when a dipole and reflector are used for direction finding purposes, or to reduce interference from one particular direction. Aerial systems are in use in which the reflector spacing is less than one quarter-wavelength, and may be as low as 1/8th or 1/12th wavelength. The writer could not find in the generally available handbooks or textbooks any adequate account of the effect of such modifications upon the directional pattern of the aerial, and being particularly interested in the direction-finding aspect of the subject, decided to make an experimental investigation.

A five-metre dipole was available, mounted upon a rotatable wooden framework, and situated upon a flat roof which made it possible to get from one to two wavelengths away in the plane of the aerial. The dipole was coupled loosely to a crystal-controlled transmitter by means of 80-ohm balanced transmission line, the radiation from which was found to be negligible. Loose coupling to the transmitter was employed, and the input to the final stage kept constant throughout the tests at about 20 watts, it being assumed that the effect of modifying the aerial would not appreciably affect the efficiency of this final stage. The RF power in the aerial was thus assumed to be constant, although there may be a small error in the results obtained owing to that assumption. The field strength meter used was of a simple type, consisting of a battery-operated diode valve in series with a Cambridge 0-120 micro-ammeter. The valve voltmeter thus formed had been calibrated and extensively used at lower frequencies, and was known to be linear except for the last few degrees of its scale. To minimise the risk of error from that cause, tests were repeated at least once at different levels of scale reading, generally corresponding to distances of about 15 and 30 feet from the aerial, respectively. The terminals of the meter were joined by a coil of a few turns, and to each was attached a length of about two feet of copper tubing to form a small non-resonant horizontal dipole. Under these conditions typical readings were in the order of four volts.

A preliminary experiment consisted in measuring the directional curve of the horizontal dipole and reflector normally in use at G6GR. Both radiator and reflector are built of half-inch diameter copper tubing, supported upon small porcelain stand-off insulators.

Method of Measurement

The aerial is 7ft. 11in. in length, whilst the reflector is 8ft. 4in., the spacing between them being 4ft. The field strength meter was set up permanently, and the curve obtained by rotating the aerial system, whilst taking readings at every 15 degrees. This method has the advantage that the calibration of the meter remains constant, and is free from the large errors often introduced when moving it from place to place. The curve obtained is shown in Fig. 2, and will be seen to compare quite closely with that given in most textbooks. Its general shape is confirmed by reports from amateur stations situated at greater distances. The very low radiation from the ends of the dipole is well brought out, and it will be seen that the ratio of forward to backward radiated field strength is about six, corresponding roughly to a 36-fold power ratio. The slight lopsidedness of the curve is also interesting, being almost certainly due to the presence of an iron gutter which runs within two feet of the aerial on the West side. An easily measurable RF potential is found to be induced into this gutter.



The author's 5-metre dipole, on which experiments were made.

It was next decided to verify the fact that a spacing of one quarter-wavelength between dipole and re-

Aerial Reflectors—

flector results in the maximum gain in forward radiation. To do this the aerial was directed towards the meter, and the reflector, having been detached from its supports, was moved progressively towards the radiator, readings being taken at intervals of three inches. The results

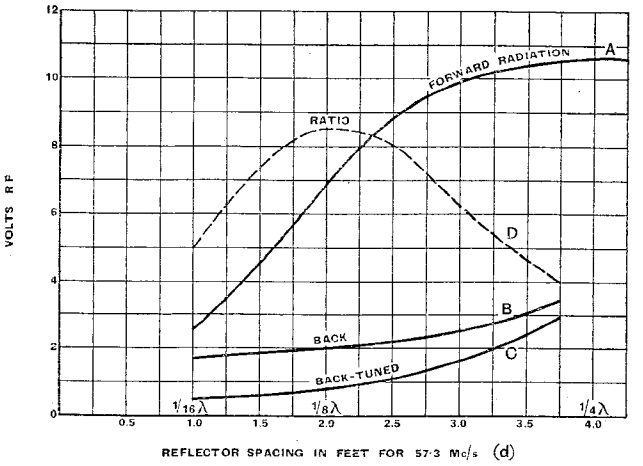


Fig. 3.—Curves showing the effect on radiation of variation of spacing between aerial and reflector.

when plotted appeared as curve A of Fig. 3. They show that a flat maximum occurs at the quarter-wave position, whilst there is no sign of any second optimum position in the case of a parasitic reflector. Close spacing does not seem to offer any advantages in forward radiation, therefore, although somewhat different conclusions might be reached in cases where the reflector is directly fed from the transmitter. The general nature of this curve did not seem to be changed if the reflector was retuned to compensate for its closer proximity to the radiator. In the present case, however, it was not thought worth while to resonate the reflector exactly for each reading, since this process is tedious, and there is no reason to expect a second maximum position on theoretical grounds.

Whilst investigating these points, a similar test was made for a parasitic director, the resonant length for which seemed to be about 7ft. 5in. to 7ft. 8in. A very similar curve resulted, showing a flat maximum with the director 6ft. in front of the radiator, namely, at the theoretical value of 3/8th wavelength. No signs of a second maximum position could be found, and, since in this case the greater spacing between radiator and director obviated any marked detuning effect upon the latter, the tests can probably be taken as conclusive. It was noticed that the gain in forward field strength due to a director was slightly less than that given by a similar reflector, being in the order of from 55 per cent. to 65 per cent. for a brass-coated rod. This effect is probably explained by the smaller current which would be induced into the director, on account of its greater distance from the dipole.

The use of both reflector and director together would naturally be very useful, the measured gain in field strength being in the neighbourhood of three. Accurate figures are not easy to obtain, since the presence of these additional elements modifies the radiation resistance of the dipole appreciably, and thus indirectly alters the feeder impedance matching, the feeder current, and the power absorbed from the transmitter. These factors are not easy to allow for exactly. The effective width of beam, over which the radiation from this arrangement exceeds that from a plain dipole, was found to be in the order of 60 degrees; and, except when working to a fixed point, a rotatable construction would seem to be essential. It is also interesting to note that in the author's experience, based on tests of the kind described, a combination of one dipole with reflector and director gives a somewhat greater gain in the forward direction than do a pair of dipoles in phase each with its own reflector, but without directors. The former arrangement is also more easily matched to a feeder than the latter, in which trouble is likely to be experienced in persuading energy from the transmitter to divide itself equally and in the correct phase between the two dipoles.

Reverting now to matters more directly concerned with reception, measurements were continued to determine whether a greater reduction in backward radiation (or reception of interference) than that shown in Fig. 2 could be achieved. The field strength meter was, therefore, placed behind the aerial system, and the reflector spacing varied as when taking curve A. Curve B of Fig. 3 resulted, showing a progressive reduction of backward radiation as the reflector was moved closer to the dipole. This curve, however, is not entirely satisfactory, for it neglects the factor already mentioned—that the tuning of the reflector is affected by its proximity to the dipole, and that its length should be readjusted to give minimum backward radiation. This effect is most pronounced at the closer spacings which are of particular interest, and seems to have more influence upon the backward than upon the forward radiation.

Tuning the Reflector

To allow for it, the measurements were repeated whilst adjusting the reflector length for each reading. This was done by cutting lengths of one inch at a time from the reflector with the aid of a hack saw, and when necessary replacing them by means of spring clips to verify that too much had not been removed.

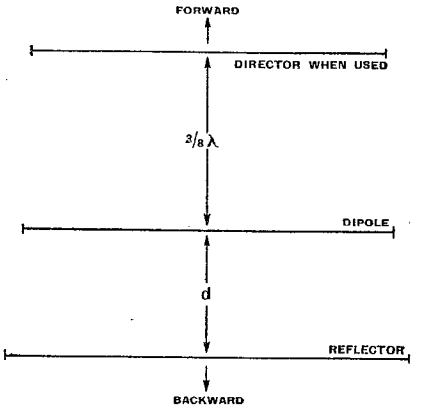


Fig. 4.—Arrangement of the aerial system (in the horizontal plane) during experiments with variations of the spacing dimension *d*.

Under these conditions curve C was obtained, showing that whereas the rate of fall of the back radiation is

Aerial Reflectors—

similar, the actual reduction is considerably greater when the reflector is appropriately tuned.

A final curve D was then drawn showing the ratio of backward to forward radiation for various reflector spacing, and which shows a very definite maximum at a spacing of about $\frac{1}{8}$th wavelength. It is probable that the exact location of this maximum would depend upon a variety of factors which are not easily taken into account, such as the effect of closer reflector spacing upon the radiation resistance and impedance of the dipole, and subsequent tests seem to suggest that still closer spacings up to about 1/12th wavelength are also effective.

New Form of Aerial

A particular construction of aerial which it is hoped to describe later gave optimum ratio for a spacing of 16 inches, as compared with that of 24 inches shown. A general inference can, however, be safely drawn to the effect that when maximum efficiency in the forward direction is not essential, as for example when receiving signals that are of ample strength, a reduction in interference from the back can be attained through the use of close-spaced reflectors. This explains why the reflectors of television aerials were often spaced by considerably less than the quarter-wavelength (about 5 feet) from the receiving dipole, whilst the direction of the whole was not necessarily towards the television transmitter, but sometimes differed by the better part of a right angle. Such an aerial was erected mainly to overcome local interference, and was set with its "dead" direction towards the most serious source of noise, which might, for example, be a main road carrying considerable traffic.

The experiments also throw some light upon the close spaced aerial arrays, such as the W8JK beam, which became popular at amateur transmitting stations before the war. It seems unlikely that these result in actual increased forward radiation, but most probably function through the concentration of radiation into desirable directions, the elimination of radiation in directions likely to interfere with the main beam, and consequently in lowered angles of radiation in relation to the horizon.

It is fully realised that the experiments described in this article are by no means comprehensive, and might be extended in many directions.

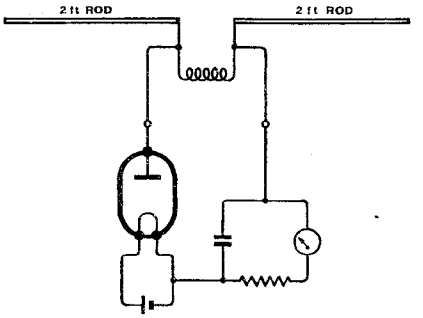


Fig. 5.—Circuit of the field strength meter used for making measurements.

They are, in fact, being continued in the direction of a very compact aerial structure, incorporating a compressed dipole and compressed tunable reflector, whereby a large ratio of forward to backward response is obtainable in a form very suitable to ultra-short wave direction-finding. It is hoped to have an opportunity to describe this arrangement later.

Marconiphone Model 950

DETAILS have been received of the Model 950, which is the sole radio-gramophone so far represented in the Marconiphone 1940 programme.

It is an AC/DC instrument with a superhet receiver chassis (4 valves + rectifier). Push-button control of waverange switching is included, and there are five station selector buttons, three for medium-wave stations and two for long.

On the gramophone side, a high quality pick-up is coupled to the receiver through a 3:1 step-up transformer, which isolates it from the chassis.

The vertical rectangular tuning scale suits the style of the cabinet, which measures 36¼in. high, 19½in. wide and 15¼in. deep.

Deliveries are scheduled to begin early in September, and the price will be 27 guineas.

Henry Farrad's Problem Corner

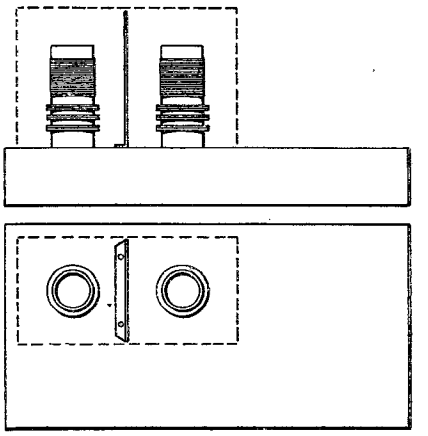
No. 51.—RF Instability

An extract from Henry Farrad's correspondence, published to give readers an opportunity of testing their own powers of deduction :—

2, Tanner Road,
Shillingsworth.

My dear Henry,

I'm sorry to be troubling you again so soon, but here is another little spot of bother. I have a very old but quite good receiver with a RF stage, tuned by input and output coils mounted on a chassis and screened from one another by a sheet of aluminium between them, as shown in the sketch. Recently the RF valve



gave out, and as it was an obsolete type I had to replace it with a more modern one. Since then the set oscillates continuously and can't be stopped (except by switching off!). It seemed to me that the screening wasn't good enough for the higher mutual conductance of the new valve, so I found an oblong tin box—all my aluminium scrap has gone to Lord Beaverbrook—which by a stroke of luck just about fitted the existing screen, and with it formed a complete screen around each coil, as shown dotted.

But it still oscillates. So I looked for possible capacity couplings outside the screens, but can't find any. However, as the coils are *completely* screened, I suppose there must be something. Do you think it is the valve? Your ever,

Bob.

Why the lack of stability? Turn to p. 442 for Henry Farrad's explanation.

S-W Intervalve Couplings

ADVANTAGES OF A MODIFIED TUNED ANODE CIRCUIT

By
W. T. COCKING, A.M.I.E.E.

The design of RF intervalve transformers for short-wave work is often a matter of considerable difficulty to the experimenter. It is explained in this article that the difficulty lies in the effect of the various unwanted circuit capacities, and an alternative coupling is described which is found to be much easier to use.

IN short-wave apparatus the general practice is to use RF transformers for the RF intervalve couplings, and this applies whether the receiver is a straight set or a superheterodyne with a stage of signal-frequency amplification. The circuit diagram of a stage is identical with that of one designed for the medium or long waveband and takes the form shown in Fig. 1, but the true diagram is very different and is more like the circuit of Fig. 2.

The difference is brought about by the circuit capacities, for it is no longer permissible to neglect either the primary capacity C1 or the inter-winding capacity Cc. No attempt is usually made on short waves to use the so-called large-primary transformer, and the transformer is used merely to give the performance of a tuned-anode or tuned-grid circuit with the practical convenience of a double-wound component.

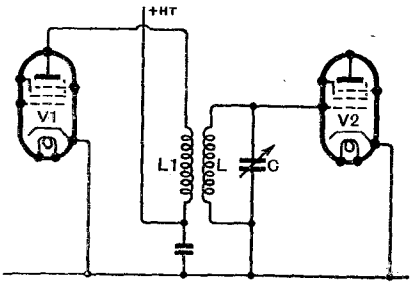


Fig. 1.—This diagram shows a conventional RF transformer coupling with tuned secondary.

It is found, however, that it is usually unsatisfactory to employ a unity turns ratio between primary and secondary, because the circuit approaches too nearly to a coupled pair of circuits with only the secondary variably tuned. If the secondary capacity is low, it will tune to a frequency quite close to the primary resonance frequency between L1 and C1. Selectivity and amplification both suffer and ganging becomes difficult.

To overcome this it is usual to employ fewer turns on the primary than on the secondary, thus making the primary inductance the lower of the two and ensuring that the primary resonance occurs at a frequency higher than any to which the secondary will tune. This entails a loss of amplification over that possible with a tuned-anode or tuned-grid circuit, but this is often considered unimportant.

The "top-end" capacity Cc greatly affects the performance and in a manner which depends upon the relative direction of the windings and their connections. It also enormously complicates any mathematical investigation of the properties of the circuit, with the result that RF transformer design is still largely empirical.

One factor of considerable importance is often overlooked when deciding upon an RF coupling in a short-wave receiver. This is the input resistance of the valves; it is due to a combination of electron transit-time effects and the internal cathode lead impedance. At very high frequencies, such as those used in television, it can assume values of a few thousand ohms only, but although it is considerably higher over the normal short-wave bands it is by no means always negligible. When it is not negligible, the conventional coupling is certainly not the best.

On medium and long waves the two important resistances are the anode AC resistance of the valve and the dynamic resistance of the tuned circuit. In most cases only the dynamic resistance is really important, as with modern RF pentodes the AC resistance is so high in comparison that it can often be neglected. For a tuned-anode, tuned-grid, or unity ratio transformer coupling the stage gain is then g RD, where g is the mutual conductance of the valve in A/V and RD is the dynamic resistance in ohms.

At very high frequencies the anode AC resistance is still unimportant, but through electron transit-time effects the valve has a much lower output resistance. For the same reason the succeeding valve has an input resistance which is actually still lower in value. This resistance has no physical existence as such, of course, but is a convenient method of simulating the power lost in the input circuit of the valve.

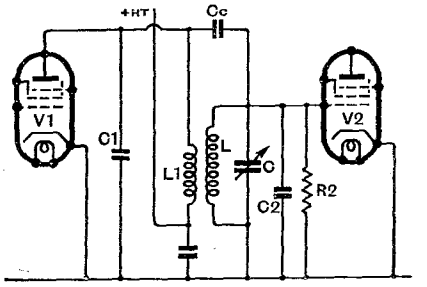


Fig. 2.—The circuit of Fig. 1 is in reality complicated by the stray capacities shown here and by the input resistance of V2.

In reality, the grid circuit of the valve absorbs power at high frequencies, and in circuit computation it is convenient to assume that the valve is perfect and absorbs no power and to shunt the input circuit by a resistance of such valve that it absorbs the same power as the practical valve. This resistance is called the input resistance of the valve and is R2 in Fig. 2.

The problem in design is to couple a valve of output resistance R1 to another valve of input resistance R2 by means of a tuned circuit of

S-W Intervalve Couplings—

dynamic resistance RD. There are two possibilities; the valve and tuned circuit can be connected together and a suitable transformer can be used between the combination and R2, or a suitable transformer can be used between R1 and the tuned circuit, the latter being connected directly to the second valve.

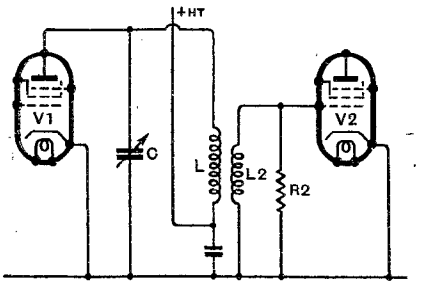


Fig. 3.—When R2 is of low value, it is better to use a tuned-primary transformer with the "untuned" winding feeding the second valve.

This second arrangement is the usual one and is the one shown in Figs. 1 and 2. The resistance R2 then comes directly in shunt with the dynamic resistance RD so that the combination has an effective resistance $R2\,RD/(R2+RD)$. Optimum coupling exists when the transformer constants are such that the effective resistance is halved, so that the selectivity is the same as that given by a circuit of dynamic resistance $R2\,RD/2(R2+RD)$. The stage gain becomes $\frac{g}{2}\sqrt{\frac{R1R2RD}{R2+RD}}$.

The alternative arrangement is sketched in Fig. 3 and the resistance R1 now comes directly across the dynamic resistance RD and there is a transforming action to R2. The effective resistance of the tuned circuit is now $R1RD/R1+RD)$ and with optimum coupling the tuned circuit has the same selectivity as one with a dynamic resistance of $R1RD/2(R1+RD)$. The stage gain becomes $\frac{g}{2}\sqrt{\frac{R1R2RD}{R1+RD}}$.

It might be thought that there would be a third possibility—to use a double transforming action with an optimum ratio between R1 and RD and another optimum between RD and R2. This is sketched in Fig. 4 and looks as if it would be the most efficient of all. Unfortunately it is not, for it is not possible to obtain the two optimum couplings. For any fixed coupling between L and L2 there is an optimum value for the coupling between L1 and L; similarly, for any fixed coupling between L1 and L there is an optimum value for the coupling between L and L2. There are, however, no optimum values for both couplings varied simultaneously.

A choice is consequently limited to the basic circuits of Figs. 1 and 3. On medium and long waves R2 is usually much longer than R1 and the usual circuit of Fig. 1 is the better of the two. On the higher short waves R1 and R2 may be of the same order and there is then little or nothing to choose between the circuits. On really short waves, however, R1 is normally longer than R2 and then the circuit of Fig. 3 is the correct one to use, although it is rarely adopted.

Tuned Circuit Loss

The dynamic resistance of the tuned circuit always represents a loss. If it were infinite the stage gain with either circuit would be $\frac{g}{2}\sqrt{R1R2}$. In practice it is never infinite and it causes the minimum loss when it is connected across the lower of the two resistances. This means that the circuit of Fig. 1 is better than that of Fig. 3 from the point of view of stage gain when R1 is greater than R2 but is inferior when R1 is smaller than R2.

On the other hand, selectivity is better when the tuned circuit is joined across the higher of the two resistances. From this point of view, therefore, the circuit of Fig. 1 is better than that of Fig. 3 when R1 is smaller than R2 and inferior when R1 is larger than R2.

As an example, suppose R1 is 100,000Ω, RD is 50,000Ω, and R2 is 20,000Ω while the valve has a mutual conductance of 2.0 mA/V. With the circuit of Fig. 1 the stage gain is 37.8 and the tuned circuit gives selectivity equivalent to that of a circuit with a dynamic resistance of 7,150 ohms. With the circuit of Fig. 3 the stage gain is 25.7 times, but the equivalent dynamic resistance is 16,600 ohms, so that the selectivity is over twice as good.

This is, of course, rather an extreme case and the tuned circuit is not a very good one. It is, moreover, not a very practical case, for it would not be possible to use the circuit of Fig. 1 with these circuit values since it would necessitate L1 being larger than L and the primary capacity would then upset matters. In practice, L1 must be smaller than L and the matching conditions cannot then be met. They can be met readily, however, with the circuit of Fig. 3, for in this case a step-down turns ratio is needed, so that the condition that the untuned winding must be of lower inductance than the tuned is automatically fulfilled.

In spite of its convenience from many points of view the double-wound transformer shown in all these circuits is by no means ideal. The various unwanted capacities prevent the desired performance from being secured in all cases and greatly complicate any exact analysis of the circuit. There is further the difficulty of adjusting the turns ratio exactly to the optimum—in fact, it is almost impossible to do so without quite elaborate measuring equipment.

It is not always realised that there is an alternative to the transformer which is free from these disadvantages. It is quite possible to secure the effect of a transformer by means of a suitable arrangement of capacities in a tuned circuit. In effect, one can use an auto-transformer with a capacitive instead of an inductive tapping point.

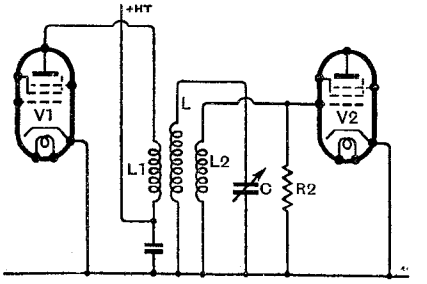


Fig. 4.—The use of a three-winding transformer usually confers no advantage.

The arrangement is shown in Fig. 5 and accurate matching can be secured by suitably proportioning C3 in relation to the other components. As before, let R1 represent

S-W Intervalve Couplings—

the output resistance of V1 and R2 the input resistance of V2, while RD stands for the dynamic resistance of the tuned circuit. To save writing we shall let R stand for the parallel value of R1 and RD; that is,

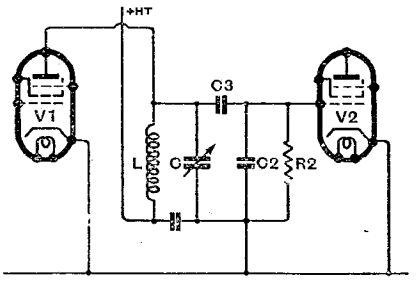


Fig. 5.—The effect of a step-down transformer can be obtained by means of a single tuned circuit and a suitable combination of capacities.

$R = R_1R_D/(R_1 + R_D)$. Then when C3 has its optimum value the stage gain is $g\sqrt{RR_2/2}$, and the optimum value of C3 is given by

$$C_3 = C_2/(\sqrt{R/R_2} - 1)$$

Thus we might have g=2.0 mA/V, R_1 = 100,000Ω, R_D = 50,000 Ω, R_2 = 20,000 Ω, and C_2 = 10μμF. Then R = 33,000Ω or the stage gain is 25.7 and C3=34.5μμF.

If C3 were made very large, thus converting the coupling into the standard tuned anode circuit, the stage gain would be 25 times, which is only very slightly lower in this case. The selectivity, however, would be that of a circuit with a dynamic resistance of 12,500 Ω instead of 16,600 Ω, while the capacity added to the tuned circuit by the second valve would be 10 μμF instead of 7.75 μμF.

With the tuned anode circuit the whole of C2 comes in parallel with C, and so restricts the tuning range, for C3 is so large that it can be considered infinite. With the circuit of Fig. 5, the capacity added to the tuned circuit is only $C_2C_3/(C_2 + C_3)$ and is appreciably less than C2.

If R2 were lower there would be a bigger difference between the couplings. As an example, suppose R2 is 5,000 ohms only, all other values remaining the same. The stage gain is then 12.85 times, the effective dynamic resistance is unchanged at 16,600 Ω, C3 is 6.36 μμF, and the capacity added to C is 3.9 μμF. With tuned anode coupling the stage gain would be only 8.8 times, and the effective dynamic resistance 4,400 ohms. Both selectivity and gain are considerably lower in this case.

The main advantage of correct matching in this way is a gain in selectivity which is of considerable advantage in the preselector circuits of a superheterodyne. Gain is improved as well, but to a lesser degree. One big point in favour of the capacity system, however, is the ease with which exact matching can be secured, for C3 can readily be an air-dielectric trimmer, and so easily adjusted for maximum signal strength.

Practical Application

The practical circuit can well take the form shown in Fig. 6. R2 disappears now, for it is only a fictitious component, and is replaced by R3. This resistance is included merely to complete the grid circuit to direct current and should have a value very large compared with R2, so that it exercises a negligible effect upon the performance. The condenser C2 also disappears, for in reality it is the input capacity of the valve. The circuit is thus extremely simple and effective, and save for the values of components is identical with the ordinary tuned anode coupling.

The adjustment of C3 must be carried out on a signal, and it is better for this to be provided by a signal generator or modulated test oscillator than for it to be an actual short-wave transmission, which may be subject to fading. The coupling condenser C3 must be adjusted for maximum signal strength, but as it alters the tuning as well as the coupling C must be adjusted at the same time to keep the circuit in resonance. With ganged tuning controls the same procedure applies, but it is now the trimmer in parallel with the tuning condenser which must be kept adjusted for resonance rather than the tuning condenser itself.

It will be found that in most cases the optimum setting of C3 is rather flat; that is, appreciable changes of capacity on either side of the optimum value reduce the stage gain only slightly. The effect on selectivity, however, is much more marked and as this always increases for a reduction in capacity, it is much better to set C3 below optimum than above. In general, the best results are secured when C3 is somewhat smaller than the optimum value for stage gain; the loss of amplification is small, and the capacity thrown on to the tuned circuit is reduced while selectivity is increased.

It should be pointed out that this circuit is only capable of matching to the tuned circuit a lower value of resistance. It gives only a step-down ratio, not a step-up. Therefore, if R2 exceeds R in value no optimum for C3 can be found. The correct course in many cases will then be to connect the tuned circuit directly to the second valve and have C3 between the first valve and the tuned circuit. In other words, a form of tuned-grid coupling should be used instead of tuned anode. An optimum value can then be found for C3 as long as R3 is less than $R_D R_2/(R_D + R_2)$.

For certain circuit values it may not be possible to meet either condition; R1 and RD in parallel may be less than R2, while R2 and RD in parallel are less than R1. Matching by this means is not then possible.

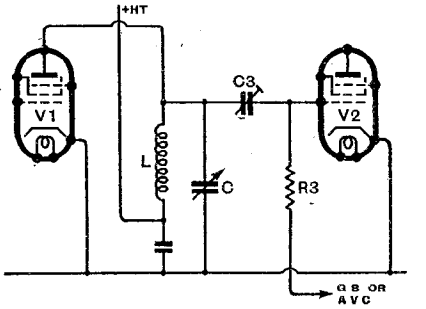


Fig. 6.—The practical equivalent of Fig. 5 is shown here; R3 is the grid leak.

This condition is most likely to occur when R1 and R2 are about equal in value and it will always occur when they are equal. In general, however, on the most used short-wave bands R2 is considerably less than R1 and the trouble will then occur only if RD is low in value. The remedy is then to use a tuned circuit having lower losses, thus improving the general efficiency.

Noise Limiter

SATURATING DETECTOR CIRCUIT

MANY cases are encountered in practice where local noise seriously affects reception, and it is well known that when the noise consists of peaks of very short duration but large amplitude compared with the signal it can be greatly reduced by the use of noise-limiting circuits. The quality of reproduction is often adversely affected, so these circuits are not greatly used in broadcast receivers; they do find great application in short-wave work, however, when the ability to receive an intelligible signal is of prime importance.

A recent addition to the noise-limiting circuits which is extremely simple is shown in Fig. 1, and it will be seen to consist essentially in the use of a triode to replace the usual diode detector, with the triode grid controlled by the signal. The anode-cathode path of the triode is used to operate as a diode, and is connected in the usual way with the load resistance R and by-pass condenser C, the output being taken off through C3.

The grid is connected to a tapping on R, and the anode end of this resistance is taken through R1 to a point positive with respect to cathode. This is shown by the battery B in Fig. 1.

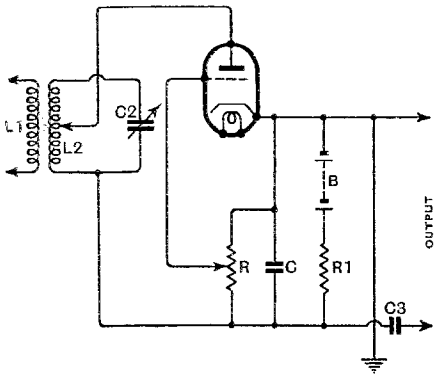


Fig 1.—In this noise limiter a triode is used for the detector instead of the usual diode and exhibits a marked saturation characteristic.

In the absence of signals the anode potential is maintained positive with respect to cathode by the voltage developed across R, and the grid is also positive with respect to cathode, but to a lesser degree, since it is tapped down R.

The valve is then able to function as a form of diode detector, and as the signal increases the anode and grid potentials become less positive. With sufficiently strong signals the potentials actually become negative with respect to cathode, and if the valve has a large amplification factor a form of saturation occurs. Once this point is reached, a further increase in signal hardly increases the output at all.

The magnitude of this limiting action is controlled by the position of the tapping point of the grid on R, and is greatest when the grid is joined to the junction of R and C3. Further, the higher the voltage B the greater is the signal strength at which saturation commences.

It is possible to use a screen-grid or pentode valve in place of the triode with an even simpler circuit. R1 and B are no longer required, but the screen must be maintained at a suitable positive potential with respect to cathode; otherwise the circuit is the same and operates in a similar manner.

It should be noted that RF potentials must not be applied to the grid. Consequently, if appreciable RF voltage exists across R, a simple filter should be inserted in the grid lead.

In addition to acting as a noise limiter, this detector, which is due to the R.C.A. Laboratories, gives a form of AVC action on morse signals which is especially convenient, since normal AVC circuits do not function properly on CW, as there is no sustained carrier.

Five New Cossor Receivers

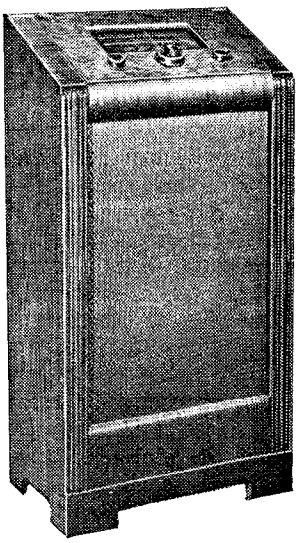
BATTERY AND AC MODELS

IN these difficult times it is something of an achievement to be able to release five new models at a sitting, and A. C. Cossor, Ltd., are to be congratulated in this notable effort to keep the listening public well supplied with a varied choice of receivers.

All the new models are in the popular price category and the Model 39, a "straight" three-valve battery set with 8-inch moving-coil loud speaker, costs £7 19s. 6d., less batteries. An AC mains version (Model 49) is available at 9 guineas. Both these receivers are in the "Melody Maker" tradition, and give a very good performance on the medium and long waves at low cost.

The Model 35 is a new battery superhet with a short wave range from 16.35 to 51.3 metres. There are four valves and the frequency changer is a triode heptode. Grid bias is automatic and the price without batteries is £10. A similar receiver, the Model 37 de luxe, has a special loud speaker with a magnet of high flux density and costs 10 guineas.

Lastly, there is an AC console with a superhet circuit (4 valves + rectifier) built into a cabinet of new design standing 33½ inches high. Special attention has been given to quality of reproduction, and the 8-inch wide-response loud speaker is fed from a triode output valve. The price of the Model 63 console, which includes a short-wave range from 16 to 52 metres, is £14 7s. 6d.



The tuning controls and scale are conveniently placed in the new Cossor Model 63 console.

Direct - Reading DF

SIMPLIFYING THE PROCESS OF TAKING BEARINGS

By
J. A. McGILLIVRAY

The author suggests two methods—one mechanical and the other electronic—of obtaining a direct visual indication of the bearing of a distant station. The systems are especially applicable to aircraft.

THE most usual type of direction finder, using a rotatable loop aerial or its equivalent, suffers from the disadvantage that considerable skill is required in order to obtain accurate results. In order to simplify operation, many efforts have been made to produce automatic direction finders, especially those using some form of visual indicator in the output stage.

One system which is in general use employs a rotatable aerial for feeding the receiver, and a centre-zero milliammeter in the output stage indicates deviation to left or right from the correct direction. This type of instrument is widely used in aircraft, but suffers from the disadvantage that it does not indicate the amount of deviation, in degrees, from the correct bearing. It indicates only "on course" or "off course."

The instruments described below are designed to indicate directly on a calibrated circular scale the bearing from the receiver of the wanted transmitter. The two instruments have some points of similarity, but the reproducing portions differ widely, one being mechanical and the other purely electrical.

Frame Aerial Action

The directional properties of a loop aerial are fairly common knowledge. To recapitulate briefly, when a loop aerial is used as the signal-collecting device for a receiver, the signal strength will rise and fall as the loop aerial is turned. The input (and output) will be maximum when the loop is pointing straight at the transmitter, and minimum (theoretically zero) when the loop is at right angles to this position. In 360° of rotation the output will reach maximum value at two points 180° apart.

The ordinary loop aerial, when fitted on ships or aircraft, suffers badly from quadrantal error. This is caused by pick-up and re-radiation of signals by the metal structure of the craft, and has the effect of misplacing the bearings. The amount of error introduced in this way may be considerable, and the appropriate correction must be made before the correct bearing is resolved.

In the Bellini-Tosi type of direction finders quadrantal errors can be reduced to negligible proportions by adjustment of aerial pick-up properties, and for this reason it is proposed to confine our attention to Bellini-Tosi aerial systems. These are electrically equivalent to a simple rotatable loop, and consist of two loop aerials fixed at right angles to each other, and mounted so that they cannot be moved in any direction. The loops feed a radiogoniometer, which is a special type of transformer. It has two fixed field windings, at right angles to each other, and each fed from one of the loops already mentioned.

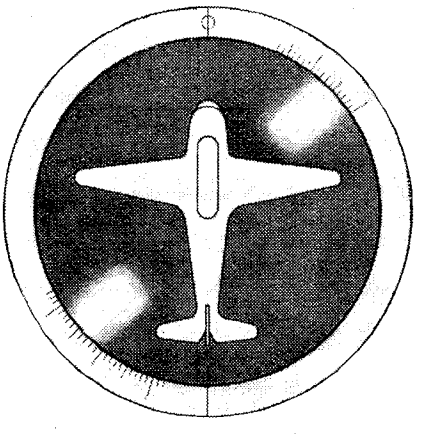


Fig. 1.—A suggested scale for the neon lamp indicating system described in this article.

A search coil, which feeds a radio receiver, is rotatable within the resultant field of the fixed coils, and is used to determine the position of the maximum (or minimum) resultant field strength. This bears the same angular relationship to the field coils as the original signal does to the loop aerials. If the search coil is rotated, the signal strength will rise and fall, as is the case with a simple loop, reaching maximum value twice per revolution.

Rotating Search Coil

In each of the instruments described below the search coil is kept in continuous rotation as long as the instrument is in use, so that the output from the receiver and amplifier will be fluctuating.

The idea of a "rotating aerial" input is not new, as it is one of the principal features of the Standard Telephones Type R.5 direction finder. There a rotating loop aerial, driven at 600 r.p.m., is used for the input, and an electrodynamic meter in the output stage shows direction.

In the mechanical system suggested by the writer the search coil is rotated continuously by an electric motor, and feeds an amplifying and detecting system. Connected across a condenser in the output stage is a neon lamp, which will flash twice per revolution of the search coil.

The gain of the amplifier is adjusted manually, so that the lamp will flash only at the instant of maximum signal. While the flash cannot be made absolutely instantaneous, it can be fairly sharply defined.

The neon lamp is mounted on a rotating arm, revolving at the same speed as the goniometer search coil.

Direct-Reading DF

Synchronising is ensured by using the same motor to drive both, through flexible shafting.

The neon lamp rotates behind a transparent circular scale, calibrated in degrees. At each flash it will illuminate a small portion of the scale, from which the required bearing, or the reciprocal, may be read (Fig. 1). Any doubt about the "sense" of the bearing can easily be removed by switching into circuit a small sense aerial. When correctly adjusted this will cancel one of the flashes per revolution, and make the correct one very much broader without altering its optimum position.

At Short Range

As the aircraft approaches closely to the transmitter, the flashes become much broader unless the gain of the amplifier is reduced. At very close range the whole scale is illuminated, and when passing through the "cone of silence" immediately above the transmitter there is a complete black-out on the scale.

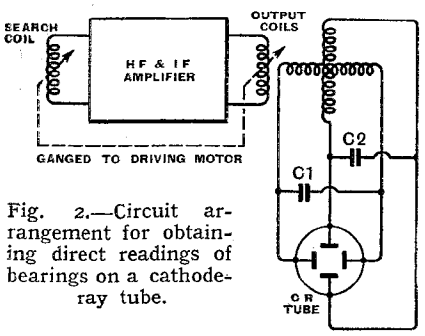


Fig. 2.—Circuit arrangement for obtaining direct readings of bearings on a cathode-ray tube.

The second system to be described uses a cathode-ray tube with a graduated circular screen as the reproducing device. The aerial system is identical with that already described, including the goniometer and rotating search coil, which feeds into a high-gain superhet amplifier. The output from the final IF stage is fed into the search coil of a second goniometer, synchronised or ganged with the "signal" search coil.

The field windings of the second goniometer are tuned to the IF so as to produce the maximum of voltage across C1 and C2 (Fig. 2). The deflecting plates of the CR tube, when connected across C1 and C2, should produce a "solid" figure-of-eight on the screen, and the deflection is adjusted by IF gain control until the extremities just touch the graduated scale, as in Fig. 3. Sense finding is carried out as before, the effect of introducing the sense aerial being to black-out half of the figure of eight, and distort the remainder.

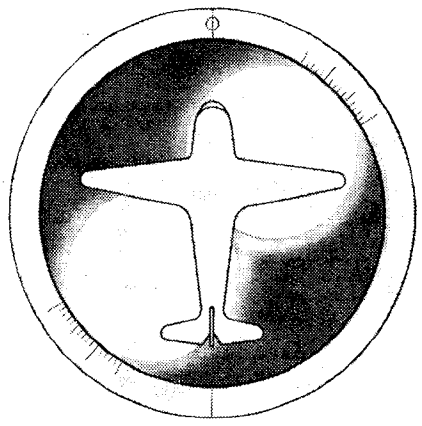


Fig. 3.—Indicating scale of the cathode-ray type of instrument suggested by the author

In aural direction-finding systems the bearing is always observed on the minimum signal position, because the minimum is much more sharply defined than the maximum, and it is extremely difficult to read the correct bearing by using maximum signal in head telephones. It is thought, however, that this objection to using maximum signal cannot fairly be applied to direction finders in which there is a visual indication.

An advantage gained by using "maximum" instead of "minimum" is, in connection with the determination of sense, to eliminate the 180° ambiguity which arises when a loop aerial alone is used for DF. In the maximum signal system the introduction of the sense aerial does not displace the original, but merely eliminates one of the two possibles. In the minimum signal system the introduction of the sense aerial eliminates one minimum and displaces the other by 90°. To overcome this effect the indicating system must be duplicated, which introduces possibilities of confusion.

The degree of accuracy obtained by using instruments of this type in aircraft, for which they are primarily designed, will not be as high as that obtained by a skilled operator at a ground station. Nevertheless, it is considered that a sufficiently high degree of accuracy will be obtained for their purpose. In each case the indicator should be mounted on the dashboard in front of the pilot.

The loop aerials could be mounted where convenient, and by using a separate DF receiver with push-button tuning a high degree of simplicity may be obtained without sacrificing accuracy. In each case the same results may be obtained by using a rotating loop aerial, with some type of quadrantal correcting mechanism at the indicator, but the Bellini-Tosi aerial system is preferred, as it lends itself admirably to the reduction of these errors nearer to the source.

Test Report

Armstrong Model EXP48

AC SUPERHET. (SIX VALVES + RECTIFIER AND TUNING INDICATOR). CONTINUOUS SW COVERAGE 13-160 METRES. PUSH-PULL OUTPUT STAGE.

THIS receiver has made its appearance at an opportune time. Not only does it fulfil overseas requirements in the matter of waverange coverage and the first essentials of "tropical" finish, thus qualifying for the important export trade, but it makes a welcome addition to the now restricted number of sets which can claim to be something more than mere broadcast receivers.

Although from the point of view both of the export and home markets, a long-wave range is now of little interest, the makers have wisely included this band in anticipation of the resumption of services after the war. They have also taken the long view in providing a really good output stage for high quality reception from the B.B.C. programmes. These decisions are based on the assumption that the receiver as a whole will not approach obsolescence for some time to come, a view which a glance at the specification is sufficient to confirm.

Circuit.—The triode-hexode frequency changer is of the type in which the oscillator grid is common with the inner control grid of the hexode section. It is claimed for this electrode arrangement that the effect of AVC on the oscillator frequency is reduced. The oscillator is of the Colpitts type.

The short-wave range of 13 to 160 metres is covered in two overlapping bands. Large-diameter coils are used and wide spacing on the underside of the chassis takes the place of the more usual electrostatic screening.

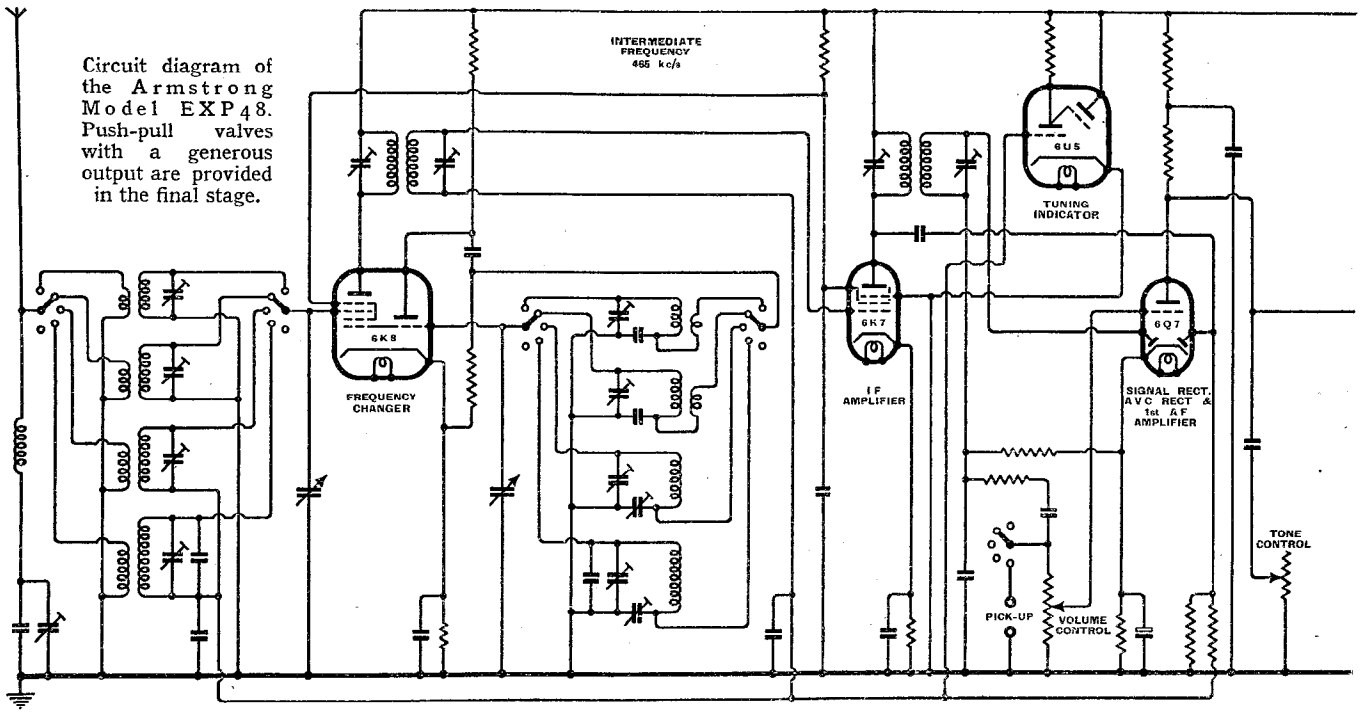
The IF stage has been given special attention and includes high-efficiency transformers of the iron-cored type.

A double-diode triode follows the IF amplifier and feeds a triode phase splitting valve for the push-pull output pentodes.

Normally the chassis is supplied without loud speaker so that a push-pull output transformer presenting 8,000 ohms across the anodes will be required. If a permanent-magnet loud speaker is employed, a smoothing choke with a resistance of 1,000 to 1,250 ohms should take the place of the field winding.

Performance.—The sensitivity of this receiver is fairly uniform throughout its whole frequency range, and while it is not high enough to cause an unpleasant background at full volume, is nevertheless sufficient to ensure reliable reception from every worthwhile station.

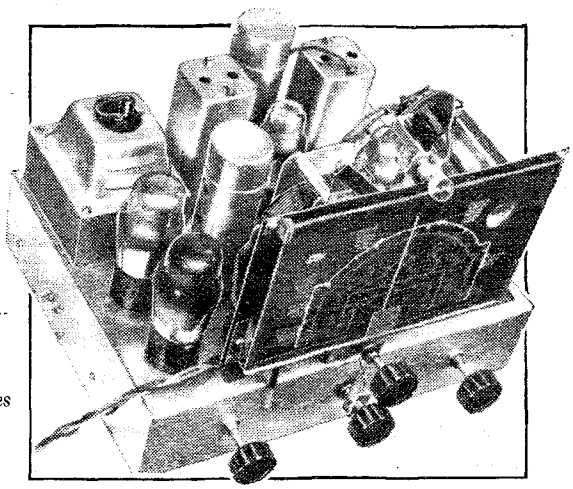
No difficulty was experienced in picking up American stations, and it was found that tuning drift was very small. A certain amount of second channel interference must be expected with only a single tuned circuit before the frequency changer and evidence of this in the form of whistles was found on the medium-wave band. Repeat tuning points on the short-wave band, however, were to be found only by careful searching and did not cause serious



Circuit diagram of the Armstrong Model EXP48. Push-pull valves with a generous output are provided in the final stage.

confusion in identifying stations. Signal-to-noise ratio was quite good, and microphonic feedback on the shortest wavelengths was negligible.

When used in conjunction with a good quality loud speaker,



WAVERANGES

Short (1) ..	13-	45 metres
(2) ..	43-	160 ,,
Medium ..	200-	550 ,,
Long ..	1,000-	2,000 ,,

PRICE: (Including valves but excluding loud speaker) 8 Gns.

the reproduction given by this receiver is excellent. The bass response is unrestricted, and the general balance is just right. There can be no doubt that the maker's rating of 6 watts is available as useful undistorted output from the push-pull stage.

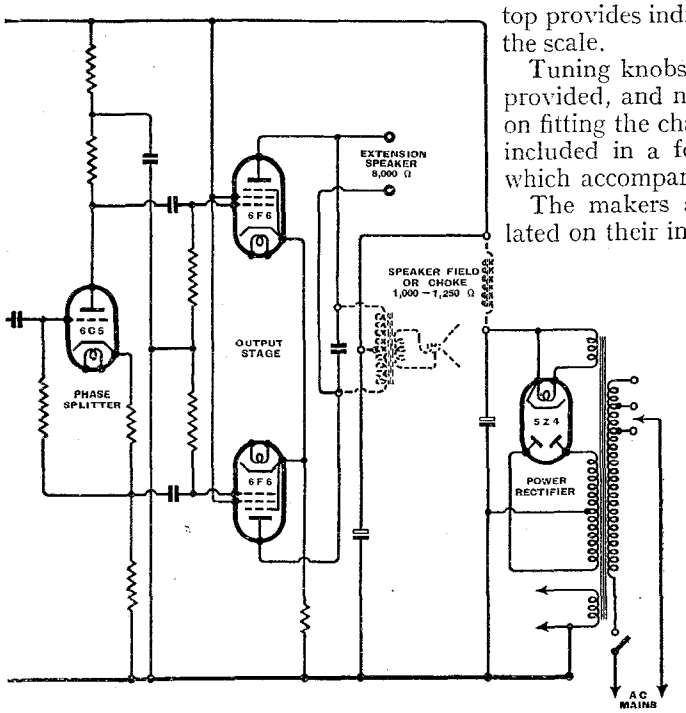
Constructional Details. — The steel chassis and all the dial fittings have been heavily cadmium-plated to withstand tropical conditions. All RF and IF coils are treated to make them impervious to moisture, and the switch contacts, which are of more than usually robust design, are silver-plated.

The tuning scale is well arranged with the scale for the shortest wavelengths on the outside where the diameter is greatest. An indicator is provided to show the position of the waverange switch, and this is balanced by the cathode-ray tuning indicator. A single dial light at the top provides indirect illumination for the scale.

Tuning knobs of good quality are provided, and notes and suggestions on fitting the chassis in a cabinet are included in a folder of instructions which accompanies each set.

The makers are to be congratulated on their initiative in producing a chassis which so adequately meets present-day needs at home and abroad at a price which clearly does not exploit any tendency to rising costs of materials and labour.

Makers. — Armstrong Manufacturing Co., Warlters Road, Holloway, London, N.7.



The Wireless Industry

V. G. MANUFACTURING Co., Ltd., Gorst Road, Park Royal, London, N.W.10, have just issued an illustrated catalogue of electrical wiring accessories and materials, including "Scruit" connectors and porcelain interlocking insulating beads.

Two new Ferris UHF signal generators are announced. The Model 18c covers 3 to 175 Mc/s in seven bands and has a calibrated output from 0.1 volt down to a fraction of a microvolt. In the Model 40a the range is 20 to 250 Mc/s in four bands, and the direct-reading accuracy is 1 per cent. Further particulars are available from the agents, Leland Instruments, Ltd., 21 Bedford Row, London, W.C.1.

The Latem Electrical Co., Bradford, ask us to point out that the price of the Latem lamp referred to in our September issue has been increased, since May last, by 10 per cent.

A technical reference card giving details of the properties of Apiezon waxes and greases for vacuum work has been issued by W. Edwards and Co. (London), Ltd., Southwell Road, Loughborough Junction, London, S.E.5. Many additional waxes have been prepared to take the place of blends formerly imported from the Continent.

In the note under this heading in our August issue on Mullard valve price reductions, the EBL1 valve was mentioned in error. The triple-diode which has been reduced from 7s. 6d. to 5s. 6d. is the EAB1.

Export Enquiry

N. A. Nicolaides, Hermes St., No. 1, Famagusta, Cyprus, would be glad to receive particulars and prices of wireless receivers with a view to the establishment of an agency.

Multum in Parvo

NEARLY 450 articles on wireless and allied subjects which have recently appeared in 65 technical journals published in eleven countries are abstracted or referred to in the Abstracts and References section in the September issue of *The Wireless Engineer*. This section is a regular monthly feature of our sister journal, which is published on the first of the month. Another regular feature is a two- or three-page summary of recently accepted wireless patent specifications.

The September issue, which is obtainable through newsagents or direct from the Publishers, Dorset House, Stamford Street, London, S.E.1, at 2s. 8d., post free, also contains an article on the production of frequency modulation by phase shifting the side bands of an amplitude-modulated wave. In another article the effect of band-spreading circuits on the "tuning rate" of a tuning unit is discussed.

Reducing Interference

METHODS APPLICABLE TO THE RECEIVER

By R. I. KINROSS, A.M.I.E.E.

(*Continued from page 385, September issue*)

The effect on a receiver of a wave-train due to a transient pulse of interference is of great importance in considering any interference-preventing device intended for inclusion in the receiver itself. This matter is discussed at length in the present instalment, which also deals with the use of an auxiliary parallel amplifier for feeding silencing or blocking pulses to a receiver at instants corresponding with peaks of interference

IT was realised that the work described in the first instalment of this article did little more than nibble at the problem as a whole, but, on the other hand, it was felt that duty had been done by the simpler known inventions, and now the author felt free to try out some of the more elaborate ideas, and generally investigate the whole matter in somewhat more detail.

The first thing to do, it seemed, was to find out exactly what happened to an individual transient on its way through a receiver, starting from the aerial coupling and ending up at the loud speaker. That it would get considerably lengthened in duration on its way through was never doubted, but the information required was: At what stage in the receiver did this assume serious proportions? Were the signal-frequency circuits, for instance, increasing the wave-train for an unendurable length of time, or was it perhaps only by the time the pulse reached the AF end of the receiver that matters got serious?

It was probable that the reason that Lamb's arrangement had not worked well, even after some time delay was introduced, was that interference had already set up a wave-train of low decrement in the first part of the receiver—but there was no definite proof of this. It was going to be well worth finding out, because obviously the later in the receiver the interference could be blocked the more economical would be the design of the blocking amplifier.

As explained before, it was impossible to look at the first part of the wave-train set up by a spark in a neighbouring conductor on an ordinary monitoring cathode-ray tube—it was all over much too quickly. A considerable amount of literature on ignition spark wave form was read without finding exactly what was wanted.

However, it was found that, by using a large television cathode-ray tube as a kind of backed-off peak voltmeter, it was possible to get an idea of this wave-train. A normal high-definition television line and frame scan was applied to the tube, but matters were arranged in such a way that the time to scan one line could be varied from 20 to 600 microseconds. The source of voltage was joined to the control grid of the tube, and the length of the line produced for different values of backing-off voltage was measured. In the case of a conductor placed near a sparking plug a series of curves as shown in Fig. 6 was obtained.

With regard to the effect of spark interference on the aerial, curve (a) shows the damped wave-train set up, with nothing but a 10,000-ohm resistance to earth. This curve, of course, is only one-half of the envelope of the damped wave-train set up, the fine structure filling the envelope being too fine to see. Actually, the full picture on the cathode-ray tube for one individual spark looked like the inset (a) in Fig. 6.

The variation in width of the lines was simply due to the spot going out of focus on large positive swings. The distance D corresponds to the natural LF frequency of the spark coil, and there are four or five of these damped wave-trains per spark getting successively weaker and consequently shorter. The curve (a) of Fig. 6 is for the longest of these, which lasts for a time, corresponding to the distance *d*, which in this particular case, as can be seen, was 16 microseconds.

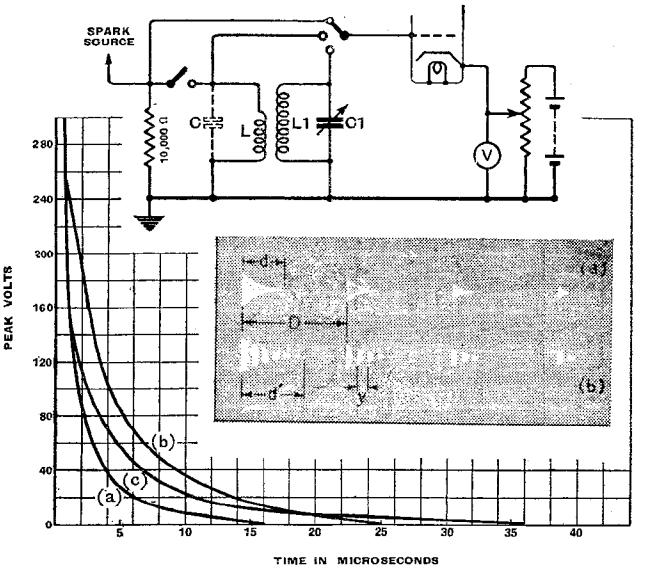


Fig. 6.—Transient investigation: behaviour of damped wave-train up to grid of first valve. Curve (a), volts across 10,000 ohms only; (b) volts across 10,000 ohms shunted by aerial coupling coil; (c) volts across signal-frequency coil L1 tuned to 1 Mc/s. The curves (a) and (b) relate to wave-trains illustrated and similarly lettered in the inset.

Now we come to the aerial coupling coil. Curve (b) of Fig. 6 shows the effect of connecting the high-impedance medium-wave aerial coupling coil of a receiver

Reducing Interference—

across the 10,000-ohm resistance. For the purpose of these experiments, a model 534 3-band H.M.V. receiver was used, the method of connection being shown in Fig. 6.

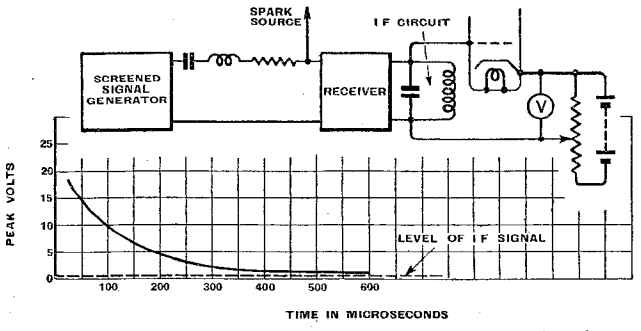


Fig. 7.—Investigation of an ignition spark wave-train after passing through the IF amplifier of a receiver.

The aerial coupling coil, together with stray capacities C, resonates at about 300 kc/s, and now the envelope of each damped wave-train is quite clearly filled in, the picture as a whole looking something like inset sketch (b) of Fig. 6.

The aerial coupling coil has now imparted to each damped wave-train a very marked characteristic of its own; that is, a 300 kc/s damped oscillation, as can be seen by the successive black and white dashes, the distance y corresponding to $3\frac{1}{3}$ microseconds.

All that the coil has done, of course, is to select, from the wide-frequency spectrum of the original transient placed at its disposal, a band of frequencies with which, by virtue of its natural resonance, it is best capable of dealing—in other words, we have here an example of what is commonly known as shock excitation. The length of the wave-train, it will be noticed, has been increased from 16 microseconds to 25 microseconds.

The effect of spark impulses on the first signal-frequency tuned circuit is shown by curve (c) of Fig. 6. Here, again, the envelope of the damped wave-train assumes a marked characteristic, this time of a damped one-megacycle oscillation, which is the frequency to which the signal frequency was tuned. The rate of decay of this curve agrees quite closely with the theoretical value obtainable from the well-known relationship that exists between the rate of decay and the Q of a coil.

Long Interference-free Intervals

So far, nothing very serious has happened. Admittedly, the lengths of the individual wave-trains have been about doubled (increased from 16 to 25 microseconds), but, even so, the whole time that matters taken up by each spark is only about 150 microseconds at the most, and so with about 100 sparks per second (which is what is obtained from a four-cylinder engine at a speed of 3,000 r.p.m.) this only represents $1\frac{1}{2}$ per cent. of the total time, and so should leave $98\frac{1}{2}$ per cent. of the time for filling in with music or speech.

Now we come to the IF amplifier and the effect of ignition sparks on it. It may be wondered at why so much trouble has, so far, been taken over something which it was found merely confirmed a sum which could have been done at the start in very much less time. The reason was that the calculation for the length of wave-train for the aerial coupling coil is easy. The academic calculation for an IF amplifier is not at all easy, and consequently it appeared desirable to try out the measuring technique first on something which could be theoretically checked.

The actual curve obtained is shown in Fig. 7. This was taken at the anode of the amplifying valve, of which there was only one, with a spark intensity as for previous curves.

Now, it looks as though the damage has been done. The original four of five wave-trains of 15 microseconds each have all been run together into one big wave-train lasting about 600 microseconds.

Having gone so far, it was thought that it would be interesting to follow the wave-train through to the end, and Fig. 8 shows what happens to it on its way through the AF amplifier.

The first diagram (a) shows its appearance across the resistance load in the anode of the first AF valve. The negative pulse from the diode on its grid simply appears as a positive pulse at its anode. That is, assuming there is no coupling to the first stage. The moment a coupling condenser and grid leak are added for the conventional RC coupling, the pulse no longer remains unidirectional, but appears as in (c), or, if only a small coupling condenser is used, as, for instance, in the bass cut position of the tone control of the receiver in question, as in (b).

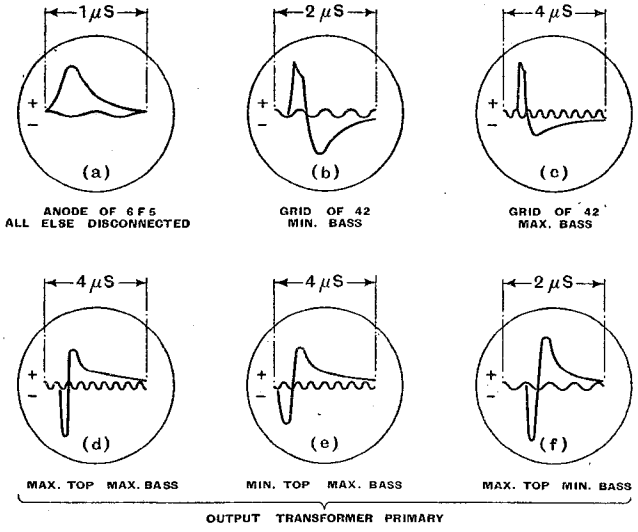


Fig. 8.—What happens to an interference wave-train in the AF amplifier. The test signal was of 1 mV from a 1-Mc/s source, modulated at 2,000 c/s to 40%.

The reason is simply an overswing, owing to the coupling condenser being small, and so having time to acquire an appreciable change in charge during the first part of the pulse.

The last three sketches—(d), (e) and (f)—show the voltages set up across the primary of the output transformer for various tone-control settings, the top cut being controlled by a capacity across the output transformer.

Reducing Interference—

From these it can be seen that the low-frequency amplifier contributes a further 5 : 1 increase in the length of the pulse; the 600-microsecond pulse at the diode has become one of 3 milliseconds at the loud speaker. It will be noticed that the effect of cutting bass is not only to reduce the length of the pulse, but also to increase its peak volts. Similarly, cutting top decreases the peak volts, but increases the length of the pulse. It looks, therefore, as though study of these curves, in conjunction with knowledge of their reaction on a speaker, might be profitable from the point of view of designing a tone control which reduces the effect of interference.

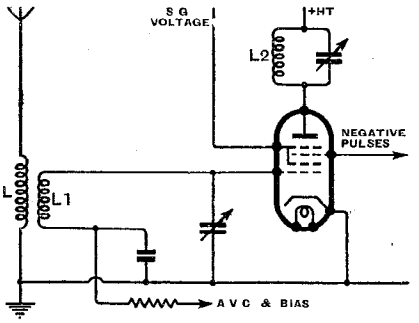


Fig. 9.—RF stage of the receiver used in the experiments described.

However, it is obvious from the foregoing that the best results will be obtained by tackling the problem at an earlier stage of the receiver.

We now have a bird's-eye view, as it were, of the behaviour of a wave-train set up by a quickly damped transient right through the receiver, and consequently have the necessary data for designing an amplifier which would supply negative pulses, and so block the receiver during the periods of interference. And the obvious place to apply these pulses for best results is the grid of the first valve of the receiver, where the pulses would be almost at their shortest.

In any case, if a parallel amplifier were designed to apply a suitable length of pulse at that point, it would always be a comparatively simple matter to lengthen these pulses and apply them at later stages of the receiver. This would be worth attempting, because, as mentioned before, the later in the receiver these negative pulses can be applied the more economical the design of the parallel amplifier becomes.

The RF stage of the receiver in use is shown in Fig. 9, and consists of a high-impedance aerial coil coupled to a tuned coil L1 and a tuned anode coil L2, capacity coupled to the frequency changer. Instead of a plain RF pentode, a 6L7 was used which had another grid screened from the first, to which the negative pulse would be applied.

The first thing done was to make sure that applying a negative voltage to this grid really would cut off all signals. This may sound pedantic, but, in point of fact, applying a full cut-off negative voltage to this grid only gave a reduction of 50 : 1 in sensitivity; and, as the interference to be suppressed often has peaks several hundred times as great as the signal wanted, this was not good enough.

However, by reducing stray-capacity couplings between grid and anode to a much greater extent than would normally be necessary from considerations of stability, and also by seeing that the valve worked with full SG volts and no unnecessarily large bias on the first grid, a ratio of about 5,000 : 1 was possible. This was all that had to be done to the receiver at this stage.

Correct timing was obviously important, and the first point to be borne in mind in designing the parallel amplifier was the fact that each negative pulse in reaching the third grid of the 6L7 must reach it slightly before the wavefront of the corresponding pulse of interference reaches the first grid. Furthermore, it must remain there until just after the effective end of the wave-train. These considerations are rather tiresome, because they are mutually contradictory from the point of view of deciding on the band-width of the parallel amplifier. In order that the negative pulse should arrive quickly, the band-width of the parallel amplifier should be broad; but, in order that they should last longer than the corresponding pulse of interference, it must be narrow. It should perhaps be explained that it was intended that the parallel amplifier should consist of four or five stages coupled to each other by means of tuned anode circuits, whose damping would be determined by such considerations as have just been mentioned.

Ensuring Correct Timing

There is one way of getting round this apparent deadlock by means of an arrangement due to Spencer and Kallmann (shown in Fig. 10). The negative pulses are applied to the cathode of a diode between A and E. The anode at once goes almost equally negative, because its internal resistance is low as compared with R, but at the end of the negative pulse between A and E the negative voltage between B and E falls to zero at a rate dependent solely on the time constant CR. Thus, a short negative pulse at A can be turned into a longer one at B, starting almost at the same time, but ending later.

However, the real difficulty turned out to be that the negative pulses did not rise quickly enough in the first place, and broadening the band-width of the parallel amplifier was impractical, as cross-modulation from local stations was already proving troublesome, and would have become more so.

The fact that the negative pulses were arriving too late was quite easily checked by experiment. One way was to apply the negative pulses to the grid of a large television CR tube, and at the same time apply the wave-train across the first tuned circuit. The negative pulse simply produced a black line, and this was preceded by just one or two cycles of the damped wave-train. Being only one or two cycles at a megacycle, it showed that the negative pulses were arriving just one or two microseconds too late. Seeing that it was impossible to speed up the negative pulses in the parallel amplifier, the only thing left to do was to slow up the interference on its way from the aerial to the receiver.

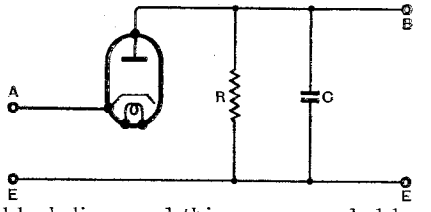


Fig. 10.—Method of ensuring correct timing of blocking impulses from a parallel controlling amplifier.

Reducing Interference—

There were two ways in which this could be done. One way would be to put in a couple of really good tuned circuits, band-pass coupled to each other, between the aerial and the grid of the first valve, but obviously this would have the disadvantage of increasing the length of the wave-trains.

The other way was to make use of a low-pass filter between the aerial and the aerial terminal of the receiver. The author is indebted to Mr. Percival for allowing him to transpose his design for a time delay suitable for television frequencies into a design suitable for broadcast frequencies. The circuit is an M-derived low-pass filter, and it will delay all frequencies equally up to half its cut-off frequency, provided $M = 1.27$. The delay will be $1/5 \times 1/f$ seconds per section, where f is the maximum frequency which the filter will handle with equal delay or phase shift.

In actual practice, it consists of a long section-wound solenoid so arranged that each section is the correct inductance and has the correct mutual with its neighbour, with condensers to earth between each section. A twenty-section filter passing up to 1,500 kc/s would provide three microseconds delay, and this was accordingly made up.

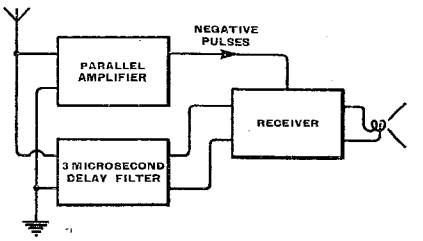


Fig. 11.—Block diagram showing connections of a parallel amplifier for feeding blocking pulses to a receiver.

This device should thus serve to fulfil the first condition of timing, namely, that the interference should not get to the 6L7 before the corresponding negative pulse.

The second condition, namely, that the negative pulse should outlast the interference wave-train, is best fulfilled by making the damping on the tuned circuits of the parallel amplifier of such value that a transient applied to it sets it ringing for just a bit longer than the first signal-frequency coil of the receiver, say, 40 microseconds. It will be remembered that the wave-train in the first tuned coil of the set lasted 36 microseconds.

That was easily done, and resulted in a four-stage, tuned-anode coupled amplifier having a selectivity curve 20 db. down at ± 30 kc/s at 500 kc/s; this was thought to be suitable for medium-wave work in the London district.

Encouraging Results

So now we have an arrangement as shown in Fig. 11. Results on this arrangement were easily the best obtained so far, the measured figures for spark showing that almost any original amplitude was reducible to the equivalent of about 0.6 per cent. modulation.

Incidentally, while waiting for this delay filter to be made up, a band-pass filter, consisting of two Litz coils with a Q of 210 each, inductively coupled, was used as a preselector to introduce delay of the wanted signal. As was to be expected, results were not so good as with the low-pass filter, though, even so, they were considerably better than could be obtained by applying negative pulses to the IF amplifier.

Despite the big improvement obtained from the low-pass filter, the residual noise due to negative blocking pulses was still sufficient to spoil a programme. This residual noise was simply due to the fact that the RF amplifier was not being switched on and off silently. The mere fact of stopping and starting the anode current through the RF tuned-anode coil was sufficient to start a wave-train.

One way of getting over this would be to reduce the steepness of the wave-front of the negative pulse, simply by passing the negative pulse through a low-pass filter. But a low-pass filter, while it would round off the negative pulses nicely and quieten their effect on the receiver, would cause them to get there too late.

A possible solution would have been to put two RF valves in push-pull and switched them both off, but that seemed a bit clumsy. A better way, it seemed, would be to switch off the AF amplifier a bit later, and so remove any noise of whatever kind that might be left over, which would be of small amplitude and short duration.

A push-pull stage of AF can be switched on and off almost silently. For the details of how to switch a push-pull amplifier off really quietly the author is indebted to A. H. Cooper, who had previous experience of this problem in an entirely different connection. Suffice to say here that, unless the intervalve transformers are symmetrically wound, external capacities will have to be added to get a good balance. Matters were accordingly arranged, as in Fig. 12. Negative pulses lasting about 40 microseconds were fed to the 6L7, and negative pulses lengthened to 100 microseconds by the device in Fig. 10 (which was found by experiment to provide optimum timing) were fed to the centre tap of the intervalve transformer feeding the push-pull AF stage.

Interference Inaudible

Results on ignition noise were now startlingly effective. Such noise, loud enough initially to completely drown signals from distant or neighbouring stations, could be reduced to an inaudible level without affecting the signals. Results on commutator noise, arcing contacts, neon and atmospherics, were not improved to anything like the same extent. The second figures of merit for spark, commutator and neon were respectively 0.15 per cent., 2.0 per cent., and 1.6 per cent.

It will be seen that for spark the goal in view initially had virtually been reached, but with regard to other noises it was still very far away.

So far, to keep variables down to a minimum, measurements were all carried out at 1 megacycle, and listening tests restricted to medium waves for the various devices tried. In view of the promising results obtained by the last methods described, it was decided to modify the apparatus to deal with SW and LW, with the following results:—

On the long-wave band performance was not so good as on the medium-wave band, owing to the longer wave-train set up by the aerial tuning coil. On short waves

Reducing Interference—

results were even better than on medium waves on ignition for the following reasons:—

(1) Less likelihood of cross-modulation in parallel amplifier, and consequently—

(2) Broader band permissible for parallel amplifier, i.e., quicker rise of pulse. Consequently—

(3) Aerial band-pass filter as opposed to low-pass filter in the receiver was sufficient to delay the interference.

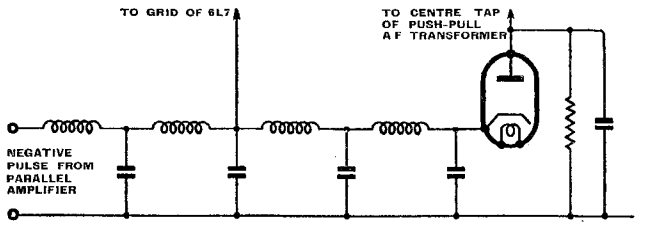


Fig. 12.—Filter circuit for feeding blocking pulses to the AF section of the receiver.

(4) SW band-pass filter did not increase length of wave-train to audible length of time, as happened on MW.

The main drawback to this parallel amplifier method is, of course, that it is expensive and bulky, requiring, as it does, an amplifier of at least four valves and their associated components. It should be possible to make the vision amplifier of a television receiver play the part of parallel amplifier to the broadcast receiver usually incorporated in the same cabinet, so far as sound reception on short waves is concerned. The parallel amplifier need not work on the same waveband as the receiver, but as a rule it should be tuned to a wavelength of the same order. For example, a parallel amplifier of 7 metres will usually deal with interference occurring on a receiver working up to about 30 metres. A vision amplifier of the superheterodyne, as opposed to the TRF, class will introduce too much delay on frequencies higher than its own intermediate frequency.

(To be concluded.)

Short-wave Receiving Conditions

PROSPECTS FOR OCTOBER

(COMMUNICATED BY THE ENGINEERING DEPARTMENT OF CABLE AND WIRELESS, LTD.)

THE daily average magnetic activity for the first fourteen days of August, on a zero (very quiet) to 9 (very disturbed) basis, exceeded that for the remainder of the month by about 60 per cent.; short-wave conditions were consequently less settled during the early part of the month, reception being notably subnormal on the following dates:—August 3rd, and 6th to 10th inclusive.

The period 0700 August 9th to 0600 August 10th was particularly disturbed. (These and other times given in this report are GMT on the 24-hour clock notation.)

In addition many readers will no doubt have noted in the daily Press that a fade-out of radio-transmissions across the Atlantic was experienced about mid-day on August 8th[1].

The poor conditions which obtained from August 6th to 10th (inclusive) were not entirely unexpected, for readers may recollect that, in the review of conditions for June[2] a reference was made to the prospects of increased magnetic activity during the second week of August.

Only one sudden ionosphere disturbance of the "Dellinger" type was observed during the month; this occurred at approximately 1435 on August 15th, and affected simultaneously a number of circuits in various directions relative to London.

Atmospherics were noted to be above normal on the following dates:—August 4th to 9th (inclusive), 12th to 14th (inclusive), 16th, 19th and 30th.

Particulars of the broadcast bands which, it is considered, should prove most reliable under normal conditions of propagation during October on five selected routes are given below; these may serve as a guide when considering reception from places other than those mentioned.

Considerations of transmitter power and efficiency of aerials at both the transmitting and receiving end may often result in better reception being obtained on other wavelengths, as may also be the case during disturbed conditions.

Tokio: Midt/0130, 25 or 31 m; 0600/0700, 19 or 25 m; 0700/1400, 16 m; 1400/1700, 16 or 19 m; 1700/2000, 19 or 25 m; 2000/midt, 25 or 31 m.

Melbourne: 0600/0800, 25 m Westward (via Pacific); 0800/1000, 25 m Westward or 16 m Eastward (via Calcutta); 1000/1300, 16 or 19 m Eastward; 1300/1400, 16, 19 or 25 m Eastward; 1400/1600, 19 or 25 m Eastward; 1600/2200, 25 m Eastward; 2200/midt, 19 m Westward. The prospects of reception during the period midt to 0600 are extremely small, except possibly for short intervals prior to 0600.

Bombay: Midt/0530, 25 or 31 m; 0530/0730, 19 or 25 m; 0730/1300, 16 m; 1300/1700, 16 or 19 m; 1700/2000, 19 or 25 m; 2000/midt, 25 or 31 m.

Buenos Aires: Midt/0500, 31 m; 0500/0800, 25 or 31 m; 0800/1000, 19 or 25 m; 1000/2000, 16 or 19 m; 2000/2200, 19 or 25 m.; 2200/midt, 25 or 31 m.

Montreal: Midt/0300, 25 or 31 m; 0300/0700, 31 or 41 m; 0700/1100, 25 or 31 m; 1100/1400, 19 or 25 m; 1400/2,000, 16 or 19 m; 2000/midt, 19 or 25 m.

A gradual diminution of local atmospherics is to be expected as the month advances.

"Skip" distances in respect of propagation via the F_2 layer will probably reach a minimum average value between 1000 and 1600.

The present trend of magnetic activity suggests the probability of reception conditions for the first and last few days of October being less settled than those for the middle of the month.

[1] See, for example, *Daily Telegraph*, August 9th, "Sun spots Stop Radio—Atlantic Fade-out."

[2] See *Wireless World*, August, 1940, p. 362.

Current Topics

RECENT EVENTS IN THE WORLD OF WIRELESS

HIGH-FREQUENCY APPARATUS

Prohibition Order

AS a result of careful measurements taken of the electric field radiated by high-frequency apparatus, especially of the electro-medical type, the Home Secretary has made an Order forbidding any person in the U.K. to use or possess high-frequency apparatus having an HF output of over 10 watts, except under permit from the Postmaster General. Such permits may be issued only to hospitals, clinics or other authorised institutions, to manufacturers who require to use HF apparatus, to makers of and dealers in such apparatus, and to research laboratories. Applications for permits must be made to the Engineer in Chief, Radio Branch, G.P.O., Harrogate, Yorks.

The principal types of apparatus to which the Order applies are:—(i) diathermy and electro-medical apparatus using valves or spark coils; (ii) high-frequency furnaces; (iii) eddy current heating apparatus such as is used by valve and electric lamp manufacturers; and (iv) testing oscillators with a high-frequency output exceeding 10 watts.

It does not apply to the normal type of violet-ray equipment, to X-ray apparatus, infra-red and ultra-violet ray apparatus, medical shocking coils, or to wavemeters and low-powered test oscillators as used by radio dealers.

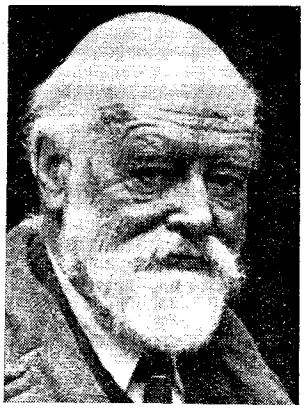
The Order, which came into force on September 2nd, requires all private individuals and private nursing homes (to whom permits will in no circumstances be granted) to take immediate steps to ensure that no further use is made of apparatus of the type covered by the Order by any person. They must also, if they have not already done so under the Order made in June, report their possession of the apparatus to the local police; moreover, the apparatus must be surrendered on demand to officers of the Post Office for custody.

The danger of interference at considerable distances to the wireless communications of the Services and to the radio control of our own aircraft has been proved to be so great that it has been found necessary to issue this prohibition. Where permits are granted, the room where the apparatus is installed must be electrically screened in accordance with the specifications laid down by the Post Office.

SIR OLIVER LODGE

THE name of Sir Oliver Lodge, F.R.S., who passed away at the age of 89, at his home at Amesbury, Wilts, on August 22nd, will be recorded in the annals of wireless telegraphy as the pioneer of tuning. It was in 1889 that he conducted his now famous experiment with "syntonic jars" and a few years later, in 1897, he took out a patent, No. 11575, entitled "Improvements in syntonized telegraphy without wires."

Another outstanding contribution to wireless made by Sir Oliver Lodge was his annular-gap electro-magnet, which was the forerunner of moving-coil speakers. At the early age of 26 he took the degree of Doctor of Science.



The late Sir Oliver Lodge.

Students of Birmingham University, from its foundation in 1900 when he was appointed principal, until his retirement in 1919, will ever remember his kindly personality and his great gift as an expounder. In 1932 he was awarded the Faraday medal by the Institution of Electrical Engineers.

WIRELESS OPERATOR TRAINEES

THE Government's announcement that marine wireless operator trainees born between 1913 and 1920 who are registered under the National Services Act will be enlisted in the Signals Branch of the R.A.F. on qualifying and will be reimbursed with £6 for training fees, has brought forth many criticisms. In a recent reply to a question in the House of Commons, the Secretary of State for Air, Sir A. Sinclair, stated a few weeks ago that it had now been decided that compensation up to £25 may be made.

U.S. AMATEURS

Transmitting Ban

A RECENT Order of the Federal Communications Commission prohibited the operation of portable and mobile amateur transmitters on frequencies below 56 Mc/s. According to *QST*, this Order arose from the feeling that at such a time as this the F.C.C. "must know precisely *where* every station is operating."

An amendment to this Order was, however, issued a few days later which provided that it would not apply to stations which were actually engaged in supplying domestic communication in the public interest during a bona-fide communications emergency when normal facilities have broken down; or to stations actually engaged in the testing and developing of self-powered equipment intended for use in domestic communications emergencies. The latter tests must be made at specified times.

A continuous watch of all communication channels is also to be maintained by the F.C.C. To effect this policing, the Commission is to increase its fixed and mobile monitoring stations and to have a further 10 long-range DF stations.

NEW AMERICAN PICK-UP

Mirror Galvanometer Principle

THE Philco Company in America has announced a new pick-up to be marketed shortly in their record-player units and similar instruments. The pick-up will not be available separately.

This new pick-up is novel in that it operates on the reflecting mirror galvanometer principle, which, it is believed, has not hitherto been applied commercially to this purpose. The stylus has a permanent bell sapphire point, and, instead of moving a crystal or magnetic armature, it actuates a small thin mirror so that the lateral variations in the record grooves oscillate the mirror in accordance with the groove modulations. A pencil light-beam from a torch-bulb type lamp shines on the mirror and, as the mirror oscillates, the light-beam is deflected in conformity with the groove modulations. The reflected light is focused upon a photo-electric cell, the output of which is fed to an amplifier.

The small exciter lamp is argon-filled and fed from a high-frequency oscillatory source to avoid modulat-

Current Topics—

ing the output by mains-frequency flicker.

As the stylus has to move nothing but the minute mirror, the moving mass is low, and so the needle impedance (stiffness) is small, and the light weight of the pick-up considerably reduces the pressure of the sapphire point on the record. It is claimed that these two factors in combination markedly reduce record wear and surface-noise. The frequency range of the pick-up is from 50 to 5,000 c/s, any response above or below this range being purposely diminished to eliminate needlenoise.

P.A. AT AMERICAN TERMINUS

Dual Loud Speaker System

THE last word in public address equipment has been installed by R.C.A. at the Los Angeles, California, terminus of the three great United States railways—the Union Pacific, Southern Pacific and Santa Fé. The amplifying installation, which comprises five 50-watt units, feeds what are designated "two-way" speakers which are fitted in major positions throughout the station. They each consist of two low-frequency speakers, mounted on a baffle weighing about 500 lb., and two high-frequency speakers which are mounted above the baffle on a cellular-type horn containing eleven "throats."

The frequency response of the complete unit is said to be from 30 to 10,000 cycles.

A cross-over network, consisting of high- and low-pass filters, is inserted between the output of the amplifiers and the dual-speaker system to control the correct response of the high- and low-frequency speakers.

THE CONTROL DESK of the PA installation at the Union Termini, Los Angeles. Microphone lines, provided at vantage points throughout the station, terminate in this control room.

AMERICAN TELEVISION

THE N.B.C.'s television transmitter W2XBS in the Empire State Building, New York, ceased transmissions on August 1st in order that the equipment could be adjusted to the station's new frequency in the 50-56 Mc/s band. The change has been made necessary by the allocation of the original No. 1 television channel of 44-50 Mc/s to frequency modulation sound broadcasting.

The change of frequency has necessitated the dismantling of the aerial, which is 1,200ft. above the street. The alterations, which also include a change from 441-line scanning to 507 lines, is expected to be complete by the beginning of October.

This station was among the first ten recently granted permission for regular transmission by the F.C.C.

In an endeavour to formulate technical standards for television, the Radio Manufacturers' Association of America has organised a national television committee.

It has been announced by the Columbia Broadcasting Company that from January 1st they will introduce coloured television.

SIR J. J. THOMPSON

SIR J. J. THOMPSON, O.M., F.R.S., the famous scientist and Master of Trinity College, Cambridge, who died at the age of 83 on August 30th, is by general consent credited with the discovery of electrons, or corpuscles as he called them in his lecture at the Royal Institution in 1897. Not only did he prove their existence, but he also showed that if a metallic surface is bombarded by electrons travelling at a great enough velocity, it will itself emit electrons in much greater number than those originally projected on to it, or what is to-day commonly called secondary emission. He was at that time Cavendish Professor of Experimental Physics in Cambridge University, in which position he had succeeded the late Lord Rayleigh at the early age of 27.

SERVICEMEN'S RESERVATION AGE

ALTHOUGH no official announcement has been made, it was learned after we had gone to press with the September issue that a new ruling had been made by the Ministry of Labour raising the reserved age for wireless engineers, servicemen, repairers, and mechanics.

This ruling, which was made on August 1st, raises the age reservation from service in their trade capacity from 30 to 35. The reserved age for fault finders and testers remains at 30, but they must be employed on the task whilst the receivers are in the course of factory production.

RADIO INDUSTRY AIRCRAFT FUND

UNDER the sponsorship of our contemporary, *The Wireless and Electrical Trader*, a Radio Industry Aircraft Fund has been started, which the Ministry of Aircraft Production hopes will be devoted to the cost, or part of the cost, of a bomber. The proprietors of *The Wireless World* and the sponsors have each contributed £25. The cost of a bomber, without equipment, is approximately £20,000. Remittances, which will be recorded in *The Trader*, should be made payable to The Radio Industry Aircraft Fund, and sent to Dorset House, Stamford Street, London, S.E.1.

ROYAL SIGNALS COMFORTS

THE largest number of men in the Royal Corps of Signals are found in the trade of Operator, all of whom are trained in theoretical and practical wireless. A great number of these have been recruited from the radio industry or will one day find their way into it.

The conditions under which these men work are usually onerous, involving long hours without relief. Stations are frequently isolated and the number of men in each is very small. At such times warm clothing and games make all the difference to these men.

Donations and gifts of woollen garments, books, magazines and games for the personnel will be most gratefully received by the Hon. Secretary, Royal Signals Comforts Fund, 95, Belgrave Road, London, S.W.1. All articles for sale in the Royal Signals Comforts Fund Shop should be sent to Mrs. Ozanne, 18, Trevor Place, London, S.W.7.

FRENCH REORGANISATION

THE French National Broadcasting Service, which ceased transmissions from all stations in unoccupied territory in accordance with the terms of the Armistice between Germany and the Pétain Government, was recently permitted to recommence its activities. According to information received from the International Broadcasting Union, the programmes are broadcast by the stations of Limoges, Toulouse, Radio-Toulouse, Montpellier, Marseille and Radio-Lyon, and by the private stations Radio-Montpellier, Radio-Agen and Radio-Nimes. All are working with the same frequencies and powers as in the past.

The daily transmissions from 7 a.m. to 8.30 p.m. do not include any programmes in foreign languages.

WOMEN W/Os

THE position of wireless operator is no longer a masculine preserve. The Women's Auxiliary Air Force has announced openings for women between the ages of 18 and 35, "for special duties and as wireless operators." Applicants, who must have good eyesight and hearing, and "must not be liable to get flustered," should make application to any W.A.A.F. Area Headquarters, the address of which can be obtained from the Post Office, Employment Exchange or Combined Recruiting Office.

DIRECTOR OF TELECOMMUNICATIONS

MR. F. W. PHILLIPS, C.M.G., Post Office Director of Telecommunications, retired on September 6th. He has been a member of the P.M.G.'s Television Advisory Committee since it was formed in 1935. He has been succeeded by Mr. J. Innes, B.Sc., M.I.E.E., who, since 1936, has been responsible for the administration of the telephone service in this country and in 1939 became a Principal Assistant Secretary when the war activities of the Post Office on communications were greatly increased and were placed under his charge.

U.S. INTERNATIONAL STATIONS

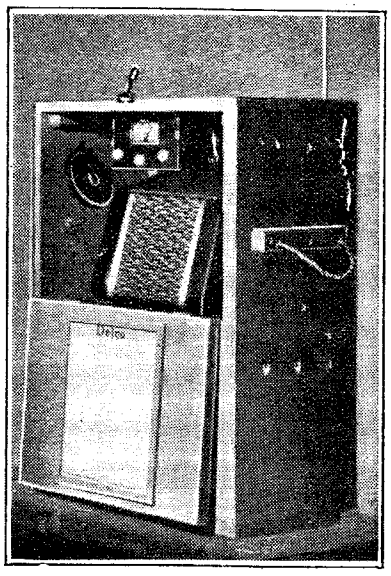
AN extension of time to January 1st, 1941, has been granted by the Federal Communications Commission to international stations to comply with the order for them to use a power of not less than 50 kW. Only two stations were, at the appointed time—July 1st—operating with the required power. They were Crosley's 50-kW WLWO at Mason, Ohio, and General Electric's 100-kW WGEO at Schenectady.

NEW YORK'S FIRST REGULAR F-M TRANSMITTER

TO ensure high fidelity signals with frequency-modulation broadcasting, the full range of frequencies have to be "put in at the microphone and kept in right up to the aerial," said Mr. J. R. Poppele, the chief engineer of W2XOR, when it was inaugurated as New York's first full time F-M station. Using a mid-frequency of 43.4 Mc/s, the 1-kW transmitter and aerial is situated at the top of a 600-foot skyscraper in Madison Avenue, New York, being linked with the studio by nearly three miles of telephone cable capable of transmitting all frequencies from 20-22,000 c/s. The signals from W2XOR have a flat overall characteristic of 30 to 17,000 c/s.

CAR RADIO CONVERSION

A CORRESPONDENT, speaking from experience of difficult active service in the field, recently put forward the view that the best type of receiver for comparatively large bodies of troops in canteens, etc., is a modification of "car radio." The requirements are fulfilled by the Delco-Philco "Active Service" transportable, which is a five-valve superhet of the car-radio type housed in a stout wooden case which has rope carrying handles. Power is derived from a car battery which is located in the lower half of the case.



FOR ACTIVE SERVICE. A Philco car-radio receiver adapted by Delco-Remy and Hyatt for the Forces.

A telescopic aerial, which is entirely out of sight when not in use, is fitted to the case. An advantage is that it is non-directional.

FROM ALL QUARTERS

News in Morse

BRITISH official news bulletins in morse are transmitted from the Post Office stations GIA, 15.27 metres; GAI2, 16.03 metres; GIM, 23.13 metres; GAY, 33.67 metres, and GBR, 18,750 metres, at the following times (B.S.T.):—

00.30 GBR, GAY, GIM
13.00 GBR, GAI2, GIA, GIM
17.02 GBR, GAI2, GIA, GIM
20.48 GBR, GAY, GIA, GIM

Transmitter GIA is used with an aerial array directional on South America.

British Listeners

CAPT. C. WATERHOUSE, the Assistant P.M.G., recently announced in the House of Commons that the number of wireless receiving licences in force on July 31st was approximately 9,132,200, which is an increase of approximately 67,000 during the preceding two months. The increase is much greater than during the first nine months of the war, when it was only 21,000.

Radio-controlled Landing Lights

NIGHT landing lights for seaplane bases which can be switched on from a distance of approximately six miles by wireless have been developed in the U.S.A. by Westinghouse Electric and Firestone Tyres. The lights, mounted on doughnut-shaped rubber buoys, are each equipped with a small battery-operated receiver and a "whip" aerial.

Leipzig Fair

THE Germans have not been slow in advertising the fact that the Leipzig Autumn Fair has been held in spite of the war. At this fair the section devoted to wireless replaced the normal Berlin Radio Exhibition, which was held annually from 1922-39. Apparently the Germans still hope for a growing oversea market, for the export section was well supported by the manufacturers. Among the latest developments to be seen was a diminutive centimetre-wave radio-telephone set.

Two German Pioneers Dead

GRAF GEORG VON ARCO died recently in Germany at the age of 71 years. With Professor Slaby, he was responsible for the development of the original Telefunken system of wireless telegraphy, of which the "quenched spark" was the basic feature.

Paul Nipkow, the inventor of the Nipkow disc used in the early experiments in mechanical television, died at the end of August, two days after his 80th birthday. He is held by Germans to be the father of television.

B.B.C. Short-wave News

THE call signs and frequencies to be used during this month by the B.B.C. for the transmission of news in English in the European short-wave service are: GSA, 6.050 Mc/s (49.59 m); GSL, 6.110 Mc/s (49.10 m); GSW, 7.230

Current Topics—

Mc/s (41.49 m); GSB, 9.510 Mc/s (31.55 m); GRX, 9.690 Mc/s (30.96 m); GSN, 11.820 Mc/s (25.38 m); and GSE, 11.860 Mc/s (25.29 m).

The times (B.S.T.) of the transmission of news and the calls used are:—

00.30—GSA, GSW, GRX.
07.15 } GSA, GRX.
09.00 }
12.45 } GSA, GSL, GSN, GSE.
14.15 }
17.00—GSA, GSE.
19.00—GSA, GSL, GSB, GRX.
23.00—GSA, GSW, GRX.

The 41.49-metre wavelength is now being used experimentally for the transmission of the Forces programme.

Finnish Anti-interference Campaign

As part of a scheme to reduce electrical interference the Finnish electricity supply companies refused to instal electrical appliances unless fitted with anti-interference filters. A committee appointed to inspect appliances already installed found that of the 1,500 lifts examined in Helsinki 635 required interference filters.

Italian Listening Tax

THE Italian Government has introduced a new general tax, which, although it is known as a tax on revenue, is in reality a tax on expenditure for it imposes a levy of 2 per cent. of the retail price on all purchases. It is learned from the Bulletin of the International Broadcasting Union that the tax is applicable to broadcasting and accordingly listeners will in future have to pay an additional 1.65 lire to the annual receiving licence fee, which will then be 82.65 lire.

B.I. Spitfire Fund

A CHEQUE for £5,000 has been sent to the Minister of Aircraft Production for a "Spitfire," as a result of the subscriptions of the employees of British Insulated Cables. The company subscribed an amount equal to that given by the employees.

NEWS IN ENGLISH FROM ABROAD

REGULAR SHORT-WAVE TRANSMISSIONS

Country : Station	Mc/s	Metres	Daily Bulletins (B.S.T.)
America			
WNBI (Bound Brook)	17.780	16.87	5.0, 6.0.
WCAB (Philadelphia)	6.060	49.50	11.45 (Tu., Wed. and Fri.), 12.0 midnight†.
WCAB	9.590	31.28	11.45 (Mon., Th. and Sat.).
WBOS (Millis)	9.570	31.35	11.45.
WCBX (Wayne)	15.270	19.65	8.30‡, 10.50§‡.
WCBX	17.830	16.83	1.0, 2.0†, 3.0†, 3.15§‡, 4.0*†, 4.30§‡, 6.0, 6.30§‡, 7.55†.
WGEO (Schenectady)	9.530	31.48	8.30†, 9.55§‡, 11.25‡.
WGEA (Schenectady)	15 330	19.57	1.0, 2.0‡, 9.55§‡.
WPIT (Pittsburgh)	15.210	19.72	6.0.
WRUL (Boston)	6.040	49.67	12.15 a.m.‡, 12.0 midnight*.
WRUL	15.250	19.67	12.15 a.m.‡, 8.30§‡, 9.30§‡, 12.0 midnight*.
WLWO (Cincinnati)	9.590	31.28	7.25 a.m.‡.
WLWO	11.870	25.27	7.25 a.m.†, 1.15.‡.
WLWO	15.270	19.65	12.0 midnight†.
Australia			
VLQ (Sydney)	9.615	31.20	9.15 a.m.
VLQ2	11.870	25.27	9.15 a.m.
VLQ7	11.880	25.25	9.50.
VLR (Melbourne)	9.580	31.32	10.0 a.m. 3.0
VLR3	11.850	25.32	9.50.
China			
XGOY (Chungking)	9.500	31 58	10.30.
XGOY	11.900	25.21	11.30 a.m., 12.10, 10.30.
Finland			
OFD (Lahti)	6 120	49.02	12.15 a.m., 8.55 a.m., 7.15, 10.15.
OFD	9.500	31.58	
Hungary			
HAT4 (Budapest)	9.125	32 88	1.30 a.m.§.
HAT5	9 625	31.17	12.15 a.m.‡ 12.30 a.m.†.
HAS3	15.370	19.52	3.55†.
India			
VUD2/3 (Delhi)	9.590	31.28	9.0 a.m., 1.30, 4.50, 6.30.
VUD3 (Delhi)	15.290	19.62	9.0 a.m.
Japan			
JZJ (Tokio)	11.800	25.42	9.5.
JZK	15.160	19.79	9.5.
Manchukuo			
MTCY (Hsinking)	11.775	25.48	8.0 a.m., 10.5.
Rumania			
Bucharest	9.280	32.33	10.40‡.
Spain			
FETI (Valladolid)	7.070	42.43	8.50.
EAJ7 (Madrid)	9.860	30.43	12.30 a.m.
Sweden			
SBO (Motala)	6.065	49.46	10.45.
Turkey			
TAP (Ankara)	9.465	31.70	7.15.
TAQ	15.195	19.74	12.15.
U.S.S.R.			
—— (Moscow)	7.545	39.76	10.30, 11.30.
RW96	9.520	31.51	7.33 a.m., 7.30, 9.0, 10.30, 11.30.
RAL	9.600	31.25	1.0 a.m.
——	11.499	26.09	12.0 noon.
——	11.710	25.62	9.0, 10.30.
RNE	12.000	25.00	1.0 a.m., 9.0†, 10.30.
——	14.720	20.38	12.0 noon, 5.0.
RKI	15.040	19.95	1.0 a.m.
RW96	15.180	19.76	1.0 a.m., 7.33 a.m., 9.0 a.m., 7.30, 9.0, 10.30, 11.30.
——	18.540	16.18	12.0 noon.
Vatican City			
HVJ	6.190	48.47	8.0 (Tu. and Fri.).
Yugoslavia			
YUA (Belgrade)	6.100	49.18	10.25.

The times of the transmission of news in English for Europe from the B.B.C. short-wave station are given on page 449.

REGULAR LONG- AND MEDIUM-WAVE TRANSMISSIONS

Country : Station	kc/s	Metres	Daily Bulletins (B.S.T.)
Bulgaria			
Sofia	850	352.9	9.55 (Th. and Sat.).
Hungary			
Budapest 1	546	549.5	11.10.
Ireland			
Radio-Eireann	565	531	6.45‡, 10.10 (10.5 Sun.).
Latvia			
Madona	583	514.6	10.0 (Tu. and Fri.).
Kuldiga	1,104	271.7	10.0 (Tu. and Fri.).
Rumania			
Radio-Romania	160	1,875	10.45‡.
Bucharest	823	364.5	10.45‡.
Spain			
Radio-Coruna	968	309.9	1.10 a.m.
Sweden			
Motala	216	1,389	10.45.
Stockholm	704	426.1	10.45.
Goteborg	941	318.8	10.45.
Falun	1,086	276.2	10.45.
U.S.S.R.			
Moscow 1	172	1,744	11.30.

All times are p.m. unless otherwise stated. * Saturdays only. § Saturdays excepted. † Sundays only. ‡ Sundays excepted.

Letters to the Editor

THE EDITOR DOES NOT NECESSARILY ENDORSE THE OPINIONS OF HIS CORRESPONDENTS

Air Defence Cadet Corps

ONE of the most urgent needs to-day in the R.A.F. is for trained wireless operators. The Air Defence Corps organisation sponsored by the Air League of the British Empire is making every effort to help train cadets for Signals work before joining the Services.

Already many squadrons have the benefit of prominent radio amateurs as instructors, but nearly all squadrons are in urgent need of morse keys, buzzers and head telephones.

The purpose of this letter is to ask whether any of your readers can assist us in the task of seeing that squadrons are supplied with morse equipment.

The strength of the A.D.C.C. organisation may be judged from the fact that within 18 months of its formation in 1938 200 squadrons (representing 20,000 cadets) were enrolled.

Readers who have spare equipment to donate are invited to send it direct to Squadron Leader H. W. Woollett, London Area Controller, A.D.C.C., Kinnaird House, 1a, Pall Mall East, London, S.W.1, or to the writer at the address given below.

JOHN CLARRICOATS,
Cadet F/Lt. (Signals Officer,
Southgate Squadron,
A.D.C.C.).
16, Ashbridge Gardens,
London, N.13.

Appreciation of Quality

IN the September issue "Diallist" mentions his doubts as to whether the man in the street appreciates real quality, and states "he still seems to like what he calls 'a mellow tone.'"

Although much evidence seems to confirm this general opinion, I would like to state emphatically that the man in the street does appreciate "real" quality, and that on those rare occasions when he has the opportunity of hearing it he is literally astounded—remarks such as "I never knew wireless could sound like that" being typical.

By "real" quality I mean the output from first-class apparatus when free from interference, whistles, etc., with the kind of transmission we pray for when important demonstrations are imminent.

Such reproduction is sweet and full and very satisfying to the ear because bass and treble is correctly balanced, and it is free from treble peaks or spurious high frequencies caused by distortion of even the mildest kind.

The sound is not harsh, and therefore does not require "mellowing." Any top cutting only causes "muffling" without compensating advantages—a very different thing.

Even if the man in the street is given first-class receiving equipment, he will still be driven to turning the tone control knob to "mellow" at times of interference or when a distorted transmission reaches him. After having found repeatedly that such turning is desirable, he must be forgiven if in his ignorance he concludes that that is the best position for the knob.

Until the B.B.C. ensures that unpleasant sounds are "mellowed" prior to transmission, and until the radio industry produces sets which compensate for B.B.C. top lift, and are free from treble peaks and harmonic distortion, tone controls must be fitted, and the public in self-defence will turn them to "mellow."

It is up to technicians (including the P.O. land line experts) to make such self-defensive measures unnecessary. High-quality local station receiving equipment will then come into its own, and it will be found not only that the man in the street *does* appreciate quality, but that he had never even realised that a wireless set could produce such satisfying sound.

P. G. A. H. VOIGT.
Voigt Patents, Ltd.,
London, S.E.26.

"Sound on Film"

MR. R. F. E. MILLER has compressed much information into his lucid article on the elements of sound-film recording in the August issue.

When describing systems of noise reduction, I think Mr. Miller might with advantage have at least mentioned that the method whereby the negative sound-track is made as transparent as possible, thus producing a dense positive print allowing for the desired modulation but minimising film grain and abrasion noise, is known as a "squeeze track." Also, another important term in the technique of noise reduction is "matted track," *i.e.*, decreasing the width of the

Letters to the Editor—

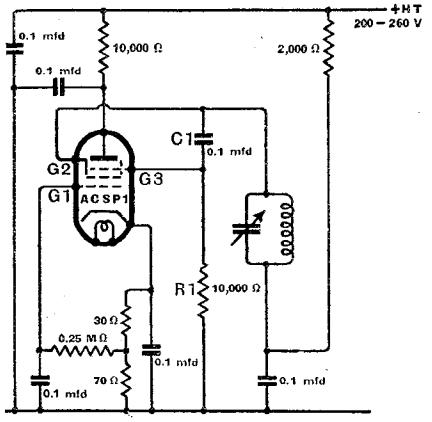
effective variable-density track and simultaneously increasing the modulation percentage where the required output is considerably less than maximum, resulting in an improved signal/noise ratio in low volume sequences.

DONALD W. ALDOUS.

Torquay, Devon.

The Numans Oscillator: New Style

WITH reference to Major Cocking's article in the September issue of *The Wireless World*, I beg to add some remarks on the application of a Mazda AC/SP1 to a Transitron circuit, as I have found it much superior to other RF pentodes in this application.



The AC/SP1 has been designed for AFC and noise-suppression circuits and is distinguished by a very steep negative (suppressor grid)-(screen current) characteristic over a considerable range, with full anode and screen voltages. Calculation shows that this valve in a circuit of the type shown will offer a negative AC resistance of less than 2,000 Ω between screen and earth.

In practice, this results in the following desirable properties:—

(1) Wide frequency coverage. The writer has used the circuit shown from a few cycles up to 12 Mc/s by merely changing the tuned circuit. From the vigour of oscillations at 12 Mc/s it is thought that considerably higher frequencies still can be obtained with this circuit.

(2) Purity of the sine wave-form and constancy of amplitude over the entire range, as revealed by an oscilloscope.

(3) The arrangement will oscillate with a very poor tuned circuit—thus satisfactory results were obtained with 25 μH and 1,000$\mu\mu$F at 1 Mc/s, and it was found that the L/C ratio could still be reduced.

(4) The frequency of oscillation is largely independent of the valve and its voltages—this, of course, is true of all negative resistance oscillators.

Decoupling filters, self-bias resistors, etc., are included in the accompanying diagram of my oscillator; R1 should not be made too high as this will cause difficulty in self-starting; it can be replaced by a suitable choke if desired. Anode and screen currents are about 4 and 11 mA, resulting in an oscillation of about 10 volts RMS across the tuned circuit.

T. J. REHFISH, B.Sc.(Eng.).

United Insulator Co., Ltd.,
12-16, Laystall Street,
London, E.C.1.

Interval Signals

YEARS ago I suggested to the B.B.C. an international system of signals for all transmitting stations. I now repeat my original idea, and shall be glad to hear any comments by your readers.

All stations should give interval signals of one, two or three notes in the scale of C Major. This system would give a different pattern for no fewer than 4,680 stations. The addition of a fourth note would increase this number by 32,768. After the war, I can see no reason why the nations of the world should not subscribe to this plan, except for the fact that there appears to be no known way of bringing the idea to the notice of anybody with any authority.

MAURICE ELLINGER.

London, W.2.

Henry Farrad's Solution

(See page 423)

ALTHOUGH it looks on paper as if the coils are completely screened, it is by no means certain that they are so in fact. The centre partition, being aluminium, would be covered with a transparent oxide film which would prevent it from making good electrical contact with the tin box that "just about" fits. Unless thoroughly sound electrical contact is made along both joints, the tin screen embracing both coils is not at all effective in reducing magnetic coupling between them. Bob should try separate screens for the coils.

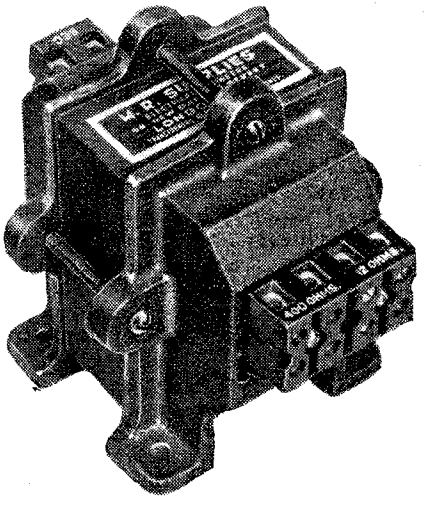
Apparatus Reviewed

M.R./331 MICROPHONE TRANSFORMER

THE good characteristics of moving-coil and high-grade carbon microphones are often obscured by the use of an inferior coupling transformer. To meet the demand for a transformer which will be as good as or better than the microphone with which it is used, M.R. Supplies, 68, New Oxford Street, London, W.C.1, have introduced their type M.R./331, costing 19s. 6d.

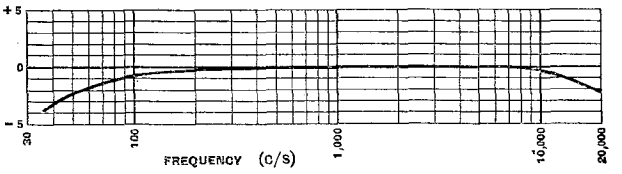
This transformer has two primary windings, one of which is suitable for carbon microphones with an impedance of the order of 400 ohms and the other for moving-coil instruments of approximately 12 ohms impedance. The construction is unusually substantial and the cross-section of the core is more than adequate for the DC polarisation which is likely to be introduced by carbon microphones. Cast end-plates totally enclose the windings and bakelite terminal blocks are provided for the connections. The finish is in black crystalline enamel.

The transformer is designed to work into a secondary load of 100,000 ohms, which is a convenient value, and, when properly loaded on both primary and secondary, an excellent frequency response is obtained. Our tests showed that even on the high-ratio, 12-ohms winding, there was little evidence of leakage inductance and there



M.R./331 dual purpose microphone transformer.

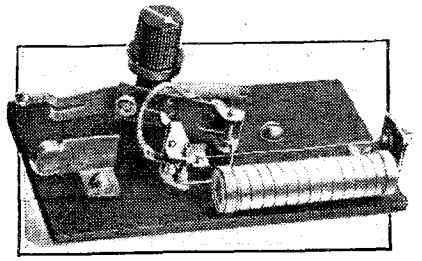
is not more than a 2.5 db drop at 50 c/s or 20,000 c/s. Under working conditions the effective voltage step-up is about 65 for the 12-ohm winding and 10 for the 400-ohm winding.



Frequency response of M.R./331 microphone transformer under load on the 12 - ohm primary winding.

AN INEXPENSIVE CIRCUIT-BREAKER

WE have recently tested an interesting cut-out switch submitted by Leslie Dixon and Co., 218, Upper Thames Street, London, E.C.4. The heating effect and consequent expansion of a wire under tension is used to release a trigger which gives a quick break to the spring-loaded main contacts. The latter are of tungsten and carbon, and the gap is approximately 1 inch.



Two-amp. thermal trip switch sold by Leslie Dixon and Co.

The switch is rated to carry 2 amp. and to break at 3 amp. These figures were confirmed on test, and in setting up the relay it was found that the adjustment of the wire tension was by no means critical. Also, the value of current required to break the circuit was accurately repeated.

The speed at which the relay works depends on the magnitude of the overload. Taking the rated figures as a basis, we set the relay to break at 3 amp., reduced the circuit to 2 amp., then increased to 3 amp. The time which elapsed before the contacts opened was 5 seconds, but on immediately re-setting the relay on overload a period of 2 to 3 seconds passed before the circuit was broken.

The relay is suitable for circuits in which a steady current rise is to be guarded against. The fibre base-plate measures 4in. × 2in. and the position of the re-setting knob makes the unit suitable for back-of-panel mounting. The price is 5s. 6d.

Book Review

Principles of Television Engineering. By Donald G. Fink. Pp. 541+xii. Published by McGraw-Hill Publishing Co., Ltd., Aldwych House, London, W.C.2. Price 33s.

THE great merit of this book is the clarity and detail with which the principles and methods of image analysis and synthesis are described. The first three chapters are devoted largely to these important matters, and the author then goes on to treat electron optics. This treatment is quite brief, but entirely adequate for a book of this nature.

The theory of focusing and deflection is dealt with in a satisfactory manner, but deflection equipment is much less well treated. Time-bases and time-base amplifiers, for instance, are in themselves a complex subject, while sync separators are not nearly as simple as one might be led to believe. The author discusses only methods used in American equipment, and these form only a small fraction of those available or, indeed, of those used in this country.

The electrostatic CR tube is chiefly treated, and the magnetic type is considered something of a rarity. Consequently, there is little or no information to be found on the design of deflection coils and transformers.

Both transmission and reception are discussed in detail, and apart from the omissions noted, the whole subject is treated excellently. Mathematics are used freely, but of a moderately simple kind, and the book is in no sense for mathematicians only. It contains large numbers of extremely good photographs illustrating defects in image reproduction which the author is to be congratulated on obtaining—such photography is by no means easy!

The book covers the whole field of television and is unusually free from error. It can confidently be recommended to all seriously interested in television. W. T. C.

Random Radiations

By "DIALLIST"

Ham Jargon

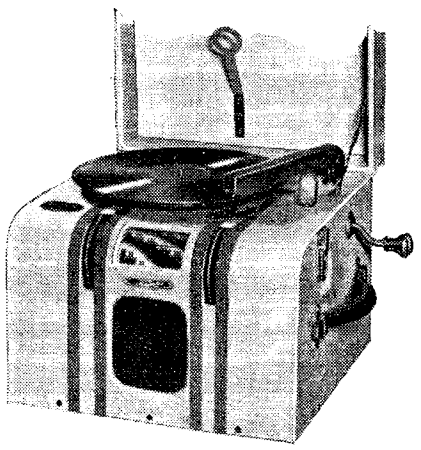
THAT ingenious but rather noisy instrument, the teleprinter, was recently installed at my headquarters. It's fascinating to watch the "works" as it operates and to think how much thought and experiment must have been needed before it was perfected. But what interested me perhaps more than anything else was to find that teleprinter operators use the same jargon as wireless transmitting fans. They call CQ on circuits taking in a number of stations. They *invariably* address one another as OM when not actually sending an Army message. They are SORRI when they make mistakes; they send TIC when they mean "wait a minute"; they use PSE and probably, when there's no officer or N.C.O. looking on, they send each other and their O.W.'s BEST 73's. A queer thing, this transmitter's jargon. I can't see that it saves much time, for so many unnecessary OM's and PSE's are dragged in at every possible opportunity. It had often struck me that many wireless fans would get on with the job more quickly if they used plain English and forgot about the conventional greetings, excuses and other frills. However, meeting the old jargon on the teleprinter struck a chord and made one regret the old days of listening to the amateurs on the short waves.

The Volume Control Again

DO you remember that I told you a month or two ago of my tribulations with a volume control of unprintable horribleness? You know the kind. Sometimes it is as good as gold for a while—quite a long while. Then it becomes scratchy and chancy in its contact and causes the receiver to play queer pranks—usually just when the most interesting item of the news or the most desirable piece of music is coming in. By giving it a tap or a tweak you manage to cure it for the time being. But the taps and the tweaks become less and less effective and the periods of good behaviour of shorter and shorter duration. Disliking the job of replacing the thing, you go on enduring its nasty ways. You promise yourself that you'll fit a new one to-morrow, if it isn't any better (as if it really could be!). And, behold, on the morrow it works to perfection—for a while. And so it goes on. Well, eventually mine became so dreadful that I could find no more excuses for delaying. I hoicked the set out of its cabinet, removed the old VC and flung it as far as I could through the window. A new one was put in place, and when the set was switched on all was very well indeed . . . that was just three weeks ago; and now my new volume control is proving just as villainous as the old one. Ah, me!

May It Be Soon

NOT long before I sat me down to write these notes I was looking at the list of European medium-wave and short-wave stations as it stood in the summer of last year. It seems almost incredible that a change so complete and so unpleasant should have occurred in one year. Then one could turn to scores of stations with the certainty that something good would be forthcoming. One could learn something of the life, the point of view and the outlook of this country and of that. Now, nearly all are directly or indirectly under the same repulsive control, and it is seldom that any is worth the cost of current. The distorted news bulletins were amusing in the early days of the war. Now they are just silly. And the interminable flow of the crudest of crude propaganda is a sickening business. One of the things to which I look forward most when we have cleared up the present mess is the restoration of their individuality to European broadcasting stations on all wavelengths. What a joy it will be to find them sane once more, and engaged in doing their proper job.



This "music box" made by the American Majestic Corporation, comprises a portable battery set, an AC home receiver and a spring-driven electric gramophone.

The Cheering Short Waves

Luckily, the short-wave set is not confined to Europe. With its help one can travel into the fresher air of more distant parts of the world and hear broadcasting free and untrammelled, as it should be. Of course, there's lots of propaganda—you can hardly be free of it anywhere in these queer days—amongst even the distant short-wave stations. But there are plenty still left that don't fling this kind of thing at you morning, noon and night. You can find real entertainment amongst them, and you can glean news of countries of which we don't hear much now that newspapers are reduced to their wartime size. It's possibly struck you that but for the wireless set we'd be in danger of becoming more insular as a nation just now than at any time for centuries. Not for ages have we been so completely confined physically to this small island of ours. We can't travel abroad; we can't even meet men and women who have just returned from travelling abroad. The short-wave set saves the situation, for with it we can still keep in touch with some folk in other parts of the world and get to know something of what they are thinking and doing.

Frequency Modulation

INTERESTING to observe the progress of frequency-modulated transmission and reception in the United States. Those who have developed it are spending a deal of money and making no small effort to prove its worth. On the other hand, manufacturers of wireless receivers who had no hand in launching it have been at pains to show that it isn't really all that good and anyhow that results at least as good could be obtained if apparatus as complicated and as costly were used for the transmission and reception of amplitude-modulated broadcast. There's something to be said on both sides; but I do feel that a strong case has been made out for FM in its proved ability to avoid the horrid results of man-made interference. The

Random Radiations—

Federal Communications Commission is evidently mu impressed by the possibilities of FM, which it has hailed as one of the most significant contributions to radio development made in recent years. The FCC has gone beyond a mere expression of opinion by cutting down the number of channels available for television in order to be able to assign more to FM stations.

'Ware the Nameless Battery!

MAY I offer one bit of advice to those who buy dry batteries during the coming months, whether for torches or for radio sets? It's this: Don't let yourself be attracted by the battery of unknown make, no matter at what sort of price it may be offered. And here's why. Last winter there was a battery famine. Determined not to be caught napping again, some too-clever-to-live folk have been importing large quantities of torch and radio dry batteries during the summer, inspired possibly by the Coal Controller's plea to householders to stock their cellars during the warm months. Coal will keep indefinitely, so the Coal Controller's advice is sound. But dry batteries won't; and nothing could be much worse for their well-being than a long spell of hot, dry weather. Hence the no-name battery offered at a low price may have been marked down to something far below its original value because it has been in stock for most of the summer and hasn't improved with keeping. A battery badly affected by age under hot and dry conditions will most likely prove a very poor investment, no matter how little you pay for it. Stick, therefore, to batteries of makes you know and buy from shops you know.

A True Story

You'd be surprised at the things that do happen sometimes. A good many years ago I was called in by a firm to see if anything could be done with a batch of HTB's that they'd imported. In those days batteries cost a good bit more than they do now. These were 100-volt units made up of 2½in. by 1¼in. cells, and, to the best of my recollection, their selling price wasn't far short of a sovereign apiece. It didn't take long to see that their condition was hopeless. They were a thoroughly bad lot—something, I believe, had gone wrong in the process of manufacture. Anyhow, even on the shelf—that is, on open circuit—their voltage was falling with disquieting rapidity. Tests showed that they were worthless, and the only advice that I could give was to cut the loss and scrap the lot. Unfortunately, it wasn't taken. The firm couldn't afford to risk its own good name; but it had the labels steamed off and sold off the lot for what they would fetch to someone with an elastic conscience and a speculative turn. He had them re-supplied with gaudy labels, advertised them as the world's best battery, and sold them at about half what they would have cost, had they been in good order. The unsuspecting public fell over itself to buy them. The recording angel must have been kept pretty busy for the next few days, for none of them can have given satisfactory service, even with a small set, for more than a week at the outside. Don't be caught in the same way this winter!

Club News

British Short-wave Correspondence Club

Headquarters: The Watering, Parham, Woodbridge, Suffolk.

Hon. Sec.: Mr. A. Richardson, The Watering, Parham, Woodbridge, Suffolk.

Members are now informed that a Technical Section is at their service under the management of R. Nugent (2FTS), Field House, Windmill Hill, Nr. Hailsham, Sussex. This section is willing to answer all technical radio questions over which members may be puzzled. All those wishing to use this service should send their questions, written clearly and giving all details which may help, to the section manager at the above address, enclosing stamped addressed envelope for reply. This service, as are all others, is given to members free.

B.S.W.C.C. members serving with H.M. Forces are requested to send their QRA's to H.Q. All members of H.M. Forces who desire to get in touch with fellow radio amateurs are requested to write to H.Q., where they will be given full information.

All are reminded that this is a non-professional non-profit organisation conducted by the amateur for the amateur. Membership is free and all wishing to join should send a stamped addressed envelope to the Hon. Sec. for details.

Ashton-under-Lyne and District Amateur Radio Society

Headquarters: 17a, Oldham Road, Ashton-under-Lyne, Lancs.

Meetings: Wednesdays 7.30 p.m. Sundays 2.30 p.m.

Hon. Sec.: Mr. K. Gooding, 7, Broadbent Avenue, Ashton-under-Lyne, Lancs.

At the annual general meeting the following officials were appointed: President, J. Partington (G5PX); chairman, W. P. Green; treasurer, J. Cropper (G3BY); Hon. Sec., K. Gooding (G3PM); Hon. Asst. Sec., W. Taylor; librarian, H. Hattersley; Morse Instructors, J. Partington (G5PX) and C. Noke (G6DV). The secretary reported that since the society's inauguration two years ago 75 names had passed through the records, and that the present membership was 33. After considering the claims made by H.M. Forces and other work of National importance, the position was considered very satisfactory. Twenty-five members and friends patronised the social evening held at the clubroom on August 7th, when an entertaining programme of demonstration of members' gear was provided. 2BK made the journey from Royston to demonstrate his automatic "testcall" relay, and many varied opinions were expressed as to when we should hear this particular exhibit on the air again. Suitable music was provided by members' records and an eight-record auto-radiogram lent by Mr. W. Taylor. A "racing" record helped to swell the club funds later in the evening!

Unbiased

By FREE GRID

Radiopathy

I WONDER how many of you read of the views put forward by an American radio expert who claims to have solved the secret of telepathy, which, he alleges, is nothing more than radio transmission on what he, with a complete disregard of the indiscriminate mixing of Latin and Greek derivatives, worthy of the B.B.C., calls "Hyper-ultra-short" waves.

It appears that when, for no apparent reason at all, you are suddenly seized with a cold sweat, and a sense of dreadful foreboding, as, to quote the radio expert, "You are sitting in the subway with a blonde on the way to Coney Island, it is because the enemy at home has raided the pockets of your spare pants and discovered some incriminating correspondence." This fact, according to the expert, results in the radiation from the brain of the distant wife of "hyper-ultra-short" wireless waves modulated by whatever thought is dominant in her brain at the time, which, in this case of course, is the correspondence. Those whose brains are tuned to the same wavelength—and apparently this is always the case between husband and wife—pick up the message; hence the aforementioned cold sweat and foreboding.

Seized with a cold sweat.

This American expert claims to have invented a receiver capable of being tuned to these short waves, and so dispensing with the necessity of the human brain as a receiver. This invention is, of course, of major importance, more especially in the case of war, and I have written off immediately to the inventor to ask him for the exact wavelength of these thought waves, which he omits to state.

DF in the Black-out

I CANNOT say that I have ever been a great believer in proverbs and other wisecracks such as "Necessity is the mother of invention," as they will seldom bear the searching light of analysis. Indeed, in the case of this particular one, I think that judging by the unhappy plight of most inventors who have spent their all in developing their pet project, it would be nearer the mark if written the other way round, namely, "Invention is the mother of necessity."

However, there are exceptions to every rule, and one of the wisecracks which I *do* know to be true is that which tells us that war always has a tremendous speeding-up effect in the matter of research and invention. I may tell you that I am anticipating very great developments as the result of the present conflict. I would, in fact, venture to make so bold as to say that the immediate post-war receivers will be 1950 models. By this I mean that the sets produced immediately after the war will be fully as advanced technically as they would have been by 1950 had there been no war.

One of the biggest advances that the war is going to bring about is in our knowledge of the exact nature of man-made interference, and once we have a proper analysis of the different forms it can take we shall be a very real step nearer to getting rid of it. Curiously enough, it is the black-out which is responsible for this.

In the early days of the war, I found it often very difficult to know whether I was driving through a town, or had not yet arrived at it. It was not long, however, before radio came to my aid, and enabled me to get over this difficulty. It is a tip well worth knowing, but, unfortunately, the present car radio ban prevents your trying it out now, but you will need it in the immediate post-war period before the street lights come back again in full force. All that you will need to do is to install a good radio set and tune it to some wavelength on which no station is operating.

If the ignition system of your car is as perfectly silenced as it should be you will have no difficulty in detecting when you are passing through a large town, as you will be literally driving through a cloud of interference caused by all the many and various electrical devices, which are in use in urban areas, as compared with the few employed in rural districts. The difference is very marked in the early evening hours, and is detectable even in the small hours of the morning.

I may say that I had become so skilled at recognising different types of interference, that I had no difficulty in identifying the various streets in my locality by the characteristic type of interference produced. Needless to say I found this to be invaluable in finding my way about in the black-out on foot with the aid of a small vest pocket portable. Lately I had improved matters, in the case of my car set, by substituting a cathode-

Rolling home by radio.

ray tube in place of a loud speaker, as the different types of interference are much more easily distinguished by eye than by ear. The curve produced by a vacuum cleaner motor, for instance, is markedly different to that produced by the machinery of a lift.

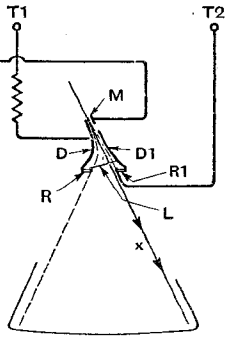
Recent Inventions

Brief descriptions of the more interesting radio devices and developments disclosed in Patent Specifications will be included in these columns

SCANNING SYSTEMS

THE movement of the electron stream of a cathode-ray tube is controlled in this invention, in at least one of the two normal scanning directions, by a "resistance switch," or relay device, mounted inside the tube.

As shown, a constant voltage is applied across the terminals T1, T2, whilst line impulses are applied to the terminals T, T1. The internal "switches" consist of resistance elements R, R1, which are preferably made of a layer of selenium or thallofide.



Improved method of scanning control.

The resistance value of the strips is greatly reduced by the impact of the electron stream, the effect lasting for a predetermined short interval of time.

The "idle" position of the electron stream is along the line marked x. The application of a line impulse to the terminals T, T1 momentarily charges-up the small electrode M. This swings the stream into contact with the resistance element R1, making the latter conductive for a period corresponding to one line interval. The two deflecting plates D, D1 are thus charged up by the voltage across the terminals T1, T2, and the stream swings over, accordingly, on to the resistance R. This is similarly rendered conductive by the action of the stream. Simultaneously the element R1 resumes its full resistance value, so that both plates D, D1 acquire the same voltage and the electron stream swings back to its original position, ready to repeat the transverse 'line" movement. A similar arrangement can be used to control the "framing" movement of the stream.

K. Tihanyi. Convention date (Germany) September 13th, 1937. No. 519168.

The British abstracts published here are prepared with the permission of the Controller of H.M. Stationery Office, from specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1/- each.

VISUAL TUNING INDICATORS

A TUNING indicator of the miniature cathode-ray type is characterised by the fact that the electrodes are arranged so that the screen receives a divergent electron stream, from which part is removed by an interposed diaphragm.

The two electrodes nearest the cathode of the indicator act as a lens, and focus the electron stream at a point just before it passes through a star-shaped aperture in the diaphragm. The control voltage from the wireless receiver is applied to the focusing electrode which is the farther removed from the cathode, and the initial biasing is such that when the set is tuned to the correct point of resonance, the image shown on the fluorescent screen of the indicator is of maximum size. Alternatively, the initial biasing may be arranged so that the fluorescent image decreases in size as the tuning point is approached.

N. V. Philips Gloeilampenfabrieken. Convention date (Netherlands) October 13th, 1937. No. 519263.

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INTERFERENCE SUPPRESSORS

A SUPPRESSOR device, particularly suitable for preventing radio-frequency disturbances from entering a wireless receiver when fed from an AC/DC converter of the vibrator type, consists of an open spiral winding, preferably of flat strip, connected between the input and output terminals. Inside the core of the winding, but separated from it by mica insulation, is a longitudinally split tube. Outside the winding is a second similarly split tube. The fact that the inner and outer tubes are both split longitudinally prevents the circulation of eddy currents.

In effect, the arrangement forms a low-pass filter circuit in which the series inductance of the coil is combined with the shunt capacity across the mica insulation to earth. The cut-off frequency of the filter can be varied by adjusting the width of the slots in the inner and outer tubes, thereby regulating the shunt capacity between the coil and the earthed conductors.

The General Electric Co., Ltd., and A. Bloch. Application date November 7th, 1938. No. 519506.

ELECTRON MULTIPLIERS

RELATES to the type of electron multiplier in which the discharge stream passes, in turn, through a series of semi-permeable targets each of which carries a progressively increasing voltage. Most of the primary electrons strike against the solid metal of the target and produce secondary electrons which are added to the main stream. Some of the electrons, however, pass clean through the openings of the permeable targets, and so acquire a higher velocity than the freshly liberated secondary electrons.

If it is desired to use such a tube as a modulator, it is necessary to apply the modulating voltages only to those electrons which have more or less the same velocity. Otherwise distortion will result.

According to the invention, electrons of uniform velocity are sorted out from the faster-moving ones, by arranging the modulating grid at an angle of ninety degrees to the main discharge path of the stream. The voltage on this grid is adjusted to deflect electrons having the required velocity so that they strike against it, and are modulated. Electrons moving at too high a speed, however, shoot straight past the grid into a collecting electrode, so that they do not affect the modulated current.

Baird Television, Ltd. (communicated by Fernseh Ak.). Application date 7th July, 1938. No. 516785.

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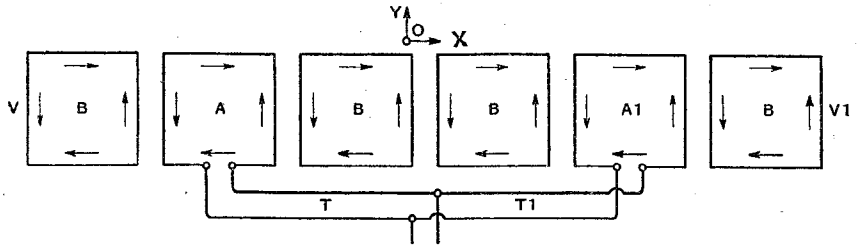
DF AERIALS

AN array of frame aerials, with sides half a wavelength long, is so arranged and energised that the radiation in one direction is much greater than that at an angle of ninety degrees to the favoured direction.

The figure shows a row of six square frames, of which those marked A and A1 are directly energised from a common RF source through transmission lines T, T1, whilst those marked B are not energised except by inductive coupling with the frames A and A1. The phase of the currents flowing in the limbs of the aerials, at any given moment, is indicated by the arrows, from which it will be seen that the adjacent vertical limbs practically neutralise each other, so far



Frame-aerial combination for DF work.

Recent Inventions—

as radiation in the OX direction is concerned, leaving the two outside verticals V, V1 alone effective. On the other hand, all the upper horizontal limbs carry in-phase current, and so have a cumulative effect in the OY direction. The same applies to all the lower horizontal limbs, which carry in-phase current in phase-opposition with that in the upper row of limbs. Since the upper and lower rows are half a wavelength apart, however, the two radiations will reinforce each other in the OY direction.

Standard Telephones and Cables, Ltd. (assignees of Le Matériel Téléphonique Soc. Anon.). Convention date (France) December 6th, 1937. No. 519350.

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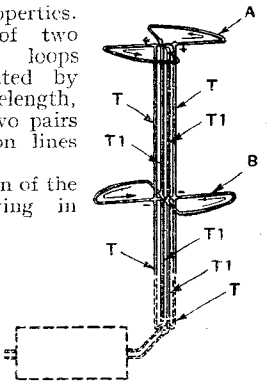
TELEVISION AERIALS

WHEN transmitting short-wave signals, particularly television, it is desirable to concentrate the radiated energy as much as possible in the horizontal plane, so as to minimise disturbances due to "space" waves reaching the receiver after reflection from the Heaviside layer. At the same time it is necessary to radiate the signals equally to all quarters, and to avoid any pronounced directional effects in the horizontal plane.

The figure shows an aerial with the required properties. It consists of two figure-of-eight loops A, B separated by half a wavelength, and fed by two pairs of transmission lines T and T1.

The direction of the currents flowing in each of the loops A, B is indicated by the arrows, the magnetic effects being additive, whilst the capacity effects balance out. The two pairs of transmission lines, being geometrically symmetrical, also helps to reduce capacity effects, the + and − signs indicating their simultaneous polarities. A number, preferably an even number, of similar units may be arranged to form an "array," giving a substantially non-directional field in the horizontal plane.



Non-directional television aerial for eliminating space-wave effects.

Hazeltine Corporation (assignees of H. A. Wheeler). Convention date (U.S.A.) 20th October, 1937. No. 519444.

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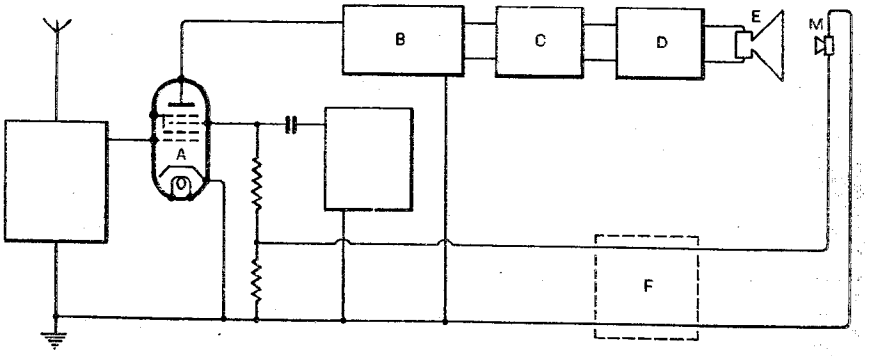
CORRECTING AF DISTORTION

IN a wireless receiver, negative feed-back is introduced between the loud speaker and one of the RF stages for the purpose of correcting the type of distortion that arises either in the detector valve or subsequently.

The figure shows a superhet set in which the mixing valve A is followed by an IF stage B, second detector C, AF amplifier D, and loud speaker E. A microphone M is coupled to the loud speaker, and feeds back an out-of-phase voltage to the oscillator grid of the valve A. The microphone has a frequency characteristic such as to offset any pre-dominant resonant frequency present in the loud speaker. The feed-back circuit may include a filter F which favours any frequency components that require correction, and also a phase adjuster to ensure that the voltages fed back reach the valve A in the correct phase to produce the results desired.



Negative feed-back by electro-acoustic link.

L. L. de Kramolin. Convention date (Germany) 4th October, 1937. No. 519786.

o o o o

CABINET RESONANCE

WHEN one or more loud speakers are mounted inside a wireless cabinet, acoustic reaction may occur between the two loud speakers, or between one of them and the circuit components. If the reaction is severe, it will set up a sustained audio-frequency note or howl.

This source of trouble is avoided, according to the invention, by supporting the chassis separately from the part of the cabinet to which the loud speaker is directly or indirectly connected. For instance, the chassis platform is fitted with four rubber feet or "grommets," which pass through apertures made in the bottom of the cabinet and rest firmly on the floor or table. The frame of the cabinet to which the one or more loud speakers are connected stands independently on its own feet, which are fixed, as usual, to the casing. To prevent any coupling through the tuning scale, the latter is flexibly mounted between the chassis and cabinet, so as to allow of a very limited degree of relative movement.

The General Electric Co., Ltd., and W. H. Peters. Application date September 14th, 1938. No. 518991.

o o o o

TRANSMITTER TUNING COILS

IT is common practice to use tuning coils with powdered-iron cores in receivers, where the RF currents are of the order of a few milliamps only. With small-gauge wire, and subdivided windings, the coil loss is then practically negligible. The conditions are, however, quite different in the case of wireless transmitters, where currents and voltages of much higher value are concerned, and the flux density may be a thousand times as much.

According to the invention, the coil loss is kept low, when handling high power, by using tubular or ribbon windings of comparatively large cross-section, and by forming the magnetic core from particles of smaller grain than those used in receivers. The core is open-ended, and is built up of separate sections of compressed granules separated from each other by thin insulating layers of mica. Compared with the air-cored coils normally used for transmitters, the number of turns can be halved for the same inductance value, with a corresponding saving in copper.

W. J. Polydoroff. Application date September 9th, 1938. No. 518945.

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SECONDARY-EMISSION AMPLIFIERS

THE secondary-emission plates or targets of an electron-multiplier are arranged so as to form two or more complete spirals around a heated cathode. The targets carry progressively increasing positive voltages, so that those in an outer limb of the spiral act as "accelerators" to the secondary electrons emitted from the corresponding targets in the inner limb of the spiral.

A magnetic field is applied along the axis of the tube, in the usual manner, from an external winding. Under the combined action of this field and the static field between the positively charged electrodes, the electron stream from the heated cathode is forced to strike against the nearest target. From here, the electron stream, augmented by the liberated secondary electrons, follows the line of each spiral, jumping from one target to the next, until it reaches the last of the series. It is then collected by a cylindrical anode which substantially encloses the whole system.

Telefunken ges. für drahtlose Telegraphie m.b.h. Convention date (Germany) September 25th, 1937. No. 519592.

Wireless World

CLASSIFIED ADVERTISEMENTS

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

Each paragraph is charged separately and name and address must be counted.

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ADVERTISEMENTS for the November issue are accepted up to First Post on Thursday, October 10th at the Head Offices of "The Wireless World," Dorset House, Stamford Street, London, S.E.1, or one day earlier at the Branch Offices, 8-10, Corporation Street, Coventry; Guildhall Buildings, Navigation Street, Birmingham, 2; 260, Deansgate, Manchester, 3; 26a, Renfield Street, Glasgow, C.2.

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

Cheques and Postal Orders sent in payment for advertisements or deposits should be made payable to ILIFFE & SONS Ltd., and crossed. Notes cannot be traced if lost in transit. They must therefore be regarded as being despatched at sender's risk. Alternatively, they may be sent per registered post.

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

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes. They also retain the right to refuse or withdraw advertisements at their discretion.

ARMSTRONG

TO OUR NEW FRIENDS

In the Argentine, Portugal, Russia and Spain who have recently communicated with us in response to our invitation through these advertisements, we would like to say that the same service, which for so many years has been at the disposal of our friends at Home, is available to you.

As our older customers will know, our aim in business has always been to give the best possible quality at reasonable cost, coupled with genuine and understanding service.

It has paid us and it has paid them and we intend continuing on the same sound principles.

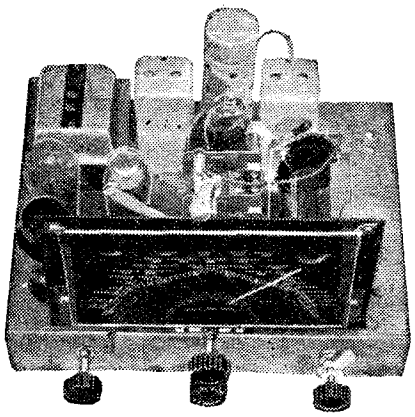
We want to increase still further our Export market and shall be glad to send details of the Special Model described below to any interested Overseas reader.

A limited number of Model EXP48 is available for the Home market.

SPECIAL OVERSEAS MODEL EXP48

8-v. 4-BAND ALL-WAVE SUPERHET CHASSIS

(13-160m. continuous & normal Broadcast bands)



This chassis has been developed on the lines of our Model AW38 which has proved an outstanding success since its introduction at 1939 Radiolympia. Overseas requirements, however, have been given primary consideration. Firstly, an additional short-wave band has been incorporated and the chassis now gives an efficient continuous short-wave coverage from 13 to 160 metres. All coils and I.F. transformers have been specially treated to render them impervious to humidity. Switching is of extra robust construction and contacts heavily plated. The mains transformer is interleaved and has a generous iron content to avoid excessive temperature rise and the steel chassis itself is heavily cadmium plated for tropical use.

International standard base valve-holders are **8** gns. used throughout .....

With 8" P.P. Speaker £9.9.0

With 10" P.P. Speaker £10.3.0

Plus 4/6 for part cost of packing and carriage on all orders in the U.K.

OVERSEAS TRADE BUYERS are invited to get into touch with us.

For our friends at Home

OUR ILLUSTRATED ART CATALOGUE fully describes the above new model, our well-known AW125 PP (reviewed so favourably by "The Wireless World"), the SS10 and all other chassis in the Armstrong range. Write for your copy to-day—6d. p.f.

ARMSTRONG MANUFACTURING CO.

WARLTERS RD., HOLLOWAY, LONDON, N.7, ENGLAND

'Phone: NORth 3213

For the convenience of private advertisers, letters, other than circulars, etc., may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 1/- to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." All replies should be addressed to the Box number shown in the advertisement, c/o "The Wireless World," Dorset House, Stamford Street, London, S.E.1. *Remittances should not be sent through the post to Box Numbers.*

DEPOSIT SYSTEM

Readers who hesitate to send money to advertisers in these columns may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt. Notes and Money Orders save time. Cheques should be made payable to Iliffe & Sons Ltd., and are acknowledged to seller when "cleared."

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. Details of any arrangement made between parties which does not concur with any of the above conditions must be advised to us when the deposit is made. For all transactions whether a sale is effected or not a commission of 1 per cent. is charged on and deducted from the amount deposited (minimum charge 2/-). All deposit matters are dealt with by Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

NEW RECEIVERS AND AMPLIFIERS

CHALLENGER RADIO CORPORATION.—We still lead with best value money can buy; send 2½d. stamp for illustrated catalogue of finest all-wave receivers, handsome speakers and valves, firsts only 3/- each; every article fully guaranteed; buy now before prices again rise.

CHALLENGER RADIO CORPORATION, 31, Craven Terrace, Lancaster Gate, London, W.2. [9229

ARMSTRONG Company have a Limited Number of Chassis not Included in the Current Catalogue, but carrying the makers' guarantee. Chassis are offered at especially economical prices. Examples are given below.

ARMSTRONG AW3PB, 7-stage all-wave radiogram chassis, incorporating press-button tuning, supplied complete with moving coil speaker; 6 gns.

ARMSTRONG RFPP7 All-wave Radiogram Chassis, with R.F. pre-amplifier and push-pull output using PX4 valves capable of handling 6 watts; £7/7.

ARMSTRONG Have Several Other Models. Please write for particulars.

ARMSTRONG COMPANY, Warlters Rd., Holloway, London, N.7. [9228

£11/10 Only.—Usual price £22; *Wireless World* 2 R.F. Receiver with push-pull quality amplifier, 10 valves, including tone control stage, 8 watts triode output, ideal for quality reproduction from radio and gramophone; limited number.—Bakers Selhurst Radio, 75, Sussex Rd., South Croydon. [9191

RECEIVERS AND AMPLIFIERS

CLEARANCE, SURPLUS, ETC.

ERLA 6 Volt All-wave Battery Set, vibrator power pack, new; £5.—Ambrose, 19, Wellington St., Glasgow. [9239

COSSOR Television and All-wave Radio Set, new, Console model 1210, list price 53 gns.; also H.M.V. Console model 903, vision and sound only, list price 45 gns., demonstration model, offers wanted.—Box 5939, c/o *The Wireless World*. [9217

RECEIVERS AND AMPLIFIERS

BANKRUPT Bargains, brand new 1939-40 models, makers' sealed cartons, with guarantees, at 25 to 40% below listed prices; also mains and battery, portables and midgets; send 1½d. stamp for lists.—Radio Bargains, Dept. W.W., 261-3, Lichfield Rd., Aston, Birmingham [9220

COMMUNICATION RECEIVERS

NATIONAL N.C. 81X, 10 valves, 5 bands, crystal filter, separate speaker, new, £30; Sky Buddy, new, £9; R.M.E. 3-range band expander, 3.5m. to 10m., £6.—Ambrose, 19, Wellington St., Glasgow. [9243

Wanted

SECOND-HAND Communication Receiver, in good condition.—20, Oakwood Rd., Sutton Coldfield. [9211

USED SETS FOR SALE

HALLICRAFTER

HALLICRAFTER Sky Challenger SX15, perfect; £12/10.—Dardwicke, 29, Warwick Ave., Crosby, Lancs. [9224

Wanted

PETO SCOTT Pre-amplifier, perfect condition, state price.—45, Westholme Rd., Manchester, 20. [9223

WANTED, Midwest 16-valve 1935 receiver.—Particulars to BRS 3744, 96a, New Walk, Leicester. [9206

PUBLIC ADDRESS

VORTEXION P.A. Equipment

IMITATED, but unequalled.

WE Invite You to a Demonstration.

A.C.-20 15-20-watt Amplifier, 38-18,000 cycles, independent mike and gram., inputs and controls, 0.037 volts required to full load, output for 4, 7.5, and 15 ohms speakers, or to specification, inaudible hum level, ready for use; 8½ gns. complete.

(This advertisement continued on next page.)

PUBLIC ADDRESS

(This advertisement continued from previous page.)

C.P. 20 12-volt Battery and A.C. Mains Model, as used by R.A.F., output as above; 12 gns.

A.C.-20, in portable case, with Collard motor, Piczo pick-up, etc., £14; C.P.20 ditto, £17/17.

50-WATT Output 6L6s, under 60-watt conditions, with negative feed back, separate rectifiers for anode screen and bias, with better than 4% regulation level response, 20-25,000 cycles, excellent driver, driver transformer, and output transformer matching 2-30 ohms impedance electronic mixing for mike and pick-up, with tone control, complete with valve and plugs; £17/10.

COMPLETE in Case, with turntable, B.T.H. Piezo pick-up and shielded microphone transformer; £22/10.

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

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

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

WE are Compelled Through Rising Costs to Increase our Prices by 10%.

ALL P.A. Accessories in Stock; trade supplied.

SEE Our Display Advertisement on page 445 (Edit.).

VORTEXION, Ltd., 257, The Broadway, Wimbledon, S.W.19. 'Phone: Lib. 2314 [9232

NEW MAINS EQUIPMENT

V

VORTEXION Mains Transformers, chokes, etc., are supplied to G.P.O., B.B.C., L.P.T.B.; why not you?

WE are Compelled Through Rising Costs to Increase our Prices by 10%.

VORTEXION, Ltd., 257, The Broadway, Wimbledon, London, S.W.19. 'Phone: Lib. 2814. [9233

NEW LOUD-SPEAKERS

BAKERS Brand New Surplus Speaker Bargains.

EVERY Music Lover Interested in Realistic Reproduction should write for free descriptive leaflet now.

£4/15; usual price £10.—Brand new permanent magnet infinite baffle speaker, complete with beautifully finished cabinet in polished walnut.

£2/7/6; usual price £5.—Brand new super quality triple cone speaker, permanent magnet model; exceptional bargain; limited number.

SECURE One of These Exceptional Bargains Now.

BAKERS SELHURST RADIO, 75, Sussex Rd., S. Croydon. [9193

TRIPLE CONE CONVERSIONS

BAKERS Triple Cone Conversions Will Immensely Improve Reproduction of Your Present Speaker. ("For a few shillings you have converted a speaker scheduled for the scrap heap into one worth pounds.—W. E. Darby, Grad. I.E.E.")

SPECIAL Offer.—We will loan you a speaker free of charge whilst we fit a triple cone to your present unit; write for details.

BAKERS SELHURST RADIO, 75, Sussex Rd., Sth. Croydon. [9192

SHORT-WAVE EQUIPMENT

G5NI for Short Wave Equipment; largest stocks in the country; communication receivers; National agents; American and British Valves, etc. See advertisement on page 4.—44, Holloway Head, Birmingham. [1551

"H.A.C." Short-wave Receivers, famous for over eight years; latest model one-valver now available; complete kit of precision components, accessories, full instructions, requiring no soldering; only 16/-, postage 6d.; illustrated catalogue free.—A. L. Bacchus, 109, Hartington Rd., S.W.8. [9244

CABINETS

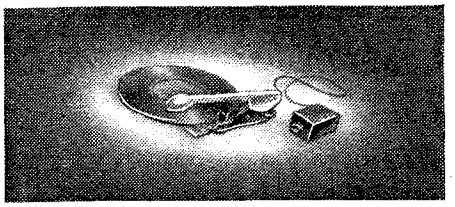
A CABINET for Every Radio Purpose

SURPLUS Cabinets (Undrilled) from Noted Make.

WE Have Hundreds in Stock (no Catalogues); send measurements of chassis, etc., and say what kind of cabinet required; stamp for reply.

INSPECTION Invited.

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



The most outstanding Pickup of our time!

Designed by P. G. A. H. VOIGT

Specification:

Operating System— ***moving coil.***

Voltage Output (Loud Records) ***approx. 50 millivolts.***

Reproducing Point Stiffness ***approx. 1½ gms./thou.***

Pressure on the Record from ½ ounce.

Provisional Price—Experimental Models £6.

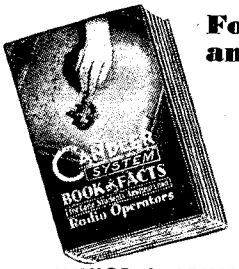
Patent applied for.
Delivery 6 to 10 weeks.

Advance information free.

VOIGT PATENTS LTD.

THE COURTS, SILVERDALE, LONDON, S.E.26.
Tel.: SYDenham 6666. Regd. Office: 22 Castle St., E.C.1.

CODE COURSES



For Beginners and Operators

The Candler System of Code training is just what one needs for entering or advancing in Army, Navy, Air Force, Amateur Radio work, or the Commercial side of telegraphy.

JUNIOR & ADVANCED COURSES
on Cash or Monthly Payment terms.

There's no royal road to learning—but there IS a quick, sure way to genuine CODE skill. Thousands upon thousands of Candler Trained Operators have proved the value of this truly remarkable system of Code Instruction.

J. Clarricoats, Sec., Radio Society of Great Britain—says: "I regard the Candler System as being the most important system of its kind and already large numbers of Members of the Radio Society of Great Britain have intimated to me that they are studying the course of instruction with a view to preparing themselves for service in one branch or another of H.M. Forces."

In the "BOOK OF FACTS," which will be sent FREE on request, you will see that full information is given concerning the subjects covered by Courses for beginners and also for operators.

COUPON

Please send me a Free Copy of Candler "Book of Facts"
NAME .....
ADDRESS .....
.....

Post Coupon in 1d. unsealed envelope to London Manager
CANDLER SYSTEM CO. (Room 55W), 121, Kingsway, London, W.C.2
Candler System Co., Asheville, North Carolina, U.S.A.

1040

DYNAMOS, MOTORS, ETC.

ANODE Convertor, 12v. D.C. input, 700v. D.C. output; 50/-.—Ambrose, 19, Wellington St., Glasgow. [9240

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

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

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

RECORDING EQUIPMENT

Wanted

ALL Kinds of Recording Equipment and Accessories Wanted; highest cash prices given.—Box 2536, c/o *The Wireless World*. [9209

WANTED, V.G. tracking gear and cutting head, must be perfect condition.—Price, particulars, to F. Ball, 6, Edinburgh Place, Weston-super-Mare. [9207

VALVES

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

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

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

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

METROPOLITAN RADIO SERVICE.—American Valves, in all types, trade supplied.—1021, Finchley Rd., N.W.11. Speedwell 3000. [0436

METERS, ETC.

GOVERNMENT Surplus Stock.

WESTERN Galvometers; 25/- each.

WESTERN 30-volt Meters; 20/- each.

BRIDGES; from 20/- each.

BRIDGE Galvometers; from 5/- each.

SULLIVAN Galvometers; from 50/- each.

FIELD Telephones, mike insets, morse inkers, morse keys, and electrical sundries.

CALL: Jack's Surplus Stores, 240, Camden High St., N.W.1. Gulliver 4844. [9210

Wanted

WANTED, Ferranti 500 uA or 1 mA. meter.—Box 2542, c/o *The Wireless World*. [9245

TEST EQUIPMENT

R. and C. Bridges, new model (200-250v. A.C.); £6/15/6.—MacLachlan and Co., Strathyre. [9246

TRIPLETT Battery Signal Generator, all-wave with audio, new, £8; Hickock mains all-wave ditto, audio 0-10,000 cycles (used), £6; Ferranti 3¼in. meters, 0-5 m.a., 0-100 m.a., 0-2½v., 0-25v., 0-5v. A.C., 20/- each; Ferranti 3-range 0-7½v., 0-150v., 0-15 m.a., 25/-; Beede all ranges except 1 m.a., 2¼in., 12/6; 2½in., 15/-; 3in., 17/6; 3½in.×4½in. fan, 25/-; 4in.×4½in., 30/-; Hickock thermocouple 49T dual H.F. meter, 0-2 amps., 0-5 amps., 40/-; Jewell 3¾in., type 54 m.c., 0-500 volts., 35/-; Hallicrafter R. meter, 12/6.—Ambrose, 19, Wellington St., Glasgow. [9241

Wanted

MODEL 7 Avometer, all wave mains oscillator, moving coil relay, good condition essential.—Pritchard's Radio, Menai Bridge, Anglesey. [9234

COMPONENTS

SECOND-HAND, CLEARANCE, SURPLUS

PREMIER RADIO.

PLEASE See Our Displayed Advertisement on page 5. [0488

SOUTHERN RADIO'S Wireless Bargains.

ALL Goods Previously Advertised Still Available.

SOUTHERN RADIO, 46, Lisle St., London, W.C. Gerrard 6653. [9238

L.T. Metal Rectifiers, 12v., 1 amp., 3/6.—Champion, 42, Hewitt Rd., London, N.W.3. [9225

L·R·S EASY TERMS

We can give **immediate delivery** of the new

ARMSTRONG SPECIAL OVERSEAS EXP48 CHASSIS

(With matched P.P. Speaker.)

Supplies are limited, so order NOW

Cash **£9.9.0** plus **4/6** for part carriage or **50/-** (plus **4/6** carriage) with order and 6 monthly payments of **25/6.**

For details see Armstrong advt., page 10).

We shall be glad to quote for other high-grade equipment such as **Ambassador Chassis and Receivers, Sound Sales Amplifiers, Voigt Speakers and Pick-ups, AvoMeters and Portable A.R.P. Receivers.**

VORTEXION AMPLIFIERS

This well-known equipment is now available from us on Easy Terms. May we send you full details and quotation?

VICEROY Non-electric DRY SHAVERS *(Made by Rolls Razors, Ltd.)*

Ideal for men in the Services or at home where electricity is not available. No brush, soap or water is needed. Complete in case **£2.10.0** or **10/-** with order and 6 monthly payments of **7/3.**

Send 2½d. postage for full details and terms of any of the above.

The *Evacuation address:* **Est. 1925.**

LONDON RADIO SUPPLY COMPANY

"Winden," Ardingly Road, Balcombe, Sussex

Masteradio —MALLORY

VIBRAPACKS

PERFECT PORTABLE POWER

British-made Vibrator Power Supply Units employing the WORLD-FAMOUS "MALLORY" VIBRATORS

OUTPUTS of up to 30 watts from either 6 volt or 12 volt battery supply.

EFFICIENCY as high as 70% including rectification.

LIFE. Masteradio-Mallory Vibrators mean longer life. Longer life means LOWEST COST PER HOUR ACTUAL USE.

DEPENDABILITY. In Masteradio-Mallory Vibrapacks the Vibrator is working under ideal conditions, thus ensuring utmost dependability.

Used by the War Office, Air Ministry, G.P.O.

Let our Technical Dept. solve your portable power problems. Write for details:

MASTERADIO Ltd.

***(Dept. W. W.)* Vibrant Works, RICKMANSWORTH ROAD, WATFORD, HERTS.**

'Grams: Mastiola, Watford. 'Phone: Watford 9885.

GREENWOOD

COMPONENTS—SECOND-HAND CLEARANCE, SURPLUS, ETC.

RYALL'S RADIO.—We regret to inform readers that owing to damaged premises we are unable to execute orders or answer correspondence at present. Immediately we are able to do so a further announcement will be made. [9244

5/- Only.—Bargain parcel comprising speaker cabinet, drilled steel chassis, condensers, resistances, and many other useful components, worth 35/-; limited number; postage 1/-.—Bakers Selhurst Radio, 75, Sussex Rd., South Croydon. [9194

COULPHONE RADIO, New Longton, Preston.—Prompt personal service. Cosmocord Series III crystal pickups, 18/6; Rola G12 energised, 1,250 or 2,500, with transformer, 52/6; guaranteed American valves, 4/6, octal, 5/6; Tungsram valves 33⅓% discount. Bulgin components. Lowest prices for all advertised chassis; K.B., Ferguson, R.G.D., Decca, G.E.C., Decca and Pilot receivers. Immediate delivery newly released Ferguson 104 and Mains Minor 909. Stamp for new comprehensive list. [9236

VAUXHALL.—Rola 8in. P.M. speakers, 14/9; Rola 10in. P.M. speakers, 18/6; Rola G12 P.M. speakers, 69/6; Rola energised 1,500 ohm 8in., 12/6; all with transformers. Electrolytic condensers, card board case, 8 mfd. 500v., 2/-; 8+8 mfd. 500v, 3/6; 50 mfd. 50v., 1/9; volume controls, 2/-; with switch, 3/-; iron-cored tuning coils on base, terminals, switch, 2-gang, 12/6; 3-gang, 19/6; bar type 2-gang condensers, 0.0005 mfd. straight, trimmers, 6/6; skeleton HT10 rectifiers, 11/-; one-watt resistors, 4d. each; Niclet 3½-1 L.F. transformers, 5/9; variable selectivity 465 k/c. I.F. transformers, 8/6; gramophone pickups, 11/- and 18/9.

VAUXHALL UTILITIES, 163a, Strand, London, W.C.2. Postage extra orders under 3/-, stamp for list. [9221

Wanted

TWO Bulgin C.52 Four-band Superhet. Coils.—Marsden, 60, Leigh Rd., N.5. [9215

RECORD CHANGER Wanted.—Full particulars to Nicholls, Five Grange Close, Westmonkseaton, Northumberland. [9216

MISCELLANEOUS

CARDS, memos, billheads; 1,000, 6/9; samples. Rubber stamps.—"B," Tice's, 11, Oaklands Grove, London, W.12. [9235

EVERY Radio Dealer Who is Not a Regular Reader of "The Wireless and Electrical Trader" should send his trade card at once for a specimen copy and full details of the "Trader" Services. "The Wireless and Electrical Trader" has the widest influence, and is read by all the leading manufacturers and traders. Trade only, 17/6 per annum, post free. Published at Dorset House, Stamford St., London, S.E.1. [0615

REPAIRS AND SERVICE

GUARANTEED Repairs, any transformers, choke, motor armature, converter, dynamo, etc.; keenest prices, immediate quotation, prompt, dependable service.—See below.

L.T.P. (LONDON TRANSFORMER PRODUCTS, Ltd.), Willesden, N.W.10. Willesden 6436 (3 lines). [9227

MAINS Transformer Service, repairs, rewinds, or construction to specification of any type, competitive prices and prompt service.—Sturdy Electric Co., Dipton, Newcastle-on-Tyne. [0516

"SERVICE with a Smile."—Repairers of all types of British and American receivers; coil rewinds; American valves, spares, line cords.—F.R.I., Ltd., 22, Howland St., W.1. Museum 5675. [8934

METROPOLITAN RADIO SERVICE.—Guaranteed repairs to American and British receivers; American valves, condensers, volume controls, linecord resistances, Majestic I.F. transformers, and rewinds, trade supplied.—1021, Finchley Rd., N.W.11. Speedwell 3000 [0435

SERVICE With a Guarantee.—Let Challenger overhaul your radio and bring it up to date for the winter; low prices, best workmanship; 3 months' guarantee card given with every job; all replacements; valves 6/- each.—Challenger Radio Corporation, 31, Craven Terrace, London, W.2. [9230

REPAIRS to Moving Coil Speakers; cones/coils fitted or rewound; fields altered or wound; prices quoted, including eliminators; pick-ups and speaker transformers rewound, 4/6; trade invited; guaranteed satisfaction; prompt service.—L. S. Repair Works, 5, Balham Grove, London, S.W.12. Battersea 1321. [0394

SITUATIONS VACANT

RELAY Engineer Required for Re-diffusion System.—Write, stating experience and salary required, to Box 2537, c/o *The Wireless World*. [9213

RESISTOR Chemist Required with Good Knowledge of Control and Manufacture of Carbon Resistances.—Write, stating age and experience, to Box 2540, c/o *The Wireless World*. [9222

GALPINS
ELECTRICAL STORES
75, LEE HIGH ROAD, LEWISHAM, LONDON, S.E.13

Telephone: LEE GREEN 5240

Terms: Cash with Order

D.C. MOTOR BLOWERS, 2in. inlet and outlet. Aluminium body, laminated field, ideal for dug-out ventilation. 100 volt, **25/-**; 220 volt, **30/-**, carriage paid.

CRYPTO SHUNT WOUND DYNAMO, 12/18 volts, 8/10 amps., 2,200 r.p.m., in new condition, **37/6,** carriage forward.

X-RAY TUBES by well-known makers, 7in. bulb Tungsten Targets, **15/-** each, carriage forward.

MAGNAVOX PM PUBLIC ADDRESS MOVING COIL HORN SPEAKERS, handle 15/20 watts, size of horn 40in., 20-in. flare. Price **47/6,** carriage paid.

EX-G.P.O. UNI-SELECTOR SWITCHES, with relay, 8 rows of 25 contacts, in new condition, **15/-** each.

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INDEX TO ADVERTISEMENTS

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