HEIGHT INDICATOR FOR AIRCRAFT

The Wireless World

6d.

THE PRACTICAL RADIO & TELEVISION JOURNAL

Thursday, February 2nd, 1939.

MOTOR CAR INTERFERENCE

The Wireless World

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

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EDITORIAL COMMENT

Television

Accelerating Rate of Progress

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

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

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

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

National Service

The Wireless Register

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

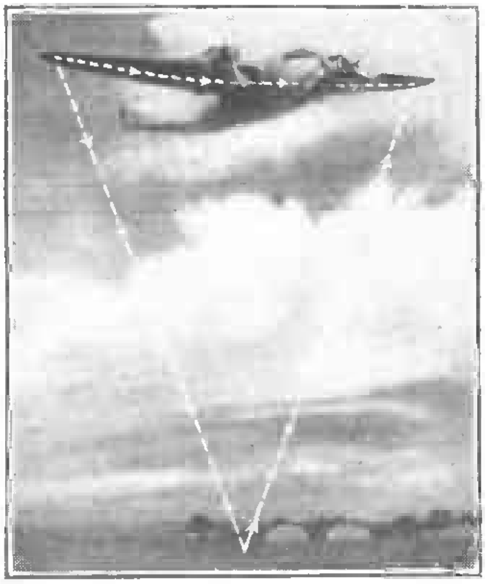
As we have already explained, filling up the form does not involve any liability, but will provide a means of classifying those experienced in wireless, so that in the event of an emergency which would require that everyone should put himself at the service of the country, the right job could be found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

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

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

Wireless Altimeter

"ECHO SOUNDING" FOR AIRCRAFT



By Our New York Correspondent

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

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

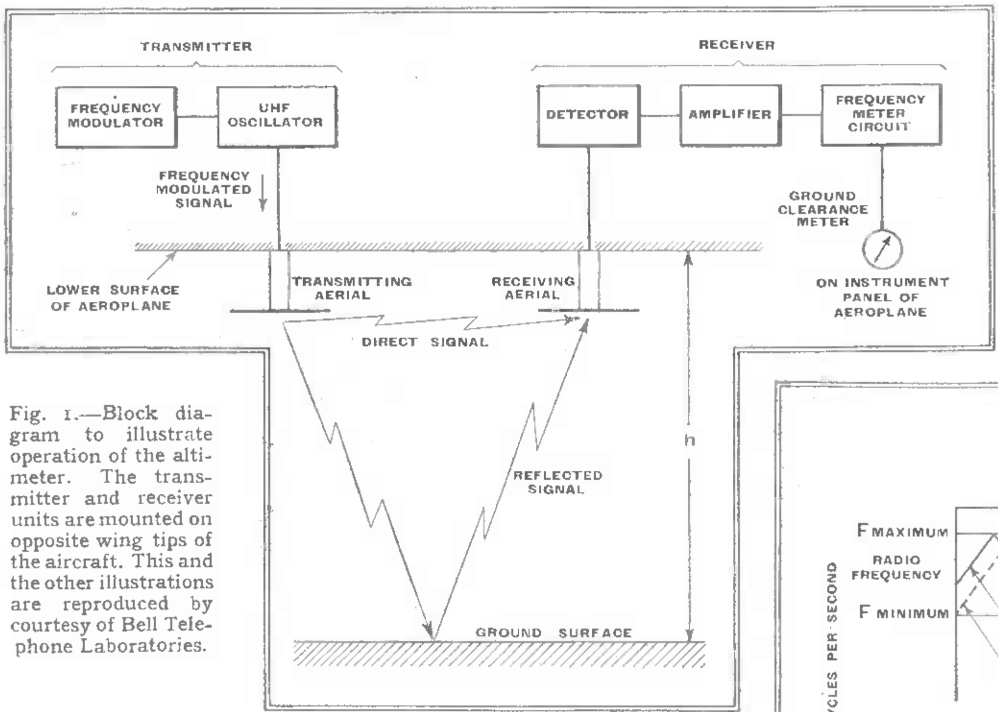


Fig. 1.—Block diagram to illustrate operation of the altimeter. The transmitter and receiver units are mounted on opposite wing tips of the aircraft. This and the other illustrations are reproduced by courtesy of Bell Telephone Laboratories.

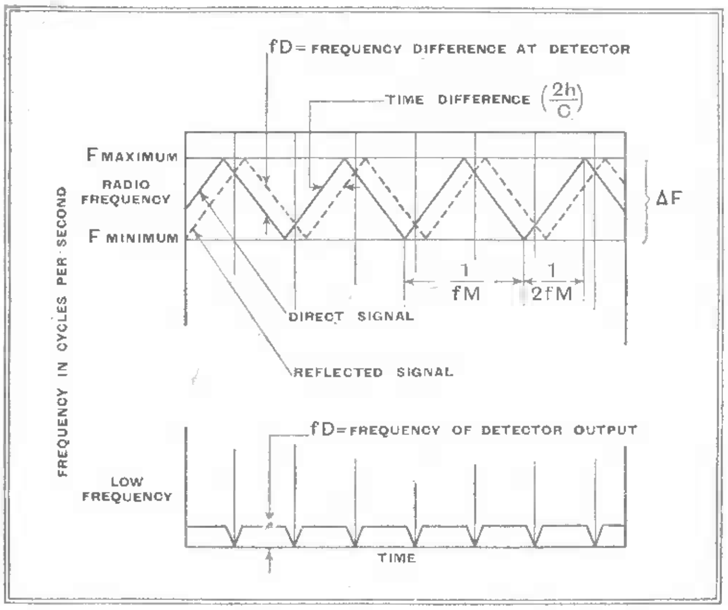
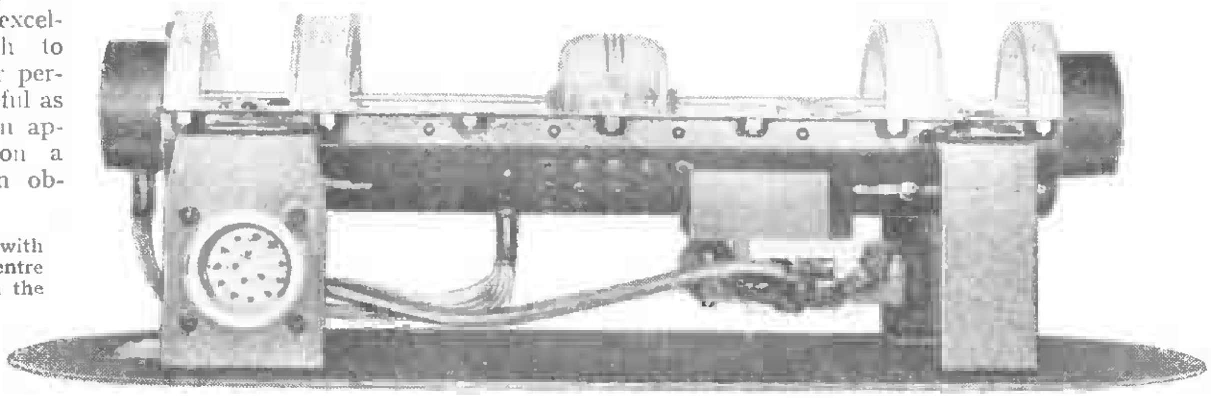


Fig. 2.—Method of obtaining a frequency proportional to altitude.

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

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

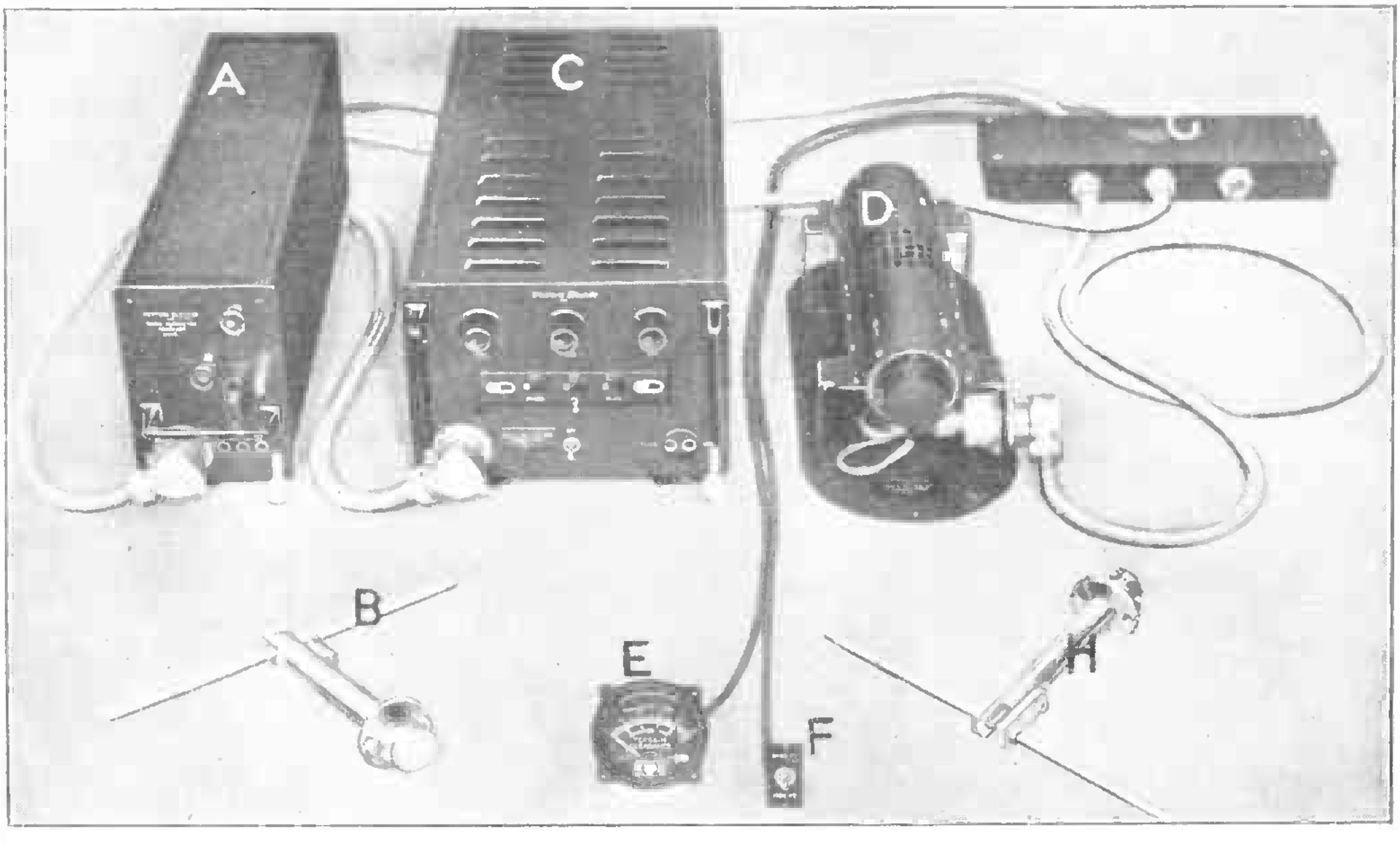
FOR fairly obvious reasons, the pilot of an aircraft flying over, say, hilly country in conditions of poor visibility is less interested in knowing his height above sea level than in the height above the surface of the earth immediately below him. The Western Electric Altimeter described in this article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



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

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

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



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

Wireless Altimeter—

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

"Door-knob" Valve

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

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

PROBLEM CORNER—5

Test Your Powers of Deduction

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

99, Blomfontein Parade,
Surbiton.

Dear Henry,

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

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

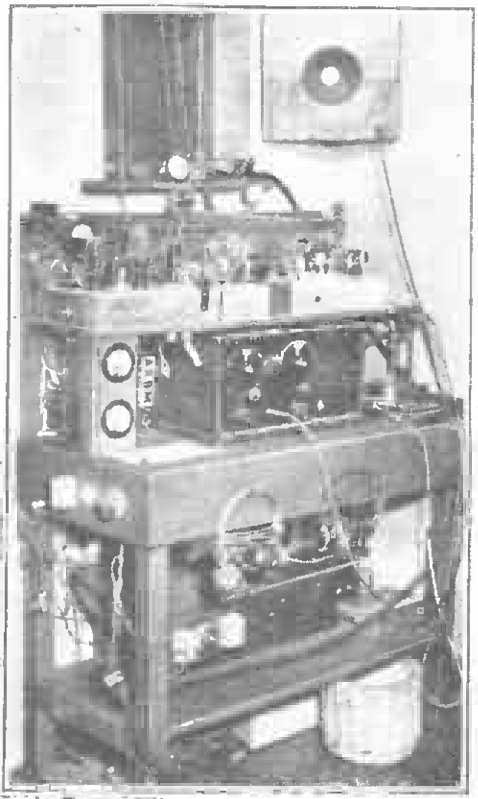
Your affectionate
Uncle Adrian.

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

Amateur Transmitting Station G5CD

At Hendon, London, N.W.4

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

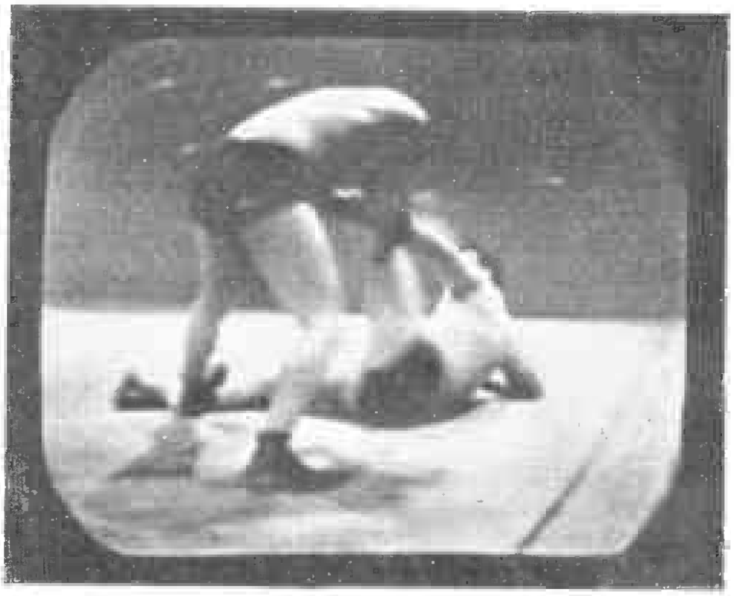


A considerable amount of work is done under artificial aerial conditions. The inset picture above shows the equipment used for transmission on 57.68 Mc/s, which can operate on an input up to 100 watts. The station is usually to be heard on Sundays, in the morning on 1.7 and 3.5 Mc/s bands and in the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

Motor Car Interference

Part I.—HOW IGNITION SYSTEMS AFFECT TELEVISION RECEPTION

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



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

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

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

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

(1) Ignition systems of internal combustion engines.

(2) High-frequency medical apparatus.

(3) Oscillation from certain badly designed broadcast receivers.

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

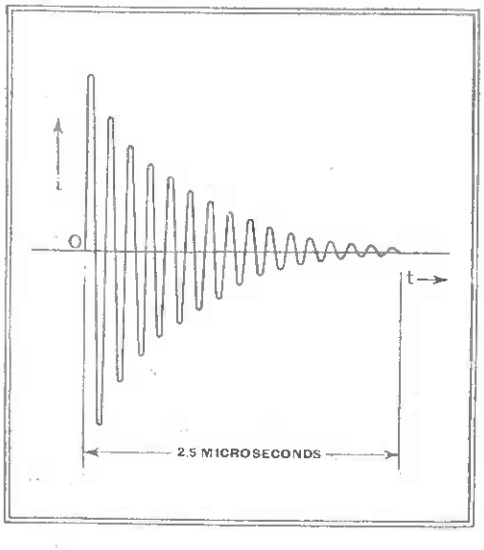


Fig. 1.—Diagram showing waveform of an interfering pulse produced by a discharge from an ignition coil across the gap of a sparking plug.

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

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

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

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

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

Effect on Television Reception

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

Motor Car Interference—

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

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

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

Now let us take the vehicle to a more distant point so that the magnitude of the impulse when it arrives at the aerial system of the receiver is much smaller, as depicted in Fig. 2 (*b*). It is clear now that the time between initiation and the instant T1, over which the pulse is of sufficient amplitude to give full-vision white, has been reduced by quite a considerable amount; for example, at a distance of a few feet the impulse may be of such magnitude that it has the effect of maintaining full-vision white amplitude at the cathode-ray tube for a period of 2½ microseconds, wheras when taken 30 or 40 yards away the effective time over which this full-vision white is maintained may be less than ½ microsecond.

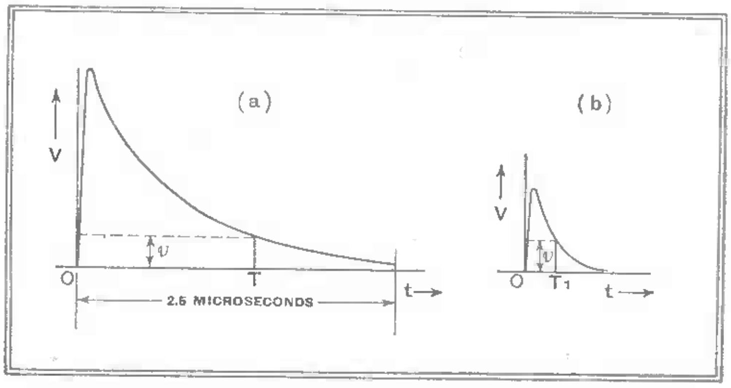


Fig. 2.—The interfering pulse of Fig. 1, after rectification; the diagrams represent two different amplitudes.

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

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

When Interference Disappears

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

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

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

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

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

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

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

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

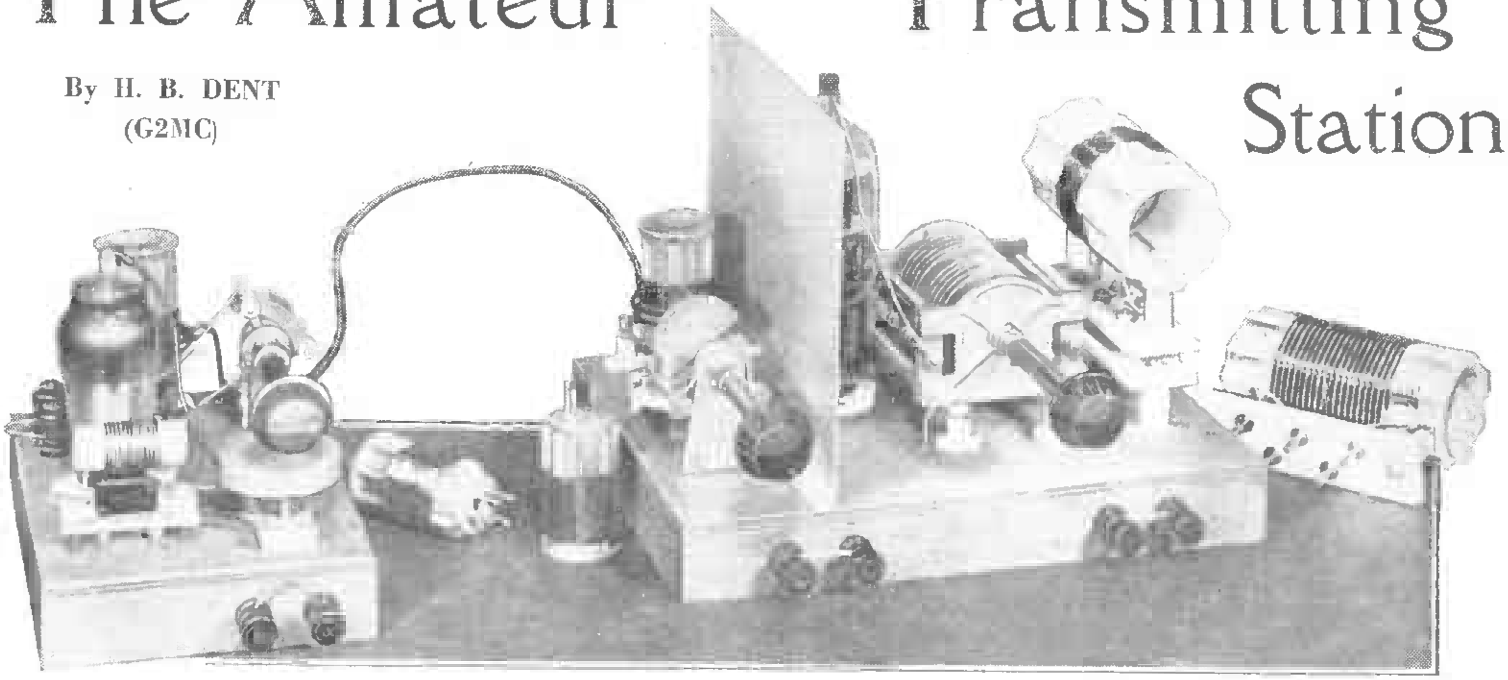
It must not be forgotten that these measurements must be taken under conditions where no stray effects can be introduced. It is well known, for example, that the interference can be picked up by telephone and telegraph wires and carried some distance and re-radiated on to the receiving aerial, but this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

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

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

The Amateur Transmitting Station

By H. B. DENT
(G2MC)



Part V.—Constructing and Adjusting the Power Amplifier

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

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

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

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

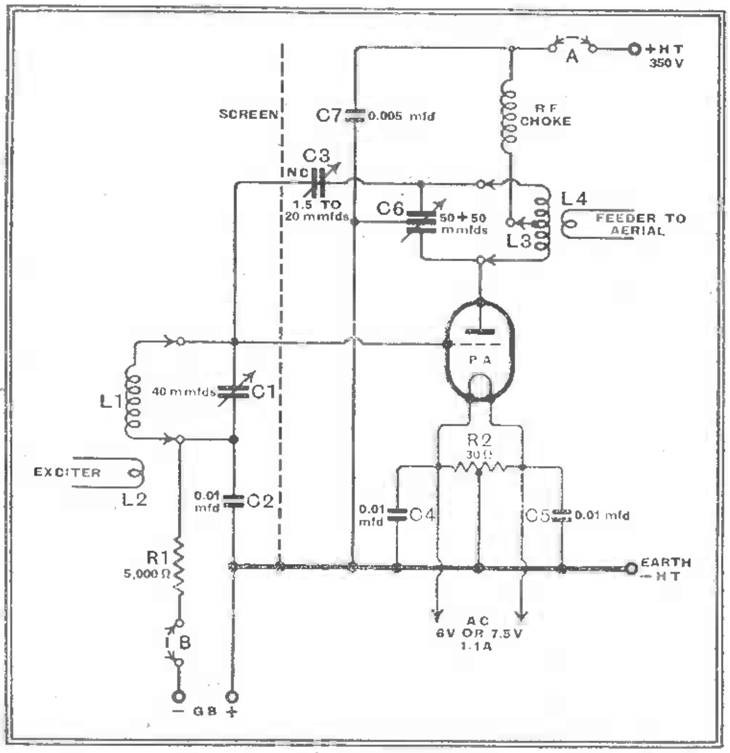


Fig. 11.—Theoretical circuit of the power amplifier. The neutralising condenser C3 must be proof against short circuits and capable of withstanding the full HT voltage.

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

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

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

Grid Bias Arrangements

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

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

The Amateur Transmitting Station—

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

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

For the 42-metre coil, 20 turns of No. 14 enam. wire are employed, while for the 21-metre coil 8 turns of the same gauge wire are required.

Though there are holes in the lower part of the former at every alternate groove it is well nigh impossible to thread the thick wire through them and bring it out again and down to the plugs on the sub-base. At least, the writer found it to be so.

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

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

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

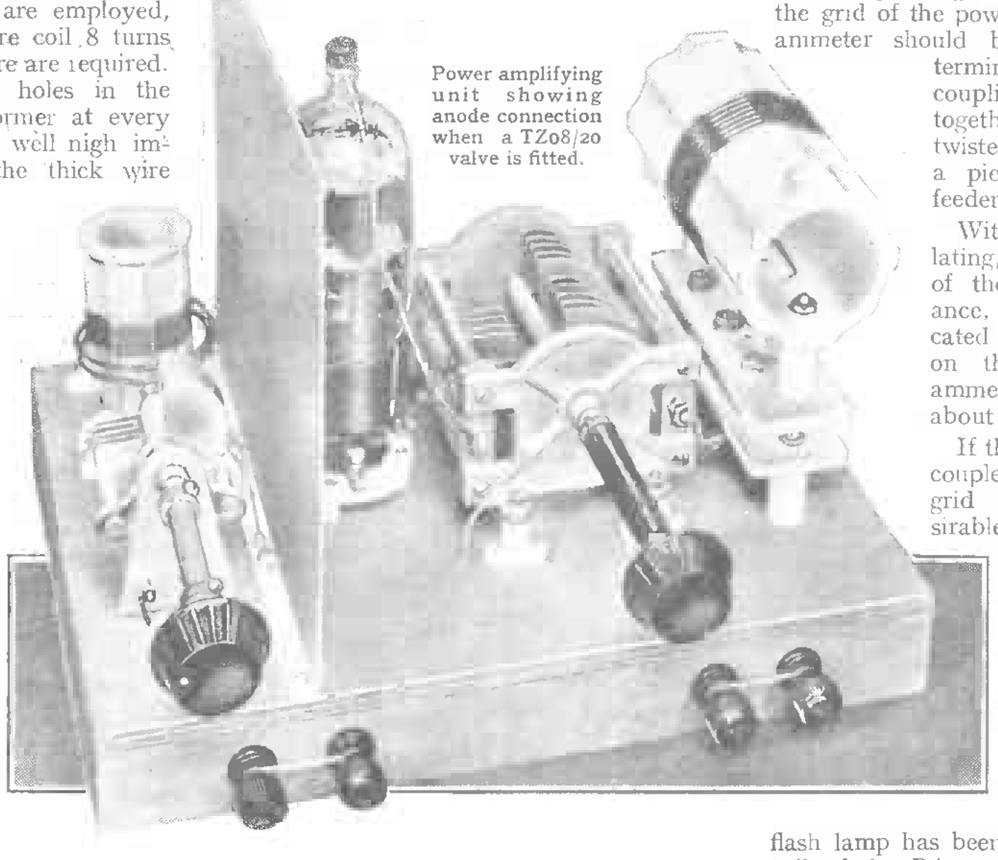
With 10 watts input the anode current will be about 30 mA under normal conditions of operation, but bearing in mind future requirements a meter capable of recording up to 75 mA at least should be obtained.

Multi-Purpose Meter

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

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

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



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

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

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

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

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

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

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

The Amateur Transmitting Station—

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

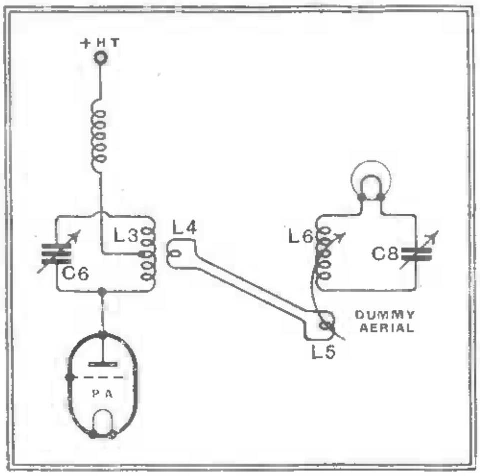


Fig. 12.—Method of coupling the PA anode circuit to a dummy aerial, using a low-impedance link (twisted flex).

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

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

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

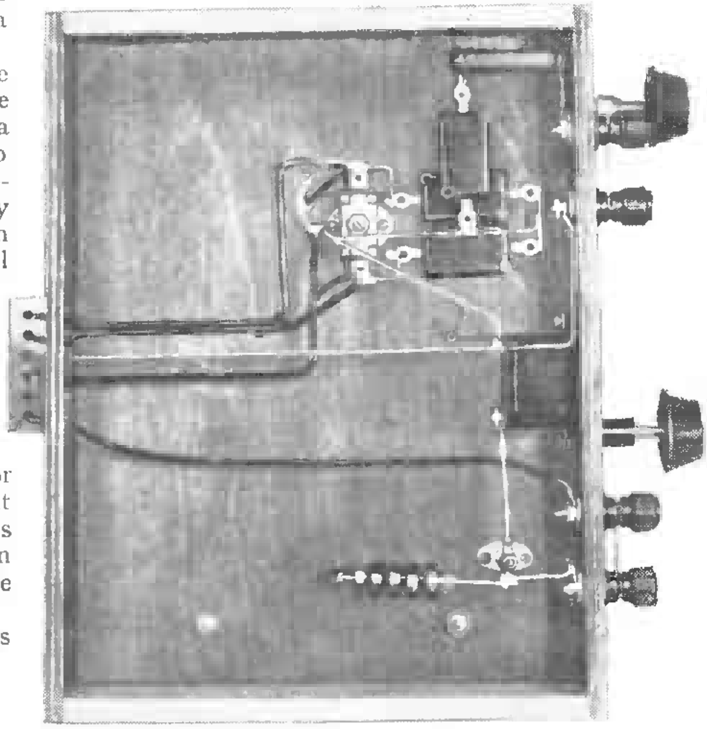
Anode dissipation is the difference between the power applied to the anode and the power taken out by the load. Thus if we apply 10 watts to the anode and draw 5 watts of RF for the aerial, the anode dissipation is 5 watts. Now both the TZ05/20 and the TZ08/20 have an anode dissipation rating of 20 watts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

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

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

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

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



The arrangement of the components housed underneath the baseboard.

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

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

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

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

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

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

LIST OF PARTS REQUIRED

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

UNBIASED

A Case for Legislation

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

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

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

An acidulous spinster.

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

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

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

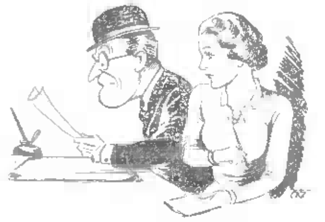
By
FREE GRID

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

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

One for Henry Farrad

IT has always been one of the guiding principles of my life to give even the devil his due, and consequently when I received a letter the other day from a friend up North, in which he somewhat



A letter from a friend.

bitterly anathematised the manufacturer of a certain anti-static aerial, which he declared to be a dud, I at once constituted myself as counsel for the defence, and informed him that it was much more likely that it was the maker of the set who was deserving of censure.

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

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

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

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

NEWS OF THE WEEK

B.B.C. FOREIGN SERVICE

Revised Schedules and Staff Reorganisation

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

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

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

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

U.S. GOVERNMENT STATION

Plan for Latin American Transmissions

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

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

TELEVISION CAMPAIGN LAUNCHED

Hopes for a Nation-wide Service

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

A Nation-wide Service

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

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

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

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

Transatlantic Sales Contest

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

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

C.B.S. EXPERIMENTS

High-frequency Broadcasts in America

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

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

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

B.B.C. STAFF AND NATIONAL SERVICE

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

BROADCASTING IN WAR

Confiscated Wireless Sets in Barcelona

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

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

P.A. AT THE WORLD'S FAIR

Three-Thousand-Watt Output

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

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

News of the Week—

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

EDUCATIONAL BROADCASTS

The Position in India

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

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

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

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

STUDIO ON SPRINGS

Hollywood's Room Within a Room

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

INDIAN ADVISORY COMMITTEE

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

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

THE MOST POPULAR NEWS BULLETIN

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

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

FROM ALL QUARTERS

Amateurs in Czecho-Slovakia

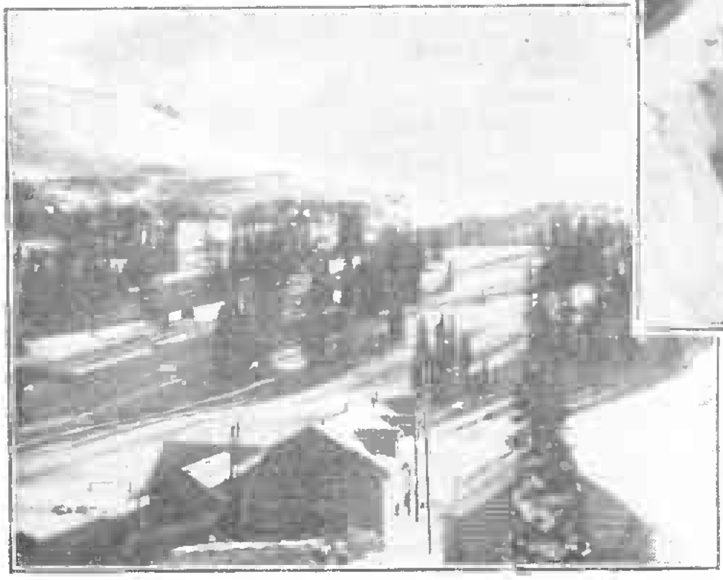
ABOUT two hundred amateur wireless operators in Czecho-Slovakia, who were licensed before October 10th, 1938, have been granted permission to recommence their transmissions. The authorities, however, are not prepared to issue new licences.

News from China

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

Newfoundland and Broadcasting

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



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

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

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

Peak Listening Hours

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

Out of Action

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

Station at Yarmouth

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

Landing in Fog

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

Television Receiver Tax

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

Denmark Halves Licence Fee

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

Interference Permanently Waived

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

Receiving Conditions in the Arctic

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

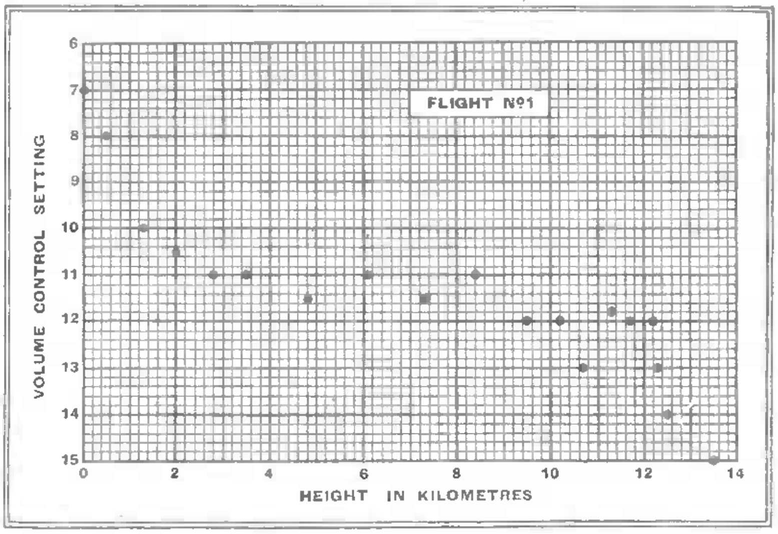
By I. M. HUNTER

A BRIEF SUMMARY OF RADIO RESULTS OBTAINED BY THE WORDIE EXPEDITION

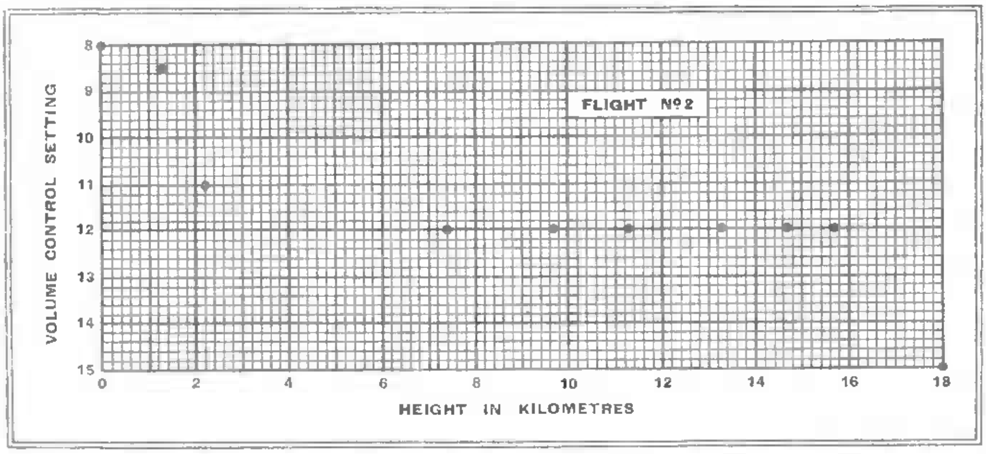
IN the summer of 1937 Mr. J. M. Wordie, of Cambridge, led a scientific expedition to West Greenland. One of the objects of this expedition was to examine the variation with altitude of the cosmic radiation near the geomagnetic pole, and for this purpose automatic radio transmitting apparatus was sent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

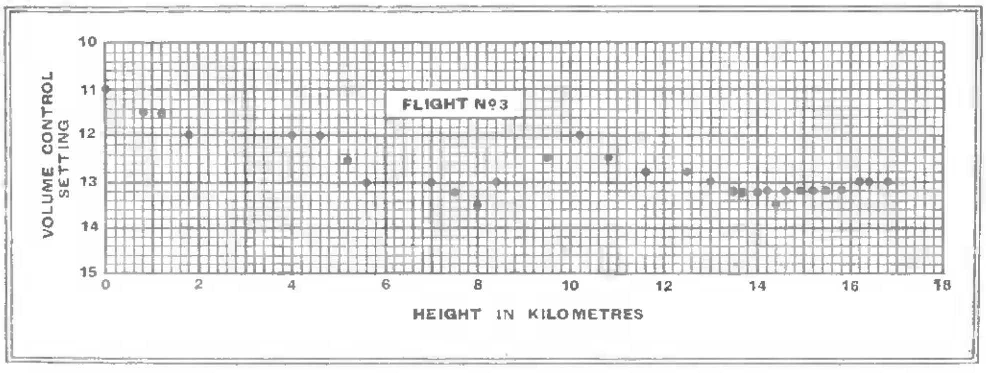
A fuller account of the development and use of the apparatus has already appeared in this journal,[1] but a short description may be advisable here. The apparatus consisted of a number of Geiger-Müller counters whose output was arranged to modulate a radio transmitter operating on 40 megacycles, the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

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



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





Observation of signal strength from three typical balloon ascents.

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

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

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

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

Receiving Conditions in the Arctic—

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

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

Effect of Low-level Layers

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

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

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

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

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

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

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

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

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

Television Programmes

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

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

THURSDAY, FEBRUARY 2nd.

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

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

FRIDAY, FEBRUARY 3rd.

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

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

SATURDAY, FEBRUARY 4th.

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

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

SUNDAY, FEBRUARY 5th.

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

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

MONDAY, FEBRUARY 6th.

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

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

TUESDAY, FEBRUARY 7th

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

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

WEDNESDAY, FEBRUARY 8th.

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

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

HENRY FARRAD'S SOLUTION

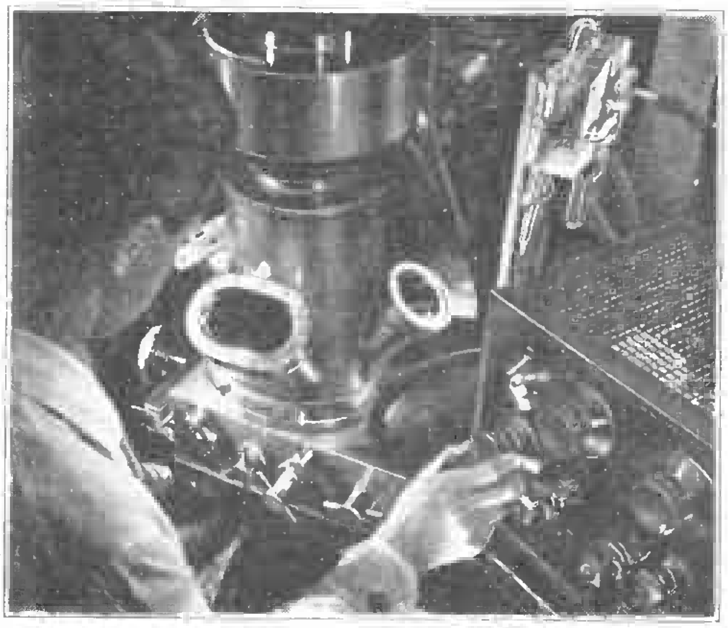
(See page 102)

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

The Cathode Ray Microscope

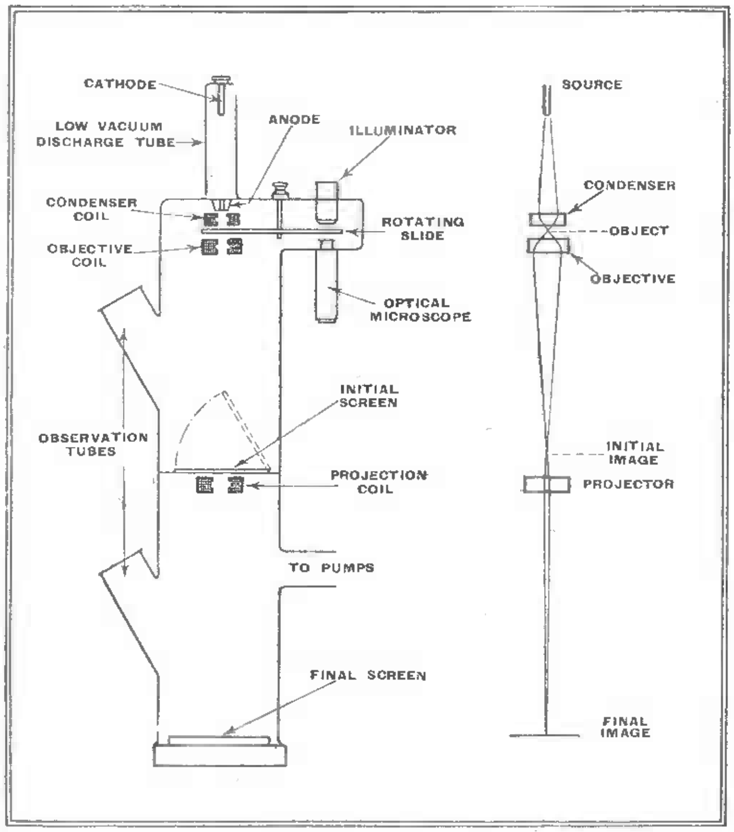
OUR TECHNIQUE INVADES THE WORLD OF OPTICS

By "CATHODE RAY"



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

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



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

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

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

Greater Resolving Power

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

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

The Cathode Ray Microscope—

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

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

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

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

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

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

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

The European Wavelength Conference

PROPOSED MEDIUM- AND LONG-WAVE ALTERATIONS

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

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

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

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

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

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

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

The European Wavelength Conference—

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

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

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

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

The bulk of the shared wavelengths, which are of considerably less importance from an international point of view, are suggested to be distributed as follows:—

France 16, Germany 11, Russia 11, Italy 10, Spain 10, Norway 9, Great Britain 8, Poland 6, Belgium 4.

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

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

WANDERING WAVE.

Letters to the Editor

The Editor does not necessarily endorse the opinions of his correspondents

Ignition Interference

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

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

Purley. J. M. SELLORS.

Television Transmissions

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

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

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

R. POLLOCK.

N. Wembley, Middlesex.

Non-removable Valves

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

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

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

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

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

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

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

C. GORDON.

Short-range Fading

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

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

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

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

The effect is purely night fading.

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

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

London, S.W.16.

THREE NEW COSSOR RECEIVERS

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

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

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

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

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

Scott "Phantom"

A COMPREHENSIVE CIRCUIT SPECIFICATION IN AN EXCEPTIONALLY WELL FINISHED CHASSIS

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

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

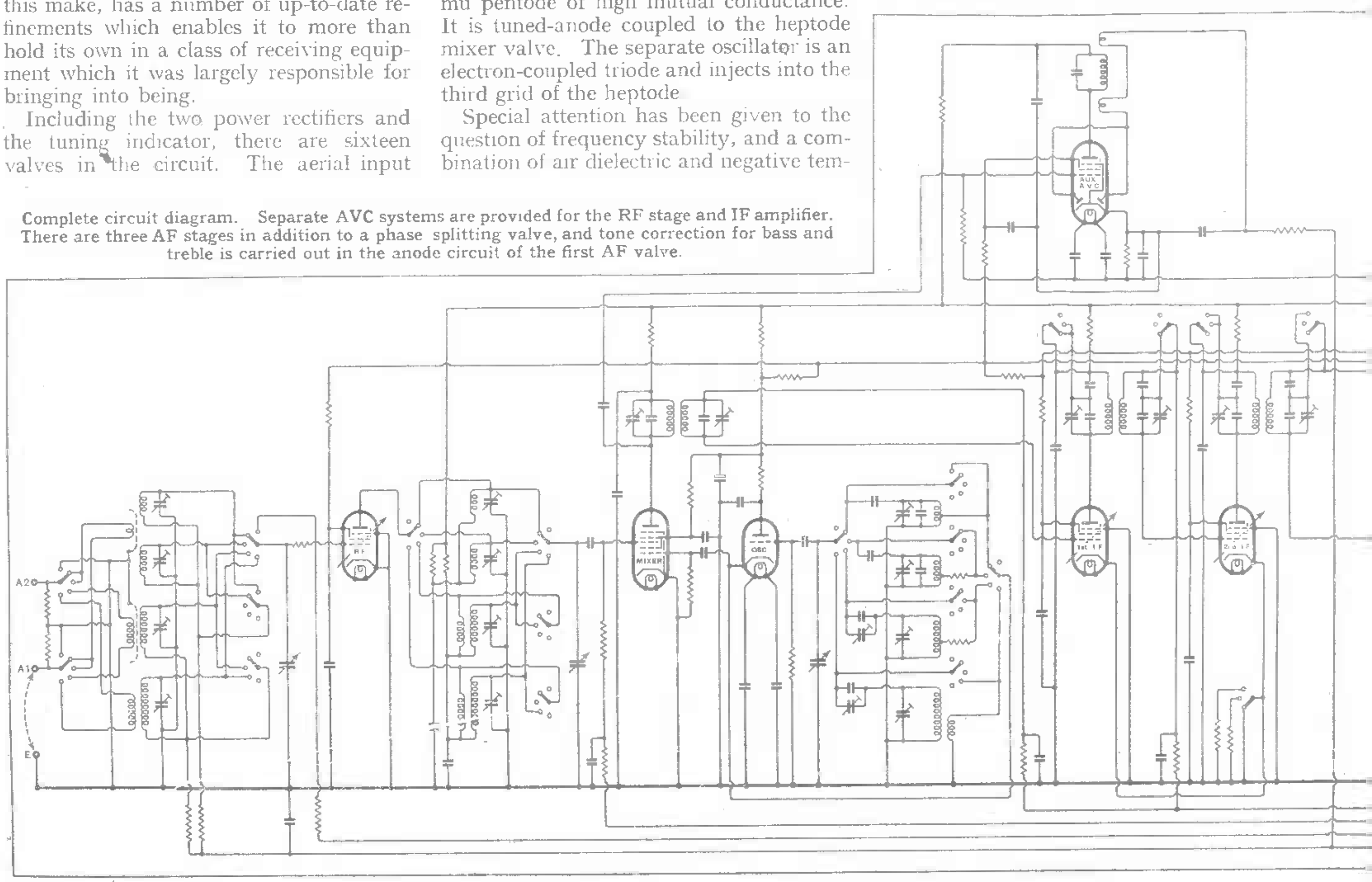
The latest model, while retaining all the qualities of range, selectivity and power output which have been associated with this make, has a number of up-to-date refinements which enables it to more than hold its own in a class of receiving equipment which it was largely responsible for bringing into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

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

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

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

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



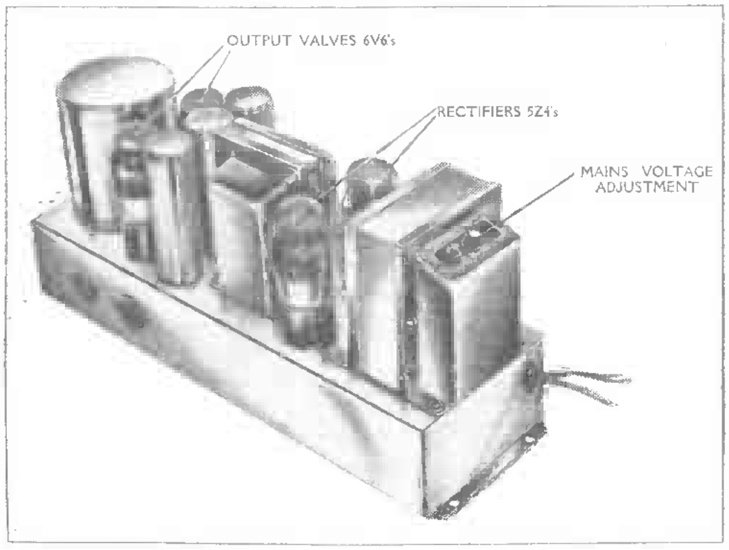
Complete circuit diagram. Separate AVC systems are provided for the RF stage and IF amplifier. There are three AF stages in addition to a phase splitting valve, and tone correction for bass and treble is carried out in the anode circuit of the first AF valve.

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

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

The total trimming capacity in the IF circuits is large, so that the alignment is not seriously affected by changing valves. High circuit efficiency is ensured by the use of stranded wire in the coils and large-diameter (3½ inch) screening cans. Decoupling is provided for each circuit and a high overall gain is achieved with stability. The overall gain is not appreciably disturbed by changes in selectivity, as the standing bias in the two IF valves is automatically adjusted by contacts in the selectivity switch assembly.

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



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

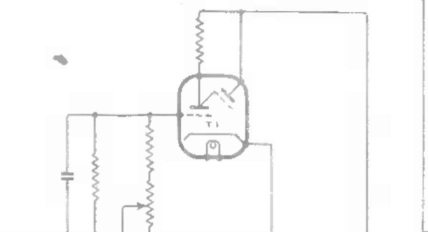
After rectification by one of the diodes associated with the third IF stage the signal passes through a tone-compensated volume control to the first AF amplifier, which is a pentode with a double resonant choke system in the anode circuit. Separate damping resistances are provided for each circuit, so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

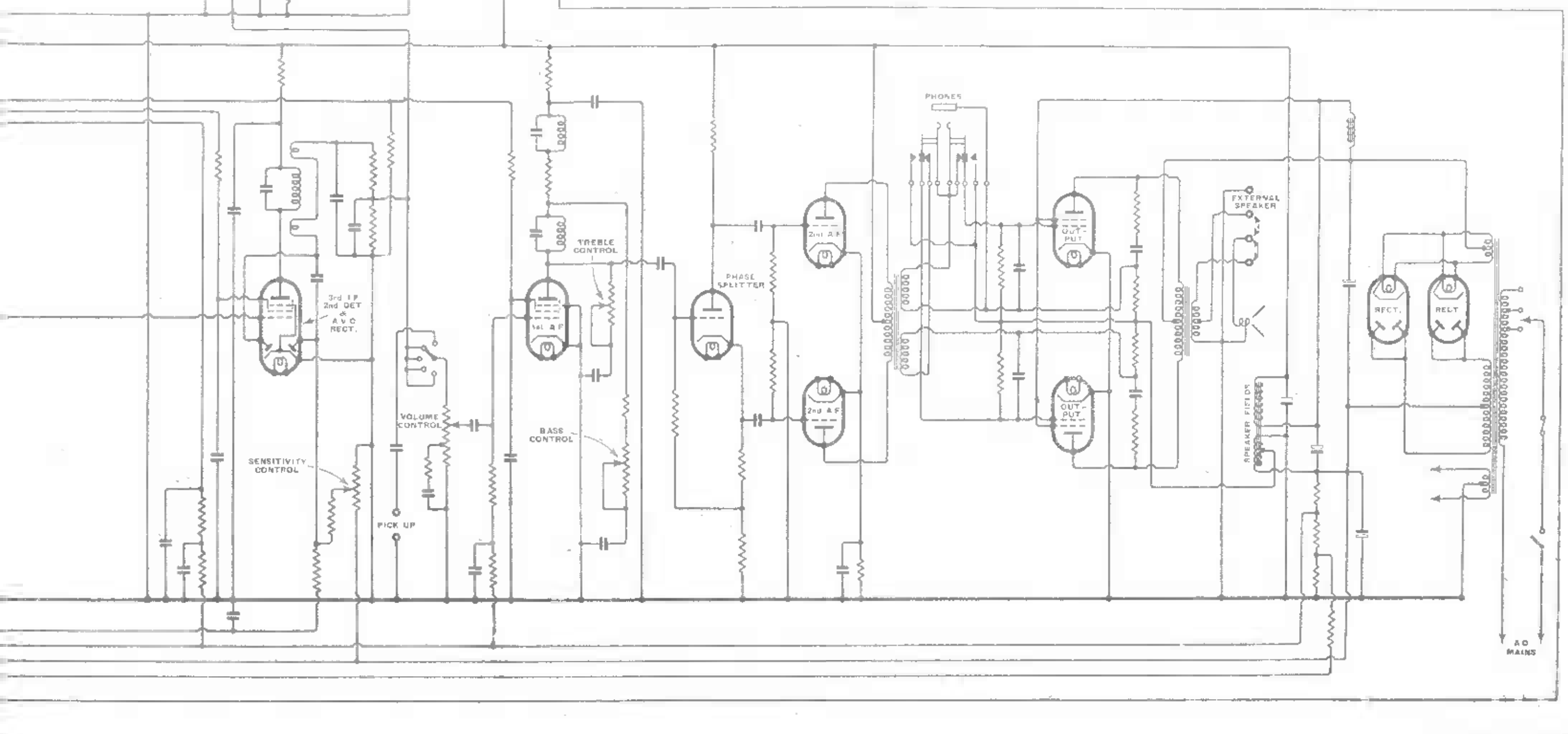
A triode phase-inverting valve feeds the second AF stage proper, which consists of two more triodes in push-pull. These are coupled to the output valves through a transformer with split secondary, and both bias and negative feed-back are applied separately to each valve. There is provision for connecting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

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

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

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

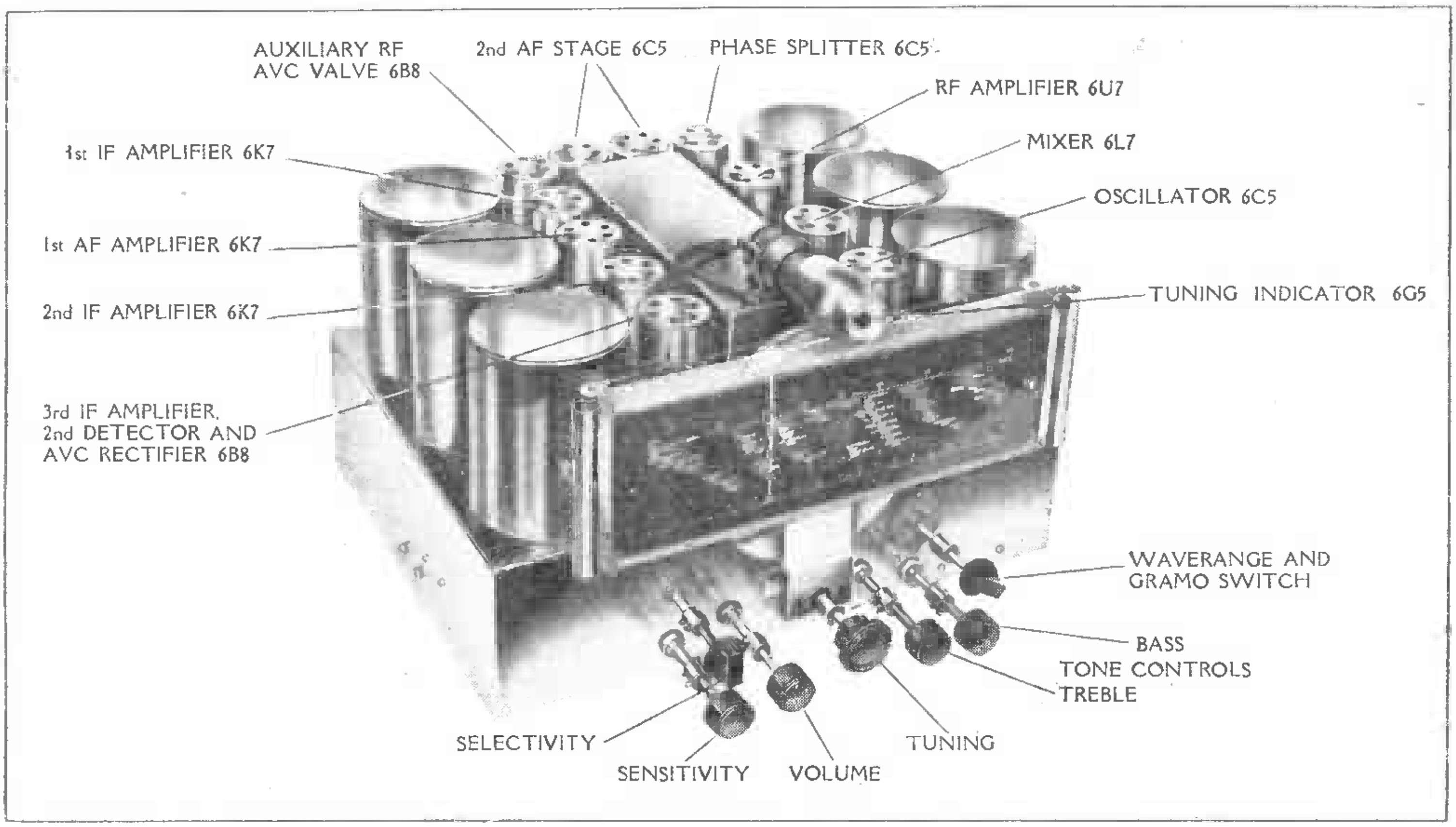




Scott "Phantom"—

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

This is a set which amply justifies the



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

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

High Selectivity

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

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

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

Background Noise

With the aerial disconnected there is no direct pick up in the set at any wavelength and the background is silent over about three-quarters of the volume range. In the last quarter valve hiss is apparent, but under working conditions it is rarely pos- use of so many valves and one which is very pleasant to handle. In the matter of AVC control and selectivity it is a receiver of outstanding merit.

"Designing a Filament Transformer"

A CORRECTION

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

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

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

Frequency-Changing Problems—

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

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

Hexode-type Valves

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

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

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

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

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

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

Random Radiations

By "DIALLIST"

Major Armstrong's Scheme

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

Transatlantic Expectations

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

Conditions Different

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

A Wiser Policy

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

Hard Lines

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

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

Spoonerisms

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

Communication Receivers

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

Better Tuning Wanted

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

What We Miss

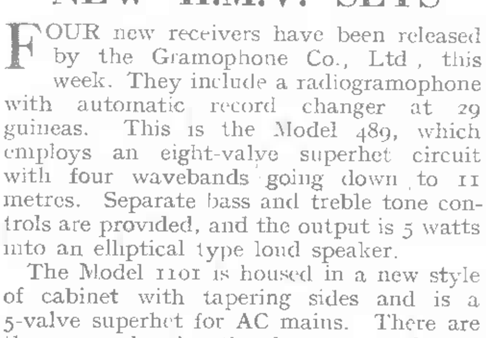
That's just one example of the good things that listeners are missing because of the low price of receiving sets. To introduce band-spreading costs money, and though it would treble the attractiveness of the short-wave range of the "all-wave" receiver, it can't be done if every penny has to be considered.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

NEW H.M.V. SETS

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

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

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



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

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

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

Club News

Croydon Radio Society

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

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

South London and District Radio Transmitters' Society

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

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

Slough and District Short-Wave Club

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

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

Midland Amateur Radio Society

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

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

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

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

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

Radio, Physical and Television Society

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

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

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

PRINCIPAL BROADCASTING STATIONS OF EUROPE

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

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

Recent Inventions

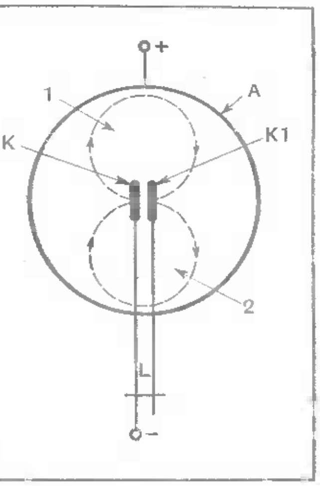
Brief descriptions of the more interesting radio devices and improvements issued as patents will be included in this section

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.

SECONDARY-EMISSION "OSCILLATORS"

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

As shown in the Figure, two



Oscillation generator depending on secondary emission.

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

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

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

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REMOTE CONTROL FOR LOUD SPEAKERS

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

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

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

o o o o

PRODUCING TELEVISION SIGNALS

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

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

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

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

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AUTOMATIC "HOMING"

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

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

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

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RADIO BEACONS

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

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

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

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

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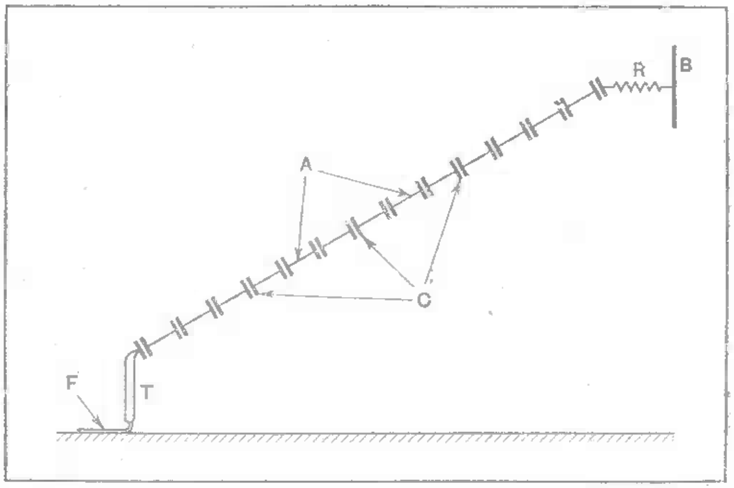
SHORT-WAVE AERIALS

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



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

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

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

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HIGH-FREQUENCY OSCILLATORS

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

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

Recent Inventions—

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

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

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DIRECTION FINDERS

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

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

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

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SECONDARY-EMISSION MULTIPLIERS

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

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

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

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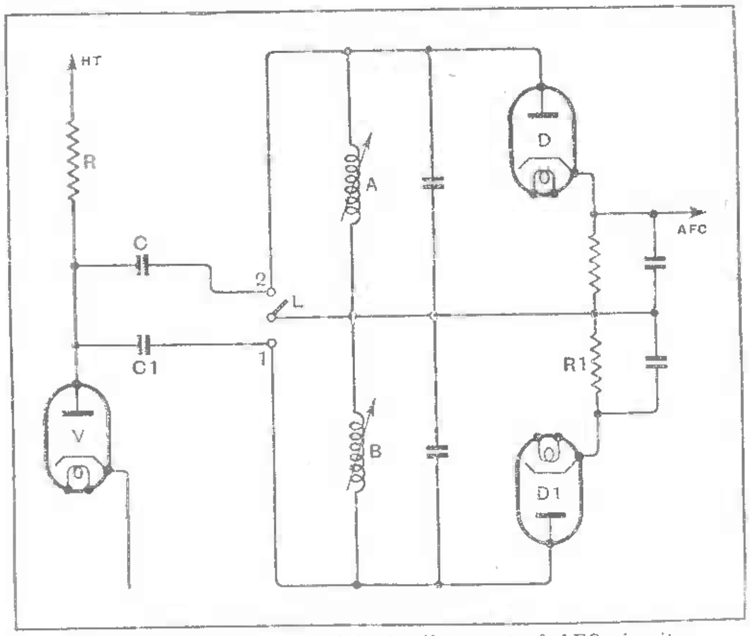
AUTOMATIC TUNING CONTROL

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

As shown in the Figure, the anode of one of the IF valves V of a superhet receiver is connected to the HT supply through a resistance R, and is coupled to the two discriminator circuits A, B, through condensers C, C1. When assembling the set the movable connection L is first placed on the contact 1 as shown, and the two circuits A, B, are then tuned exactly to the IF frequency. The



Method of facilitating the initial adjustment of AFC circuits.

connection L is next moved over to the contact 2, the tuning of both circuits thus being altered by equal and opposite amounts. The connection L is then permanently soldered in position. The required AFC voltage is taken off, as shown, from the load resistance R1 of the diodes D, D1.

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

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FIDELITY CONTROL IN TELEVISION

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

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

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

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

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RADIOGONIOMETERS

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

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

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

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

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ELECTRON CAMERAS

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

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

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

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AVC DISTORTION

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

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

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

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"ANTI-FADING" AERIALS

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

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

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

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

NATIONAL WIRELESS REGISTER

THE MINISTRY OF LABOUR is issuing a booklet giving the details of various services which are essential for the defence of our country, and is asking members of the public to volunteer their services so that the whole efforts of the country may be rightly directed. Every individual can then be put to that task for which he is most fitted by previous training. A large percentage of readers of "THE WIRELESS WORLD" possess technical qualifications which in many cases have been acquired from years of training and practical experience. In the event of a state of emergency arising, the defence services of the country will have a great need of wireless operators, teleprinter operators, and technical personnel capable of caring for and repairing wireless and light electrical apparatus. During the Great War the needs of the Services for operators were largely met, especially during the early stages by the voluntary enlistment of trained Post Office operators, but as Morse is no longer used in the Post Office, this possible source of supply is rapidly dwindling. It is therefore imperative that all our readers who have at least a good working knowledge of Morse or have other qualifications such as ability to service and repair wireless and electrical apparatus, should apply to help fill the vacancies which now exist in the R.N.V.(W.)R., the Royal Corps of Signals, T.A., and the R.A.F.C.W.R.

Such applications will enable much valuable time to be saved and will facilitate volunteers being in their right position at the right moment if the necessity arises.

Readers who are not at present in a position to volunteer in the above-mentioned Services are asked to complete the Questionnaire which is reproduced below, and post it without delay. From the answers to this Questionnaire a register of wireless experts who are willing to serve their country should an emergency arise will be compiled in conjunction with the Wireless Telegraphy Board. This Register will be regarded as confidential and the information contained therein will only be made available to the Defence Services.

1. Name in full (in capitals) ....
2. Permanent address ....

   ....
3. Age ....
4. State whether British by
   (1) Birth ....
   (2) Naturalised ....
   (If naturalised, state former nationality and date of naturalisation.)
5. Give particulars of any technical degrees or other recognised qualifications ....

   ....
6. In which of the following categories would you place your qualifications :—
   (1) Research and design of wireless apparatus ....
   (2) Servicing and tracing faults ....
   (3) Construction of apparatus from blueprints and designs ....
   (4) Wireless operating. State number of words per minute ....
   (5) Teleprinter operating ....
7. Have you a sound knowledge of wireless theory and the ability to read circuit diagrams? ....

   ....
8. Have you had war experience, if so, give brief details ....

   ....
9. Are you already liable for service with any Force or Organisation? (If so, state particulars) ....

   ....
10. Have you any preference for service in either the Navy, Army or Air Force? ....
11. Are you physically fit? ....
12. Present occupation ....

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On His Majesty's Service

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WIRELESS TELEGRAPHY BOARD,
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WHITEHALL,
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