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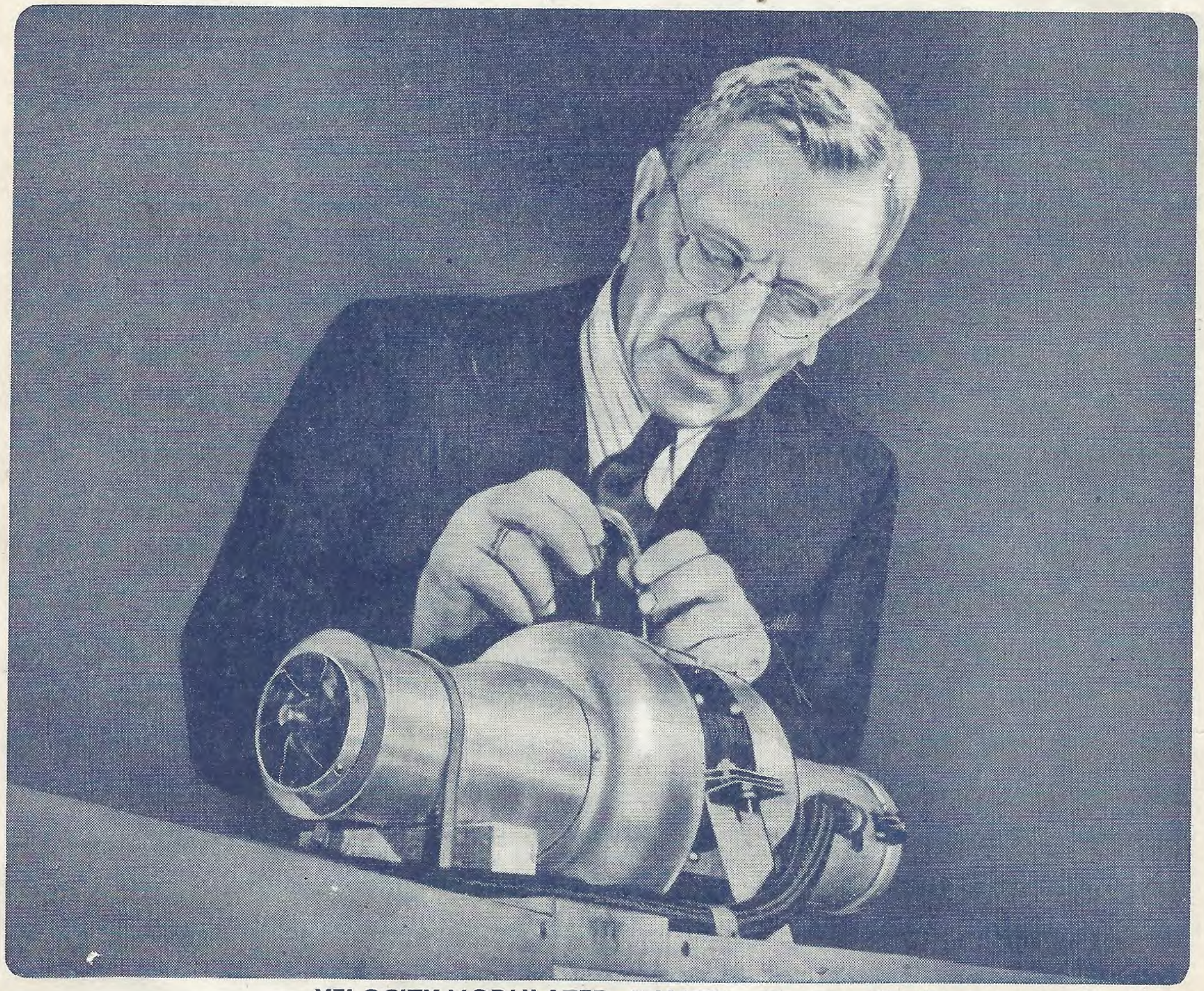

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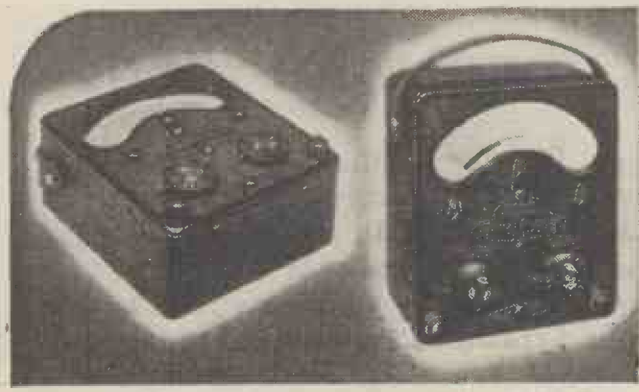

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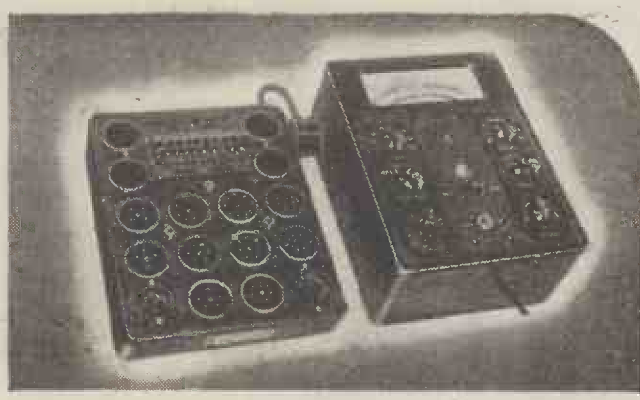

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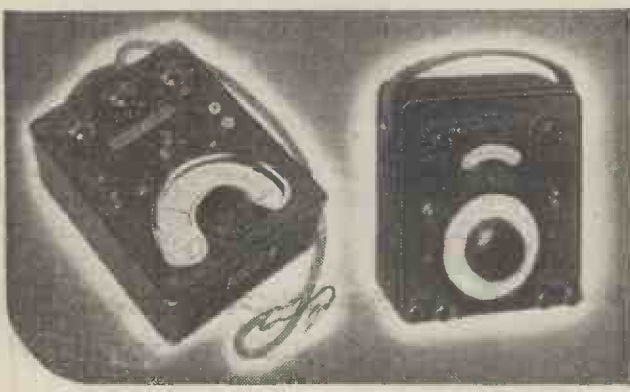

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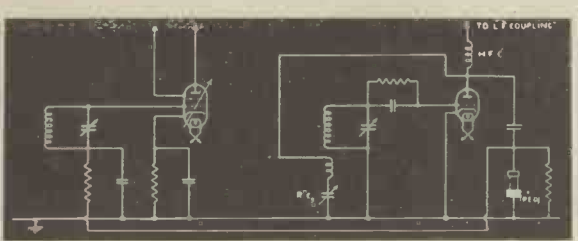

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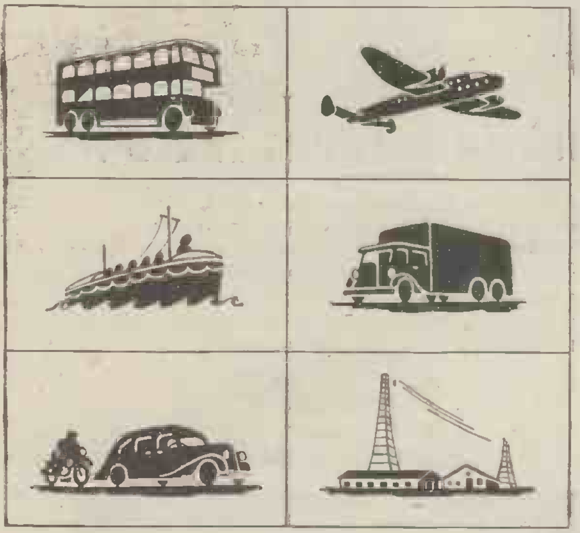

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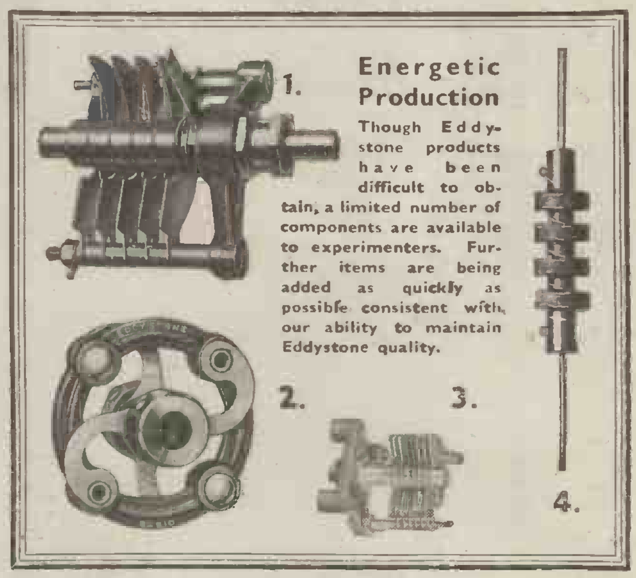

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The
Wireless World

COVERING EVERY WIRELESS INTEREST

ESTABLISHED 1911

Vol. XLVII. No. 1072 — OCTOBER, 1941 — Price One Shilling

New-style Jamming

Imagination in Wireless Warfare

WRITING in last month's issue, we urged "fierce and stubborn resistance" to the continual spreading of Nazi broadcast tentacles across Europe. In particular, we supported Capt. Plugge's suggestion for the installation of new propaganda stations in localities more favourable for making the voice of Britain heard over the Continent.

But it is not enough merely to possess the means of putting down a good signal over the vast areas at present dominated by German-controlled broadcasting, where the natural advantages enjoyed by the enemy are such that the best we can do in this respect is far inferior to his own. We must see to it that the best possible use is made of our relatively weaker signals; the matter broadcast must compel attention, and, more important still, imagination must be used in devising technical means of minimising the handicaps under which we labour.

Dr. Goebbels Sees Red

Our Russian allies have given us a lead in both directions. It is hardly the function of this journal to comment on the generally admitted excellence of the Russian propaganda, which, by appealing to the simplest human emotions, must command a far wider audience than matter intended to appeal to the reason. What we are more concerned with is the successfully executed technical artifice which for many days turned Dr. Goebbels into the laughing stock of the whole world. As all readers will know, the Deutschlandsender transmissions for some time suffered from superimposed anti-Nazi interruptions generally believed to be (and, indeed, admitted by Germany to be) of Russian origin. So good technically was the method of superimposition that competent observers in this country thought at first that means had been found to tap into the modulation circuits of the German transmitter. Later it became evident that radio-frequency methods were being employed. At the time of writing, an apparently effective and, it must be admitted, quite an ingenious but simple antidote seems to have been found by the enemy, but not before an incalculable amount of harm has been done to his cause.

Technical Tactics

Here, surely, is an excellent example of one method of wireless counter-propaganda that lacks none of the elements necessary for undermining a top-heavy regime like that of the Nazis, which, lacking real foundations, must be particularly susceptible to such forms of attack. It solves all the difficulties that lie in the way of making the ordinary German listen to foreign broadcasts. No longer does the lack of sensitivity and selectivity of his *Volksempfänger* give automatic protection to his sensitive Aryan ears against pollution from the outside world. No longer need he fear that the penalties attaching to foreign listening can be applied to him; even Hitler must stop short at beheading millions of listeners.

It is unlikely that any conventional method of distributing wireless counter-propaganda can, in the geographical position occupied by Britain and her Allies, achieve the success that has been achieved by the method of interjection just described. Even if the German antidote to it proves fully effective, there are other means of achieving a similar result, and every possibility, technical and otherwise, must be exploited to the full. Admittedly, an antidote to any method will probably be found, but we must have more than one string to our bow. Wireless warfare must be unrestrained.

Velocity-Modulated Valves

Modern Trends in Tubes for Ultra-high-frequency Operation

IN this article it is proposed to trace the evolution of the velocity-modulated electron tube, commencing with the work of Heil and Heil in 1935.

Without going into the mathematical theory, it might be as well to consider the difference between "intensity modulation" as met with in the conventional valve, and "velocity modulation" as employed in the tubes of Heil and Heil, Hahn and Metcalf, and Varian and Varian.

The normal type of vacuum tube operates by virtue of intensity or current conduction modulation. That is to say, the *intensity* of the continuous current component always present in

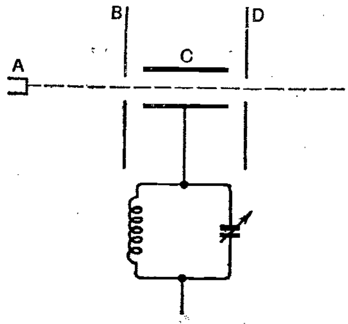


Fig. 1. Simplified sketch showing arrangement of electrodes in a velocity-modulated tube. The dotted line represents the electron path.

the valve under operating conditions is modulated or varied by the applied signal. As the term "velocity modulation" implies, the signal is employed to modulate the *speed* of the electrons in the valve.

An important point that should be kept in mind when considering velocity-modulated valves is that before the electron energy can be utilised the electrons have to be converted into an intensity-modulated beam. In other words, velocity modulation is employed because of its natural utility at very high frequencies, but intensity or conduction current modulation has to be introduced in order to make use of the advantages.

In a German article entitled "A New Method of Generating Short, Undamped Electromagnetic Waves of Great Intensity," by A. Arsenjewa Heil and O. Heil, published in *Zeitschrift fur Physik*, No. 95, 1935, are given details of a tube which was the forerunner of the modern velocity-modulated types.

Let us, firstly, consider the difficulties which have to be overcome in order to produce any considerable amounts of power at wavelengths in the region of 1 metre down to only a few centimetres. Two main difficulties exist: (1) Transit time considerations, and (2) electrode dimensioning.

The speed of the electrons is of such an order that the time they take to pass from one electrode to another (transmit time) is comparable with the period of oscillation of the valve at the high frequencies involved. At the very high frequencies this transmit time may even be greater than the oscillation period.

The second snag which is encountered is that, since the tube electrodes form the capacity of the oscillator circuit, they should be kept as small as possible. On the other hand, since heat is generated by energy loss from electrons upon impact, it is necessary to keep the dimensions of the electrodes large in order to dissipate such heat. It would appear from the above remarks that the generation of large amounts of power in the very short-wave region mentioned is quite impossible owing to these conflicting requirements.

Solving the Problems

The type of velocity modulated tube to be described overcomes these seemingly insurmountable difficulties. The underlying principle of operation is that the transit time of the electrons, instead of hindering the operation of the ultra-short-wave generator, is employed to control the electron current. The problems of keeping the capacity of the electrodes small and at the same time dissipating the heat generated by electron impact are solved by not allowing the electrons to impact. That is to say, the electrons do not reach the electrodes, being so directed that they pass through the oscillating electrode, energy being drawn out of the electron stream during this passage.

An idea of the electrode arrangement of the original Heil tube can be obtained from Fig. 1. A is the cathode, B the first accelerating electrode, C an electrode in the form of an open-ended cylinder, so providing, in effect, a "Faraday cage," and D the second accelerating electrode. Electrode C, being the oscillating electrode, is connected to the oscillatory circuit, as shown in the figure.

The electrode B is at a positive potential with respect to the cathode A. B is also directly connected to D, so that both electrodes are at the same potential with respect to A. The method of collection may be observed from Fig. 2. On the extreme right of the diagram can be seen a set of electrodes E, F, G, H, arranged obliquely with respect to the beam, the electrodes being of plate form with a hole at the centre. It is arranged that the potentials applied to these electrodes are more negative with respect to each other along the direction taken by the stream of electrons.

The operation of this generator is given by the inventors as follows: The electrons comprising the beam are accelerated towards electrode B, which is at a positive potential. As will be realised, on reaching electrode B the electrons will be retarded. After retardation, they pass into the oscillating electrode C. On passing through C they come under the influence of the second accelerating electrode C, which, as already stated, is at the same potential as B, so that once more the electrons are subject to a similar accelerating influence. The emerging electron stream, which is still a velocity-modulated one, will now have to be converted into an intensity-modulated beam by successive retardation in the collecting arrangement depicted in Fig. 2.

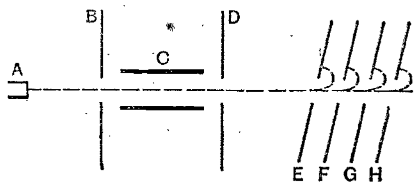
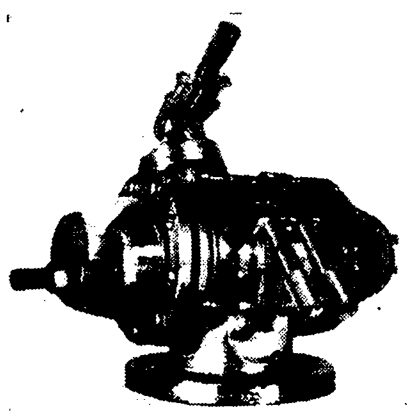


Fig. 2. Illustrating the operation of the tube.

Considering the device as a generator, imagine electrons passing through electrode B to the cage C. These form a current of negative electricity away from the cage, while the electrons inside the cage act as if they were actually on the metal of which it is composed. So much for the passage of the electrons into the cage. A control for the current is obtained from the length of time which the electrons remain inside the cage, which, of course, depends upon the velocity of the electrons; that is to say, on the potential of the cage at the time of entry.



Showing external appearance of a Klystron tube. The adjusting screws are for tuning the rhumbatrons by mechanically deforming them, and so altering their electrical characteristics.

Assuming that the oscillating circuit potential varies sinusoidally, then a cage of suitable length will ensure that slow electrons entering the cage in the negative half-cycle will in the majority of cases leave it in the succeeding positive half cycle, while at the same time the fast electrons in the positive half cycle will, by virtue of their velocity, be able to leave during the same half cycle. In this way it is arranged that in the positive half cycle there are a large number of electrons leaving the cage, while in the negative half cycle a large number of electrons are entering the cage. This collection of electrons results in a pulsating space charge generated within the cage which regenerates the oscillation. It is pointed out in the Heil and Heil paper that an indication of the energy supplied to the oscillating circuit may be obtained by calculation of the energy loss of individual electrons during one period, and adding them.

It is not proposed to enter into the mathematical analysis of this type of tube here, since it is rather involved, but it was shown by the originators of the tube that a maximum of 35 per cent. of the electron beam energy can be converted into oscillation energy, while the actual efficiency of the generator could be 100 per cent., since the electron beam can finally be stopped in the opposing field. It must be re-emphasised that this particular type of tube can only be considered as the forerunner of the modern successful velocity modulation tubes which have since been produced.

An example presented in the original paper will now be quoted—possibly rather an optimistic example—for the performance of the tube. Taking a tube in which a beam of 50 milliamps can be obtained and an accelerating electrode with a potential of 10,000 volts, the oscillating electrodes having a potential of 4,000 volts, the beam would be in the order of 400 watts, so that with an energy efficiency of 35 per cent. the output would be 140 watts. This is modified by a statement that in practice one could reckon on 25 per cent. efficiency, which would give an output of 120 watts, the length of the cage for a 20-cm. wavelength being about 5 mm.

The Klystron

The modern conception of the velocity modulated tube is the Klystron, invented by R. H. and F. Varian at the Stanford University, California, and described by them in the *Journal of Applied Physics*. The derivation of the name given to the tube is of interest, as also is the name of the resonators within the tube, in that a description of the action of the electrons is therein contained. Taking them in reverse order, from the Greek "rhumba," to oscillate rhythmically, we get the action of the electrons in the resonators, or "rhumbatrons," which form an integral part of the tube. Also from the Greek, the word "klyso," the breaking of waves on the beach, conveys an excellent impression of the manner in which electrons behave when they reach the second rhumbatron in the tube. It will be as well to mention, at this stage, the names given to the two rhumbatrons, namely the "buncher" for the one where the electrons are given velocities which results in the formation of bunches, and the "catcher" for the second, where the bunches arrive, and like the sea water, having been built up into waves, break and slow down.

The manner in which the Klystron works should not be difficult to understand, having considered the Heil and Heil tube. The same principles are employed of bringing the beam of electrons under the influence of a radio-frequency field, allowing them to drift and form themselves into bunches, and then abstracting power from the velocity-modulated beam. But in the Klystron, electrical resonators are employed instead of plain grids for the principal electrodes.

For a considerable number of years now the properties of electrical resonators have been well known. Much of the early work was done by J. J. Thomson in studying the nature of Hertzian waves, when he showed that the natural wave-length of a solid metal sphere was 1.4 times its diameter. Since that time, it has been proved that the natural wave-length of a hollow conducting sphere is 1.14 times its diameter. In using resonators through which electrons have to pass in tubes operating at very high radio frequencies, this figure shows that if the resonator were of spherical form a fast electron would not be able to pass through it before phase reversal took place. The Varian brothers designed a resonator which is of toroidal form. A fairly good idea of the shape can be formed by considering an inflated rubber balloon of spherical shape, held between the thumbs. The thumbs are then pressed in until they nearly meet, so leaving a distance between the walls of the balloon at this point which is considerably less than the diameter. In the Klystron resonators the grids through which the electron beam passes are situated at these closely adjacent re-entrant points, so that the electrons pass right through the resonator in a fraction of the change-of-phase time. Fig. 3 shows a cross-section of the resonator and position of the grids.

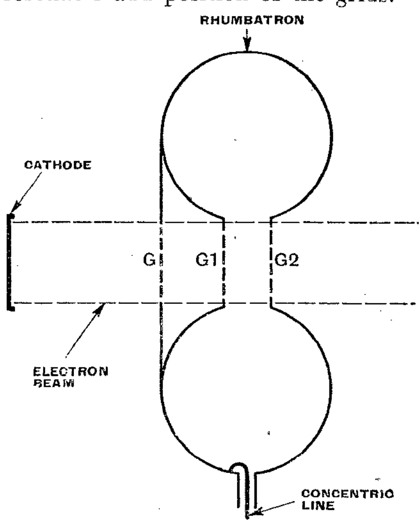


Fig. 3. Arrangement of cathode and first-stage (buncher) electrodes in a Klystron tube.

Let us now consider the operation of the Klystron as amplifier, oscillator, detector or modulator. Electrons, after leaving the plane cathode before enter-

Velocity-Modulated Valves—
ing the first rhumbatron or buncher, pass through a grid of tungsten wires G, the purpose of which is to ensure a parallel beam by straightening the lines of force of the electrostatic accelerating field between the cathode and the buncher. Having passed through this grid the electrons traverse the field-free space between it and the first buncher grid G1, which, like all the grids in both buncher and catcher, is of honeycomb construction. Radio-frequency energy, fed to the buncher via the concentric line seen in the diagram, causes the electrons to assume different velocities according to the phase and magnitude of the RF operating upon the buncher during the time of transit of the electrons. This can be readily appreciated after considering the Heil and Heil tube.

Fig. 4 shows the complete Klystron with the two rhumbatrons, the buncher and the catcher connected by a tube, the length of which forms a field-free drift space. (The final anode B and the oblique grid C are only to be considered when dealing with the tube as a detector, and are included in order to obviate the reproduction of diagrams that would be identical with the exception of these additions.)

We will now consider the Klystron as an amplifier. Having emerged from the final grid G2 of the buncher, the electrons enter the drift space, and by virtue of their different, but now unchanging, velocities form themselves into bunches, as in the tube described earlier, so that the beam is composed of layers of great electron density separated by comparatively rarefied spaces. The catcher rhumbatron is placed at a distance from the buncher where the maximum electron beam density due to the bunching takes place.

Let us consider the action of the second rhumbatron. In the buncher, changes in velocity of the electrons are achieved by giving energy to the electrons by exciting the resonator. If electrons were passed through a resonator with opposite phase relationship, they would be de-accelerated, and instead of taking energy from the resonator would give it up inductively. This is what happens in the second rhumbatron or catcher, which by virtue of the phase and strength of this oscillation takes from the electron beam more power than was originally given to the electrons at the buncher, so making the Klystron into an amplifier. It should be observed that what the catcher primarily acquires from the electron beam is power and not current, since the electrons may go on beyond the grids.

A further word must now be said regarding drive power given to the resonator. In the case of the buncher the radio-frequency signal is applied to it, this signal setting up oscillation at the natural frequency of the resonator. In the case of the catcher rhumbatron no external source of radio-frequency power is used for excitation. The passage of the bunched electron stream through the first grid induces charges on the metal, and so a pulsating current is induced in the resonator and oscillation is set up. This oscillation is used as described, to slow down the stream and abstract power from the electrons.

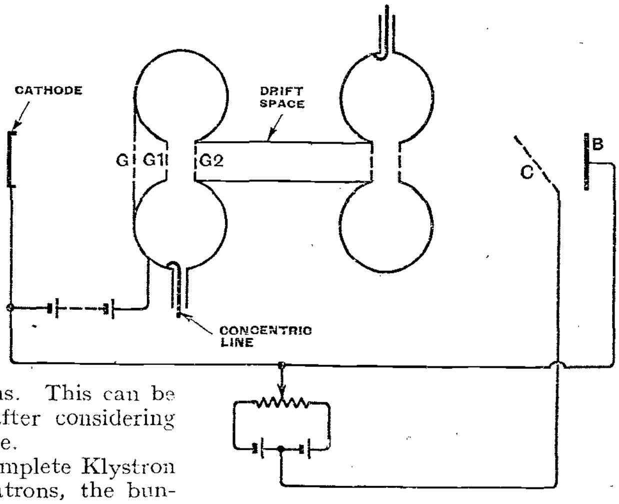


Fig. 4. The complete Klystron tube and its external circuit.

As an Oscillator

In using the Klystron as an amplifier, the buncher is driven by an external source of power, such as a radio signal from an aerial, the signal directly controlling the amount of bunching that takes place. When it is desired to employ the tube as an oscillator, the driving power for the buncher is derived from the oscillatory power in the catcher, a proportion of which is fed back; whereupon more concentrated bunching takes place, with a resultant increase in the induced field at the catcher, which is followed by still greater bunching influence when the proportion of the oscillatory power at the catcher is employed at the buncher. The only modification necessary to the Klystron in order to use it as an oscillator is that the concentric line used to feed the buncher, instead of being terminated for introducing external power, is connected directly to the catcher. This feed-back connection can be clearly seen in Fig. 5.

Reverting to Fig. 4, and this time taking the final anode and the obliquely inclined grid into consideration, we have the arrangement of the Klystron elements for use as a detector. In this case, use is made of the fact that, although a large majority of the electrons in the beam give up energy to the catcher, and therefore pass the last catcher grid with a decreased velocity, some of the electrons must pass through in the wrong portion of the cycle and therefore gain energy and speed. The oblique grid shown in the diagram is employed as a device for sorting electrons according to their velocities, the potential applied to it being near that of the cathode. With no signal input to the tube, almost all the electrons pass straight through the grid. In the presence of an applied signal, however, the electron beam undergoes a bunching action, the bunches resulting in the build-up by induction of a field in the catcher, this field causing some of the electrons to slow down to such an extent that they do not possess sufficient velocity to pass the collector grid, so causing a variation in the amount of current received by the collector anode. Another method of obtaining the same result is to apply a potential to the collector grid, of such magnitude that with no signal at the buncher, no electrons are able to pass through to the collector. Any increase, then, in electron velocity due to a signal being applied to the tube is sufficient to carry the electrons past

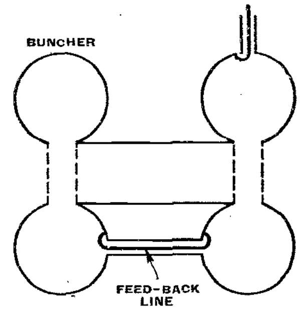


Fig. 5. Feed-back connection for converting the Klystron into an oscillator.

the grid and cause a current to flow to the anode.

It is possible to use the tube as a modulator by varying the beam current, or by varying the cathode potential, which causes corresponding variations in phase relationship.

Finally, it is proposed to set down the most important requisites for a Klystron oscillator and amplifier as given by Varian and Varian in their original paper. "For an amplifier: (1) Efficient resonators, such as rhumbatrons, with holes or grids permitting cathode rays to pass through them along the lines of force of their electric fields. (2) A beam of cathode rays going through both resonators and carrying power enough to make the catcher oscillate more powerfully than the buncher. For a Klystron oscillator the requirements are those of the amplifier, and in addition: (3) A coupling loop or some practical equivalent line feeding power from the catcher to the buncher. (4) A PD between the cathode and the rhumbatrons such that the bunches arriving at the catcher are not too far out of phase with the field within it."

[It is hoped to describe other velocity-modulated valves in a subsequent article.]

Standardised Condensers

More Efficient Production

THE issue of a new War Emergency British Standard Specification dealing with condensers for wireless receivers was mentioned in our last issue. The object is to increase the efficiency of receiver condenser manufacture by restricting the number of types to that considered sufficient to meet the normal requirements of the industry under wartime conditions.

The Specification provides for nine types of electrolytics, with working DC voltages ranging from 12 to 500 and capacities from 8 to 50 μF. Tubular paper condensers are divided into Types 1, 2 and 3, with rated DC working voltages of 250, 500 and 1,000 respectively. Eight capacity values, from 0.001 to 0.25 μF, are provided in each range.

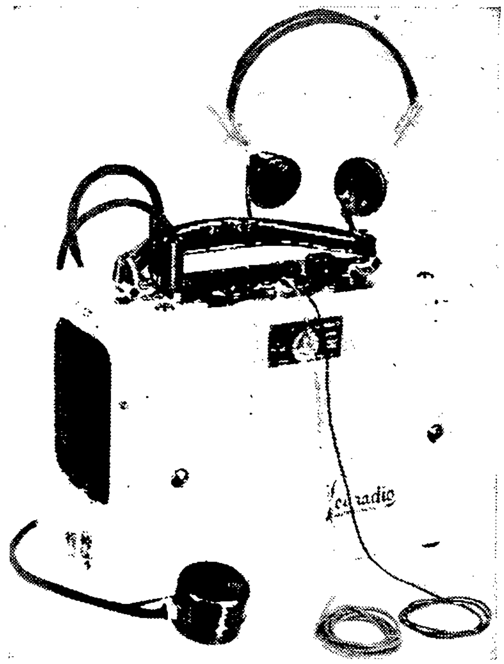
Methods of construction and dimensions of condensers are standardised, and the Specification includes an agreed colour code for indicating capacity values, etc.

Copies of the Specification (No. BS 271—1941) are obtainable from the British Standards Institution, 28, Victoria Street, London, S.W.1, for 2s. 3d. by post.

Aviation Portable

Novelty from the U.S.A.

COMPLETE coverage of the aeronautical and medium-wave broadcast frequencies in three bands is the outstanding feature of the "Learavian" portable recently marketed by Lear Avia, Inc., of New York. The portable, which may be operated from self-contained dry cells, or from AC or DC mains, covers the following wavebands: 195-410 kc/s and 2,200-6,300 kc/s (aeronautical, maritime DF, and meteorological), and 540-1,560 kc/s (broadcasting).



The control panel is mounted on the top of the portable. When the headphones are plugged in the loudspeaker is cut out.

An additional feature of this portable is that it incorporates an inter-communication 'phone system for which the only control is the microphone "press-to-talk" button.

In addition to its built-in frame aerial, provision is made for the use of an external aerial and earth, which would be necessary on board aircraft.

Housed in a case measuring 8½in. high, 12in. wide, and 6in. deep, the portable weighs only 14 lb. 3 oz. including the dry cells, which are of sufficient capacity for 200 hours' working. The cost, complete with batteries, but excluding microphone and headphones, is $44.95.

Valve Voltmeters

New Salford General Purpose Instruments

Salford Type BW218 valve voltmeter with vertical scale and (below) peak diode voltmeter Type BW211 for frequencies from 20 c/s to 200 Mc/s.

IN the Type BW218 valve voltmeter recently introduced by Salford Electrical Instruments, Ltd., Peel Works, Silk Street, Salford, 3, Lancs, the meter is provided with an easily read vertical scale, and the three ranges of 0-5, 0-25, and 0-100 volts are selected by a rotary switch. The instrument works from a 3-volt dry cell which is inserted through a removable finger button at the back. The input terminals are also at the back of the case, and the live terminal is insulated with low-loss ceramic material.

The Type BW211 is designed for a wider frequency range (20 c/s to 200 Mc/s), and consists of a probe type diode rectifier giving peak readings in association with a degenerative DC amplifier. There are five ranges with maxima of 1.5, 5, 15, 50, and 100 volts respectively, and the accuracy is ±2 per cent. of full scale on all ranges. The instrument is suitable for operation from AC mains 200-250 volts without adjustment.

The makers state that quick delivery can be given to high-priority orders.

Future of European Broadcasting

Some Technical Aspects of Channel Allocation

ON the face of it, there would appear to be no point in discussing the technical or any other aspects of the ill-fated and apparently still-born Montreux Plan, which the war prevented from being put into operation. Actually, this is not so, for whatever be the conditions in Europe after the war, this plan, or some modification of it, will have to be put into force as soon as possible after the conclusion of peace. This statement holds good even in the unthinkable event of Hitler winning the war and turning Europe into one country. The reason is that the necessity of the plan is dictated not only by the ever-increasing number and power of European stations but by the physical structure of the European continent and the laws governing wave propagation. These things are immutable, and even Hitler can do nothing to alter them.

For these reasons it will not be unprofitable to examine certain technical considerations associated with the Montreux Plan which are put forward in a recent issue of the *Journal des Telecommunications* by M. Raymond Braillard, the well-known chief of the Brussels checking station of the U.I.R. The technical aspects which he discusses will hold good after the war even though political considerations may call for some modification of the original plan.

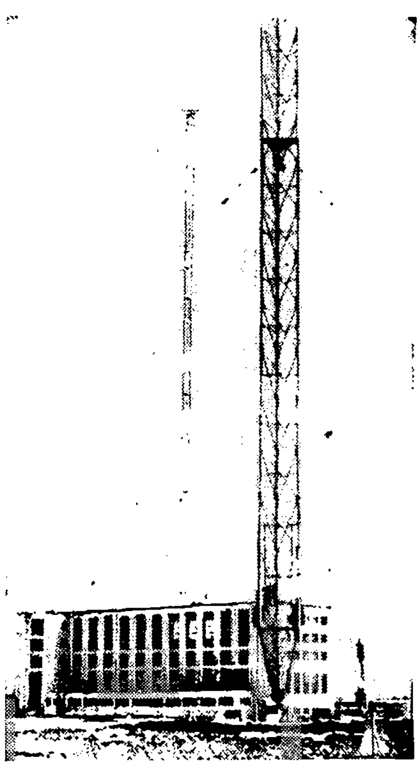
Synchronised Transmitters

It is common knowledge that the problem of avoiding mutual interference between European broadcasting stations has been steadily becoming more acute as the power and number of stations has risen. Probably at some future date frequency modulation or simple USW broadcasting may take a hand in solving the problem, but for the present the key to the puzzle is synchronisation and directional radiation, or "beam broadcasting" as it is sometimes called with a fine contradiction in terms.

Now it is quite easy on paper to cause any number of stations to share a common wavelength and radiate the same programme on it, but a tremendous amount of work has had to be done before it has become the practical proposition which it is to-day. The difficulty has been that, owing to various causes well known to wireless men, the carrier wave is apt to wander slightly from its allotted frequency.

Even with this problem of synchronisation solved, however, it would not be possible to allot the same frequency to stations radiating different programmes no matter how far apart they might be geographically within the confines of the European broadcasting zone. Even two stations of comparatively low power situated at opposite ends of Europe will interfere with each other at times by means of the indirect ray, as has been abundantly proved.

The solution here is directional radiation in the case of stations where geographical considerations permit. For instance, a station on the north coast of Africa has no need to radiate in a northerly direction over the sea as it has no listeners to serve there. Similarly, a station on the south coast of Finland has no need to radiate in a southerly direction. If, therefore, technical considerations permit—and they do permit—the northward and southward radiation of two stations situated as mentioned above may be respectively cut out, and the stations allotted a common frequency.



The anti-fading mast radiator of the Radio-Paris transmitter at Allouis.

In the Montreux Plan the obligation of using special aerials for directional radiation is imposed on 47 stations compared with 6 in the case of the Lucerne Plan. This ratio is, of course, at rock bottom, a measure of the increase in the congestion of the European ether, but it is also a measure of the technical progress that has been made since 1933 in the design of directional aerials.

Directional Radiation

There are three classes of directional aerial arrays which stations are called upon by the Plan to employ, the type varying in accordance with geographical and other considerations. The first class of aerial is known as a type D (directive), and is intended to give radiation of both ground and sky waves in one particular direction. The second, known as a P type (protégeant), is intended not so much to cause radiation in a certain direction as to stop it as far as possible along one particular direction where it would cause interference, this again applying both to ground and space waves. The third known as the R type (rayonnement indirect) is meant to stop radiation, in a certain direction, solely of the indirect wave, the ground wave being unaffected. This last known type of aerial is for use in districts where the broadcasting station is situated in the centre of its service area so that all-round radiation of the direct wave is required.

In order to remove all possible doubt as to the efficacy of directional aerials at great distances, the technical commission of the U.I.R. decided in January, 1939, to carry out certain tests to prove this point. The main object of the tests was to decide whether the polar diagram obtained in the neighbourhood of a directional aerial was maintained at a considerable distance from it. The results of the tests were very conclusive.

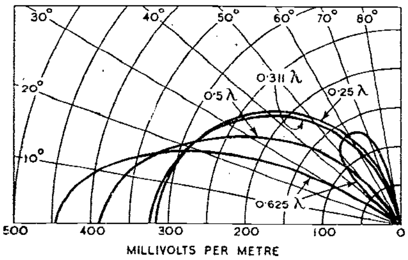
One of the tests was made in connection with the 50-kW stations at Baronowicze and Madona, both of which are situated in Eastern Europe some thousand miles from Brussels. The former station was fitted with an ordinary omni-directional aerial, the latter station having a mast radiator directed in an E.N.E. direction, or, in other words, away from Brussels, which was, therefore, in a "protected" area so far as Madona was concerned. It was found that the ratio between the strength of the fields of directional and non-directional aerials can be conservatively taken as five to one, which corresponds to a reduction of the power of the interfering station by a ratio of 25 : 1.

Special Aerial Systems

Let us now consider a concrete case, namely, that of the stations at Turku, in Finland, and Tunis, in North Africa, for which the Montreux plan made provision for the sharing of a common wavelength. They are situated some 1,700 miles apart, a distance which, with 100 kW in the aerial, would be totally inadequate to give freedom from mutual interference. Incidentally, it may be observed that with omni-directional aerials two stations of this power would have to be separated by at least 3,000 miles—an impossibility in Europe—if mutual interference were to be reduced to a negligible amount.

Using directional aerials, it would be possible for these stations to double their power to 200 kW and yet not interfere with each other to any but a negligible extent. Actually, the effect of using the directional aerial, so far as mutual interference is concerned, is that the apparent power of the interfering station is reduced to 4 kW. It should be particularly noticed that in the cases discussed we have been considering the use of the very simplest type of directional aerial, whereas, by the use of more complicated aerial systems, it is possible to concentrate a transmission in one direction or to check its radiation in several directions simultaneously.

Reference has already been made to the R type aerial, which is intended to cut out radiation of the sky wave in a certain direction without the direct ray being affected. M. Braillard points out that an aerial of this type is used at station WLW (Cincinnati), U.S.A. Adjoining an ordinary omni-directional aerial is a directional one from which the sky wave radiates at a predetermined angle. Some ten per cent. of the transmitter power is fed to this auxiliary aerial, and by suitable



When the height of the aerial reaches 0.625 of the wavelength used, space-wave radiation re-appears in force.

adjustment of the phase of its radiation as compared with that of the main aerial the strength of the space wave in the "screened" direction is reduced by 10 db.

Much useful information is also given by M. Braillard concerning the use of non-fading aerials, which, while not specifically laid down as compulsory in the Montreux Plan, are nevertheless strongly urged for the purpose of covering a given area with lower power, so enabling the number and power of transmitters to be reduced, and therefore helping greatly in the reduction of mutual interference. Best reception is obtained when the field strength of the sky wave does not exceed one-half that of the ground wave. The point where this ratio is exceeded marks the end of the primary reception zone of the station. Conditions worsen until the two field strengths are equal, after which the night-reception zone is entered upon, where the ground wave does not interfere and fading is due solely to the vagaries of the ionised layers.

It is obvious from the foregoing that if it is possible to design the aerial so that the field-strength of the direct ray is strengthened and at the same time that of the indirect ray weakened, the primary zone of reception can be greatly extended. This can be done by using a vertical mast radiator, the height of which is usually half the wavelength used. It has been shown that the radiation of the direct ray increases until one reaches the half-wavelength value, and although a greater height will cause further strengthening of the direct ray, the sky wave, which has hitherto been kept to negligible proportions, reappears in force.

Tests show that in certain cases the use of an anti-fading aerial doubles the apparent power of the station, one of the most remarkable instances of benefit being provided by the Beromunster station, where measurements of radiation reduction at certain angles have been made by apparatus installed in an aeroplane flying round the station at a constant altitude.

Some very remarkable figures are given concerning the high degree of frequency stabilisation which has been reached. Stations have been stabilised within limits far smaller than those laid down by the Montreux Plan. Some stations show particularly noteworthy results, an instance being furnished by the Gleiwitz-Reichenbach twin transmitters, which, during August, 1939, showed a maximum variation of five-hundredths of a cycle-per-second, the average daily variation being still less, namely, 0.03 c/s. It must not be forgotten that in the above figures are incorporated also the variations of the measuring instrument and the actual errors of measurement.

Frequency Stabilisation

It can be said that it is possible to obtain a degree of frequency stability of the order of one in a hundred million, a degree of accuracy which is equal to, if not better than, that obtained in the field of astronomical horology, and corresponds to a variation of about a thousandth part of a second in a period of 24 hours. It should, furthermore, be remembered that such accuracy is not obtained by any very complicated arrangement. It is due to the progress made in such things as the cutting of crystals, the adjustment of power supply voltages, and of temperature, which have enabled laboratory methods to be used under actual everyday working conditions.

In the case of the Gleiwitz-Reichenbach transmitters mentioned above, it is of interest to note that the synchronisation has been found to be so accurate that it is impossible to detect any appreciable difference in the frequency of the two transmitters. This means that the frequencies differ by an amount considerably smaller than one-hundredth of a c/s.

All the facts and figures given above refer to a period before the war came along with the inevitable intense concentration on regardless-of-expense research and development work. It certainly gives food for thought concerning the tremendous speed-up which the war is bound to bring about in technical progress, and the effect it will have on post-war European broadcasting.

Electrolytic Condenser Test Set

A Simple Capacity-measuring Bridge: Testing for Leakage

By F. A. BOYER, B.Sc. (Lond.)

THIS article describes a simple capacity bridge which can be used with the leakage measurer described in *The Wireless World* of December, 1940, and can be built up with it to form a complete test set for checking electrolytic condensers and measuring the capacity of paper condensers.

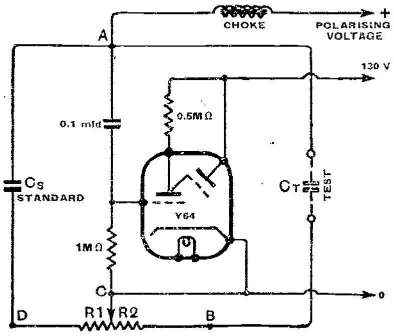


Fig. 1. Basic bridge circuit with cathode-ray indicator.

It is not intended to give precision readings of capacity, but it does enable one to see immediately if a condenser is good or whether it is a "dud," and so is particularly suited for rapidly checking condensers in workshops or service repair depots. Ordinary radio components are used in its construction, so the cost is very small.

Fig. 1 shows the basic circuit of the bridge, which is of a standard form. A potentiometer forms two limbs of the bridge, the other two being a standard condenser and the condenser under test. The AC testing signal is obtained from the mains via a transformer across points B and D, and an electron ray tuning indicator is used to determine the null position. This gives a visual indication, which is of great advantage in a noisy room, and, moreover, possesses the advantage that 50-cycle AC mains can be used as the testing signal, whereas using telephones would require the provision of a separate 1,000-cycle oscillator. The null indicator is between A and C, C being the moving arm of the potentiometer. By adjusting this arm a point of balance can be obtained to give minimum deflection on the indicator. When this occurs we get the equation: Impedance AB ÷ Impedance AD = Resistance BC ÷ Resistance CD, or $C_T = C_S \times \frac{R1}{R2}$. If the potentiometer grading is linear, the resistance is proportional to the percentage angular rotation and Fig. 2 shows a graph of capacity plotted against this percentage rotation. The law of this graph (which, incidentally, is that of a hyperbola) gives the effect of crowding the scale towards the end, which is just what is required, as we have the greatest accuracy for the smaller capacities.

Polarising voltage, which is essential when measuring electrolytic condensers, is applied across points A and C through a high-impedance choke.

Practical Details

The actual components used were chosen according to ~~what were~~ those at hand. The vital part is the potentiometer. This must be a high-grade wire-wound component. A carbon track resistance will give trouble owing to the polarising voltage passing through it. A suitable value is between 5,000 and 10,000 ohms. The standard condenser used was on ordinary 8-mfd. paper type, 500V DC working. This gives a working range from 0.1 to 50 mfds. Using a switch change-over to a 1-mfd. condenser the range could be extended down to 0.01 mfd. This extra switch was not incorporated in the actual instrument described, as it was intended only for testing high-capacity electrolytic or large paper condensers. The standard condenser must have a working DC voltage at least as high as the highest polarising voltage used.

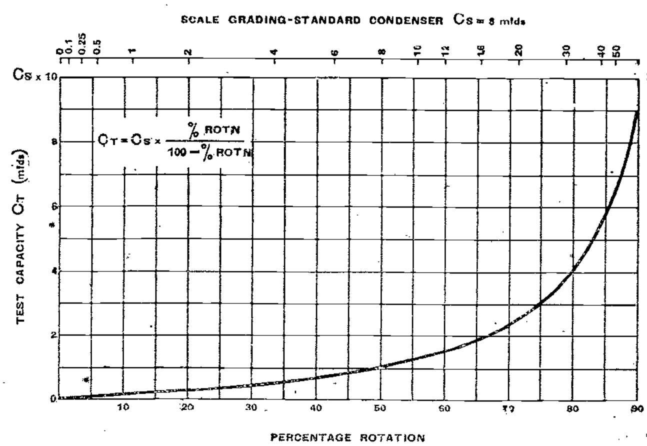


Fig. 2. Law of capacity against rotation of the bridge potentiometer.

The indicator is an Osram Y64 "Tuneray" indicator and is connected via a 0.1-mfd. 500V DC working condenser. The target operates at 130V, obtained from the power supply. The transformer giving the AC signal is an ordinary speaker transformer of ratio 18.2 : 1, which gives 12½ volts AC, which is ample to close the indicator.

The polarising voltage choke is the secondary of an AF transformer. When building the bridge it is advisable to check the effectiveness of this choke by testing a paper condenser, which requires no polarising voltage, and noting if the operation of the bridge is affected by shorting the end of the choke to earth. If so, a different AF transformer should be tried or two used in series.

The scale of the potentiometer is hand-calibrated. It can be calibrated by calculation, but the best way is to calibrate against good condensers. By connecting a few condensers in series and parallel the whole scale can be covered. Thus four 1-mfd. condensers can give readings for 0.25, 0.5, 1, 2, 3 and 4 mfds., and four 8-mfd. condensers can give readings for 2, 4, 8, 16, 24 and 32 mfds. The average of a number of readings for different condensers can be taken as the correct reading.

If a power pack is provided the bridge could be built as a separate unit. It was actually intended to be built in with the leakage measurer to make one compact test set. The whole set measures 10in. × 15in. × 6in. high, and is entirely self-contained. The switching is somewhat complicated, as it is necessary to switch the polarising voltage to either the bridge or the measurer. The complete circuit diagram is shown in Fig. 3, which gives all the switching details. So as not to add to the complications, separate "Tuneray" indicators are used. The switches used are ordinary radio switches which were adapted to make the necessary connections. A useful refinement [redacted] is the test condenser on-off switch, which discharges the condenser when switched to "off." It is convenient to mount the control knobs on top of a panel. The switches and controls are mounted below the panel, whilst the rest of the components are screwed to the base, inside the box, long flexible leads allowing the top panel to be wired and screwed in position. The tuning indicators are mounted vertically on the bottom of the box, and are viewed through light shields consisting of metal tubes, painted dull black, inside which the indicators are located.

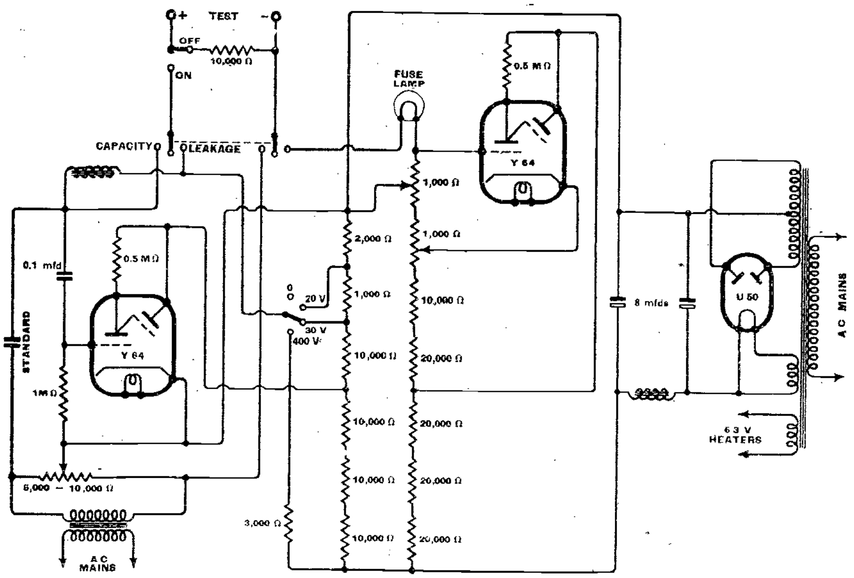


Fig. 3. Circuit diagram of the complete test set, showing switch change-over to the leakage indicator already described.

Foreign Journals

THE fact that very few of the foreign technical journals arriving in this country at the present time find their way into such "open" libraries as those at the Science Museum and the Patent Office makes the Abstracts and References section of *The Wireless Engineer* increasingly valuable to the engineer and research worker. This section of our sister journal, which in the September issue contains nearly 300 abstracts from, and references to, articles on wireless and allied subjects recently published in the world's technical journals, is compiled by the Radio Research Board. Some of the abstracts occupy more than a page, but the length is not necessarily a yardstick of the importance of the work concerned; the difficulty of language and the accessibility of the journal are determining factors.

In addition to the abstracts and references, a summary of recently accepted wireless patent specifications is given each month. The September issue, which was on sale on the first of the month, also contains a theoretical investigation of the time constants of DC amplified AVC circuits and the first of a series of articles on coupling circuits as bandpass filters.

The Wireless Engineer is obtainable to order through newsagents, or direct from the publishers at Dorset House, Stamford Street, London, S.E.1, at 2s 8d., including postage.

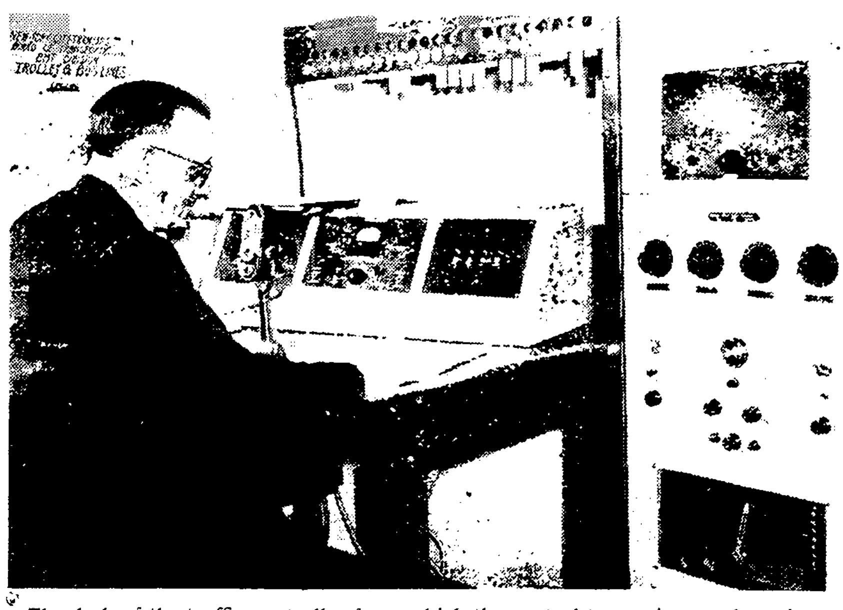
Traffic Control by Radio

New York's Two-way Communication System

A FLEET of twenty "petrol" cars equipped with Westinghouse transmitters and receivers has been brought into the service of the Brooklyn and Queen's Division of the New York Transit System to expedite the despatch of over a million passengers each day in the city's 1,235 tramcars and 300 buses. Ten of the patrol cars have 15-watt transmitters as well as receivers, whilst the remaining ten have receiving sets only.

The central transmitter has a power of 50 watts, with its aerial 240ft. above the street level. It works on a frequency of 31.46 Mc/s and is remotely controlled from the traffic controller's headquarters. All the car transmitters radiate on a frequency of 39.34 Mc/s.

The function of the cars, which carry emergency repair equipment, is to divert traffic to avoid congestion and consequent delay.



The desk of the traffic controller from which the central transmitter and receiver are remotely controlled.

Electrosurgery

Radio Technique in the Operating Theatre

By A. W. LAY, F.Inst.P.

(*Concluded from page 233 of the September issue*)

In the first part of this article the author dealt with the use of wireless technique in major operations. The application of radio principles in more delicate operations associated with the brain and the eyes are discussed in this instalment

IN contrast to cutting operations—when the ideal is to produce a white film of clotting on each side of the cut—frequently the abnormal tissue is of such a nature that the surgeon desires to destroy the diseased part by dehydrating it or, in other words, by drying it up. To accomplish this, discs are brought into contact with the tissue to be destroyed, and it is thus dehydrated *en masse* by intense local concentration of heat immediately under the disc. A temperature of 60 deg. C. to 100 deg. C. is necessary to dry out tissue completely, this being reached by using a current of very high density; it then spreads out through the body to a lower density when it is collected by the "earthing" plate mentioned earlier.

By using a metal disc of 2 centimetres diameter and applying a current of 4 amperes it is possible to dry up a volume of animal tissue 2 cms. diameter and 2 cms. deep in about 90 seconds. After applying the current for this period the tissue will be boiled dry and sparks will then appear over the edge of the disc; when this happens further drying is not possible. Tissue which has been dealt with in this matter forms a slough or dead area which gradually separates from the surrounding parts, and new tissue then fills the resulting cavity by the process known as granulation.

In order to provide sufficient current to meet the maximum requirement of this drying-out process, about 250 watts of energy should be delivered by the high-frequency equipment. This energy may be consumed as a heavy current at low voltage or as a weak current at a corresponding high voltage—depending upon the impedance in the path of the current.

Cosmetic Surgery

There is also a surgical technique known as electro-desiccation—or sometimes as fulgeration—in which a train of high-frequency sparks is made to impinge upon surgical wounds and surface abnormalities in order to dry them out. In this treatment there are two methods in use. One of these is known as the English and the other the American method.

The first of these uses a condenser couch upon which the patient reclines. Under this couch a plate is fixed and connected to one output terminal of the high-frequency generator. The other terminal is connected to the patient who, therefore, forms part of a condenser system of which neither plate is earthed. The patient's body is, therefore, electrically alive to earth, and sparks can thus be drawn from the region to be treated by advancing a needle-pointed electrode towards the tissue until the intervening air becomes ionised and sparks pass across the air space.

In the American method—which is finding increasing favour in this country—no couch is necessary, as the patient is connected to one terminal of the current source, this terminal being earthed. To the other terminal, which is the live or active terminal, is connected a cable at the end of which is an insulated handle into which is fitted a point. By bringing this close to the patient's body, a train of sparks is started.

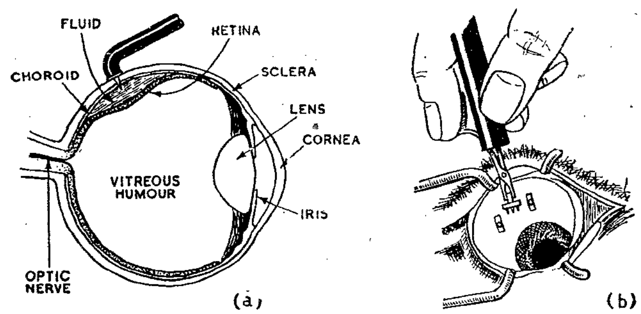


Fig. 3. A delicate eye operation. Fluid which has forced the retina away from the choroid is removed by piercing the latter by a high - frequency arc of suitable intensity.

The length of spark used depends on the nature of the abnormal tissue and the treatment. In general, sparks from about two to ten millimetres in length are used, and this naturally demands a high-voltage generator, although a high-frequency transformer across the output of standard equipments will serve the purpose.

In this form of treatment the current component of the energy is low, otherwise extensive clotting would be produced in a region where only superficial drying out is required. When a thin layer of tissue has been thus dried it becomes an insulator and the train of sparks tends to cease, but, by increasing the voltage, the sparks pierce this top layer and commence to dry out another layer. Alternatively, the distance between the point and the tissue may be reduced to produce approximately the same effect with a given voltage. Electro-desiccation is used extensively in "beauty treatment" with excellent results.

A very important application of high-frequency current for surgical purposes is in the field of urology. This necessitates cutting the tissue with high-frequency current under water; but full details and explanation of this technique are outside the scope of this article.

Yet another important application of high-frequency current is in the realm of ophthalmic surgery, where it is used for the correction of detachment of the retina. An operation for this becomes necessary owing to the accumulation of fluid between the retina and that part of the eye known as the choroid, as shown in Fig. 3. The object of the operation is to release the fluid and thus allow the retina to collapse back on to the choroid.

Until recent years this operation was exceedingly difficult, and rarely was a satisfactory result obtained. Now, however, owing to the development of a highly skilful technique by ophthalmic specialists, which makes use of high-frequency currents, very successful operations are performed in the following manner.

Small electrodes as shown in Fig. 4 are attached by means of a chuck to the operating handle, and when the surgeon is ready to operate, the electrodes are applied to that part of the eye known as the sclera, in the manner indicated in Fig. 3. The current is switched on for a very accurately timed period—just long enough for the points to pierce the sclera and choroid and to prevent bleeding. Upon withdrawal of the points the fluid drains away through the small holes thus created and the retina falls back upon the choroid. The slight local inflam-

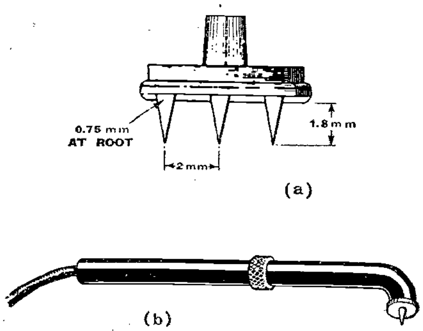


Fig. 4. The electrodes which are used to pierce part of the eye in order to remove fluid from the back of the retina.

mation caused by the operation promotes adhesion—thus assisting nature's healing process.

In the field of ophthalmic surgery many other delicate operations are performed very successfully by means of high-frequency currents. For successful work in this field it is essential that the surgeon shall have for his use a source of current of suitable characteristics which can be easily controlled to desired values very accurately; such equipment is now available, and it is being used with great success by specialist surgeons.

The Marconi - Ekco instrument, which has been developed for this purpose in close collaboration with ophthalmic specialists, is illustrated in an accompanying photograph. This instrument is known as the Therator Minor, Type MME3. Its control is simple and smooth.

By means of a graduated dial the output can be pre-set to meet the surgeon's requirement over a wide range of current values. This is continuously variable from zero to maximum output, which is 75 watts of high-frequency energy at 1,500 kc/s (200 metres). Fig. 5 gives an outline of the circuit used in this instrument. It has been fully approved by the surgeons who use it. The output from the instrument provides sufficient cutting current for major operations in general surgery when only cutting and slight clottings are desired.

When intense coagulating current, and current which will cut under water is required, then the Marconi-Ekco MME10 type of apparatus will provide the necessary output of current of suitable characteristics.

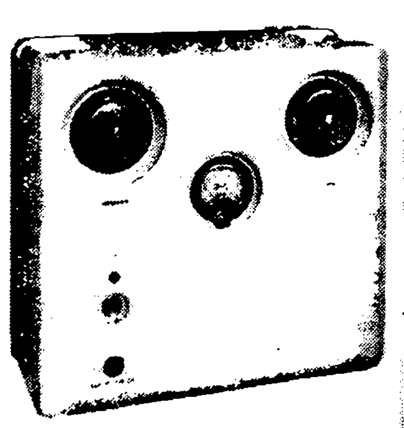
The MME3 instrument is designed to be compact, portable and robust. It is encased in aluminium, and the chassis is of this metal. Interference to radio communication is thus reduced to a minimum. This problem of interference with radio communication by medical apparatus is engaging the attention of the authorities concerned and a satisfactory solution is in sight. This solution will be applied when hospitals, clinics and other health services are provided with sufficient funds to undertake the recommendations made.

The type of apparatus used in ophthalmic surgery is suitable also for use in dermatology, or operations on the skin, and in cosmetic surgery. With this type of apparatus successful operations are being performed on skin carcinoma; also for the removal of warts, tumours, skin blemishes and hairs, and for the correction of other abnormalities with excellent results.

The Interference Problem

In the field of brain surgery this type of apparatus offers facilities for the accurate control of current, which is of paramount importance in work of this nature. A highly successful technique, involving the use of the hæmostatic—or blood-stopping—properties of high-frequency currents has been developed by specialist surgeons.

The more powerful type of apparatus, such as the MME10, is used extensively in general surgery, and in special fields—such as abdominal operations, amputations, cancer of the breast, diseases of the rectum, and other operations involving the necessity of extensive cutting and clotting.



The Marconi-Ekco valve generator. It is used largely in delicate operations associated with the eyes and brain.

In view of the handicaps which are at present imposed upon the medical profession, and the health services generally, when efforts are made to use high-frequency current for healing purposes, no doubt future legislation will balance the claims of health and entertainment in due proportion to the benefits which may accrue to the nation.

It is to be hoped that the architects of the new order will specify ample provision of funds for our hospital institutions and for research in order that medical science may be further advanced, and that the armamentarium of the surgeon may be at least comparable in quality with that of other national services.

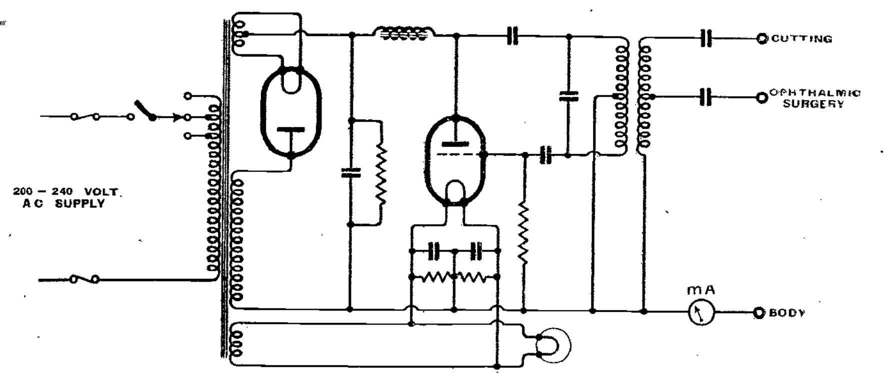


Fig. 5. The circuit diagram of the Marconi-Ekco valve generator. It provides an output of 75 watts at 1,500 kc/s. Apart from being used in ophthalmic and brain surgery it is also employed in cosmetic work for removing skin blemishes and superfluous hair.

THE WORLD OF WIRELESS

EUROPEAN LISTENERS

Some Interesting Facts and Figures

A SYNOPTIC chart showing the increase in the number of licences in the European Zone from 1938 to the end of 1940 has just been issued by the International Broadcasting Union. The chart also shows the increase or decrease in the number of receivers per 1,000 inhabitants in each country in the European zone which comprises Europe, Iceland, the regions of the Mediterranean basin and the U.S.S.R. as far east as 40 degrees.

The relatively small increase in the number of licences in the countries where broadcasting has been organised for some years points to the fact that they are nearing the point of saturation, whereas in countries where the development of broadcasting is more recent the increase is very considerable.

For the first time Sweden heads the countries of the European zone in the matter of receiver density, followed closely by Denmark, which for some years held first place. Sweden possesses 232 receivers per 1,000 inhabitants, and Denmark 225. Great Britain remains third with 198. Iceland, which has the smallest number of listeners, namely 18,261, is seventh on the receiver density chart, with 150 per 1,000. At the opposite end of the scale comes Turkey, which has only five receivers per 1,000 inhabitants. Italy has 1,400,000 licence holders, which represents only 31 per 1,000.

The international situation has been so fluid that some of the details tabulated are for June and July, 1940, whereas others are for December. The chart shows that Germany had 14,965,048 licensed listeners at the end of 1940. It does not, however, state whether this number includes Poland, for which no figures are given for 1940. The U.S.S.R. is second in the list with 10,551,361, and Great Britain, for which the figures quoted are those at June, 1940, is third with 9,132,200.

The approximate number of licensed listeners in the European zone at the end of 1940 was 49,336,000. This means that if there are, as estimated, four listeners in every family, the listening population is over 197 million.

The increase in the number of licence holders from the end of 1938 to December, 1940, was approximately 14,000,000.

HIGH-POWER STATIONS

Position in the United States

IT is foreseen by *Broadcasting* (Washington, D.C.) that the whole question of super-power broadcasting is likely to be reconsidered by the Federal Communications Committee as a result of the application of WLW, Cincinnati, for permission to use 650 kW regularly. Two other medium-wave stations—KSL, Salt Lake City, and WSM, Nashville—have applied for 500 kW.

WLW is the only station in the U.S.A. to have used 500 kW. Its permit, however, was cancelled over two years ago, and it now employs 50 kW, but is permitted to use 500 kW experimentally between the hours of midnight and 6 a.m. Those interested in logging medium-wave stations may like to know that during experimental transmissions WLW radiates on 700 kc/s. using the call letters W8XO.

WLW's application has been made as a result of a recent survey which revealed that such power was necessary to overcome atmospherics and give a serviceable signal in rural areas in the States of Ohio, Kentucky, W. Virginia, Tennessee and Arkansas.

The suggestion from the owners of WSM is that the rule governing high-power stations be altered to specify that all stations on clear channels should operate with a power of not less than 50 kW. At present 50 kW is the maximum.

E.M.I. AT SMYRNA FAIR

THE sole British exhibitor of wireless apparatus and gramophone records at the international fair at Smyrna, Turkey, where enemy and neutral countries were exhibiting, was Electric and Musical Industries. Not only were they exhibiting in the British pavilion, but they provided the public address equipment and the recordings for the music relayed throughout the fair. The transmission of the B.B.C.'s Turkish bulletin was rebroadcast in the British pavilion. The value of such an exhibit in one of the few remaining neutral countries must be inestimable. The receivers were shown by E.M.I., a specially designed range of mains and battery models for the oversea market.

ALBERT HALL ACOUSTICS

Modified for Promenade Concerts

THE artistic success of the recent Promenade concerts by Sir Henry Wood and the London Symphony Orchestra at the Royal Albert Hall was largely due to the work of Mr. Hope Bagenal, A.R.I.B.A., of the Building Research Station, Watford, in controlling the famous echo in this auditorium.

The problem was to get sufficient volume from a moderate-sized orchestra with an audience of 2,000 in an auditorium with seating capacity for 8,000.

Having observed the improved acoustics when large flags were hung from the roof and walls, it was decided to lower the velarium or canvas canopy to the floor level of the balcony. This cut off some of the echoes and reduced the size of the hall. The Denham studios of London Film Productions lent big screens which were placed behind the orchestra, thus producing a smaller hall inside a large one, which provided the necessary intimacy.

A wooden canopy over the platform was added, which prevented the sound from being lost in the dome. Finally, to reduce the effect of absorption of high notes by the air in this large auditorium, a polished parquet floor 30ft. by 10ft. was placed around the conductor's rostrum.

SETS FOR SEAFARERS

MORE than 7,000 receivers have been supplied since the beginning of the war to men of the Royal Navy working on small craft and at shore bases by the Admiralty War Comforts Committee. Those supplied for use afloat have to conform to certain Admiralty regulations, which stipulate that the receiver must be non-radiating.

The latest issue is of 500 Ever Ready All-Dry portables, the cost of which has been defrayed by the Minesweepers and Coastal Craft Fund, assisted by generous grants from the Navy League and the Nuffield Trust for the Armed Forces of the Crown. Repair depots at main bases are provided by the Committee for the servicing of the receivers.

Some of the sets for shore are unwanted receivers given by the general public. Any receiver so long as it is not archaic, will be gratefully received by the Comforts Committee.

MATERIALS IN U.S.A.

Steel Condensers : Polystyrene Film

ACCORDING to *Communications* (New York), one large American manufacturer claims complete success in using steel as a substitute for aluminium in the manufacture of variable condensers. Thanks, it is stated, to the use of a specially developed grade of soft steel, capacity drift and microphony are less troublesome than with aluminium, but cost and weight are rather greater.

Polystyrene low-loss insulating material has now been introduced by the Bakelite Corporation of U.S.A. in the form of a flexible film, 1 mil. thick, and may thus be used as a dielectric in small condensers.

Although the effect of shortages and control of material is being felt, the latest figures available would suggest that so far there has been no decline in the production of domestic broadcast receivers.

FROM ALL QUARTERS

Canadian Amateurs Serve

IN the section of *QST* devoted to activities of VE (Canadian) amateurs the writer states that at least 1,700 of the 3,380 licensed Canadian amateurs at the outbreak of war are now on active service. More than half the 1,700 are commissioned officers, the majority in the Royal Canadian Air Force. It should be pointed out that the total of 3,380 includes all ages, and every kind of physical condition.

B.B.C. News in English

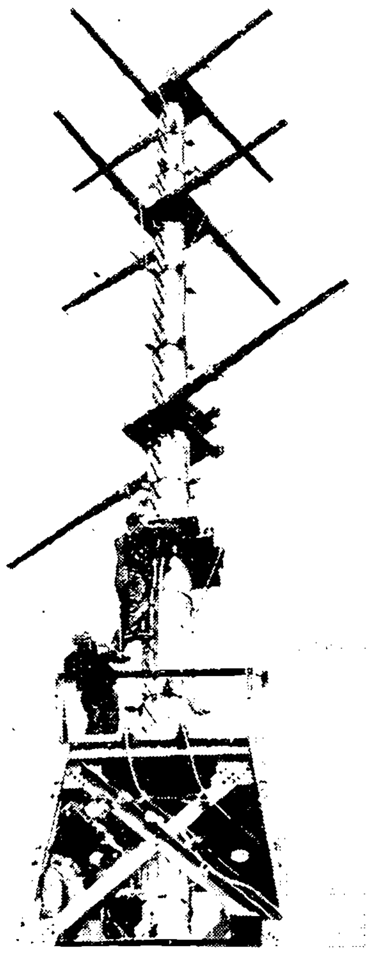
THE following schedule of the times (BST) and the wavelengths to be employed by the B.B.C. for the transmission of news in English in the European and World Services will be operating when this issue is published:

0100, 0145, 0530	31.32, 31.25, 25.53.
0715	31 55, 31.25, 25.53, 19.82, 19.66.
0900	49.59,* 41.49 * 31.55, 25.53, 25.38,* 25.29,* 19.82, 19.66, 19.60.
1200	31.25, 25.53, 19.82, 16.84, 16.77, 16.64, 13.97
1400	19.82, 16.84, 16.77, 16.64. 13.97
1430	49.59,* 41.49,* 25.38,* 25.29.*
1700	31.75, 25.53, 19.82, 16.84, 16.77, 13.92.
1900	31.25, 25.53, 24.92, 19.82, 19.66, 16.84.
2145	31.25, 25.53, 19.82, 19.60.
2300	49.59,* 41.49,* 30.96.*
2345	31.32, 31 25, 25.53.

Wavelengths marked with an asterisk are used in the European Service

Week-end Radio Course

PROVIDED sufficient enrolments have been received a week-end course in radio engineering has been arranged by the Northampton Polytechnic, St. John Street, London, E.C.1. Classes will be held on Saturdays, 2-4.30 p.m., and Sundays, 10 a.m.-4.30 p.m., from September 20th to December 21st.



Courtesy "Radio."

FM AERIAL on the top of Mount Washington, New Hampshire, U.S.A., for the Yankee network's frequency modulation station W39B. The three-bay turnstile aerial, which was built by Radio Engineering Laboratories, Long Island City, withstood the very severe weather of last winter without suffering any damage. W39B, which has been operating on 1 kW, is to have a new 10-kW R.E.L. transmitter.

U.S. Amateur Frequencies

As a result of proposals by the American Radio Relay League the U.S. Federal Communications Commission recently changed the portion of the 10-metre band allocated to the use of telephony from 28.5-30 Mc/s to 28.1-30 Mc/s. This means that all but the lowest 100 kc/s of the band may now be used for 'phone. The section of the amateur band from 29.25 Mc/s to 30 Mc/s has been opened to frequency modulation.

Procedure

"To assist in teaching the correct procedure" in wireless telephony, the War Office is issuing a set of gramophone records, comprising three discs, for each formation headquarters.

Brit. I.R.E.

IT is learned that negotiations are now in progress for the affiliation of the Australian Institution of Radio Engineers and the British Institution of Radio Engineers.

Dr. F. J. C. Van den Bosch will give a paper on the Augetron and its applications at the meeting of the London and Home Counties Section of the Brit. I.R.E. on October 25th at the Federation of British Industries, Tothill Street, London, S.W.1.

Farnsworth Honoured

AT its recent convention at Detroit the Institute of Radio Engineers presented the Morris Leibmann Memorial Prize for the year to Mr. Philo Farnsworth for his contributions in the field of electronics.

Flouting the Ether Patrol

FIFTEEN American amateurs recently had their transmitting licences suspended for a period of 60 days because they had violated the order of the Federal Communications Commission prohibiting communication with amateurs in foreign countries. No evidence of subversive activity was brought forward by the F.C.C. The suspensions were stated to be "exemplary of emergency requirements and demonstrate the futility of trying to flout the ether patrol."

Soviet's Radio Mine

IT was recently stated from the German broadcasting stations that the Russians are using a new type of land-mine which is detonated by short-wave transmissions from behind the retiring Russian forces.

Wright and Weaire

ON their appointment as directors of Messrs. Wright and Weaire, of London, N.17, Messrs. R. H. Fox and R. W. Merrick, who have been in the service of the company for many years, have assumed the offices of works director and sales director, respectively.

Salvage Drive

WE have been asked by the Ministry of Supply to draw readers' attention to the great salvage drive for waste paper which is being undertaken by the Salvage Department. The value of technical papers, however, should not be lost sight of, especially in view of the scarcity of some as a result of enemy action.

Pan-American Union

IT has been suggested by Mr. John Royal, vice-president of the N.B.C., during his visit to South America, that a Pan-American Radio Union, similar to the International Broadcasting Union of Geneva, should be instituted. He urged that it should be strictly non-commercial.

B.B.C. North American Director

THE B.B.C. has created a new post, that of North American Director, to which Mr. R. E. L. Wellington has been appointed. This post is additional to that of North American Representative, which is held by Mr. Gerald Cock, who was, until the outbreak of war, B.B.C. director of television. Mr. Wellington, who has for some time been seconded

The World of Wireles—

to the Ministry of Information, has held various administrative posts in the B.B.C.

Gear for Sea Scouts: An Appeal

CONDENSERS, resistances, metal rectifiers, wire, morse keys or any other similar wireless equipment adaptable to signal purposes that can be spared by readers would be welcomed by the 6th Weymouth Troop of Sea Scouts. Gifts should be sent to the Troop Leader, Mr. R. Knowles, 218, Preston Road, Weymouth, Dorset.

Ferguson Receivers

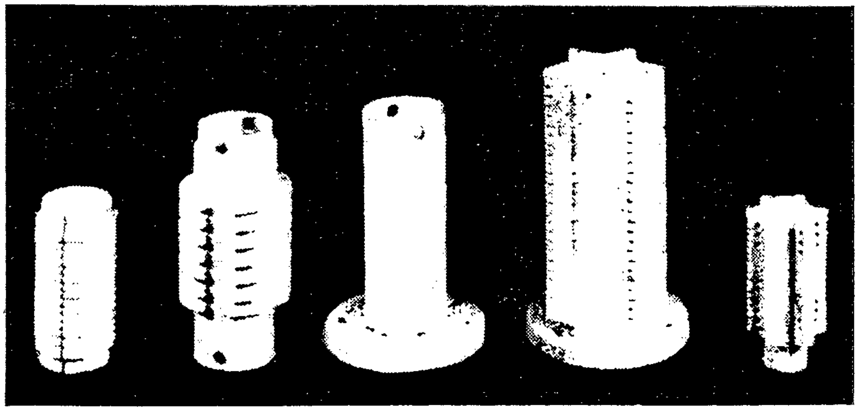
AT the recent annual meeting of the Thorn Electrical Industries, Ltd., the chairman stated that they had been able to meet only a very minute fraction of the demand for Ferguson receivers and that the company's large peacetime radio business had almost completely stopped.

Morse "Books" for the Blind?

IT is suggested by a correspondent in *Electrical Review* that morse recorded on paper spools should be used in conjunction with a photo-electric-cell reproducer for "books" for the blind. Whilst morse is ideal for copying, experienced operators will agree that it is very slow and wearisome for *listening*.

Edison Day

THE American Senate recently approved the naming of February 11th as Edison Day in honour of the birth of the famous inventor on that day in 1847.



Courtesy, Bullers, Ltd.

CERAMICS. Showing a few of the various types of coil formers, some with complex grooving and slotting, that are now being moulded in low-loss ceramic material.

Glasgow Instruction Classes

THE Scottish Radio Retailers' Association informs us that the instruction classes in receiver servicing will recommence in Alan Glen's School, Montrose Street, Glasgow, on September 22nd at 7.30 p.m.

Diary for 1942

OUR publishers announce that copies of *The Wireless World* Diary for 1942 will be ready during October. The price will be 2s. 3d., plus 6d. Purchase Tax; by post, 2s. 10½d. The data and reference sections have been compiled by the technical staff of this journal.

"Broadcasting as a Weapon"

CAPT. PLUGGE's speech in the House of Commons, commented upon in the Editorial in last month's issue, is obtainable from His Majesty's Stationery Office, price 6d. (Official Report, July 3rd, 1941, No. 80, Vol. 372.)

Bakelised Fabric

A BRITISH Standard Specification (BS972-1941) covering synthetic-resin bounded sheet for electrical and mechanical purposes has just been issued. It costs 2s. 3d. by post from The British Standards Institution, 28, Victoria Street, London, S.W.1.

NEWS IN ENGLISH FROM ABROAD

REGULAR SHORT-WAVE TRANSMISSIONS

Country : Station	Mc/s	Metres	Daily Bulletins (BST)
America			
WNBI (Bound Brook)	11.890	25.23	3.0†, 5.0, 6.0.
WRCA (Bound Brook)	17.780	16.87	3.0†, 5.0, 6.0.
WGEO (Schenectady)	9.530	31.48	9.0†.
WGEA (Schenectady)	15.330	19.57	6.45§‡, 9.55§‡.
WBOS (Hull) ..	11.870	25.27	9.0.
WCAB (Philadelphia)	6.060	49.50	12.30 a.m.†, 5.55 a.m.‡, 11.30§‡.
WCBX (Wayne) ..	9.650	31.09	10.30.
WCBX	11.830	25.36	6.30‡, 7.15†.
WCBX	15.270	19.65	1.0, 2.0.
WRUL (Boston) ..	6.040	49.67	11.30§‡.
WRUL	11.730	25.58	11.30§‡.
WRUL	11.790	25.45	8.30*, 9.30§‡.
WRUL	15.350	19.54	4.0*, 8.30*, 9.30§‡.
WRUL	17.750	16.90	4.0*.
WLWO (Cincinnati) ..	15.250	19.67	5.0.
Australia			
VLR7 (Lyndhurst) ..	11.840	25.34	5.20.
Egypt			
SUX (Cairo)	7.865	38.14	6.50, 10.10.
French Equatorial Africa			
FZI (Brazzaville) ..	11.970	25.06	8.45.
India			
VUD3 (Delhi)	9.590	31.28	1.30, 4.50.
VUD4	11.830	25.36	9.0 a.m., 1.30, 4.50, 6.15.
VUD3	15.290	19.62	9.0 a.m.
Iran			
EQB (Teheran) ..	6.155	48.74	7.30.
Japan			
JZJ (Tokio)	11.800	25.42	10.30.
Manchukuo			
MTCY (Hsinking) ..	11.775	25.48	8.0 a.m., 10.5.
Sweden			
SBO (Motala)	6.065	49.46	10.20.
Thailand			
HSP5 (Bangkok) ..	11.715	25.61	12.45.
HS6PJ	19.020	15.77	12.45.
Turkey			
TAP (Ankara) ..	9.465	31.70	7.15.
TAQ	15.195	19.74	12.15.
U.S.S.R. (Moscow)			
31-metre band ..	—	—	7.0, 8.0, 9.0, 10.15.
Vatican City			
HVJ	6.190	48.47	8.15.

MEDIUM-WAVE TRANSMISSIONS

	kc/s	Metres	*
Ireland			
Radio-Eireann	565	531	1.40‡, 6.45‡, 6.50†, 10.0.

It should be noted that the times are BST—**one hour** ahead of GMT—and are p.m. unless otherwise stated. The times of the transmission of news in English in the B.B.C. Short-wave Service are given on the preceding page.

* Saturdays only. § Saturdays excepted. † Sundays only. ‡ Sundays excepted.

Designing a Modern Superheterodyne

Investigation of AVC and Distortion in a Reflexed IF Stage

(Concluded from page 227 of September issue)

By R. G. D. HOLMES, A.M.I.E.E.

IN the calculations on sensitivity the speech diode is working at a very low level, thus damping the secondary of the last IF transformer to a much greater extent than would be the case under normal listening conditions. In this respect it is worth noting when taking selectivity measurements that the speech diode should be worked at as high a level as possible without AVC commencing, that is, at about 4 volts RF input, and the audio output should be set to a suitable level by means of the manual volume control.

Against this it should be remembered that commencement of AVC increases the damping on the primary of the last IF transformer, but to a much smaller extent.

If we consider signals which produce small diode voltages (i.e. those producing quadratic rectification) as "not worth receiving," the "Q" of the last IF transformer, before AVC commences (A), and well after AVC starts (B), can be calculated as follows :—

(A) Primary impedance $Z_1 = 0.9$, 0.3 and 0.187 megohm in pll. = 0.102 megohm.

Secondary impedance $Z_2 = 0.265$ and 0.25 megohm in pll. = 0.128 megohm.

Dynamic $R = \sqrt{Z_1 . Z_2} = 114{,}000$ ohms.

$C = 170\ \mu\mu F$. $Q = R\omega C = 57.8$.

(B) AVC diode now conducting, therefore additional damping on primary $\frac{1}{2}$ R = 0.5 megohm.

Primary $Z_1 = 0.9$, 0.3, 0.187 and 0.5 megohm in pll.

= 0.085 megohm.

$Z_2 = 0.128$ megohm.

Dynamic $R = \sqrt{0.085 \times 0.128}$ = 109,000 ohms.

$Q = 55.3$

It can be seen, therefore, that the difference of "Q" is negligible and that the selectivity suffers only slightly from the AVC diode loading.

By far the worst effect due to delayed AVC is that signals about the threshold value cause serious modulation distortion. This distortion will be maximum when the peak value of the unmodulated signal is approximately equal to the delay voltage, because during the negative half of a low-frequency cycle no current is passed by the diode, but on the positive half-cycle the diode conducts and the primary of the IF transformer is consequently damped. Since this damping depends upon signal strength it is difficult to make an exact calculation of the resulting distortion of the audio-frequency voltage. However this distortion falls off rapidly with larger signals.

Measurements of harmonic distortion were taken at 1,000 c/s using a beat frequency oscillator with a band-pass filter and harmonic analyser. The distortion of the output valve alone was first measured at different levels and the following results obtained :

Output Watts	0.25	0.5	1.0	2.0	3.0
Total Distortion (per cent.) ...	1.38	2.0	2.8	3.9	7.3

These measurements were made at the secondary of the output transformer with a resistive load.

It will be seen that the distortion does not increase with additional AVC bias.

Large aerial signals bias back the IF valve towards "cut-off" where the $I - V_a$ characteristics become closer, and since the signal on the IF grid is also increasing anode rectification takes place. As we have an audio load in the anode circuit of this valve, the rectified signals are passed through the coupling condenser straight into the output valve grid. This means that a large signal would produce an audio output even when the volume control is set at zero.

Measurements were taken of input signal against output power to see how bad this effect is with the connection to the slider of the volume control taken off and earthed, thus preventing signals rectified by the diode getting to the audio amplifier grid. The following results were obtained :—

RF Input (microvolts)	Up to 5,000	10,000	20,000	50,000	100,000	200,000	300,000	500,000
Output (milliwatts)	0	0.1	0.15	0.3	0.6	1.3	2.0	3.2

Since the DC bias on the driver valve varies between 2 and 11 volts, depending upon the strength of the received signal, it was necessary to make some measurements to verify that under these conditions the valve does not produce any additional distortion. Measurements were taken of the complete audio amplifier at 3 watts power output, with RF signal input to the receiver varied from the threshold of AVC to a maximum of 0.5 volt.

Aerial Input (microvolts)	Distortion (per cent.) at 3 watts
100	5.2
200	5.2
300	5.2
400	5.1
500	5.1
1,000	5.1
2,000	5.0
5,000	5.0
10,000	5.0
100,000	5.7
500,000	5.2

It can be seen that a powerful local transmitter can produce an output of only 3.2 milliwatts when the volume control is set at zero, which cannot be considered as objectionable. These measurements were taken after the AVC had been adjusted to meet the other two more important conditions previously mentioned, that is, half AVC to this valve.

However, to see if any improvement of rectification could be obtained with another value of AVC, a test was carried out varying the amount of AVC to the IF valve by means of a calibrated potentiometer inserted in place of the 1 megohm AVC load resistance, the slider of which fed the IF valve, and the AVC voltages were taken with a sensitive electrostatic voltmeter. The aerial input was adjusted to 0.5 volt, measurements were taken of power output and AVC voltages against the amount of

Designing a Modern Superheterodyne—AVC fed to the IF valve. The following table shows the results :—

Fraction of Total AVC on IF Valve	AVC Volts IF Valve	AVC Volts on Frequency Changer	Power Output (milliwatts)
0	0	23.0	1.3
0.1	2.2	22.0	3.4
0.25	5.0	20.5	2.6
0.28	5.6	20.0	2.4
0.5	10.0	19.5	3.2
0.75	12.5	17.5	5.4
1.0	16.5	16.5	9.0

It can be seen from this table that the greater the proportion of AVC fed to the IF valve the less the total AVC becomes. This is fed directly to the frequency changer and consequently the slope of the frequency changer increases and a larger signal arrives at the IF valve grid: this can be seen to give a larger power output due to rectification.

A glance at the curve of Fig. 9 plotted from this table shows that the power output rises to a peak of 3.4 milliwatts when 0.1 of the AVC is applied to the IF valve, then falls to a trough at 0.28 and after that steadily rises to a maximum of 9 milliwatts when the full AVC is applied.

An analysis was then made to find the reason for the peak at 0.1 of the AVC. A low-loss "acorn" valve voltmeter was inserted across the input to the IF valve and a signal of 0.5 volt applied to the aerial. The AVC to the IF valve was adjusted to 0.1 of the total by means of the calibrated potentiometer and the peak of 3.4 milliwatts was noticed on the output meter. The IF transformer was retrimmed to allow for the small added input capacity, and the signal appearing on the grid was 0.45 volt peak. The total grid bias (AVC plus cathode circuit) was measured and found to be 4 volts.

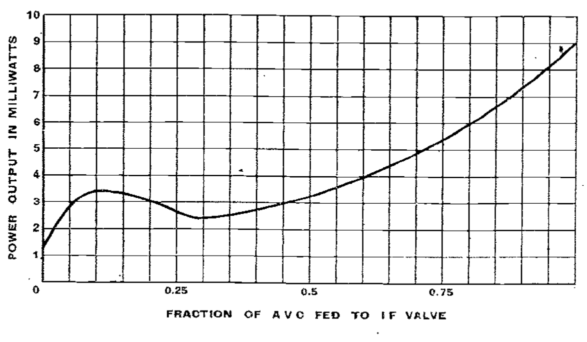


Fig. 9. Power output due to rectification plotted against fraction of AVC fed to IF stage. Slider of volume control disconnected and earthed. Aerial input 0.5 volt RMS.

The IF valve being of the "variable-mu" type can be considered as two valves in parallel, the first having a very short grid base and the second a long grid base. At a point where these two meet there is an irregularity in the V_g-I_a characteristic, this takes place at − 4 volts.

The V_g-I_a characteristic was taken at this point under dynamic conditions, that is, with the screened grid voltage held constant with an external battery source. Grid bias points were taken each side of − 4 volts up to a value equal to a peak carrier voltage of 0.54. This characteristic is reproduced as Fig. 10.

Using the "5 Point Analysis"[1] the DC component can be obtained containing up to the fourth harmonic by the formula $-\frac{1}{3}$ $(h + 2n)$ this will then be $-\frac{1}{3}$ $(0.11 + 0.06) =$ $- 0.057$ mA. When the carrier is modulated, the steady value of the DC component will vary in amplitude about this mean value by plus and minus the percentage modulation.

It is this alternating component of the anode current which develops the rectified output across the 10,000 ohm anode load. In our case the modulation $m = 0.3$. Hence the RMS value $= E_R = m \times$ DC component $\times 0.707 \times 10{,}000 = 0.3 \times 0.057 \times 10^{-3} \times 0.707 \times 10^4 = 0.12$ volt.

This figure agrees fairly closely with the value of 0.13 volt RMS which was found necessary to produce 3.4 milliwatts output.

Conclusion

In conclusion, it can be seen that quite a reasonable receiver can be produced having all the advantages claimed, providing the following points are considered :—

(*A*) *Cathode circuit of Output Valve.*

It is important that the lowest audio-frequencies should be bypassed effectively since the voltage developed across this resultant impedance undergoes an amplification of 20 times in the driver valve. This trouble could be eliminated by combining the diodes with the IF amplifier, rather than with the output valve.

(*B*) *IF Input Condenser* (*Grid of EF9*).

The value of this condenser has to be a compromise. The capacity must be large compared with the grid input capacity to avoid attenuation of intermediate frequency, yet its reactance at the highest audio-frequency must be high as compared with the grid leak, for together they form a potentiometer at audio-frequencies.

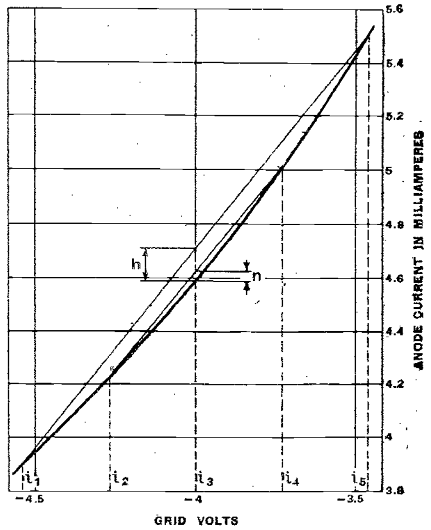


Fig. 10. Illustrating method of calculating rectification in the IF stage.

(*C*) *Anode Bypass Condenser* (*IF Valve*)

This again has to be a compromise, it must be large enough effectively to bypass IF to earth, yet its reactance must be high as compared with the anode load with which it is in parallel, so as not to attenuate high audio-frequencies.

(*D*) *Application of AVC Voltage to IF Valve.*

The application of AVC to the IF valve is arranged to meet three conditions :—

(1) Because this valve amplifies both audio and IF frequencies, forward and backward AVC control is obtained and the amount of AVC fed to this valve should be adjusted to give a constant output irrespective of the input signal: this was found to be approximately half the AVC voltage.

(2) As this valve has to handle the largest IF signal, it must not be allowed to overload, otherwise serious distortion, as described in the text, will occur. The amount of AVC is chiefly governed by this consideration, and if condition (1) can be satisfied while retaining the requirements of this case, so much the better.

(3) With an audio load in the anode circuit any rectification taking place in the valve is passed on to the output valve grid. This requires that the fraction of AVC applied to the IF stage should be as small as possible (see Fig. 9).

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[1] "Distortion in Valves with Resistive Loads" by A. Bloch. *The Wireless Engineer*, Dec. 1939.

SHORT-WAVE BROADCASTING STATIONS

Arranged in Order of Frequency

Some of the stations listed are of comparatively low power, while others, owing to their geographical position, operating frequencies and times of working, are heard in this country only under extremely favourable conditions. They are, however, included in order that the list may be as comprehensive as possible. Moreover, the ever-changing world situation brings into prominence overnight stations which to-day are of little or no interest.

It should be pointed out that owing to the demands upon our space it is not anticipated that this list will be repeated for some time. Any major changes will be noted in our pages.

Station	Call Sign	Mc/s	Metres	kW
49-Metre Band (6.000–6.200 Mc/s)				
Moscow (U.S.S.R.)	RNE	6.000	50.00	20–100
Colon (Panama)	HP5K	6.005	49.97	—
Rangoon (Burma)	XYZ	6.007	49.94	10
Pretoria (South Africa)	ZRH	6.007	49.94	5
Pernambuco (Brazil)	PRA8	6.010	49.92	—
Sydney (Nova Scotia)	CJCX	6.010	49.92	—
Moscow (U.S.S.R.)	RW96	6.030	49.75	20–100
Hsinking (Manchukuo)	MTCY	6.030	49.75	20
Lourenco Marques (Mozambique)	CR7AA	6.035	49.71	10
Moscow (U.S.S.R.)	—	6.040	49.67	20–100
Boston (U.S.A.)	WRUL	6.040	49.67	50
British Oversea Service	GSA	6.050	49.59	10–100
Philadelphia (U.S.A.)	WCAB	6.060	49.50	10
Antananarivo (Madagascar)	—	6.063	49.48	—
Motala (Sweden)	SBO	6.065	49.46	12
Toronto (Canada)	CFRX	6.070	49.42	—
British Oversea Service	GRR	6.075	49.38	10–100
Vancouver (Canada)	CFKX	6.080	49.34	—
Lima (Peru)	OAX4Z	6.082	49.32	15
Nairobi (Kenya)	VQ7LO	6.083	49.31	1
Penang (Malaya)	ZHJ	6.090	49.26	2.5
Pereira (Colombia)	HJFK	6.090	49.26	—
Toronto (Canada)	CRCX	6.090	49.26	—
Cape Town (South Africa)	ZRK	6.097	49.20	5
Moscow (U.S.S.R.)	—	6.100	49.18	20–100
British Oversea Service	GSL	6.110	49.10	10–100
Saigon (French Indo-China)	FZR	6.116	49.05	12
Hsinking (Manchukuo)	MTCY	6.125	48.98	20
Moscow (U.S.S.R.)	—	6.130	48.94	20–100
Noumea (New Caledonia)	FK8AA	6.130	48.94	—
Moscow (U.S.S.R.)	—	6.140	48.86	20–100
British Oversea Service	GRW	6.140	48.86	10–100
Hull (U.S.A.)	WBOS	6.140	48.86	50
Winnipeg (Canada)	CJRO	6.150	48.78	2
Teheran (Iran)	EQB	6.155	48.74	14
Quebec (Canada)	—	6.160	48.70	—
Schwarzenburg (Switzerland)	HER3	6.165	48.66	25
Penang (Malaya)	ZHP2	6.175	48.58	2.5
Lima (Peru)	OAX4G	6.180	48.54	15
Saigon (French Indo-China)	—	6.180*	48.54	12
Schenectady (U.S.A.)	WGEA/O	6.190	48.47	50/100
Vatican City	HVJ	6.190	48.47	25
Athlone (Ireland)	—	6.190	48.47	—
Lima (Peru)	OAX45	6.190	48.47	—
Lisbon (Portugal)	CS2WD	6.200	48.39	—
La Paz (Bolivia)	CP5	6.200	48.39	—
Ica (Peru)	OAX1A	6.335	47.35	—
Santa Clara (Cuba)	WOHI	6.450	46.51	5
Geneva (Switzerland)	HBQ	6.675	44.94	20
Bandoeng (Dutch E. Indies)	PMH	6.720	44.64	1.5
Cairo (Egypt)	SUR	6.784	44.24	—
Managua (Nicaragua)	YNOW	6.850	43.80	—
Kweiyang (China)	XPSA	6.980	42.98	—
British Oversea Service	GRS	7.065	42.46	10–100
Valladolid (Spain)	FET1	7.070	42.43	—
Tangier (Spanish Morocco)	—	7.090	42.31	—
British Oversea Service	GRT	7.150	41.96	10–100
41-Metre Band (7.200–7.300 Mc/s)				
Moscow (U.S.S.R.)	—	7.200	41.67	20–100
Moscow (U.S.S.R.)	—	7.210	41.61	20–100
Calcutta (India)	VUC2	7.210	41.61	10
British Oversea Service	GSW	7.230	41.49	10–100
Bombay (India)	VUB2	7.240	41.44	10
Singapore (Malaya)	ZHP3	7.250	41.38	20
Tokio (Japan)	JVW	7.257	41.34	50
British Oversea Service	GSU	7.260	41.32	10–100
Lisbon (Portugal)	CSW8	7.260	41.32	10
Madras (India)	VUM2	7.270	41.27	10
Delhi (India)	VUD2	7.290	41.15	10
Salisbury (Rhodesia)	—	7.317	41.00	—
Moscow (U.S.S.R.)	RWG	7.360	40.76	20–100
Pointe-à-Pitre (Guadeloupe)	FG8AH	7.440	40.32	—
Moscow (U.S.S.R.)	RKI	7.520	39.89	20–100
Moscow (U.S.S.R.)	—	7.545	39.76	20–100
Cairo (Egypt)	SUX	7.865	38.14	10
Rio de Janeiro (Brazil)	PSL	7.955	37.72	—
Moscow (U.S.S.R.)	RIA	8.070	37.17	20–100
Kweiyang (China)	XPSA	8.484	35.36	—
Casablanca (Fr. Morocco)	CNP	8.795	34.11	—
Moscow (U.S.S.R.)	—	9.010	33.30	20–100
Libreville (Fr. Eq. Africa)	FHK	9.320	32.19	—
Lima (Peru)	OAX4J	9.340	32.12	—
Geneva (Switzerland)	HBL	9.345	32.10	20
Dakar (French W. Africa)	FGA	9.405	31.90	—
Ica (Peru)	OAX5C	9.430	31.81	—
British Oversea Service	GRU	9.450	31.75	10–100
Moscow (U.S.S.R.)	—	9.465	31.70	20–100
Ankara (Turkey)	TAP	9.465	31.70	20
St. John's (Newfoundland)	VONG	9.482	31.64	—
31-Metre Band (9.500–9.700 Mc/s)				
Moscow (U.S.S.R.)	—	9.500	31.58	20–100
Chungking (China)	XGOY	9.500	31.58	35
Bangkok (Thailand)	HS8PJ	9.500	31.58	10
Mexico City	XEWW	9.503	31.57	10
British Oversea Service	GSB	9.510	31.55	10–100
Moscow (U.S.S.R.)	RW96	9.520	31.51	20–100
Pretoria (South Africa)	ZRG	9.523	31.50	5
Hong Kong (China)	ZBW3	9.525	31.49	2.5
Schenectady (U.S.A.)	WGEO	9.530	31.48	100
Moscow (U.S.S.R.)	—	9.530	31.48	20–100
Treasure Island (U.S.A.)	KGEI	9.530	31.48	20
Calcutta (India)	VUC2	9.530	31.48	10
Tokio (Japan)	JZI	9.535	31.46	50
Motala (Sweden)	SBU	9.535	31.46	12
Suva (Fiji)	VPD2	9.535	31.46	—
Hsinking (Manchukuo)	MTCY	9.545	31.43	20
Moscow (U.S.S.R.)	—	9.550	31.41	20–100
Vatican City	HVJ	9.550	31.41	25
Bombay (India)	VUB2	9.550	31.41	10
Bandoeng (Dutch E. Indies)	YDB	9.550	31.41	1.5
Perth (Australia)	VLW2	9.560	31.38	—
Lima (Peru)	OAX4T	9.562	31.38	15
Hull (U.S.A.)	WBOS	9.570	31.35	50
Madras (India)	VUM2	9.570	31.35	10
Montevideo (Uruguay)	CXA2	9.570	31.35	5
Manila (Philippine Islands)	KZRM	9.570	31.35	—
British Oversea Service	GSC	9.580	31.32	10–100
Melbourne (Australia)	VLR	9.580	31.32	2
Cincinnati (U.S.A.)	WLWO	9.590	31.28	75
Delhi (India)	VUD3	9.590	31.28	10
Philadelphia (U.S.A.)	WCAB	9.590	31.28	10
British Oversea Service	GRY	9.600	31.25	10–100
Moscow (U.S.S.R.)	RAL	9.600	31.25	20–100
Cape Town (South Africa)	ZRL	9.606	31.23	5
Panama City	HP5J	9.610	31.22	2.5
Sydney (Australia)	VLQ	9.615	31.20	—
San José (Costa Rica)	TIPG	9.620	31.19	—
Bogota (Colombia)	HJCT	9.630	31.15	—
Chungking (China)	XGOY	9.635	31.14	35
Taihoku (Formosa)	JFO	9.636	31.13	—
Buenos Aires (Argentina)	CXA14	9.640	31.12	7.5

Station	Call Sign	Mc/s	Metres	kW
Montevideo (Uruguay)	CXA8	9.640	31.12	5
Manila (Philippine Islands)	KZRH	9.640	31.12	—
Wayne (U.S.A.)	WCBX	9.650	31.09	10
Vatican City	HVJ	9.660	31.06	25
Buenos Aires (Argentina)	LRX	9.660	31.06	7
Manila (Philippine Islands)	KZRH	9.660	31.06	—
Perth (Australia)	VLW4	9.665	31.04	—
Bound Brook (U.S.A.)	WRCA	9.670	31.02	100
Treasure Island (U.S.A.)	KGEI	9.670	31.02	20
Teheran (Iran)	EQC	9.680	30.99	14
Mexico City	XEQQ	9.680	30.99	10
Sydney (Australia)	VLQ5	9.680	30.99	—
Moscow (U.S.S.R.)	RW96	9.684	30.98	20–100
Guatemala City	TGWA	9.685	30.98	10
British Oversea Service	GRX	9.690	30.96	10–100
Buenos Aires (Argentina)	LRA1	9.690	30.96	10
Singapore (Malaya)	ZHP1	9.700	30.93	2.5
Forte-de-France (F.W.I.)	—	9.705	30.92	—
L. Marques (Mozambique)	CR7BE	9.710	30.90	10
Chungking (China)	XGOA	9.720	30.86	35
Pereira (Colombia)	HJFK	9.730	30.83	—
Lisbon (Portugal)	CSW7	9.740	30.80	10
Durban (Natal)	ZRO	9.750	30.77	—
Baghdad (Iraq)	HNF	9.820	30.55	—
Aranjuez (Spain)	EAQ	9.860	30.43	30
Cairo (Egypt)	—	10.055	29.83	10
Leopoldville (Belg. Congo)	OPM	10.140	29.59	—
Rio de Janeiro (Brazil)	PSH	10.220	29.35	—
Bandoeng (Java)	PMN	10.260	29.24	1.5
Buenos Aires (Argentina)	LSX	10.350	28.99	12
Belize (British Honduras)	ZIK2	10.600	28.30	—
Bandoeng (Dutch E. Indies)	PLP	11.000	27.27	1.5
Lisbon (Portugal)	CSW6	11.040	27.17	10
Geneva (Switzerland)	HBO	11.402	26.31	20
Moscow (U.S.S.R.)	—	11.500	26.09	20–100
Moscow (U.S.S.R.)	RIC	11.640	25.77	20–100
Canton (China)	XGOK	11.650	25.75	—
25-Metre Band (11.700-11.900 Mc/s)				
Panama City	HP5A	11.700	25.64	2
Santiago (Chile)	CB1170	11.700	25.64	—
Motala (Sweden)	SBP	11.705	25.63	12
Cincinnati (U.S.A.)	WLWO	11.710	25.62	75
Moscow (U.S.S.R.)	—	11.710	25.62	20–100
Bangkok (Thailand)	HSP5	11.715	25.61	10
Winnipeg (Canada)	CJRX	11.720	25.60	2
Boston (U.S.A.)	WRUL	11.730	25.58	50
Buenos Aires (Argentina)	LRA3	11.730	25.58	10
Vatican City	HVJ	11.740	25.55	25
Santiago (Chile)	CB1174	11.740	25.55	—
British Oversea Service	GSD	11.750	25.53	10–100
Guatemala City	TGWA	11.760	25.51	10
Lyndhurst (Australia)	VLR8	11.760	25.51	2
Moscow (U.S.S.R.)	RNE	11.766	25.50	20–100
Hsinking (Manchukuo)	MTCY	11.775	25.48	20
Saigon (French Indo-China)	FZR	11.780	25.47	12
Boston (U.S.A.)	WRUL	11.790	25.45	50
Tokio (Japan)	JZJ	11.800	25.42	50
Tokio (Japan)	JVZ	11.815	25.39	50
British Oversea Service	GSN	11.820	25.38	10–100
Buenos Aires (Argentina)	CXA8	11.820	25.38	5
Moscow (U.S.S.R.)	—	11.830	25.36	20–100
Delhi (India)	VUD4	11.830	25.36	10
Wayne (U.S.A.)	WCBX	11.830	25.36	10
Perth (Australia)	VLW3	11.830	25.36	—
Lisbon (Portugal)	CSW5	11.840	25.34	10
Lyndhurst (Australia)	VLR7	11.840	25.34	2
Shanghai (China)	XMHA	11.853	25.31	—
Rio de Janeiro (Brazil)	PRF5	11.855	25.31	—
British Oversea Service	GSE	11.860	25.29	10–100
Hull (U.S.A.)	WBOS	11.870	25.27	50
Schwarzenburg (Switzerland)	—	11.870	25.27	25
Sydney (Australia)	VLQ2	11.870	25.27	—
Sydney (Australia)	VLQ7	11.880	25.25	—
Bound Brook (U.S.A.)	WNBI	11.890	25.23	25
Moscow (U.S.S.R.)	RNE	11.900	25.21	20–100
Chungking (China)	XGOY	11.900	25.21	35
Moscow (U.S.S.R.)	—	11.910	25.19	20–100
Rabat (Morocco)	—	11.940	25.13	—
Santiago (Chile)	CB1180	11.945	25.12	—
Brazzaville (Fr. Eq. Africa)	FZI	11.970	25.06	—
Shanghai (China)	XIRS	11.980	25.04	—
Santiago (Chile)	CB1180	11.980	25.04	—
Moscow (U.S.S.R.)	RNE	12.000	25.00	20–100
Shanghai (China)	XGRS	12.015	24.97	—
British Oversea Service	GRV	12.040	24.92	10–100
Shanghai (China)	—	12.090	24.81	—
Aden	ZNR	12.115	24.76	—
Moscow (U.S.S.R.)	—	12.240	24.51	20–100
Quito (Ecuador)	HCJB	12.460	24.08	—
Rabat (Morocco)	CNR	12.831	23.38	—
Moscow (U.S.S.R.)	—	13.210	22.71	20–100
Moscow (U.S.S.R.)	—	13.770	21.79	20–100
Geneva (Switzerland)	HBJ	14.538	20.63	20
Bandoeng (Dutch E. Indies)	PLJ	14.630	20.51	1.5
Moscow (U.S.S.R.)	RKI	14.717	20.38	20–100
19-Metre Band (15.100-15.350 Mc/s)				
Moscow (U.S.S.R.)	RKI	15.040	19.95	20–100
Teheran (Iran)	EPB	15.100	19.87	14
Tokio (Japan)	JLG4	15.105	19.86	50
Vatican City	HVJ	15.120	19.84	25
Boston (U.S.A.)	WRUL	15.130	19.83	50
British Oversea Service	GSF	15.140	19.82	10–100
Motala (Sweden)	SBT	15.150	19.80	12
Bandoeng (Dutch E. Indies)	YDC	15.150	19.80	—
Tokio (Japan)	JZK	15.160	19.79	50
Guatemala City	TGWA	15.170	19.78	10
Moscow (U.S.S.R.)	RW96	15.180	19.76	20–100
British Oversea Service	GSO	15.180	19.76	10–100
Ankara (Turkey)	TAQ	15.195	19.74	20
Chungking (China)	XGOX	15.200	19.74	35
Hull (U.S.A.)	WBOS	15.210	19.72	50
Lisbon (Portugal)	CSW4	15.215	19.72	10
Cincinnati (U.S.A.)	WLWO	15.250	19.67	75
British Oversea Service	GSI	15.260	19.66	10–100
Wayne (U.S.A.)	WCBX	15.270	19.65	10
Delhi (India)	VUD3	15.290	19.62	10
Buenos Aires (Argentina)	LRU	15.290	19.62	7
British Oversea Service	GSP	15.310	19.60	10–100
Sydney (Australia)	VLQ3	15.315	19.59	—
Soerabaya (Dutch E. Indies)	YDB	15.315	19.59	—
Schenectady (U.S.A.)	WGEA/O	15.330	19.57	50/100
Treasure Island (U.S.A.)	KGEI	15.330	19.57	20
Boston (U.S.A.)	WRUL	15.350	19.54	50
Moscow (U.S.S.R.)	RW96	15.410	19.47	20–100
Moscow (U.S.S.R.)	—	15.490	19.37	20–100
Chengtu (China)	XOZ	15.510	19.34	—
Tunis (N. Africa)	—	15.650	19.17	—
Moscow (U.S.S.R.)	—	15.715	19.09	20–100
16-Metre Band (17.750-17.850 Mc/s)				
Boston (U.S.A.)	WRUL	17.750	16.90	50
Bound Brook (U.S.A.)	WRCA	17.780	16.87	50
Hull (U.S.A.)	WBOS	17.780	16.87	50
British Oversea Service	GSG	17.790	16.86	10–100
Tokio (Japan)	JLU4	17.795	16.86	50
Chungking (China)	XGOX	17.800	16.85	35
Guatemala City	TGWA	17.800	16.85	10
Sydney (Australia)	VLQ8	17.800	16.85	—
British Oversea Service	GSV	17.810	16.84	10–100
Wayne (U.S.A.)	WCBX	17.830	16.83	10
Athlone (Ireland)	—	17.840	16.82	—
Tokio (Japan)	JLS2	17.845	16.81	50
Moscow (U.S.S.R.)	—	17.910	16.75	20–100
Lourenco Marques (Mozambique)	CR7BI	17.915	16.63	10
Geneva (Switzerland)	HBF	18.450	16.26	20
Geneva (Switzerland)	HBH	18.480	16.23	20
Moscow (U.S.S.R.)	—	18.540	16.18	20–100
Bangkok (Thailand)	HS6PJ	19.020	15.77	10
Bandoeng (Dutch E. Indies)	PMA	19.380	15.48	—
Leopoldville (Belg. Congo)	OPL	20.040	14.97	—
13-Metre Band (21.450-21.750 Mc/s)				
Boston (U.S.A.)	WRUL	21.460	13.98	50
British Oversea Service	GSH	21.470	13.97	10–100
Schenectady (U.S.A.)	WGEA	21.500	13.95	50
Philadelphia (U.S.A.)	WCAB	21.520	13.94	10
British Oversea Service	GSJ	21.530	13.93	10–100
Hull (U.S.A.)	WBOS	21.540	13.93	50
British Oversea Service	GST	21.550	13.92	10–100
Wayne (U.S.A.)	WCBX	21.570	13.91	10
Schenectady (U.S.A.)	WGEA/O	21.590	13.89	50/100
Bound Brook (U.S.A.)	WRCA	21.630	13.87	50
British Oversea Service	GRZ	21.640	13.86	10–100

Stations of which the names are "indented" are working outside the regular broadcasting bands.

Servicing Equipment and Its Uses

Part IV.—Special Tools and Appliances

By "SERVICE"

In this, the last article of this series, the author shows how small tools can be of great assistance in making easier much of the newcomer's work in radio servicing.

SPECIAL tools play a very important part in the efficient and expeditious servicing of modern radio receivers. For example, even with the most accurate and expensive of oscillators best results cannot be obtained unless correctly designed trimming tools are used for adjusting the various trimmers.

The chief consideration in a trimming tool is the amount of metal work which is allowed to come within the field of the components comprising the tuned circuit which is to be trimmed, and, although in a large number of cases a very small amount of metal may be tolerated, in UHF circuits even the smallest amount will not enable an accurate setting of the trimmer to be made. One has to employ guesswork by over-adjusting a trimmer so that when the trimming tool is removed the circuit is more or less lined up to its proper frequency. Such a method cannot be tolerated nowadays.

A difficulty which confronts those who have to work on receivers of various makes is that there are several types of trimmer screws and methods of adjusting trimmer condensers. Some have screws, others nuts, while yet a third variation comprise the two and employ a nut which adjusts one trimmer of a IF transformer, while a concentric screw inside the nut adjusts the second trimmer of the transformer.

For this type of trimmer arrangement the box-spanner combination tool has to be used so that the nut may be rotated to the desired position and maintained in that position while the screw is adjusted.

An extra-short trimmer screwdriver is handy for use where it is possible to adjust the trimmer while the chassis of the receiver is in its cabinet. It is not always possible to carry out this operation without having to withdraw the chassis from the cabinet.

It must be emphasised that trimming tools are by no means robust, and, while being entirely satisfactory for the job for which they were designed, they will not stand up to such jobs as forcing trimmers which have been sealed with wax, which should first have the wax broken by unscrewing the trimmer screw with an ordinary screwdriver.

Many recent radio and television chassis incorporate tubular condensers in which the two elements are made up of a metal rod sliding through, but insulated from, a metal tube. By pushing the rod in or out of the tubular element the capacity of the arrangement may be varied. When the correct position of the sliding element has been ascertained, it is fixed into position by a lock-nut.

A tubular condenser trimming tool generally comprises a long, hollow box spanner which will adjust the locking nut and a long, thin metal rod having one end in the form of a hook. This is inserted down the hollow box spanner and the hook engaged in a hole in the sliding element of the tubular condenser. By means of the box spanner the lock-nut is slackened and the sliding element of the condenser is adjusted in or out by means of the hooked tool. When the correct position has been found, the box spanner is used to tighten up the locking nut, and the operation is completed.

Another extremely useful tool is what is sometimes termed an inductance trimming tool. It comprises a piece of square insulation material about the length of a pencil with a point at one end with three or four slots cut into the body of the tool at various angles. The purpose of the tool is to enable wiring to be gripped in the slots of the tools and moved about so as to overcome troubles due to interaction between the wiring, which gives rise to such faults as hum, RF, instability, etc.

Some short-wave receivers have loops in the wiring which form part of the tuned circuits, and the loops have to be in a certain position to obtain maximum efficiency. The inductance trimming tool enables these adjustments to be carried out while the set is "live," and without any hand capacity effects due to the proximity of the operator's hand to the wiring.

In short-wave receivers the disposition of the internal wiring is of great importance, and the results obtained from an instrument may be far below standard merely because a length of wiring in a grid circuit is too near other wiring or the metal chassis. Instability can also be caused by such derangement of the wiring, and a proper tool is necessary to ascertain the effect of moving the wiring.

This little tool is also very useful for investigating intermittent faults. Leads may be pushed or pulled about, soldered joints may be pushed or tapped, and such-like investigations made to locate the causes of intermittent failures in receivers.

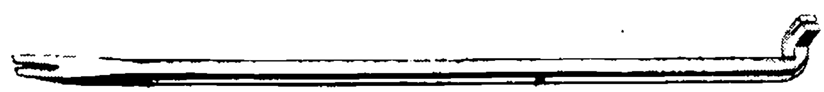


Fig. 1. Tool for adjusting the springy blades of old-type switches.

Other small tools with which the newcomer should become acquainted are switch adjusting tools. In a great number of receivers manufactured before the advent of rotary wave-change switches, flat-bladed Post Office type switches were used. In some types of receivers these switches are very inaccessible, so that the contact blades cannot be reset to the correct tension without practically removing the complete switch assembly from the chassis.

Weak contact pressure is a fault quite distinct from that of dirty contacts, which may often be corrected by the application of switch-cleaning liquid. Weak contact between switch

Servicing Equipment and its Uses

blades can only by corrected by the resetting of the blades. To accomplish this satisfactorily a switch-adjusting tool is necessary and a typical example is illustrated in Fig. 1. Another type may be seen in Fig. 2. This type is useful for adjusting the flat springs which control the switch contacts on tuning motors.

A useful small tool, quite unnecessarily shrouded in mystery in some quarters, is the tuning wand. It enables the user to determine whether a circuit requires retrimming, always provided that it is possible to insert the wand into the coil former. In appearance the tuning wand resembles a pencil before it is sharpened. Its ends are either differently coloured or they are left plain, one end being brass and the other of a dark iron-dust composition.

Inserting the brass end into a coil former lowers the inductance of the coil and should put that coil circuit "off-tune." Inserting the iron end of the wand into a coil will increase its inductance and should also put it "off-tune." When a service oscillator is connected to a receiver and the output of the receiver is fed into an output meter, the output will be seen to vary as the tuning wand is dipped into the coil. If the particular coil is accurately trimmed the output from the receiver will decrease, no matter which end of the tuning wand is used.

If, however, inserting one end of the wand increases the output from the receiver, this implies that trimming can be improved. If inserting the brass end increases the output from the receiver the trimmer capacity must be reduced, while if the receiver output increases when the iron-dust end of the tuning wand is inserted into the coil, then the trimmer capacity must be increased. Alignment is therefore correct when a decrease in output is obtained whichever end of the wand is inserted into the coil former.

So that beginners may recognise these small tools when they are met with, a representative collection of them is shown in Fig. 2. Although one or two of them are applicable only to the needs of a particular manufacturer's receivers, the majority of the tools are of general use.

In addition to trimming tools the well-equipped service workshop will have a full complement of spanners, feeler gauges, scrapers, etc., for loudspeaker servicing. Fig. 3 illustrates a typical kit of loudspeaker tools in which the various items are enumerated; their uses are as follows: (1) Ring gauges for the alignment of the pole plate and centre pole of electro-magnetic speakers. (2) Adhesive for the fastening of the periphery of cones to cone chassis where this method of cone edge suspension is employed. (3) Spanners for adjusting small nuts as used for holding Paxolin spiders on the underside of speaker cones. (4) Hexagonal box spanners for the manipulation of nuts and bolts holding pole plates to magnet yoke systems, etc. (5) Feeler gauges for insertion between speech coils and the centre pole piece to assist in the re-centring of cones. The gauges are non-magnetic so that they may be used with permanent magnet loudspeakers as well as with energised types. (6) Scraper for removing old suspension and fixing materials from cone chassis before making a replacement. The edge of the scraper may be used as a knife to rip away old cones. (7) Plasticine for the removal of metallic filings from permanent magnet pole pieces. (8) Tweezers for regaining small washers, nuts, etc., dropped near the coil spider and for clearing foreign matter from the pole gap, etc.

The ring gauges are very helpful when reassembling loudspeakers after a field coil has been replaced. The pole plate, which acts as a yoke completing the magnetic field from the two side members of the magnet assembly, has a centre hole which accommodates the top of the centre pole piece. As the latter has a smaller diameter than that of the hole, there is a gap surrounding the centre pole in which the speech coil of the cone operates, and it is essential that the centre pole be absolutely concentric with the hole in the pole plate. If it is not it will be impossible properly to centre the speech coil in the gap; even if it appears to centre properly it is quite likely that it will foul the pole pieces after the speaker has warmed up, thus giving rise to distortion after a period of operation.

By selecting the correct gauge for the type of speaker being serviced, assembly of the pole pieces is simplified and the time taken for the operation considerably reduced. The gauge is merely inserted into the gap and the bolts holding the pole plate to the loudspeaker field assembly tightened up. When the gauge is removed the gap is ready to receive the speech coil of the cone assembly.

At this stage, however, trouble can still occur if the coil is not accurately centred so that it lies equidistant from

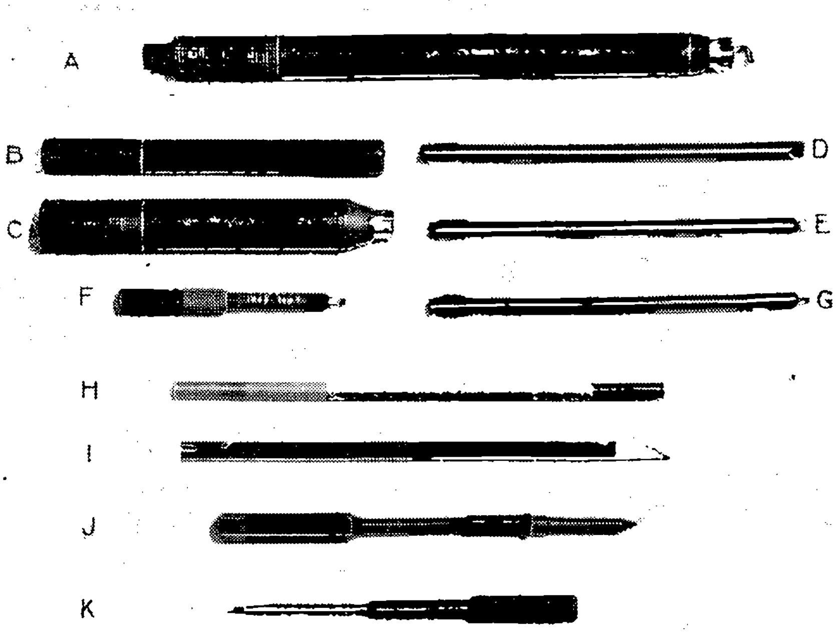


Fig. 2. Trimming and other tools. A, Tubular condenser trimming tool; B, handle for D and E; C, hollow box spanner for adjusting trimmers fitted with lock nuts; D, fibre trimmer shaft for ultra-HF trimmers; E, metal-tipped trimmer shaft for normal trimmers; F, short tool for trimmers in confined spaces; G, special metal-tipped trimmer shaft with very narrow blade; H, tuning wand; I, short-wave inductance trimming tool for adjustment of wire loop trimmers and wiring; J, friction drive tool for certain types of iron-cored inductances; K, motor spring adjusting tool.

Servicing Equipment and its Uses

the centre pole and the edge of the hole in the pole plate. This is where the feeler gauges facilitate the replacement of the cone, and Fig. 4 shows how they are used.

By inserting three or four feelers between the centre pole piece and the inside of the moving coil it is only a matter of screwing up the nuts holding the spider in order correctly to centre the cone. This procedure takes only a fraction of the time necessary with the method of moving the cone up and down and listening for any rubbing of the coil against the pole pieces.

Modern loudspeaker units have such small clearances that the eye cannot be depended upon for centring the moving coil in its gap. Some types of speakers have the speech coil winding on the inside as well as the outside of the speech coil former and care should be taken when inserting feeler gauges to see that no damage is done to the internal winding.

Feeler gauges are extremely helpful when replacing cones in speaker units where the periphery of the cone is held to the metal cone chassis by adhesive.

A scraper may be employed as a knife to rip round the old cone as near as possible to the speaker chassis. The major part of the cone then being out of the way, the scraper may be used to remove pieces of cone material and old adhesive still fixed to the chassis. The new cone can then be fitted after having applied adhesive to the chassis, and the feeler gauges will prevent any movement of the speech coil while the adhesive is drying.

With the feeler gauges in position, the suspension material may be manipulated until the cone is suspended with equal tension all round its periphery so that there is no undue pull in any one direction. This can be ascertained by removing the feeler gauges every now and again to see whether the speech coil remains in position. If it does the feeler gauges can be put back into place and the speaker put on one side for the adhesive to dry out.

Having learnt how to use service equipment the beginner must acquire the habit of looking after his gear, and a few hints in this direction may prove of value.

Analysers, or any multi-range meters, should always be left adjusted to the highest voltage range if they have no definite "OFF" position. This will prevent many a burnt-out meter, which can easily happen when the leads of the instrument are thoughtlessly applied to a source of high voltage before the range of the meter has been selected.

This point may appear to be hardly worth mentioning, but the writer repeats this warning from personal experience. There are often times after a heavy period of fault-finding when we develop mental tiredness and are apt to do things unthinkingly. If the habit has been formed of always re-setting the meter to its "OFF" position, or to its highest voltage range, lapses of memory will not have any serious effects.

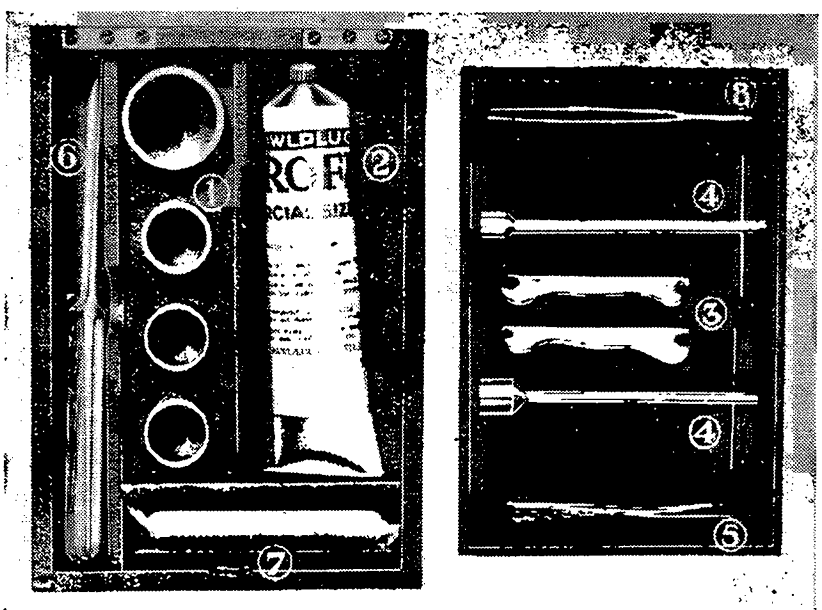


Fig. 3. Appliances for loudspeaker repairs.

Never leave an analyser or ohm-meter which contains internal batteries on the low-resistance measuring range. In many instruments the low-resistance range derives its potential from a potentiometer connected across a dry cell. Thus the cell is delivering current all the time it is switched to that range, no matter whether the test leads are connected to a resistance or not. Therefore, once more the advice is to always switch the instrument off after every test or adjust it to its highest voltage reading range.

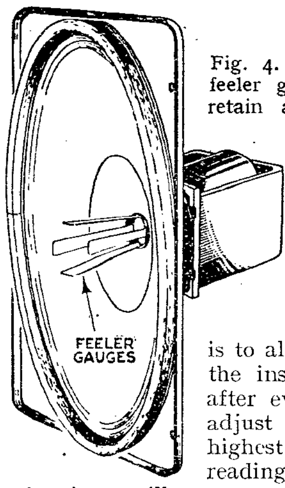


Fig. 4. Use of feeler gauges to retain a speech coil in position.

Service oscillators are very robust these days, but, nevertheless, they should be treated kindly in order to preserve as long as possible their original calibration. Valve replacements may slightly alter calibration on some older types of instruments, but in more recent designs valve replacements affect the calibration very little, if at all.

When it is known that an instrument is out of calibration, but the manufacturers are unable to overhaul it owing to their war commitments, then the oscillator readings should be compared with those from one which is known to be up to standard and which could be borrowed for an evening while tests are carried out. It is not necessary to take a great number of readings and to prepare new charts. Just a few of the most-used calibration points should be compared and a note made on the existing chart as to the error at that point. This can then be allowed for whenever the oscillator is used.

It has not been possible in this short series of articles to cover every point concerning service equipment and accessories about which the beginner would like to have information. It is hoped, however, that the articles have been of value to newcomers and will have helped them to overcome their initial lack of confidence in handling service equipment and assisted them to obtain a better understanding of their work.

LETTERS to the EDITOR

The Editor Does Not Necessarily Endorse the Opinions of His Correspondents

Compulsory Interference Suppression

I SUBMIT that the time for the authorities to introduce compulsory ignition interference suppression is now. I understand that most Service vehicles are already suppressed, and so no difficulty would arise about them when they pass into civilian use after the war. So far as private cars are concerned, many are laid up, and so the hardship imposed would be less than in peacetime.

Compulsory suppression is desirable not only in the interests of television—when it restarts after the war—but to give a fair chance for new uses for short and ultra-short waves to be developed.

"SERVICE ENGINEER."

Tunbridge Wells.

Standardisation

I HAVE just read with interest "Diallist's" comments upon the differences that exist between English and American wire gauges, drill sizes, etc.

I am in complete agreement with his suggested proposals, but would point out that his conclusions regarding the use of the "jar" as a measure of capacity are not quite correct.

In this connection I would refer your contributor to a paragraph of the Prefatory Note to the 1940 edition of the "Admiralty Handbook of Wireless Telegraphy," where it is stated: "In order to bring the unit of capacity into line with commercial practice, the use of the jar as the Service unit of capacity has been discontinued (A.F.O. 1552/37). It is to be considered as obsolescent for a few years, the farad and its sub-multiples gradually replacing it as the practical unit of capacity for standard use in the Service."

Incidentally, while on this question of standardisation, only a very small though extremely useful addition need be made to the English Standard Resistor Colour Code to bring it into line with its American counterpart. I refer here to the "dot" system of additional "O's." Whereas the British system does not extend any further than six noughts, indicated by a blue dot, the American system includes up to nine noughts indicated by a white dot. Admittedly this is merely a minor point, but it is only by attending to all these small differences that the complete alignment of the British and American standards can be brought about. K. BEAUCHAMP.

Stoke, Coventry.

Receiver Servicing

IF I may be permitted to make some comments on the letters of Messrs. Hosking and "P. Q." in the September issue, I will refer especially to the whole of the last sentence of Mr. Hosking's letter and to the first of that of "P. Q." The impression one gets is that they consider any criticism of the practice of servicing and reference to unethical behaviour "an unwarranted attack" on a pure and blameless profession. To put it bluntly, this sounds, to a fellow-professional, like unconvincing cant. Your correspondents would hardly deny that there are honest men *and* knaves in radio servicing, as in every other branch of human affairs. The virtuous indignation of the honest men at any doubt cast on the status and honour of their profession affords, unfortunately, excellent cover for the knaves. I have little doubt that a number of petty profiteers will be very grateful to these correspondents. They would, I feel, have done better had they been less zealous in displaying the particular instances of their own probity and quicker to admit frankly what every technician knows—that the radio service game, with its exceptional opportunities for profiting unethically by the general public's ignorance and the absence, in this branch of commercial radio, of discipline and organisation, that strongly attract a certain type of "business" acumen, is far from clean. They should urge the adoption of obvious methods of cleansing it, to lengthen this letter with expositions of which is hardly necessary. Their attitude is, unfortunately, fairly common in commercial radio; I would point out that so long as they persevere in it, so long will incompetence and unscrupulousness continue to exploit the protection it affords—to the disadvantage of the pockets and reputations of honest men like themselves.

W. H. CAZALY.

Post-war Amateur Transmission

HERE are my suggestions for licensing conditions after the war.

Code test to be raised to 20 w.p.m. It will be a very poor operator who cannot do 20 after the war. Mild theory test at local P.O.

No 'phone tickets except for 5 metres.

No inter-G contacts except on 5 and 160 metres.

No high-power tickets.

To discourage piracy, no AA tickets and no transmitting valves to be sold except on production of a licence.

Ten minutes to be maximum time allowed for each QSO, and time to be shared according to the following timetable. I am assuming that, in addition to the G2, 3, 4, 5, 6, 8 call-sign prefixes, we will have G1, 7 and 9 after the war.

Mondays: G1, G2, G3, G4, G5 stations use only 40, 80 and 150 metres, while G6, G7, G8, G9 use 5, 10 and 20 metres.

Tuesdays: G1—5 use 5, 10 and 20 metres, while G6—9 use 40, 80 and 160 metres. And so on for the remaining weekdays.

On alternate Sundays G2, 4, 6 and 8s would change round with G1, 3, 5, 7 and 9s in using the 40, 80, 160 or 5, 10, 20-metre bands.

WILLIAM MORRIS ex G4HU.

Romiley, Cheshire.

Should Amateurs Know Morse?

I WOULD like to add a few comments on the letter in your September issue, by Mr. H. W. Haydon. Serving as a radio operator at sea for nearly three years before the war and at present engaged on radio work of national importance, I hope to take out my first amateur radio licence at the end of the war. I feel sure that if morse qualifications are not made a condition for obtaining a licence, then the babel of pre-war days will be increased ten-fold.

Regarding your correspondent's first point that well-qualified and scientific workers are barred from obtaining a licence because they are forced to learn morse, I would like to mention that, together with a number of schoolfellows, I succeeded in reaching twelve words per minute when I was only about thirteen years old, in a period of about four months. If schoolboys can achieve this, surely a qualified and therefore presumably intelligent person can do as well if not better.

For the second point that morse should be abandoned as a nuisance, surely your correspondent realises that in the band-width of 10 kc/s occupied by a telephony transmitter dealing with audio frequencies only up to 5,000 c/s, at least ten CW transmitters can be accommodated without interference, providing a suitable crystal band pass filter receiver is used. In view of the limited spectrum available for the large number of amateurs, it looks as though it would be better to condemn telephony rather than telegraphy on the grounds of being a nuisance.

I do not think that any experienced operator would agree that the theoretical knowledge of radio is a sufficient qualification for allowing the operation of a radio station. For proof of this, I suggest that, when peace returns, your correspondent listen on any of the "shared" commercial bands and see the difficulty which an inexperienced operator can unwittingly cause.

Finally, should it at any time become necessary for amateurs to perform a service of national importance in emergency, as they have so often done in the United States, I pity the poor operator who can only read "phone" trying to copy an urgent message with a howling gale or thunderstorm in progress.

No, I do not think it is a question as to whether there shall be "morse or no morse," but more a question as to whether our post-war amateurs shall be efficient, competent and skilled men, or whether they shall be a band of "chin-waggers."

"J. B. T."

MORSE requires less power than telephony and is more reliable than the microphone when accuracy is essential. We are all familiar with the pitfalls of telephony due to misunderstanding of pronunciation, with consequent requests for repetition.

The international Morse code minimises the difficulties of those with a limited knowledge of foreign languages. To waive the morse qualification would limit the scope of the R.S.G.B. and lessen the usefulness of the P.M.G.'s licence.

Surely those who have attained a high standard of technical and scientfic knowledge should not find it difficult to qualify in morse.

C. G. WISDOM.
108, Novar Drive, Glasgow, W.2.

Circuit Diagrams

THE secretiveness regarding technical information that appears to have been the traditional policy of British domestic radio trade and industry has, I believe, been positively harmful commercially (especially as regards foreign trade in British-made apparatus) and certainly an unnecessary nuisance to both amateur and professional technicians who do not actually work in or own shops or factories. It is partly responsible, too, I think, for the distressing amount of technical ignorance that is being revealed in the training establishments of the Services in this war. Admittedly, the retailers have to obey the behests of the manufacturers and wholesalers, so it is not their fault that they withhold technical information from their customers. But surely now is the time, as never before, when the mystery about domestic radio should be dispelled by the issue, with each receiver sold, of a plain circuit diagram and table of technical data.

"TECHNICIAN."

Recording Blanks

IN response to my appeal (August *Wireless World*) for details of methods of re-coating direct recording blanks a number of letters has reached me, amongst which I would particularly acknowledge those of D. Elmore, W. G. Corderoy and D. Roe.

Mr. W. H. Pierce, in the September issue, has contributed a most informative description of a method of making a gelatinous type blank, so I will only offer suggestions for producing blanks of the nitro-cellulose, *i.e.*, so-called cellulose-acetate, and synthetic resin thermo-setting types.

For renovating cellulose-coated blanks the following two methods have met with some success: (1) High-grade cellulose-thinners is applied liberally, in a dust-free atmosphere, to the surface of the used discs and, after a time, the old grooves will collapse and if left for about 24 hours a new surface is produced. The results with this process depend on the freedom from dust and the evenness of the applications of cellulose-thinners. (2) Pour a quantity of amyl-acetate with a spot of camphor on to the blank rotating at about 10 r.p.m. and then efface the old grooves by radial movements with a 1-in. camel-hair brush. The blank is then left on the turntable or placed on the level elsewhere to enable gravity and surface tension to act in producing a new surface.

The following is an account of some experiments in producing new synthetic resin blanks, using glyptal or alkyd type resins. The resin is applied in a suitable solvent to a plain aluminium or zinc base as the disc rotates at about 5 r.p.m. in a horizontal plane. This rotation is continued until the layer has air-dried and will no longer "run" and is "tack-free." The grooves can then be cut in the

Letters to the Editor—
layer and subsequently hardened by baking.

Two glyptal resins, Paralac 2001 and 3101, of Imperial Chemical Industries, Ltd., have been tried. With Paralac 2001 it was found necessary to dilute the material (a 50 per cent. solution of solid resin in "Cellosolve") with an equal bulk of diluent, such as a mixture of equal parts of methylated spirit and toluene, or equal parts of butyl alcohol and xylene. Taking the figure of 50 per cent. solid resin in the original solution it is possible to calculate the volume of diluted solution required to give a dried layer 0.005 to 0.007in. thick on any size blank. The air-drying process is unfortunately a lengthy one as it takes two or three weeks before the surface is absolutely "tack-free" and hard enough for cutting, after which it can be "stoved" for one hour at 120 to 125 deg. C., when a hard permanent surface is produced.

Paralac 3101 is slightly less viscous than the 2001 but it still requires the same diluent. The preliminary air-drying may be accelerated in both cases by a short bake at around 100 deg. C., but great care must be taken to ensure that the surface is not allowed to harden too much. It should be noted that unnecessarily thick films of lacquer are not satisfactory as bubbles form during the baking and spoil the surface.

DONALD W. ALDOUS.
Torquay, Devon.

RANDOM RADIATIONS

By "DIALLIST"

Wire and Watts

TILL the other day I'd no idea how hard it was to get some kinds of wire just now. I wanted two or three ounces of No. 34 enamelled copper wire to rewind the small induction motor of an electric fan. DCC in that gauge I had in plenty; but that wouldn't do, for it occupied too much space. The bakelite case surrounding the motor is so small that you can't get enough turns on to the coils unless enamelled wire is used. I've tried shop after shop without success and given it up as a bad job. But there's a way out of the difficulty, which you may find useful if a fan or other small domestic appliance of yours becomes a casualty. This particular fan is of American make. The case is marked "200-250 volts. Current 0.4 amp." Now, it struck both the Signals Instrument Mechanic, who was doing the job for me, and myself that 80-100 watts was a pretty large ration for a small fan and that 0.4 ampere was more than was good for No. 34 wire. We resolved to do some experimenting, and what we found was this: Coils wound with No. 32 wire could be made to contain sufficient turns for the efficient working of the motor, but, naturally, they heated up too much, owing to the heavier current passed. Therefore an ordinary lampholder was wired in series with the fan motor and lamps of various wattage were tried. To our surprise, we found that the fan would run at adequate speed (*and* keep perfectly cool) with a 60-watt lamp in series. One concludes that some, at any rate, of the smaller and cheaper American-made fans pass far more current than is necessary and burn out—I've had more than one that met its end in this way—because the load is too heavy for the windings. When I get the time I'm going to make experiments with the series lamp and other fans. If you don't want the light of the lamp you can always paint the bulb over with black japan enamel and regard it purely as a resistor.

Butting In

THE antics of the fellow who daily messes up the transmissions of the Deutschlandsender have been most amusing. Doubtless you've heard him at work. One presumes that Moscow No. 1 must be used for the purpose, though I have no certain information; Russia may well have several stations whose power can be increased, when the need arises, to a formidable figure. Whatever else the interrupter may have accomplished, he has certainly made the German broadcasting authorities do a bit of thinking and has largely succeeded in spoiling their long-wave programmes as serious entertainments. The musical programmes at the time of writing are extraordinary affairs: without an instant's pause, a singer succeeds a pianist and an orchestra the singer. If any hitch gives an interval of more than a second or two the voice that has now become so famous chips in with one of his pointed remarks.

Dyed-in-the-Wool

RECENTLY one of the officers who are my accomplices in the present job of work fell sick. As we were already short-handed, I put in for a stop-gap to help us out. Through came a telegram that Lieutenant Oldsweat had been attached to my establishment for all purposes and ordered to report to me for duty forthwith. And late on a dark and rainy night he turned up, having travelled more than a hundred miles in one of those blessed "utility" light vans that so well earn their name. Grand fellow, long row of medal ribbons, keen as mustard. When I'd given him an outline of the work he'd have to do we went over to the mess, and the Mess waiter was commanded to "bring out the Bass." (Yes, we had a few precious bottles.) At that moment the telephone rang. Signals officer asking if wireless communications were satisfactory. What my newly joined officer heard as my end of the conversation was something like this: "Field strength at —— is hopeless . . . if you'll raise that aerial at —— to 60ft., I believe you'll do it. . . . Yes, but what about sticking in an extra amplifying valve?" When I hung up, my latest acquisition enquired, with a knowing look in his eye, whether I was a wireless man. "Guilty," sez I; "and you?" I learned that he was a real old dyed-in-the-wool radio fanatic. Made his own variable condensers (any of you remember the tip for straightening out the vanes when you'd cut them out with a pair of tin-snips, by using a nearly red-hot flat-iron?), valve holders and grid leaks in the days when such things, if obtainable at all, cost certainly their weight in silver.

Chinwagging

With a start like that we naturally got down to real wireless talk, and presently I found that he was amongst the keenest of keen DXers. A further discovery was that he was a correspondent of mine of many years' standing. I didn't let on at first that I was "Diallist," though at length it had to come out. Anyhow, we had the most soul-satisfying chinwag on wireless—a real joy after months spent without meeting any genuine long-distance enthusiast. This was the prelude to many other jolly talks and to some amusing adventures on the short waves with the only receiver available—an "all-wave" broadcast set, with the coarsest of coarse tuning arrangements on its SW band. Like so many old hands, he'd built every receiver he'd ever used until a short time before the war broke out. So had I, and we discussed the respective merits of heaps of famous *Wireless World* sets that we'd made up—and, of course, improved upon!

Improvements!

TALKING of improvements reminds me of a very unkind cut once delivered to me. At the request of her family, I once designed and had made up for an old lady a completely foolproof set that really did deliver the goods in the shape of two alternative programmes, but could not be made to commit the then unforgivable sin of interfering with neighbours' reception by causing squeals; it couldn't energise its own aerial because it was so designed that it was impossible to make it oscillate. The only controls were two switches. One turned the set on; the other, if in one position, brought in Station A at fine strength. In the other position it caused the alternative Station B to come in equally well. Some months later friends who lived near the old lady complained bitterly that she was ruining their reception by producing squeals that ran up and down the musical scale interminably. "Impossible," I said; "she couldn't do it with her set if she tried." I thought, though, that I might as well investigate, and did so. I found that a week or two before the set had packed up—a burnt-out valve, I learned later—and that, "not liking to trouble me," the old lady had called in a local service man. He had at once proceeded to "improve" the set by adding (*a*) a tuning arrangement to enable the whole MW band to be covered, and (*b*) a reaction control knob. The set had thus become far from foolproof, and the dear old soul had been playing the dickens with reception in the vicinity by her misguided endeavours to find the "silent point between squeals." I had the set put back again to its original form, and all was well. But I wonder how many receivers have been ruined by the "improvements" made in them by enthusiasts whose keenness on results outran their skill as designers!

The Wireless Industry

A NEW moving-coil microphone has been introduced by the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2. It is housed in a sloping desk cabinet with a control key and is eminently suitable for message-broadcast centres. The impedance is 15 ohms and the list price is £4 4s.

W. T. Henley's Telegraph Works Co., Ltd., Milton Court, Westcott, Dorking, Surrey, announce that owing to restrictions in the supply of materials the "Handyman" 65-watt "Solon" electric soldering iron has been withdrawn. Industrial models, including 65, 125 and 240 watt types, are still available.

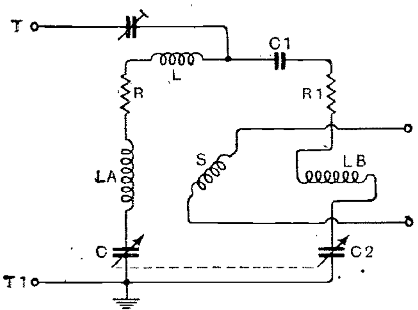
A second (revised) edition of the brochure describing the HS1/HS2 transmitter has been issued by Standard Telephones and Cables, Ltd., Connaught House, Aldwych, London, W.C.2.

RECENT INVENTIONS

A Monthly Selection of the More Interesting Radio Developments

PHASE-ADJUSTING CIRCUITS

A CURRENT fed to the terminals T, T1 is split between the two branch circuits L, R, LA, C and C1, R1, LB, C2 respectively. If the values of L and C1 are suitably chosen, and the condensers C and C2 correctly set, the currents flowing in the two circuits can be brought into phase quadrature. The two amplitudes can also be made equal by equating the values of the reactances. Finally, if R is made equal to the inductive and capacitive reactances, the two currents will remain substantially in phase quadrature over a comparatively wide variation of the input frequency.



Method of counteracting interference from nearby transmitters.

The two coils LA and LB are set at right-angles to each other, as in a goniometer, so that a rotating field is set up between them. An output current of any desired phase relation can then be drawn off from a pick-up coil S pivotally mounted between the two field coils LA and LB.

If, for instance, the terminals T, T1 are fed by a voltage tapped off from the oscillatory circuit of a transmitter, the voltage derived from the coil S can be injected into the circuits of a nearby receiver, so as to neutralise or balance-out any direct interference both as regards amplitude and phase.

Marconi's Wireless Telegraph Co., Ltd. (Assignees of W. van B. Roberts). Convention date (U.S.A.) July 30th, 1938. No. 530407.

PUSH-BUTTON ADAPTER

A NUMBER of units, each designed for a preselected wavelength, are compactly housed in a thin flat box, which is then attached to one of the walls—or preferably below the base of the cabinet of a standard wireless receiver, so as to adapt the latter for push-button tuning. The connections necessary to substitute one or other of the fixed elements in place of the ordinary tuning condenser of the set are taken from the top of the adapter and through the bottom of the cabinet.

The particular unit to be inserted in circuit is controlled by a series of buttons mounted on the forward edge of the adapter box. One of the buttons brings the variable tuning condenser into circuit when it is desired to use ordinary manual control. Each of the switch-tuned elements is made semi-variable so that the selected wavelength can be adjusted as desired.

Telefunken Co. Convention date (Germany) May 6th, 1938. No. 528916.

PREVENTING "FLUTTER"

IN a multi-band superhet set, where the local oscillator valve is supplied from the same anode-voltage source as the audio-frequency amplifier, there is a noticeable tendency, particularly when using the set for short-wave reception, for interaction to occur between the two valves in question, and to result in an undesirable "fluttering" of the oscillator valve. This can, in practice, be prevented by inserting suitable filter circuits in the anode-supply, but since it is necessary to use large-value condensers of the electrolytic type the remedy is an expensive one.

As an alternative it is now proposed to use a two-stage AF amplifier and to couple the stages together by a circuit which produces a different phase-shift as the signals fall above or below a certain critical frequency. There is a common cathode impedance, and the arrangement is such that for signals above a particular frequency the feedback is positive, whilst for signals below that frequency the feedback is negative. This provides a stabilised circuit free from the defect first mentioned.

Marconi's Wireless Telegraph Co., Ltd. (Assignees of M. C. Jones). Convention date (U.S.A.) April 30th, 1938. No. 528632.

AERIAL COUPLINGS

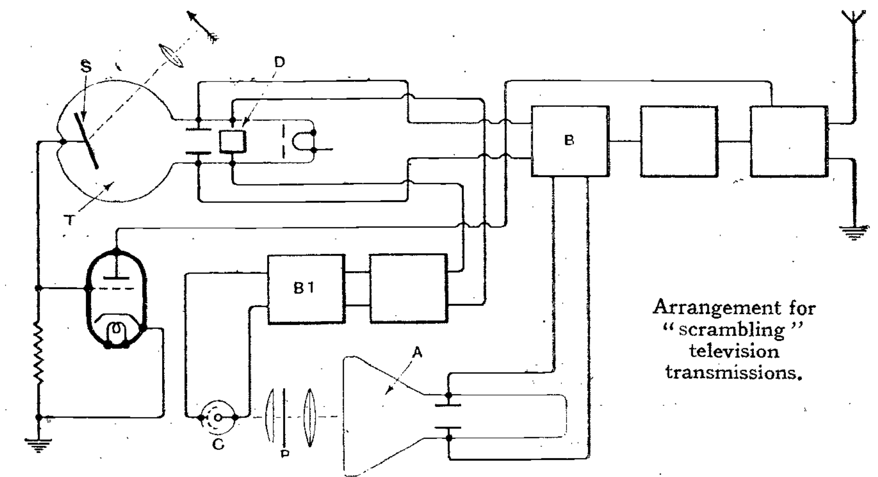
WHEN a receiver is coupled to an aerial of the so-called anti-static type through a transmission line, it is difficult to match the impedance of the line to that of the aerial over a wide band of frequencies—covering say the short, medium and long waves—without using a complex and expensive form of coupling network.

According to the invention, the usual two-wire feed line is replaced by two similar pairs of feeders. One two-wire feeder is coupled directly to the long-wave coil in the aerial circuit, and the other two-wire feeder is coupled directly to the medium-wave aerial coil. The short-wave coupling is made through a "phantom" circuit which is tapped across the mid-points of the primary coils of the two separate feeders. The "phantom" circuit can be coupled either to a short-wave aerial coil, or to a separate dipole aerial. The arrangement ensures a matched impedance coupling on all three wave-bands.

Philips Lamps, Ltd., and J. B. Kaye. Application date June 30th, 1939. No. 530220.

"SCRAMBLED" TELEVISION

THE Figure shows a television transmitter in which the picture to be transmitted is focused on to the sensitive screen S of a cathode-ray tube T, where it is scanned by the electron beam from the gun of the tube. An auxiliary cathode-ray tube A is, however, used to impart a certain irregularity to the scanning process, which, in effect, renders the transmission secret except to a properly equipped receiver.



Arrangement for "scrambling" television transmissions.

The beam of the auxiliary tube A is controlled by the time-base unit B so as to scan a control plate P. This is marked with lines which are irregularly spaced in a predetermined pattern. The spacing of the lines, in turn, controls the impulses sent by a photo-electric cell C to the time-base unit B1 which is coupled to the deflecting plates D of the transmitting tube T. The result is that the line synchronising signals are not radiated regularly but follow the deliberately imposed pattern on the plate P. Such signals will be secret except to a receiver fitted with a duplicate of the control plate used in transmission.

Scophony, Ltd., and A. H. Rosenthal. Application date March 6th and 17th, 1939. No. 530776.

RADIO COMPASS

TWO pairs of directive aerials, set at right-angles to each other, are coupled through phase-splitting circuits to a cathode-ray indicator. The signal from a non-directive aerial is added, in known fashion, to produce a rotating cardioid response on the fluorescent screen. Simultaneously, impulses derived through frequency changers from a master oscillator are applied to the control electrode of the indicator tube, and serve to mark out radial divisions corresponding to the normal marking of a compass scale on the same fluorescent screen, so that the latter shows the compass bearing of the incoming signal.

Marconi's Wireless Telegraph Co., Ltd. (Assignees of D. G. C. Luck). Convention date (U.S.A.) 30th June, 1938. No. 530979.

PIEZO-ELECTRIC OSCILLATORS

FOR generating frequencies of the order of 500 kc/s the cube type of crystal is generally superior to the plate type, particularly when high stability in spite of temperature changes is a chief consideration. The usual arrangement is to use the crystal to control a two-stage relaxation-oscillator, but this sometimes gives trouble by producing parasitic oscillations, particularly when used in connection with a bank of crystals to be switched from one operating frequency to another.

According to the invention, improved stability is obtained by using the crystal to control a single valve-oscillator of the cathode-coupled type, i.e., one in which the anode is reactively coupled to the cathode instead of to the grid of the valve. The control crystal is inserted in series with a balancing condenser, between the anode of the valve and earth, so that it is in parallel with the tuned back-coupling circuit. One of the crystal electrodes is connected to the grid, the other to the anode or to earth.

Marconi's Wireless Telegraph Co., Ltd., and G. P. Parker. Application date July 12th, 1939. No. 531639.

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.

UNBIASED

By FREE GRID

Thane of Cawdor

LIKE most other people, my time and that of my fellow scientists is largely occupied nowadays in digging for victory, although naturally our digging does not consist of actual delving into the soil like the unlettered masses, but of probing into the secrets of nature behind the locked doors of our laboratories. Since the only difference between an onion and a lump of coal lies in the number and arrangement of the electrons which constitute their respective atoms, it is not unnatural that many of the more prominent workers in the field which may be termed higher electronics are devoting their attention to this method of producing this offensively indigestible vegetable.

Such research work is not for me, however, as, whatever my faults, I have never been a slave to my stomach, and my digging for victory is on an altogether higher plane. It is, for obvious reasons, quite impossible for me to talk about my work. Modesty would forbid even if the censor didn't. You will, however, learn all about my doings when the honours list comes out at the conclusion of the war. It is not for me to say what honours will be bestowed on this or that person who has laboured in the wireless vineyard, but other people are not so cautious, and I am a little perturbed at a report which reached me the other day to the effect that Mrs. Free Grid has been seen seated before a mirror in the salon of a well-known Bond Street jewellers, trying on coronets.

"Glamis, Cawdor, Scotland, . . . all."

It is not the fact of her trying on coronets that worries me so much, but from the information I have received it appears that she has set her heart on one ornamented with strawberry leaves. Women are ignorant as well as obstinate creatures, and I can scarcely think that she can be aware of the fact that strawberry leaves are almost as strictly reserved as membership of the Jockey Club or the R.Y.S. I scarcely know what to do about it, and yet if I don't do something I shall eventually find myself in a serious mess, for Mrs. Free Grid's ambitions have much in common with those of the late-lamented Lady Macbeth. To quote the words of S. Walker, Esq., "What would you do about it, chums?"

Modern Methods of Mastering Morse

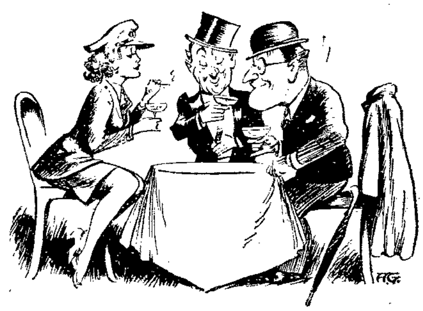
I WAS intensely interested in the article published in the June issue of this usually staid and sober journal in which it was stated that one method of improving your morse speed was to get slightly drunk.* Needless to say, I lost no time in ringing up the Editor to ask if special classes were being arranged. I obtained very little satisfaction, however, as, judging by the somewhat incoherent reply which I received, he was pre-occupied by the full-time task of improving his morse.

I, therefore, determined to put the idea into practice without delay to see whether there was anything in it, and looked about for a few pupils on whom to experiment. Being a leading member of the local temperance society I could not very well experiment in my own neighbourhood, and so I armed myself with a key and buzzer and set forth in my car—using my basic ration, of course—for the West End of London, and was soon explaining matters in the private room of the proprietor of several well-known night clubs and bottle-party rendezvous.

He proved very enthusiastic about the whole idea, and gladly gave me the free run of his establishments. I was, however, rather startled a few nights later to find that several of his places which had been incurring black looks from the police had been renamed, and were now known as "Morse Schools," and bore such legends as "Tuition by the latest method advocated by *The Wireless World*"; "Learn morse and help your Country."

I ventured a mild protest, but the proprietor speedily reassured me that no drunkenness beyond the "slightly" advocated in *The Wireless World* would be permitted, and promised to take six full-page advertisements in next month's issue to stress this point. It was, I fear, this thoroughly unscientific "slightly" which was the eventual cause of all the subsequent trouble with the police, and I am surprised at *The Wireless World* using it instead of stating so many "microfalstaffs" or whatever is the unit of drunkenness; to my mind it is equally as slipshod as defining the noise of a loudspeaker as "ever so loud" instead of stating a definite number of phons.

This gross lapse on the part of this journal makes me almost ashamed of my *Wireless World* tie, and I have been in two minds whether to do as I did with my German Orders and decorations at the outbreak of war, and return it to the Editor. I would indeed do so if I thought there was a chance of my getting back the eighteenpence I paid him for it. As it is, I have been going about lately with my new autumn overcoat (16 coupons) buttoned up to the neck in order to hide it.



A Morse Instructress.

All went well for a few evenings until certain people began to feel that they wanted to get beyond the beginners' stage and to make a spurt forward in their speed. Even then all might have been well if one of the more ardent pupils had not suggested that the electric horn of a car was an ideal morse buzzer, with the result that all the members of the more advanced class in one of these nocturnal "Morse Schools" went careering wildly through the West End in their cars morsing frantically to each other with their horns. One can hardly blame the police for the strong action which they took in the matter. But, as I have already hinted, the real cause of the whole unsavoury business is to be found in other and more august quarters.

**The Psychological Pause,* page 162, June, 1941.

NEW RECEIVERS AND AMPLIFIERS

£18/10 Only.—"Wireless World" 2R.F. receiver, with push-pull quality amplifier chassis: 10 valves, including tone control stage, 8 watts triode output, ideal for quality reproduction from radio and gramophone, limited number; reduced price includes all valves.—Bakers Selhurst Radio, 75, Sussex Rd., South Croydon [9703

RECEIVERS & AMPLIFIERS SECONDHAND, ETC.

HALLICRAFTER Super Skyrider S.X.16, with speaker and 6 spare valves; £40.—Box 2592, c/o *The Wireless World.* [9702

AMPLIFIER, suitable for large factory, £50, cost over £200; also Avometer, D.C., £6.—Nursery, Barking. 'Phone: Seven Kings 1323. [9723

Wanted

NATIONAL H.R.O. or 100X.A., also "S" meter, Hallicrafters S.X.25, S.X.17.—Price, details, 14, Common Rd., Evesham. [9711

USED Three-wave Battery or Mains Receivers; top prices paid for good quality machines.—Tregunna, 15, High Cross St., St. Austell. [9721

NEW or used Receivers, Amplifiers, Meters, Converters, Radio & Electrical Accessories. Very high prices paid for really clean apparatus.—'Phone: Gerrard 4447. [9696

McMURDO Silver, Halford, Scott or multi-valve equivalent radiogram console or chassis, sound sales tri-channel amplifier, Voigt corner speaker, Voigt pick-up, Telefunken T.O.1001 pick-up and tone control, Haynes or W.W. 2R.F. feeder, give very full details and price required.—Box 2594, c/o *The Wireless World.* [9720

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VORTEXION, Ltd., 257, The Broadway, Wimbledon, London, S.W.19. 'Phone: Lib. 2814. [9571

SHORT-WAVE EQUIPMENT

RADIOMART, largest distributors communication equipment. National distributors.—48, Holloway Head, Birmingham. [9555

NEW LOUDSPEAKERS

BAKERS Brand New Surplus Speaker Bargains.

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

£5/15; usual price £10.—Brand new permanent magnet infinite baffle speaker, complete with beautifully finished cabinet in polished walnut.

£2/15; usual price £5.—Brand new super quality triple cone speaker, permanent magnet model; exceptional bargain; limited number.

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

BAKERS SELHURST RADIO, 75, Sussex Rd., Sth. Croydon. [9709

EPOCH.—Genuine hand-made diaphragms, all models. "R.E.C.S.," Crown St., Reading. 'Phone: 2796. [9717

"GOODMAN 9" permanent magnet moving coil units fitted multi-ratio output transformers, very sensitive, excellent reproduction, new in original cartons, 22/6 each, carriage paid, cash with order.—P. & F., 49, John Bright Street, Birmingham, 1. [9693

Wanted

FERRANTI M1+ or M1 Super, or Goodmans Infinite baffle.—Box 2595, c/o *The Wireless World.* [9722

WANTED, Voight corner horn, with or without unit.—104, Wheel Lane, Grenoside, Sheffield. [9701

GRAMOPHONE EQUIPMENT

TABLE Type Twin Turntable (Metal) Garrard Universal Motor, M/I pick-ups, £14; or Piezo, £16.—Voigt, The Courts, Silverdale, S.E.26. [9718

Wanted

DE Luxe Model Simpsons Electric Turn Table, 230 v, 50 c.—Clark, "The Spinney," Wigan Lane, [9689

VOIGT Horn, pickup, twin motor, record cabinet, local feeder.—Foy, Church St., Elsecar, Barnsley. [9725

CABINETS

WE Regret That, owing to all our employees having joined H.M. Forces, we are unable to accept orders for cabinets except to callers. Limited stock only. We have a large stock of radio components.—H. L. Smith and Co., Ltd., 289, Edgware Rd., London, W.2. Tel.: Pad. 5891. [6683

TEST EQUIPMENT

TEST Oscillator Kit Available Shortly; particulars on request.—Maclachlan and Co., Strathyre. [9726

WESTON Analyzer and E692 Oscillator, complete with Adaptors in combination case. Best offer secures.—2, Birley Street, Bury, Lancs. [9692

HUNTS' Signal Generator, £8; Avo, 70/-; Clough-Brengle analyser, £8; mikes, turntables, speakers, transformers, valves, etc.—Box 2593, c/o *The Wireless World.* [9710

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'Phone : SLOUGH 20855

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ELECTRIC LIGHT CHECK METERS, small, late type, well-known makers, first-class condition, electrically guaranteed, for A.C. Mains 200/250 volts 50 cy. 1 phase 5 amp. load, 10/- each ; 10 amp. load, 12/6 ; 20 amp. load, 15/- ; all carriage paid.

D.C. ELECTRIC LIGHT CHECK METERS, 200/250 volts, 5 and 10 amps., in new condition and electrically perfect ; 7/6, post free.

AUTO. CHARGING CUT OUT AND VOLTAGE REGULATOR, ex-R.A.F., suit any dynamo up to 20 v. at 15 amps., fully adjustable, with wiring instructions, complete in metal case, 3/6, post 9d.

SOLID BRASS LAMPS fitted small B.C. double contact holder and 12-volt bulb, price 3/- post free.

110 VOLT D.C. MOTOR, totally enclosed, rated at 8 amps., ball bearing, in new condition, make good slow-speed dynamo, weight approx. 75 lbs., price 45/-,carriage forward.

EX R.A.F. SWITCH PANEL with case (new), fitted six small knife switches, complete in wood case, 2/6 each, post 6d.

POST OFFICE MORSE KEYS, standard pattern, solid brass construction, in first class condition, 12/6, post free.

8 WAY Press Button switches, fitted paxolin terminal strips, 2/- each, post free.

P.A. SPEAKER CABINETS, not polished, size 22in. by 18in. by 13in., to take 14in. dia. cone, the whole made of ½in. thick plywood. Price 20/-, carriage 2/6 ; Ditto, in Rexine, slightly soiled, 17/6, carriage 2/6.

UNIVERSAL CHASSIS, late type, all components sound, no valves, 4 and 5 Valve models, worth double, for parts only. Price 7/6, post free.

ASSORTED WIRE END resistances and tubular condensers, all good and useful sizes, 2/6 per doz., post free.

SMALL TRANSFORMERS, for rewinding, sound windings on but rating unknown. Price 4/6, post 6d.

1 KW. TRANSFORMER, for rewinding, fitted sound mains winding (Ex large tunger rectifiers). Price 35/-, carriage forward.

2 KW. TRANSFORMER, ditto as above. Price 50/-, carriage forward.

EPOCH, Super Cinema Loud Speaker, 20-watt size, 6 volt 2 amp. field, in good working order. Price £3 10s. 0d., carriage forward.

SLIDER RESISTANCE, fitted worm and wheel control, resistance 2,500 ohms, to carry 200 milliamp, 20/-, post free.

PHILLIPS, 1 MF, condensers, 4,000 volt working, large size, price 10/- each, carriage 1/6.

LARGE TRANSFORMER, 230 V. 50 cycle, 1 PH input ; output 2,000—0—2,000 volts at 200 M/A and two L.T.'s, 11 volts and 4 volts, in first class condition, price 50/- each, carriage forward.

MILLIAMPMETER, 2½ inch dia., flush fitting, moving coil, reading 0—3 milliamps. in first class condition and working order, price 40/-, post free ; Ditto milliampmeter reading 0—50 M/A, 30/-, post free ; Ditto milliampmeter reading 0—200 M/A, 30/-, post free.

LARGE 1 KW. Transformers for rewinding, rating unknown, price 20/-, carriage forward.

GUNMETAL PULLEYS, 7in. dia., to take 1in. dia. rope, complete with rope guard and hook, price 7/6, carriage 1/-.

110 V. BULBS 150 C.P., Ediswan screw fitting, half watt gas-filled, 2/6 each, post free, or 22/6 per doz., post free.

SHEET EBONITE, size 12in. by 11in. by 1/32in., best quality, price 3/- per doz., post free.

ZENITH VITREOUS RESISTANCES, all useful sizes, in perfect working order, price per doz. assorted 10/-, post free.

1,000 YARDS of hard rolled **COPPER WIRE,** 14 gauge, bare, suitable for outdoor telephone wire, etc., on drum, unused, price £3 10s. 0d.

ELECTRIC BELLS, maker "Tangent," for heavy duty, working on 6 to 24 volts D.C., fully adjustable, ironclad, fitted heavy 6in. dia. gunmetal gong, loud ringing, price 15/- each, carriage 1/6.

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TELEPHONE MAGNETOS, or hand calling generators, 3 and 4 magnet type, unboxed, in good working order, price 7/6, post free.

ROTARY CONVERTER, D.C. to A.C. ; input 80/110 volts D.C. at 33 amps. ; output 180/240 at 11 to 8½ amp., 500 cycles single phase, also 24 volt at 12½ amps. 200 cycles single phase, Ball Bearing, 2,500 r.p.m., in good condition and perfect working order, price £25, carriage forward.

FIXED RESISTANCE wire wound on slate, 40 ohms, to carry 1½ amps., protected, new & unused, price 6/-, post 9d.

All Goods sent on Three Days' Approval Against Cash.

Wanted

USED But Perfect Universal Avo Minor Meter, prompt; quote lowest price.—Box 2588, c/o *The Wireless World.* [9698

WANTED, Hunts Condenser Analyzer; all types of good test gear purchased at fair prices.—Chancery Precision Instrument Service, Middle Claydon, Bucks. [9730

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FULL Range of Transmitting Keys, practice sets and equipment for Morse training.—Webb's Radio, 14, Soho St., London, W.1. 'Phone: Gerrard 2089. [9553

MORSE Keys on Solid Oak Base, suitable for Army, Air Force and Home Guard training; sold in shops at 7/6, our price 4/3, postage 6d.—Fred's Radio Cabin, 75, Newington Butts, S.E.11. 'Phone: Rodney 2180. [9715

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

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

VALVES

SALE. 300 Valves, Components, Voigt, Tractrix, Romino. Wanted, electric motor, H.M.V. hypersensitive pick-up, with transformer.—Johnson, Claylake, Endon, Stoke-on-Trent. [9690

Wanted

AN Osterganz E.G.100, 240/250 v. valve.—Write Ullman, "Trove," New Rd., Esher. [9691

VALVES Wanted, any quantity from one upwards; also test equipment, service sheets and spares.—J. Bull, 4, Melthorne Drive, Ruislip. [9732

VALVES Purchased.—Send list of types for quick and confidential transaction.—Chancery Precision Instrument Service, Middle Claydon, Bucks. [9731

COMPONENTS—SECONDHAND, SURPLUS, ETC.

RADIO CLEARANCE, Ltd.

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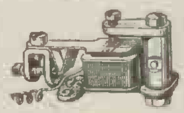

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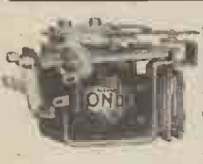

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