

DETECTION METHODS—SEE PAGE 310

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Practical Wireless

6^d

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MONTH
July, 1941.

and

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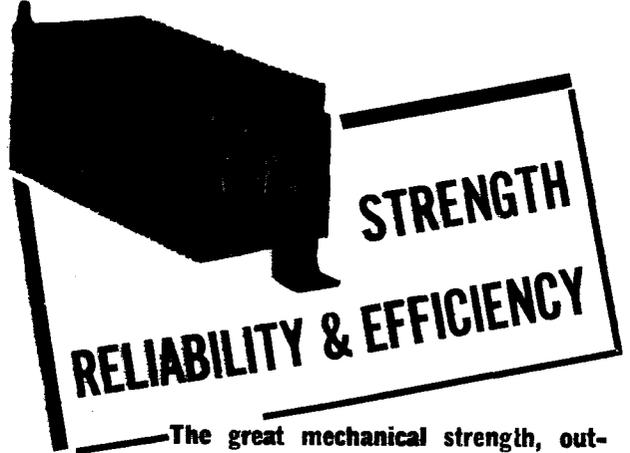
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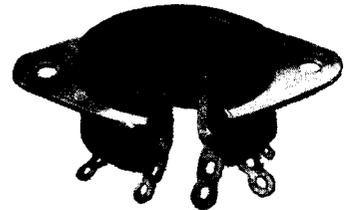
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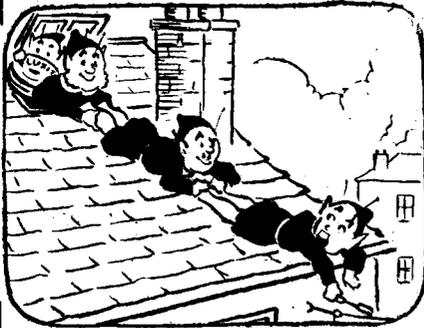
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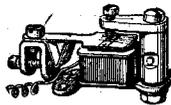
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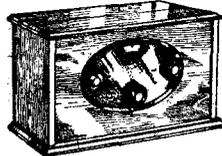
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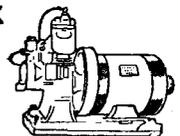
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EVERY MONTH.

Vol. XVII. No. 421 July, 1941.

EDITED BY
F. J. C. AMMStaff:
FRANK PRESTON
L. O. SPARKS.

COMMENTS OF THE MONTH

BY THE EDITOR

Broadcast Propaganda

THERE has been severe criticism of the Ministry of Information and of the B.B.C. concerning the alleged weakness of our Broadcast Propaganda. The subject was limned in Parliament recently over the arrival in this country of a German traitor. It was suggested that we had not made sufficient use of the incident in our broadcasts to Germany. The fact that the member of a political organisation flees the country bears its own propaganda value in a bald statement of the fact. To endeavour to embellish it by wishful thinking destroys its value.

Conjecture as to the possible reasons behind it only provide suitable material for bar-parlour gossip. The newspapers have been filled with suggested reasons why Hess flew to Scotland. They hailed it as a victory, and suggested that the maximum amount of use should be made of it in our German broadcasts. Our case is sufficiently strong not to need such a soporific, and in our view the endeavours to dress up Hess's flight as a sign of a German crack has cancelled out its value. It can be argued that it is no more a sign of a crack in the ranks of the German party than the sacking of Chamberlain was the sign of a crack in this country.

Politics being what they are, it is always possible that a member of a political party will find himself in disfavour, and there will always be intrigues. In this country the man is merely removed from office. In Germany, where party politics do not exist, the man flees the country. We do not wish to convey the impression in our broadcast propaganda that we are drowning people clutching at a straw. It is equally our view that we should not allow nonentities to use the air to propagate their personal views. We should, in fact, give them the air in another sense.

Raised from Obscurity

WE have always in this country made the mistake of presuming that because a man writes a successful novel he is able to express views on politics, warfare, religion, and education. He becomes famous because he writes some trifling novel which sells well and captures the public's imagination. He is interviewed and photographed, and his views are sought on diverse subjects by enterprising reporters. He has lifted himself from obscurity and "arrived." No one stops to ask the question whether he has studied the particular subjects on which he talks.

This is where the ether is being misused. It does not seem to be realised that once a man broadcasts, his views become household words, and from that point he is enabled to bask in the often undeserved limelight of public adulation.

Early Philosophers

BETTER use could be made of quotations from famous authors and public men now dead, and particularly those of German origin. Quotations could be made from the writings of the early philosophers, for their views have been confirmed by over 2,000 years of world history. Present views have not been mellowed in retrospect; they deal with the possibilities of the future, whereas the writings of Horace and Virgil and Plato have impacted on world history, and we are able to assess whether their views have been confirmed during the passage of the centuries.

Take the following quotation:

"Is it not always the practice of the commons to select a special champion of their cause whom they exalt to greatness? Then, obviously, whenever a despot grows up, his origin may be traced wholly to this champion-ship which is the stem from which he shoots. He must keenly notice who is manly, who high-minded, who prudent, and who wealthy. He is compelled to plot against them until he has purged them, directly counter to the process by which the physician purges the body, for the physician purges what is bad, and leaves what is good, but the tyrant removes the good and leaves the bad. As soon as he has relieved himself of his enemies his first measure is to be constantly exciting wars, in order that the commons may stand in need of a leader, and we know that an insane or deranged person expects to be able to lord it, not only over men, but even over gods, and attempts to do so." Who wrote that? Does

it not apply to Mussolini? It fits his case, does it not? But if you think they were written concerning Mussolini, you are wrong. Hitler, then? Wrong again. Those words were written over 2,300 years ago by Plato in the book which every schoolboy knows as "Plato's Republic."

Nostradamus

WE are somewhat surprised that greater use has not been made of this prophetic statement. There are many dozens of others which are more calculated to make the German flesh creep, including the prognostications of Nostradamus, than wishful thinking regarding the object of Hess's flight to the country he has hated so much, but which was the only country which could provide him with safety and sanctuary.

Great Britain is not the only country which is remiss in allowing nonentities to broadcast stupid views. There is the case of Col. (now Mr.) Lindbergh, a man who flew the Atlantic alone and landed in France with a world-wide reputation as the Flying Fool. It was a brave act and we do not wish to belittle Mr. Lindbergh's abilities as an airman, but he flew from obscurity as a flying fool into fame. From that moment his reputation has been world-wide, and he has been given the freedom of the air to broadcast his views on the war. Now, Mr. Lindbergh was not, and is not, a politician, and we are glad to observe that the large-hearted American nation has shown its disapproval of this misuse of broadcast. Feeling apparently was so strong against him that he has resigned his post as Colonel. Thus from the obscurity of the airman who was a flying fool he goes back to the obscurity of one who was a political fool, for, of course, Lindbergh could not possibly know the international implications of the present war. Like Hess, he fled to England for sanctuary, after a German had killed his child. He has shown poor gratitude for the great hospitality which this country showed to him. The subtle Germans, however, feted him when he visited that country, and appealed to his vanity. This may account for his distinctly pro-German, and if not pro-German, then certainly anti-British attitude in his broadcasts.

The British Public

LET us in this country, therefore, take the lesson, and be particularly careful in our selection of those to whom we extend the privilege of expressing views over the air. And let the B.B.C. remember that the British public requires of its speakers greater qualifications than that they have written a successful novel or excelled, say, in the field of sport.

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Problems of Amateur Receiver Design—II

The Use of Push-pull Amplification in Mains Receivers

By FRANK PRESTON

LAST month we considered the one-valve-per-stage type of L.F. amplifier for use in a mains-type receiver. For the average type of broadcast or "communications" receiver this form of amplification and output is most convenient, and is completely satisfactory. But when quality reproduction is an important matter, and when a large output is required without the need for very high H.T. voltage, push-pull in one of its various forms is desirable.

It should be stated that this form of amplification is not, relatively, as valuable as it was a few years ago, since modern tetrodes and pentodes can be used to provide outputs up to about 10 watts; and this is without introducing much distortion. Nevertheless, push-pull can generally be considered to be somewhat better from the point of view of quality, and it is certainly valuable when a high-power output is required while using an H.T. voltage of, say, 250 or less. From this it should not be assumed that push-pull is not satisfactory at high anode voltages. It is even more efficient in those conditions, but we are here mainly concerned with receivers from which an output up to 10 watts is ample.

Advantages of Push-pull

Considered from the aspect of undistorted output for a given input, push-pull is at an advantage over the forms of amplifier considered last month. Another advantage is that it provides a greater undistorted output than twice that of one of the valves used singly. These points will stand out more clearly if reference is made to a particular valve used in different sets of conditions. The PX4 is probably the best-known power-amplifying triode available, so we may look at a few figures relating to this valve. When used as a single Class A amplifier with 300 volts on the anode, this valve has a rated output of 3.5 watts; in this circuit the anode current, as given by the makers, is approximately 50 mA. Two of these valves used in a Class AB1 push-pull circuit provide a power output of 10 watts, whilst each valve passes a standing anode current of 40 mA, which rises somewhat on loud passages of strong signals. The increased efficiency gained by using the push-pull arrangement is evident from these details, for the comparative figures may be applied to other valves of corresponding type.

Class A and B Amplification

In passing, it might be desirable to make some reference to the terms Class A, Class B, and Class AB1, as used with reference to push-pull amplifiers; there is also a Class C, but this will not be considered here because it is generally used for another purpose. In Class A amplification (and this applies also to single-valve stages) the valve works entirely on the straight portion of its characteristic curve. In other words, the sine wave A.C. applied to the grid is reproduced in amplified form in the anode circuit. Another point about this type of circuit is that the grid bias is fixed approximately midway between the bottom bend of the characteristic and zero grid volts.

In the case of Class B (which is used only in push-pull circuits) the valves are biased right back to the bottom bend,

with the result that scarcely any anode current flows on negative grid swings. As a result the output as developed in the anode circuit is in the form of a series of "peaks" instead of a sine wave. By combining the output from two valves working in "opposition"—one taking the negative grid swings while the other takes the positive swings—the sine wave may be completed by adding together the output from the two valves. In this form of amplification the average anode current is dependent upon the amplitude of the A.C. voltage applied to the grids, and therefore upon the strength of signals handled.

Class AB1

The above is only a very rough explanation, and is incomplete, but will suffice for our present purpose. Between Classes A and B there are various other arrangements, the difference generally being only in connection with the applied grid bias. Thus, Class AB1 can be described as slightly

singly and with an anode voltage of 300, as with the push-pull circuit. These figures are given only as examples, and must be modified according to the particular valves employed.

The Circuit Explained

Making further reference to Fig. 1, it will be seen that the output stage is preceded by a triode L.F. amplifier, which would, in turn, follow the double-diode-triode second detector-L.F. amplifier. The push-pull transformer, which should have a ratio not exceeding 1-3 is shown as being parallel fed. This is desirable since the anode current required by the preceding valve would be rather too high to pass through the primary winding of the push-pull transformer. The value of the anode resistor will depend upon the L.F. valve employed, which should be of the "L" type, whilst the value of decoupling resistor indicated is generally applicable.

It will be seen that there is a stopper

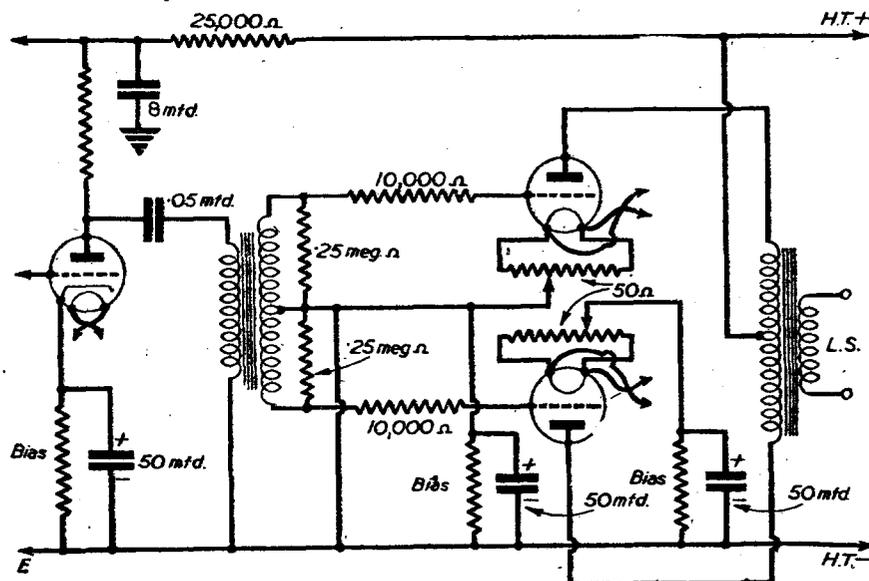


Fig. 1.—A typical push-pull output stage with intermediate L.F. amplifier, using directly-heated triodes.

over-biased Class A push-pull. It is this over-biasing which results in the reduced anode current, although it should be added that, as with Class B, Class AB1 generally takes a higher anode current as the input to the stage increases. That is, the current consumption varies with the volume of the output.

A representative push-pull circuit is given in Fig. 1, where the valves shown are power triodes with directly-heated filaments. Each valve is biased separately by means of a resistor connected between a centre-tapped resistor placed across the filament leads and earth. The resistors described as centre-tapped should have a value of about 50 ohms and should actually have a slider so that the electrical centre can be found by trial. The value of the bias resistors depends, of course, on the valves employed; for the PX4 valves previously referred to, the recommended bias resistors have a value of 1,000 ohms for Class AB1 amplification. This compares with the 850 ohms recommended when using the valves

resistor in each grid lead; these are to prevent parasitic oscillation and are desirable in almost every push-pull amplifier. The value of 10,000 ohms shown is a good average. Stability is further improved by the connection of a 25-megohm resistor across each half of the transformer secondary winding. As previously stated, the two valves are individually biased, but in some cases—chiefly when the valves are being run well below their maximum anode voltage—a single bias resistor may be used, this having half the value of that required for a single valve, due to the fact that it carries double the anode current when it feeds both valves. It is, however, best to retain the separate biasing in all other cases.

Output Transformer

When using the arrangement shown, the directly-heated output valves must have separate filament windings on the mains transformer. An output transformer of the push-pull type is shown, and this should

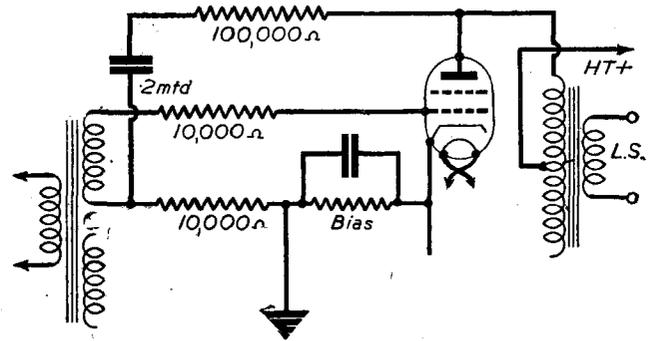
be matched to the valves. As most readers are aware, the correct ratio for any output transformer may be found by dividing the required anode load (twice that of each valve for push-pull) by the speaker impedance and taking the square root of the result. It need scarcely be stated that a large speaker is necessary to handle the output from a push-pull amplifier such as that under consideration, and that correct matching is extremely important.

Tetrodes in Class AB Push-pull

Fig. 2 gives a circuit using a pair of power amplifying tetrodes in push-pull. It is similar in most respects to that shown in Fig. 1, but the valves in this case have indirectly-heated cathodes. It will also be observed that a common bias resistor is employed, that there are grid stopper resistors, and that 100-ohm stoppers are used in the screening-grid leads. Due to the use of indirectly-heated valves it is not necessary to have a separate winding on the mains transformer for the heaters, provided that they are of the same rated L.T. voltage as the other valves in the set.

A simple form of tone compensation is used in the form of a .005 mfd. fixed condenser between each anode and earth. This also assists in giving complete stability to

Fig. 3.—A method of applying negative feed-back in a push-pull amplifier. Only one of the two valves is shown, in the interests of clarity.



resistor is in series with a fixed condenser of about .2 mfd., the condenser being connected to the tapping between the "earth" end of the input transformer secondary and a 10,000-ohm resistor. The A.C. voltage developed across the resistor is fed into the grid circuit in the form of "reversed reaction."

When using this system it is necessary to use a push-pull transformer with separate secondary windings instead of there being a single winding with a centre tapping. Such transformers are generally obtainable as alternatives to the more usual type, and are normally sold at a slightly higher price.

Reference has not been made to the wattage rating of the various resistors, but the same considerations apply as were outlined last month. Thus, all the stopper and negative feed-back resistors could be of 1/2 watt, whilst the rating of the others should be calculated by the simple method, based on Ohm's Law, which was explained in the preceding article.

Effect of Anode Voltage

It has been mentioned above that push-pull is very useful when a large output is required while using a comparatively low H.T. voltage. This will more readily be appreciated when it is considered that a representative power output valve may be rated as providing an A.C. output of 5 watts on 350 volts, 3 watts on 250 volts, and 2 watts on 200 volts. If a practical limit were set on the permissible H.T. voltage, by the mains transformer in an existing set for example, and an output of 5 watts were required, the most satisfactory method of obtaining it would probably be to use push-pull, when the required output could be obtained when using about 200 volts H.T. These figures do not relate to any particular valve, but give an indication as to what might be expected. There is, of course, a practical limit to the permissible reduction in H.T. voltage without great sacrifice in efficiency, but with most valves—especially triodes—there is a good deal of latitude with regard to the working H.T. voltage.

In a case such as that cited above, however, it is possible that it would prove more convenient to use a pentode or tetrode with high mutual conductance in place of the push-pull stage. In general, that would be a satisfactory solution only when quality reproduction is not of first importance.

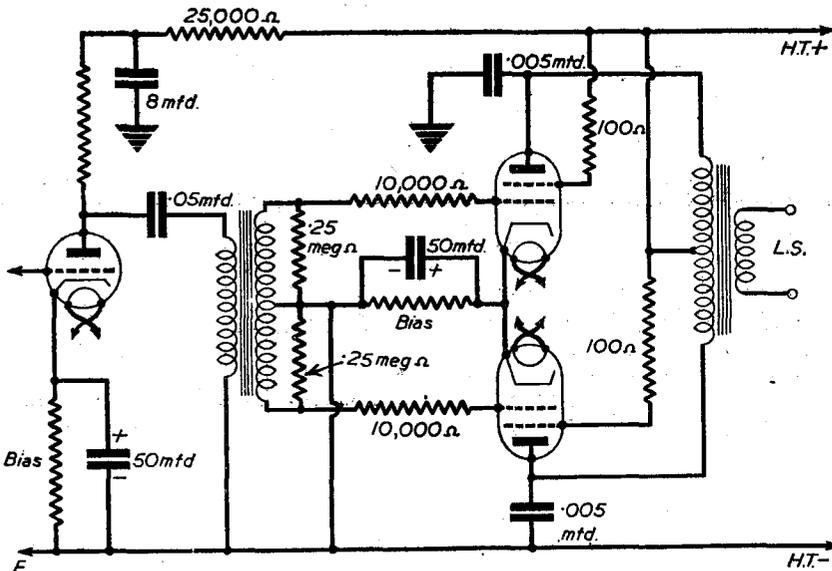


Fig. 2.—A pair of power tetrodes in push-pull. Pentodes of suitable type could be used in the same circuit.

the amplifier. As to the output transformer, precisely the same considerations apply as in the case previously dealt with. It must always be borne in mind that the anode current passing through the transformer is fairly high, and that a good component should be used. This is in spite of the fact that the current through the two halves is in opposition.

Using Negative Feed-back

Although a push-pull amplifier is normally easy to maintain in a stable condition, it is sometimes desirable, when using modern high-amplification tetrodes and pentodes, to introduce negative feed-back. This can be done fairly easily, as shown in the simplified circuit given in Fig. 3. In this case only one-half of the complete push-pull amplifier is shown for the sake of clarity; it will be appreciated that both halves are exactly alike. The actual arrangement of components is slightly different from that shown when dealing with single-valve amplifiers, since in this case there is no grid condenser and therefore the anode could not be fed back to the grid through a fixed resistor. Instead, the 100,000-ohm

BOOKS RECEIVED

CONVERSION TABLES: METRES TO KILOCYCLES. Published by H. C. Van Rood Technical Publications. 64 pages. Price 1s. 6d., post free, from Radio Society of Great Britain, 16, Ashridge Gardens, London, N.13.

THIS useful little booklet, which is in vest-pocket form, contains conversion tables for metres to kilocycles, and covers the whole range of 1 to 29,990 metres. The columns in the table are interchangeable, or in other words wavelength and frequency being reciprocal, 50 metres corresponds to 6,000 kc/s, and 50 kc/s to 6,000 metres, and so on. Radio experimenters will find this a handy reference book.

ELEMENTARY HANDBOOK FOR WIRELESS OPERATORS. By W. E. Crook, A.M.I.E.E. Published by Sir Isaac Pitman and Sons, Ltd. 102 pages. Price 4s. net.

IT is often apparent that the beginner in radio cannot "see where he is going," and bearing this in mind the author of this book has endeavoured to remove the

difficulty by presenting to the reader a general view of radio communication with an introduction to its technique, thus to enable him to tackle more comprehensive books later on. This useful book should appeal to all prospective radio operators with the Services.

DEAD RECKONING NAVIGATION. By W. J. D. Allan and William Alexander. Published by George Allen and Unwin, Ltd., 100 pages. Price 2s. 6d. net.

DURING recent years the increasing speed of aircraft has involved the introduction of a new technique, full details of which are embodied in this handy volume. The term dead reckoning covers most navigational problems other than those associated with direction-finding wireless and celestial observations. It is sometimes spoken of as pilotage, and it plays a very important part in the navigation of all types of aircraft. In this book the authors deal with each type of problem in a simple and straightforward manner, and several examples are given for exercise, most of which are illustrated by line drawings.

A Radiogram Wireless Link

Two Novel Units for the Experimenter

THE wireless link in radio-gramophones is a new development originating in America, though there is nothing new in the fundamentals employed.

The main points are that with a turntable, a gramophone pick-up, and a simple auxiliary circuit, gramophone music can be picked up by any receiver in the house. Even if the receiver is not fitted with pick-up terminals the scheme will work, since it is not necessary to disturb the wiring in any way.

Auxiliary Circuit

The following notes are intended to assist readers who wish to make up the simple auxiliary circuit, which is really a miniature transmitter. The circuit transforms the audio impulses of the pick-up into a modulated high-frequency carrier of weak power, which can be detected by an ordinary wireless receiver up to distances of 30 feet or so. The gramophone music is tuned in just like a broadcasting station,

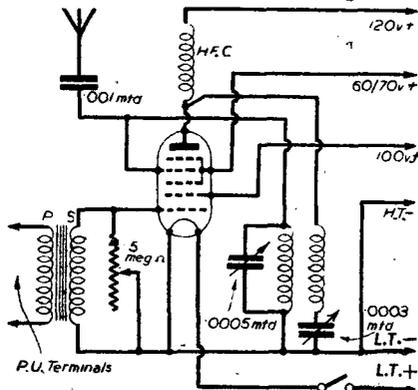


Fig. 1.—Theoretical circuit, using a heptode frequency-changer valve.

which it apparently resembles in strength.

Fig. 1 shows the theoretical circuit employed. It will be seen that a heptode frequency-changer valve, as used in a superheterodyne receiver, is used, and curiously enough it still plays the part of an oscillator-modulator, though in a different way to that in a superhet receiver. It will be seen that the pick-up is connected, through a transformer, to the first grid, where it modulates the electron stream at low frequency. The second grid is connected to H.T. positive at 100 volts. Grids three and five, which form the screening-grids of the valve, are connected to about 60 or 70 volts positive, which is the normal voltage for this class of valve. The fourth grid, which comes out at the top cap of the valve, forms the radiating electrode, and is tuned by the coil and condenser as shown in Fig. 1. High-tension is supplied to the anode of the valve through an H.F. choke. The reaction winding, necessary to maintain the valve in a state of oscillation, is also connected to the anode, and thence by way of a reaction condenser to the point of least potential, i.e., L.T.-.

Operation

To use the arrangement, connect about 10ft. of wire as an aerial, and if a low reading milliammeter is available place it in series with the H.F. choke. Now rotate the reaction condenser until the reading shows a sharp reduction, indicating that the valve is now oscillating. Switch on the receiver and set it at a point where no

station is operating, and rotate the tuning condenser of the gramo. unit until a rushing sound is heard. This indicates that transmitter and receiver are in tune. It is helpful, if the receiver has a reaction control, to make the receiver oscillate temporarily, when a whistle will be heard when the transmitter and receiver are approximately in tune. Now ease off the reaction control on the receiver and adjust its tuning knob whilst music is coming through from the pick-up. The reason for not reversing the process, that is, setting the gramo unit haphazardly, and then picking it up on the receiver, is that one must have a "clear channel" free from any interfering station if a heterodyne is to be avoided.

With stations having less than a 10 kilocycle separation on the medium waves it is by no means easy to find a clear channel after dark, though it is easy in daylight. The long waves should prove suitable in this respect, particularly towards the bottom of the long-wave band. For this reason a dual-wave coil can be used in the gramo unit, and it is then a simple matter to switch from one wave to the other.

For those who want the best possible results there is much to be said for the employment of the ultra-short waves as a radiogram wireless link. Here there will be no heterodynes, and much superior reproduction will be obtained if a good pick-up is used, particularly if the receiver has been designed with a view to first-class reproduction. The sound part of television receivers, and those receivers designed to receive the sound part of the television service, come under this heading.

On Ultra-short Waves

A gramo unit to operate on a wavelength of 5-7.5 metres is shown in Fig. 2. As will be seen it is very simple, but due care must be taken in the lay-out to get extra short leads and wiring. The valve should preferably be mounted on a pillar or turned on its side in order to get the valve-holder terminals close up to the condensers and coils. The coils themselves are each of three turns on a lin. former, and the aerial coil is adjustable in relation to the other coils. This can be done by mounting

the coil former on its side and having the aerial coil on a small separate former, which can be moved to or from the other coils. It will be appreciated that the best results will be obtained by using proper ultra-short-wave coil formers such as those made of ceramic or other material having good qualities as a dielectric at the extremely high frequencies employed in this circuit.

De-basing the Valve

It will not be necessary to de-base the valve in order to get it into the oscillating condition. The circuit, which is the split Colpitts type, is a ready oscillator at these high frequencies. Needless to say, a comparatively "young" valve should be used, however, as good emission is a prime essential; an old valve may have fallen off in this respect.

The valve may be an L.F. or driver type, having an impedance of from 6,000

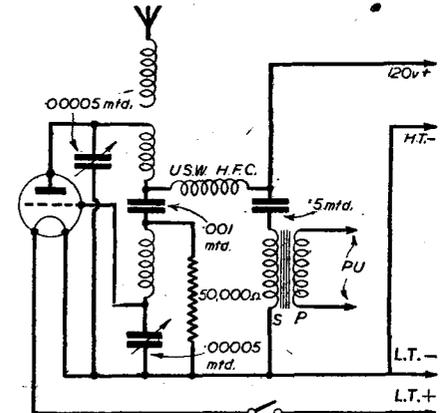


Fig. 2.—Circuit diagram of a gramo. unit to operate on the U.S.W.

to 10,000 ohms. The Ferranti driver type L2, due to its construction and the way the electrodes are placed low down in the bulb, can be recommended as suitable. A true power valve is undesirable, as is also an earth connection in either of the gramo. units described.

MICROPHONES AT LONDON RAILWAY STATIONS



One of the women microphone announcers who have taken over from men at London main line stations. Our illustration shows the woman announcer at Paddington.

BAND-SPREAD WITH PERMEABILITY TUNING

IT is now becoming apparent that tuning by variation of inductance instead of by variable capacity has certain advantages. The lay-out of the receiver chassis is simplified and the cost of the tuning element can be reduced, particularly by using a variable inductance of the variable permeability type in which a suitable core of magnetic material is moved inside a solenoid.

This type of tuning inductance lends itself conveniently to use in an all-wave receiver with band-spread. The tuning inductance can take care of the medium-wave band, and can easily be arranged to cover the long-wave band by the connection of a suitable fixed capacity in shunt. On short waves the tuning inductance can be used to provide fine tuning in the spread bands by connecting suitable values of fixed inductance and capacity in shunt so as to centre the tuning range in the frequency ranges required, the ratio of the fixed inductance to the fixed capacity being so chosen that the desired tuning range is provided by the tuning inductance.

ON YOUR WAVELENGTH



Special Requests

OF all the correspondence which struggles for existence on a journalist's desk, and particularly correspondence which struggles for existence in print, none is more prolific at the present time than that which makes an appeal. These appeals take various forms; someone wishes to sell some back issues, another has some wireless parts for disposal, whilst there are always those who want a particular component not now made. The most touching appeals, of course, come from enthusiasts in the services living in remote districts and who are without wireless. Unfortunately in these days of paper shortage and small periodicals the space is not available for them to be printed. Were space available, preference would undoubtedly be given to those in the services.

So many of them are being received that the paper would be filled with them. The War Office, as was announced in an earlier issue, has undertaken certain arrangements regarding the supply of receivers for the troops, and direct approach should be made to the Commanding Officer of the Regiment concerned. Requests for components, back issues which are out of print, or announcements that second-hand components are for sale cannot be printed. The Miscellaneous Advertisements of this journal have been specially produced at but a tithe of the normal advertising rates to meet the needs of those who have something to sell or who wish to buy. Readers will appreciate the difficulty. If such appeals were made in the editorial pages we should have to treat every reader alike, and there would be little, if any space left for articles and features; and, after all, readers buy the paper, not to read appeals, but to read articles. I hope readers will understand.

Hook-up Receivers

IN response to my recent suggestion I have received some dozens of designs for Hook-up Receivers, and I hope to publish a selection of them in the next issue. Books will be awarded to the senders of those published. The offer is still open.

Measuring Distances by Radio

RISING amidst the waters of the White Sea—part of the Arctic Ocean—is a group of islands by the curious name of "Wandering Islands." This appellation is very appropriate, as no two maps agree on their exact position. Each of the numerous explorers who attempted to settle the matter fixed the situation of the group differently: the islands "moved" to a new position. This was the situation until the summer of 1940, when an expedition of three scientists—radio-physicists—came to the White Sea on a hydrographic vessel, named *The West*, to make another attempt to chart the position of the Wandering Islands in relation to the mainland. They employed a strange new apparatus, with the aid of which they studied the sea routes and compiled charts to make navigation in Arctic waters safe. And the scientists made their measurements with extreme rapidity and ease, but the captain of the vessel remained convinced that the results obtained were no more precise than previous data.

One night in September last found the

By Thermion

expedition steering a course through a dense fog. Cruising in the "pea soup" fog, *The West* was making for the nearest port to spend the night. Somewhere along the ship's course lay a group of rocky islands known as the Stolboviye Ludi. The vessel steered a course which, according to the pilot, would avoid all danger of piling up on the rocks. Suddenly the three physicists rushed up to the captain with the alarming news that the ship was steering straight for the islands. They had determined this with the aid of their new apparatus. But the captain only smiled. He had no intention of wandering around in circles because of some unknown apparatus. And, glancing at the map, he turned the helm slightly to keep the ship exactly to her course through the dense fog. "Land ahead" came a sudden cry from the look-out. Bells clanged, orders rang out and the motors roared into reverse as the screw churned the waters with terrific force. The ship came to a standstill a few yards from the forbidding rocks.

How the Apparatus Operates

THE apparatus tested in the White Sea has come to be known as a radio distance-meter. Invented by the Soviet scientists, Professors N. Papalexi and L. Mandelstam, it employs radio waves to measure distances. The radio distance-meter consists of two special receiving and transmitting sets situated at two points, the distance between which is to be measured. Radio waves of exactly-known wavelengths are remitted from one set and received by the other, from which they are relayed back to their source. This is done to determine how many wavelengths fit into the distance being measured. But the difficulty lies in the fact that this cannot be done directly. However, if this procedure is repeated, employing a radio wave of slightly different length the second time (by changing the wavelength in which the set is operated), it then becomes possible to determine the number of waves that fit

into the distance by comparing the results of both measurements. With the aid of some simple measurements and calculations based on the knowledge of the velocity of radio waves the distance is determined precisely.

Employing such a radio distance-meter a captain of a vessel can always determine his position without using a compass or any other navigation instruments. Two radio relaying stations are located at fixed points on land and the ship's position is found as the point of intersection of two arcs whose radii are the distances from the ship to the aforementioned stations.

The principle of the method is so simple that at first it seems hard to understand why it was not employed before. But even a cursory examination of the complex apparatus answers this question. It is so highly perfected that it works as easily as the simplest tool: the process of recording the number of wavelengths is almost completely automatic, and the results are unparalleled for their precision. The apparatus fills a big gap; it supplies science with a new and rapid-working instrument for measuring long distances. It is unnecessary to speak of the great usefulness of this radio distance-meter in compiling maps and charts, in charting air routes, and so on.

Broadcasting Without a Microphone

A CORRESPONDENT writes as follows: "The lively music of a guitar met me when I entered the Acoustics Laboratory at the Moscow Conservatory of Music. The guitarist, I was told, was on the air, but the scene in the laboratory resembled anything but a radio broadcast. At the other end of the laboratory two other musicians were discussing something in rather loud voices. A third was tuning up a violin. I looked in perplexity at the guitar player, and I was suddenly struck by something distinctly odd; there was no microphone before the musician! Just then the guitarist finished. The announcer called for silence. There was a sudden hush, he switched on his table microphone at the far end of the room, and introduced the next number. He then switched his microphone off, the guitarist began his next piece, and the other musicians, after listening a second, resumed their conversation and violin tuning.

"That my curiosity was aroused would be putting it quite mildly. But the announcer did not satisfy me; he simply assured me that this was a bona fide broadcast and then he directed my attention to the secret: the guitar. I scrutinised the instrument closely. I saw nothing unusual, at first, except for a wire leading away from it. Yet this wire, as I learned later, was what made broadcasting without a microphone possible.

"The ordinary broadcasting microphone has one main drawback: it is not selective. It picks up sounds promiscuously. And all the sounds or noises striking the microphone are amplified. This is annoying to the radio listener, particularly when the broadcast is from the stage of a concert hall. Moreover, the microphone makes it necessary to effect a double transformation—from sound to electrical energy and back again—and somewhat distorts the sound of an instrument."

Our Roll of Merit

Our Readers on Active Service—Sixteenth List.

- C. L. Redshaw (A.C.1, R.A.F.),
Dover.
- W. G. Robinson (L.A.C., R.A.F.),
Liverpool.
- G. N. Daniel (A.C.1, R.A.F.),
Driffield.
- J. W. Tate (Gunner, R.A.),
Leeds.
- J. G. Smith (Sgt., R.C. Signals),
Middle East Force.
- S. Yeoman (A.C.1, R.A.F.),
Doncaster.
- D. Mies (A.C.2, R.A.F.),
Cornwall.
- K. Cohn (Pte., P.C.),
Chester.

The Relay and Its Uses

The Construction and Operation of Various Types of Relay Simply Explained

THE home-constructor and experimenter is not always aware of the many useful operations which may be performed by means of a relay. Relays suitable for amateurs' use are often offered for sale in the columns of this journal, and may be obtained quite cheaply.

A relay consists basically of a coil of wire wound on suitable magnetic material, and so arranged that when a current is passed it will pull towards it an armature (Fig. 1). The armature bears on springs (not shown) which it pushes towards or away from other springs, thus making or breaking contact between them.

Spring Sets

Spring sets may be of three types: "make," consisting of two springs which

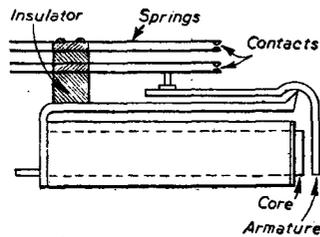
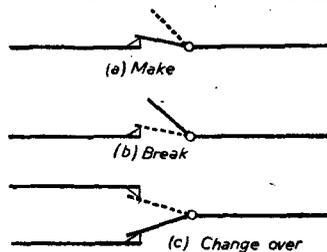


Fig. 1 (Left).—Diagram of a simple relay.

Fig. 2 (Right).—Illustrating the different types of spring-set relays.



are brought together when the relay operates; "break," two springs which separate; or "change-over." A change-over set consists of three springs, one of which can make contact with the other two; it makes contact with one of them when the relay is not operated, and the other one when it is. These different types of spring-sets are shown in Fig. 2. Change-over spring-sets may also be arranged so that the pair of contacts which are about to make do so before those which are about to break. In this case the set is said to be of the "make-before-break" type.

Springs are equipped with contacts at the points where they touch. These must be of suitable material, such that a proper low resistance contact be made, and also they must be able to withstand any arcing that takes place when the springs separate. They are usually of gold, silver, or platinum, though for relays bearing heavier currents at higher voltages, tungsten is frequently used.

Relays are often "slugged." A slugged relay is one which remains operated for a short time after voltage has been removed from its coil. Slugging is effected either by mounting a large copper ring or a closed winding at one end of the relay coil (Fig. 3). When current is dying in the ordinary coil, large currents are induced in the slug which tend to preserve the magnetism of the core and keep the relay operated. A second

coil of the same nature as the first is also sometimes wound on the core. It may be used as a "polarising winding"—if a steady current flows through the polarising winding the relay will be operated. Current in the main winding will then, in one direction, have no effect, and in the other will cause the relay to go back to its normal position. This may also be done by making the core of material which readily retains its magnetism, and magnetising it powerfully.

For Remote Control

The relay is obviously a very useful instrument in the field of remote control, and Fig. 4 shows a simple circuit by means of which a receiver, or other apparatus, may be switched on or off from a distance. The relay coil is connected in series with the

line to the distant point and a battery, and on closing the switch, the relay operates and the receiver is switched on. The disadvantage of this arrangement is that the battery must be left running continuously while the receiver is on. This is overcome in the manner shown in Fig. 5, in which case a polarised

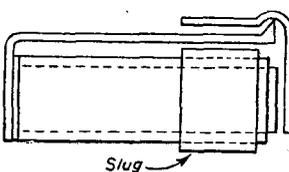


Fig. 3.—A slugged relay.

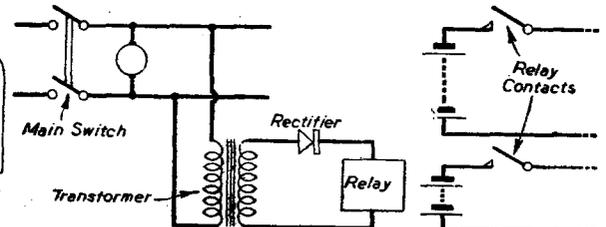


Fig. 6.—Circuit showing how a relay is used for automatic power supply control.

relay and two press buttons are used. The "on" button causes the relay to operate, and being polarised, it stays operated. But the "off" button sends current round in the opposite direction, destroys the magnetism, and causes the relay to release.

Power Supply Control

Another field of service for the relay is in that of safety, or economy. It is extremely common in the workshop to have more than one power supply. For example, one might

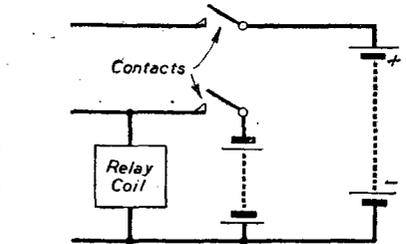


Fig. 7.—Method of using a relay for protecting bias supply.

have a broadcast receiver on A.C. mains, but be doing some work on short-wave gear running from batteries. The mains can be arranged with a proper double-pole switch and indicator lamp near the door, so it is fairly easy to make certain that these are turned off. It is very difficult, however, to be sure that all the battery supplies have been turned off. A neat remedy for this is illustrated in Fig. 6. A small transformer is connected across the A.C. supply, and across the secondary of this is connected a relay in series with a rectifier. One pair of contacts of the relay opens the H.T. battery circuit, the other pair the L.T. circuit. Thus it is only necessary to turn off the mains switch to be sure that all power supplies are disconnected.

One further use of the relay may be mentioned. Sometimes separate H.T. and bias supplies are used, and in some cases it may be very dangerous to apply H.T. even for a second without bias. In that case a relay may be connected as shown in Fig. 7.

Until the bias supply is on the H.T. circuit is broken, and hence no H.T. can be applied without bias.

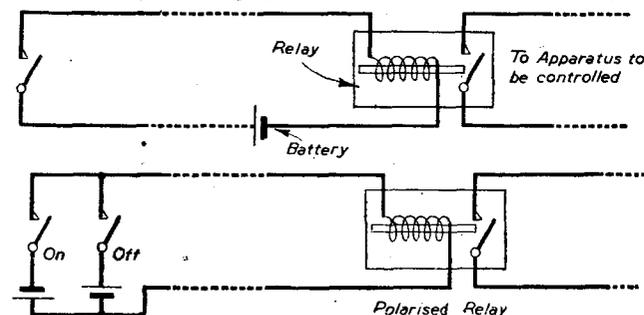


Fig. 4.—A simple remote control circuit.

Fig. 5.—An improved version of the circuit shown in Fig. 4, using a polarised relay.

THE PRACTICAL WIRELESS ENCYCLOPEDIA

By F. J. Camm

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P.A. EQUIPMENT—3

The Design and Working of Microphone Amplifiers—By "SERVICE"

AMPLIFIERS employed for P.A. work are generally very simple and straightforward. They are, naturally, designed to give as high a quality reproduction as possible, and in many cases use resistance-capacity coupling throughout in the case of amplifiers having a single valve in the output stage, but where push-pull valves are employed good quality transformers are used.

Fader and Mixer

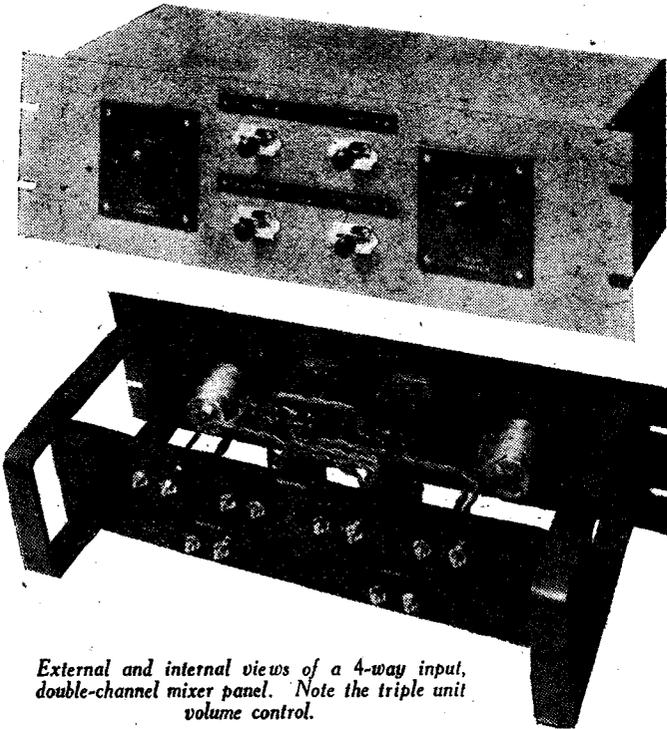
Our first considerations, therefore, will be to examine the various volume and tone control arrangements incorporated in P.A. amplifiers, and as it is wise to start at first principles we will examine a very simple fader and mixer arrangement which can control the inputs from two sources and feed the resultant signal to an amplifier.

Fig. 1 illustrates the most simple fader and mixer device which will control the output from two microphones. It will be seen that it comprises a potentiometer with the microphone M.1 connected between terminals 1 and 2 and the second microphone, M.2, connected to terminals 2 and 3 of the potentiometer. "S" is the moving

way round the potentiometer the value of the signal to the amplifier will comprise exactly 50 per cent. of M.1 and 50 per cent. of M.2 programmes. As the slider is rotated, M.2 programme will die out, M.1 programme will increase to full value until finally, with "S" right up against terminal 3, microphone M.2 will be virtually out of circuit or, rather, short-circuited.

This arrangement, while it helps to explain the fundamental principles of fading, is not of much practical use because one cannot obtain, when desired, a low background of M.1 to M.2, with the latter at, say, half volume. For example, taking the output of the two microphones as 100 per cent., it is only possible to have, say, 20 per cent. of one and 80 per cent. of the other, or 40 per cent. of one and 60 per cent. of the other, but never is it possible to obtain just 20 per cent. of each of the outputs from the two microphones.

For this reason it is generally arranged to have a volume control for each microphone, and for the fading to be accomplished manually by rotating the two controls in opposite directions and, when required, leaving them in any desired



External and internal views of a 4-way input, double-channel mixer panel. Note the triple unit volume control.

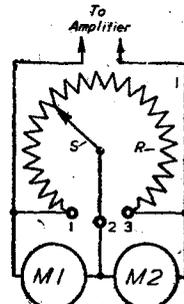


Fig. 1.—A simple two-way fader.

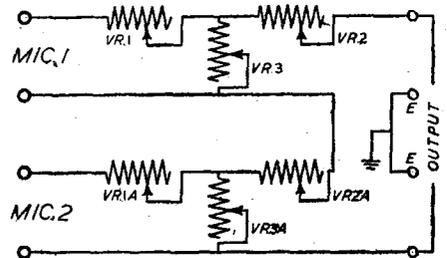


Fig. 2.—A more practical arrangement of Fig. 1, using a separate constant impedance volume control for each microphone.

The advantage of transformer couplings, of course, is the voltage step-up obtainable between the primary and secondary, thus enabling a very large output valve or valves to be driven from a comparatively small L.F. amplifier. With resistance-capacity coupling there is no amplification except that directly from the valves themselves.

The designer of P.A. amplifiers must produce an arrangement which will give as true a reproduction as possible of the signal fed into the amplifier because he probably does not know where the equipment will be used with regard to the acoustic properties of the building in which the loudspeakers will be operating. When designing an amplifier to work in a cabinet, with its loudspeaker, the designer can arrange for the chokes and transformers to emphasise or attenuate any band of frequencies he likes, so as to augment or compensate for any special acoustic characteristics of the cabinet and the loudspeaker.

The straightforward P.A. amplifier, however, must be capable of giving just the right type of reproduction to suit any environment of the loudspeaker. Therefore, the designer will endeavour to make his amplifier have a straight-line frequency response, and will incorporate appropriate tone controls to enable complete control to be obtained of both ends of the frequency response. Thus the operator can alter the reproduction to meet changing conditions.

slider and "R" is the resistance element of the potentiometer.

It will be appreciated that when "S" is right round, and up against terminal 1, microphone M.1 is short circuited and therefore its output is not applied to any portion of the potentiometer element and only the output from microphone M.2 is passed on to the amplifier at full volume.

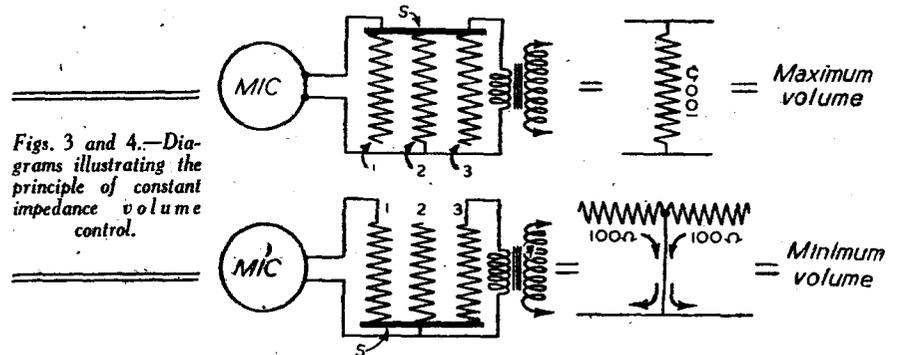
When "S" is rotated towards terminal 3 the short circuit is progressively reduced while the resistance across microphone M.2 is decreased so that the signal from it is attenuated. Thus, the programme from M.1 will be superimposed upon M.2, and will increase in strength, while the programme from M.2 decreases in strength.

When the slider "S" is exactly half-

position, as may be the case when it is desired to have a constant quiet background of music to accompany announcements or dialogue.

The next important consideration is that of correct matching between the microphones and the amplifier input circuit no matter what volume is required. If this is not attended to, quality as well as volume will be changed as the control is rotated.

Fig. 2 shows the circuit diagram of a two-way mixer with constant impedance arrangement for each of the microphones. Each control unit comprises three variable resistances in tandem connected on a common shaft. In Fig. 2, V.R.1, V.R.2, and V.R.3, are the three units on the control affecting microphone M.1, while V.R.1A,



Figs. 3 and 4.—Diagrams illustrating the principle of constant impedance volume control.

VR.2A, and V.R.3A are the three resistances in the control unit affecting microphone M.2.

Constant Impedance Volume Control

How the volume control presents a constant impedance to the matching transformer will be appreciated from a study of Figs. 3 and 4. The three elements of the triple volume control are designated 1, 2, 3 and the slider "S" (which really incorporates three sliders).

In the position of the volume control shown in Fig. 3 it will be seen that the resultant resistance is 100 ohms across the microphone and the transformer. This is the maximum volume position. Of course, the values given here, although suitable for certain types of microphones, would be different for other types, but this does not affect the operation of the device.

In Fig. 4, the sliders have been brought to the other end of the element, and in this position it will be seen that there is a resistance of 100 ohms in the microphone circuit,

The control panel may be part of the rack equipment of a large installation, but in small amplifiers the attenuator and tone controls are built-in with the amplifier on similar lines to the 10-watt amplifier illustrated in the first article in this series.

More especially is this arrangement suitable in cases where the microphones are a long way from the main amplifier. Because of the long run of microphone cables with consequent attenuation, microphone amplifiers would be necessary, and it would generally be arranged to have the fading and mixing controls on the panel built into the microphone amplifier.

Such an arrangement would be used at the side of the stage on which there might be three microphones, one of which would be for the orchestra and another for the actors, and the third for the compère at the side of the stage. The controller sitting at the microphone amplifier could watch the various turns in co-operation with the compère and fade in and out the microphones as required.

Valve Mixers

In order to bring all input channels to more or less the same level for fading purposes, and to maintain a constant impedance and load on the input circuit of the main amplifier, valve mixers are often employed. Each input has its own valve-amplifying stage which feeds into the final stage of the mixer via a master volume control.

Fig. 5 is a typical circuit of this type of mixer. The three microphone inputs being of a lower level than the radio and gramophone inputs have an additional stage of amplification. All these various inputs may be mixed, faded, or superimposed as desired in any degree, and the resultant mixture controlled by the master volume control for feeding to the power amplifiers.

Tone Controls

Unlike small amplifiers and the L.F. stages of radio receivers, the components of power amplifiers are subjected to very high voltages, and even the grid circuits may have high potentials applied to them. Consequently the simple tone control devices met with across the output transformers of domestic equipment cannot be tolerated in large amplifiers and control of tone is carried out in the early stages of an installation. Generally an extra stage of low gain amplification is used in which the required tone or frequency control may be exercised, and this stage is incorporated in the mixer or microphone amplifier so that all controls are centralised.

In this way all the various inputs may be tone corrected and the volume adjusted as required. The latter adjustment is generally necessary every time the tone controls are altered, due to the effect of the tone control circuits on the gain of the amplifier.

It is general practice to provide two separate tone controls, one for bass and one for brilliance, so that any required balance of tone may be obtained to suit the input signal and the acoustics of the place in which the loudspeakers are operating.

A typical tone control stage is shown in the last stage of the circuit of Fig. 5. V.R.1 and C.2 are the components of the brilliancy control. The condenser, C.2, by-passes the higher frequencies to earth when the variable resistance V.R.1 is at minimum resistance, but as the control is rotated to bring in more and more resistance, the effect of C.2 becomes less and less so that very little top note loss is observed with the control at maximum. In general practice, of course, the control will be wired up to give a top note cut as it is rotated in a clockwise direction, so that at the minimum position with regard to brilliancy control as indicated on the panel of the amplifier the control will be at maximum resistance.

Bass Control

V.R.2 and C.3 in Fig. 5 are the components of the bass control. C.1 is the normal coupling condenser between the two stages, and its capacity is large enough to pass the lowest frequencies required. By putting C.3 in series with it, and if the capacity of C.3 is equal to that of C.2, the effective capacity is halved, so that there is an attenuation of the lower frequencies.

V.R.2 controls the effect of C.3. When it is at its minimum resistance C.3 will be short-circuited, and at that position of the control full bass will be reproduced. As the control is rotated and more and more resistance brought into action the effect of C.3 is progressively increased, with a consequent suppression of the lower register.

(Continued on page 308)

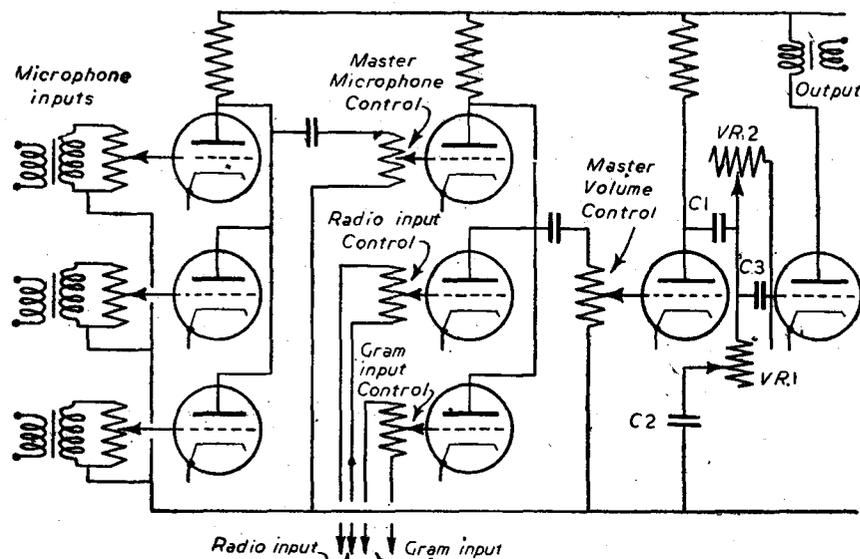


Fig. 5.—A comprehensive fader, mixer and tone control unit (unessential details omitted).

and 100 ohms in the transformer primary circuit, but that the junction of these two systems is shorted to the opposite side of the circuit, thereby preventing the transference of energy from the microphone to the transformer.

At all intermediate positions of the volume control slider there will be a total of 100 ohms in the microphone and transformer circuits. When at half volume, for example, there will be 50 ohms resistance in the two resistance elements and 50 ohms in the shunt elements, thus giving a total resistance of 100 ohms in each circuit with 50 ohms as the coupling resistance.

Fader Unit

Instead of microphones, the output of record-playing desks or a radio receiver may be used to provide the programme to be amplified and distributed by the P.A. system, and where a dual channel network is arranged to give alternative programmes from four inputs that can be used to provide alternative programmes to each of the two channels. A fader unit for such a purpose may be seen in the accompanying photographic illustrations. By means of the four switches, and after the attenuators have been rotated to "minimum" positions, the required programme is switched in at the appropriate moment and the attenuator then rotated to bring up the programme to the required volume level.

Microphone Amplifiers

Microphone amplifiers must be very carefully designed with regard to background noises, especially hum. Where an installation is designed on more or less portable lines to be hired out for work at all manner of locations, the microphone amplifier may be a self-contained battery-operated unit. It does not matter then if the microphones are at some distance from a mains supply point or the mains supply very "rough," the signal delivered to the power amplifiers will be free from extraneous noises, and any special smoothing arrangements or hum-control can be incorporated in the main amplifiers.

In some cases the microphone amplifier is fed with L.T. and H.T. by means of a multiple cable which also contains the speech leads. This arrangement is useful where it is desired to switch the microphone amplifier on and off from the main amplifier location, and where no monitoring is required at the microphone position. An example would be a microphone in a belfry from which the sound of bells would be relayed at certain times. The microphone amplifier up in the belfry near the microphone would be switched on, about ten minutes before it was needed, to thoroughly warm up; then, at the appropriate time the fader and volume controls on the main amplifier would be adjusted to the correct position as determined by previous experience.

An Improved Remote Control System

The Application of A.F.C. to Remotely-controlled Receivers

IN a radio receiver provided with motor-operated pre-selector tuning mechanism, it is sometimes found desirable to introduce automatic frequency control or so-called "pull-in tuning" to counteract slight inaccuracies in the stopping positions of the tuning member. If, as is usually the case, the receiver is also provided with a manually-operated tuning control, it is desirable to cut out the A.F.C. during manual tuning to avoid "pulling" during this operation. When the station-selecting switches, usually push-buttons, are mounted on the receiver, this presents no special difficulty, for a switch controlling A.F.C. can be coupled to the "manual" or change-over switch (or switches) which is operated to condition the receiver for either manual or pre-set tuning. In many modern receivers wave-band switching is accomplished by the operation of push-button switches, and the wave-change and station-selecting push-buttons are mechanically latched by a common bar; the depression of any station-selecting push-button thus releases the wave-change buttons, and the A.F.C. control switch can conveniently be associated with the wave-changing switches, so that it operates only when all of them are open.

If the station-selecting push-buttons, or an additional set of buttons, are remotely situated, the remote push-buttons and the local wave-band selecting or the "manual" buttons cannot be mechanically inter-latched, and the problem arises as to how to re-introduce A.F.C. and release a wave-band selection button or "manual" button from the remote point after a manual tuning operation.

Relay-operated System

This can be accomplished electrically by the use of relays. Thus, all the local push-buttons at the receiver can be latched together mechanically so that actuation of any one of these buttons will cause any other button in the group to be released, and in addition an unlatching relay can be provided for releasing this latch when a remote push-button is operated. In the case of the remote push-buttons a latching relay can be provided which will hold a depressed button down until the tuning operation has been completed, and then release it.

As before, the A.F.C. control switch will be associated with the wave-range-selecting push-buttons so that the depression of any station-selecting push-button, either local or remote, will release the wave-change buttons, and thus re-introduce the A.F.C. circuit.

An arrangement of this kind is shown in the accompanying circuit diagram of a pre-selector tuning unit that is provided with banks of push-buttons 1 and 2 for local and remote control of the receiver respectively, and with station-selecting switches 3 and 4, and their respective driving motors 5 and 6 for controlling movement of the tuning member and the wave-change switch respectively. The motor 6 may also be used to drive an additional selector switch 7 for controlling volume from the remote point by pressing one or other of the push-buttons 8 (which cause the volume to be raised and lowered respectively) until the required intensity of sound is received. The motor 6 is normally coupled by an electro-magnetic

clutch (not shown) to the wave-changing selector switch 4, but when one or other of the volume-control push-buttons 8 is depressed the clutch-relay 9 becomes energised, uncouples the wave-change selector switch 4 and couples the motor to the volume control selector switch 7.

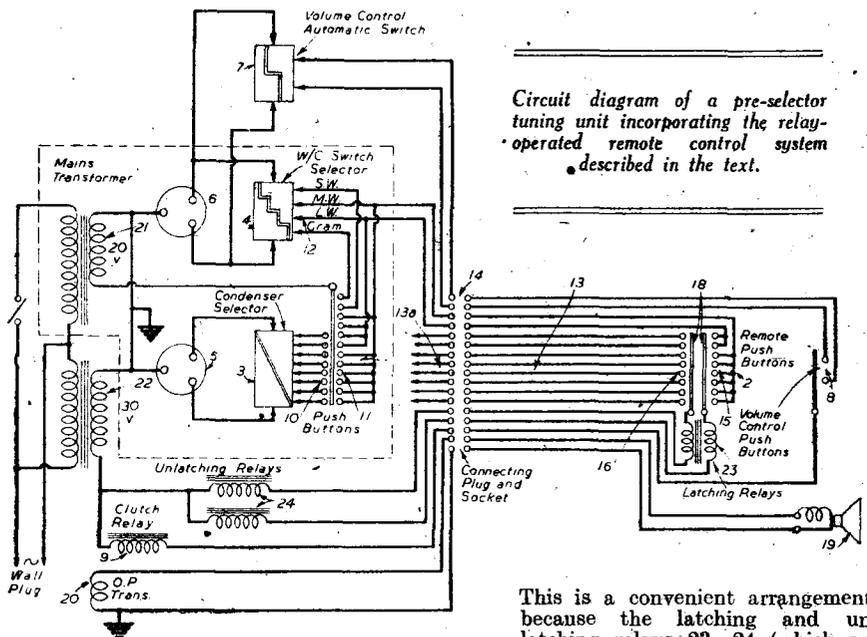
Wave-changing

The station-selector switch 3 is provided with eight contacts for selecting eight different stations from three different wave-bands, and the contacts are connected by leads to contacts 10 of eight push-button switches. Other contacts 11 of these switches are connected to the appropriate contacts 12 of the wave-range selector switch 4. The four contacts 12, reading from the top one downwards, select respectively the short, medium and long-wave bands, and gramophone reproduction.

long-wave contact on selector switch 4, and the next eight leads connect contacts 16 of the remote switches to the corresponding contacts 10 of the local bank of push-button switches 1. The remaining leads shown comprise two leads to the common terminals 18 of the remote push-button switches, a lead to the common terminal of the volume control push-button switch 8, and two leads for a remote loudspeaker 19 which is coupled to an output transformer 20.

Operating Current

Operating current is obtained from one or other of the transformers 21 and 22; transformer 21 supplies current to the system at 20 volts when any of the local push-buttons are operated, and transformer 22 supplies current at 30 volts when any of the remote push-buttons are operated.



Circuit diagram of a pre-selector tuning unit incorporating the relay-operated remote control system described in the text.

These contacts 12 are also connected to the top four contacts 11 of the band of push-buttons 1. These four push-buttons are thus for wave-band changing only, while the eight lowermost push-buttons will select predetermined stations in selected wave-bands. Actually, the six lowest buttons have been arranged in the diagram to select M.W. stations, and the next two uppermost buttons L.W. stations. The A.V.C. switch (not shown) is associated with the four wave-changing push-buttons, so that it is opened when any one of these buttons is actuated and closed to re-introduce A.V.C. when all the wave-changing buttons are "up."

The remote bank of push-button switches 2 and the volume control push-buttons are coupled by leads 13 to a terminal board 14, and thence by leads 13A to the appropriate contacts of the selector apparatus. Thus, the top two leads connect the volume control push-buttons 8 to the selector switch 7. The third lead connects contacts 15 of the six lowermost switches in bank 2 to the medium-wave contact in wave-change selector switch 4. The fourth lead connects contacts 15 of the two uppermost switches in this bank to the

This is a convenient arrangement, because the latching and unlatching relays 23, 24 (which are about to be described) and the clutch relay 9, which come into operation when tuning and volume control are carried out from the remote point, require the extra power to be obtained from transformer 22. This transformer may be permanently connected direct to the mains, and the volume control selector switch 7 can be arranged to actuate the main switch for the receiver in the extreme position of minimum volume so that the set can also be switched on and off from the remote point.

As already mentioned, the local push-button switches 1 are mechanically latched by a common bar which releases a depressed button when another local button is depressed, and the latching bar is also operated to release any local button that may be latched, when a remote push-button is operated, through the agency of a relay. This relay 24 is provided with two operating coils, one in each motor circuit, instead of a common coil, because the coil-impedance is high, and a common impedance in the motor circuits would reduce the power supplied to each motor when they operated simultaneously.

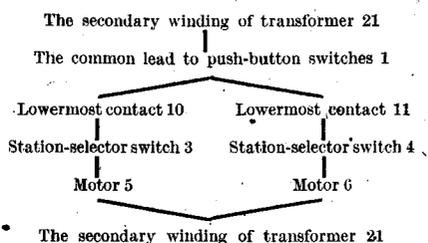
The unlatching relays 24 are connected

in the common leads to the remote push-button switches 2 and in series with them are two coils of the latching relay 23.

Operating Details

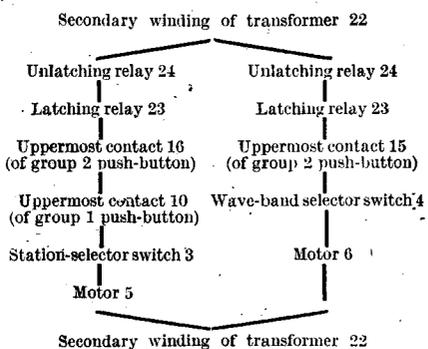
The driving motors 5 and 6 are reversible, and the selecting switches 3, 4 and 7 comprise rotating drums of the so-called "homing" type. It will be understood that the drums are mechanically coupled respectively to the spindles of the tuning reactance, the wave-band switch, and the volume control of the receiver.

The main switch of the receiver may be closed either manually or by depressing the "maximum" volume push-button 8 at the remote point. Assuming that all the push-buttons are "up," then the A.F.C. switch is closed, and the set is in condition for pre-selector tuning. If, now, one of the local station-selecting buttons (say, the bottom one of group 1) is depressed, the button is held "down" by the mechanical latch and current flows as follows:



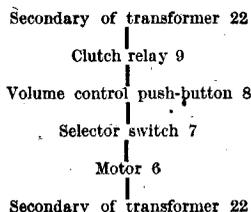
The motors are thus energised, and move the tuning reactance and wave-change switch to select a predetermined station in the medium waveband.

An operator at the remote point may wish to change the station and operates, say, the top push-button of the remote bank of push buttons 2. Current then flows as follows:



As a result the unlatching relay 24 is energised to release the local station selecting push-button previously depressed, the latching relay is energised and holds "down" the actuated remote push-button and the motors are energised and drive the tuning reactance and the wave-band switch to select the required station in the long-wave band. As soon as the selector switches 3 and 4 have ceased to move the latching and unlatching relays 23, 24, become de-energised, the remote push-button is unlatched and returned by spring pressure to its "off" position.

If the volume is incorrect the operator can actuate one or other of the push-buttons 8 to increase or decrease the volume of sound. When this occurs a circuit is established as follows:



In this case, pressure must be maintained on the push-button until the desired volume of sound is heard. To switch off the receiver the operator simply presses the "minimum" volume button until the machine is silenced.

During both the tuning operations described any slight inaccuracy in the positioning of the tuning reactance is corrected by operation of the A.F.C. circuits.

Manual Control

An operator at the receiver may now wish to control the receiver manually. He selects a desired wave-band by pressing one of the top four push-buttons of the local group, and this action conditions the receiver for manual tuning, for actuation of any wave-band selecting button causes the A.F.C. control switch to open. Had one of the local station-selecting push-buttons (group 1) been down it would have been released upon actuation of the wave-band push-button, due to movement of the latching bar. The remote push-buttons are, of course, never "down" in these circumstances.

This system has been developed by the Design Department of the Gramophone Co., Ltd.

P.A. EQUIPMENT

(Continued from page 306.)

Contrary to domestic practice with the almost universal control to cut "top" and give "mellow" reproduction, the bass cut control is often of far more use in P.A. installations to prevent "boominess" in microphony, and to clear up reproduction in places prone to reverberation and high note absorption.

Current Supply

Although an extra stage of amplification for tone-control purposes means more H.T. and L.T., it is still often desirable to run the complete mixer control amplifier from batteries to ensure a perfectly quiet background. However, as the stages of the amplifier are resistance-capacity coupled, the H.T. current is very low, and with good-capacity accumulators, regularly attended to, maintenance is not troublesome. The whole equipment may be housed in a console type of cabinet with the batteries and accumulators at the bottom and with the amplifier and sloping control panel fitted with a lockable lid at the top. The control engineer can sit at the console at the side of the stage or other location, and with a record-player handy, he can also compère the programme as required. This, however, is more a question of layout, and will be dealt with more fully later in this series.

In concluding this article on microphone amplifiers it may be noted that these units are often referred to as pre-amplifiers, "A" amplifiers or head amplifiers. The equipment known under these various names all perform the function of stepping-up a weak signal to a strength sufficiently high to overcome cable losses to the main amplifiers. Head amplifiers generally refer to the very small units fitted in the actual microphone housing, and comprise tiny valves running off dry cells.

The next article in this series will deal with the driver and large output amplifiers, and will describe the precautions taken to safeguard the expensive large valves used in the output stages of large installations.

Prize Problems

PROBLEM No. 421

THOMPSON'S superhet receiver stopped functioning and although he suspected that the frequency-changing valve was not oscillating he found that this valve showed continuity across its filament pins, and passed anode current. What easy method could he have adopted to find whether the valve was oscillating? Three books will be awarded to the first three correct solutions opened. Entries must be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 421 in the top left-hand corner and be posted to reach this office not later than the first post on Monday, June 16th, 1941.

Solution to Problem No. 420.

L.F. instability in a push-pull output stage is generally due to the use of unmatched valves, and may be cured in most cases by connecting a resistance of approximately 50,000 ohms between the G.B. terminal of the input push-pull transformer and the lead normally joined between this terminal and the H.T. - or G.B. - line. The following three readers successfully solved problem No. 419 and books have accordingly been forwarded to them: D. Leeson, 211, Sketchley Road, Burbage, Leics; R. D. Callow, Michelsmarsh, Romsey, Hants; S. E. Jaues, 72, Kimberley Road, Croydon, Surrey.

Sequel to "The Battle of Britain"

A Unique Work which is Now Available

AN appropriate sequel to "The Battle of Britain" would be a book of photographs showing the results of the bombing of Britain's towns and cities—the story in pictures of the courage and endurance of the civil population and the A.R.P. services. Such a work has just been published under the title of "Britain Under Fire."

Divided into two sections—London and Provincial Towns and Cities—it records in graphic photographs the damage suffered by famous buildings, churches, hospitals, schools and residential property. In many cases, contrasting pre-war pictures are given illustrating the beauty of these buildings.

There are nearly 200 photographs in all, and a preface—illustrated by photographs taken quite recently—tells how Britain is carrying on.

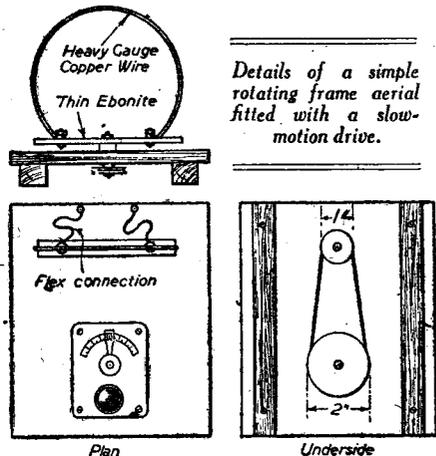
The publication of "Britain Under Fire" is a striking condemnation of the Nazi policy of indiscriminate bombing. In a special preface to the work J. B. Priestley describes the book as "a record of civilised savagery, and a two-fold story of a great crime and of a still greater people."

The book costs 6s. of booksellers, or 6s. 7d. by post from the publishers, Country Life, Ltd., 2-10, Tavistock Street, London, W.C.2, and is already in great demand in Britain and Overseas. It is a work which will be treasured as an historic souvenir of Britain's greatest Hour—of an island people who are to-day the admiration of the Empire, and all who watch the breathless struggle to uphold the democratic way of life.

Practical Hints

A Novel Rotating Frame Aerial

IN the accompanying sketch a frame aerial is shown which has proved of great use to me where it has been inconvenient to erect an outdoor aerial. As the sketch shows, it is fitted with a slow-motion drive and also a scale which is very useful when finding stations. The construction is clearly shown in the sketch. The two



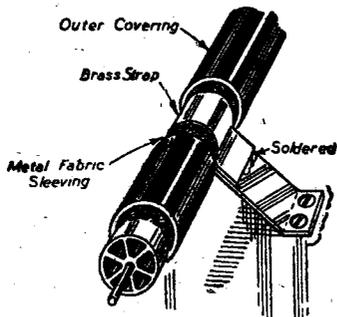
Details of a simple rotating frame aerial fitted with a slow-motion drive.

driving wheels were each made up of two circular pieces of wood, one edge of each being bevelled, afterwards being glued together. The chief measurements are not given, as these are left to suit readers' own requirements. — A. P. RUSHFORTH (Trowbridge).

Earthing Fixture for Special Cable

THE type of screened cable shown in the sketch, and known commercially as co-axial cable, is invaluable where very efficiently screened high-frequency leads are required with the least possible losses.

The amateur will find this cable ideal for many connections in short-wave receivers, or for that matter, any radio set where H.F. instability is likely to occur. When using the cable, the metal screen (which is in the form of a finely-woven wire mesh) must of course be earthed to the chassis. The mesh is covered with an outside layer of insulating material, and a portion of this must be first removed, in order to make the necessary connection. One or two turns of ordinary bared flex may be used, but a far more satisfactory job can be made by using a strip of copper or brass foil, bending one end of this round the mesh covering, and soldering, as shown in sketch. The other end is fixed to the chassis, either by screws or soldered if possible. Incidentally, this method gives



A method of earthing co-axial cable when used for connections in short-wave receivers.

THAT DODGE OF YOURS!

Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best hint submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending it in to us addressed to the Editor, "PRACTICAL WIRELESS," George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2. Put your name and address on every item. Please note that every notion sent in must be original. Mark envelopes "Practical Hints." DO NOT enclose queries with your hints.

SPECIAL NOTICE

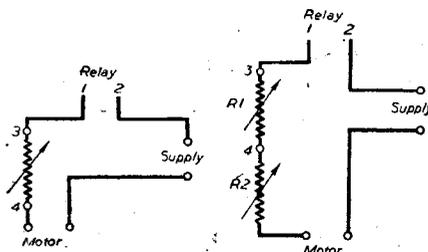
All hints must be accompanied by the coupon cut from page iii of cover

just that support necessary for the cable, where lengths of several inches or more are to be used for connecting two points at a distance away from the chassis.

A point worth noting is that of using a really hot iron when soldering the centre wire of the cable, and to make the joint as quickly as possible, otherwise the web-shaped section which supports the wire is apt to melt, throwing the wire out of centre. A quick touch with a damp cloth immediately after soldering will obviate such trouble. — R. L. GRAPER (Chelmsford).

Automatic Overload Cut-out

HAVING already burnt out one motor on my television experiments, I determined that it should not happen again, so I devised this simple cut-out and speed control, which has been duly fitted on the motor, and is working quite satisfactorily. The "full speed" position is obtained



Figs. 3 and 4.—Circuit diagrams showing arrangement of resistances for rough and fine control, respectively.

by pulling the square rod B (Fig. 1) out until the tongue of the relay is in the notch farthest away from the panel. There are eleven such notches, and each is 3/32in. long. Thus a movement of 3/32in. on B produces a movement of 1in. across the resistance A. This is only a rough control (Fig. 3), and a finer one may be added, if it is so desired, as shown in Fig. 4. (R1 is the rough control, and R2 is the fine control.)

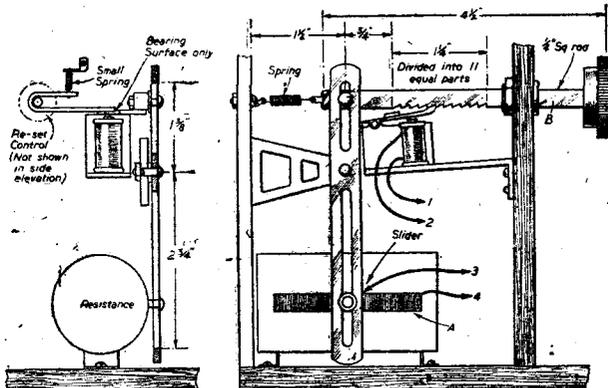


Fig. 2.—Side view of the cut-out showing adjusting arrangement.

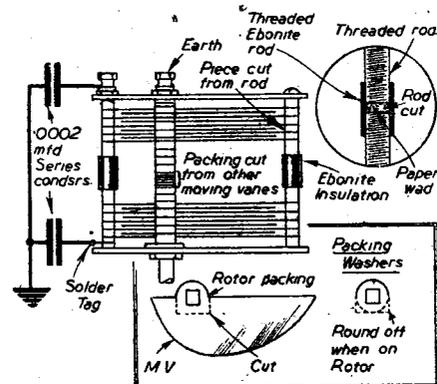
Fig. 1.—Side view of an overload cut-out and speed-control device.

If for any reason there is an excessive current passing through the windings of the motor, the relay comes into action, the tongue disengages with the notches, and the resistance, which cuts out completely at one end, is automatically open-circuited. This action isolates the motor from the mains, thus preventing any serious damage.

The relay can be set at different current ratings by means of an adjustable set screw and spring (Fig. 2). The relay was adapted from an old G.P.O. current relay. There may be a better way of resetting the cut-out than I have used, such as using another relay worked off a bell transformer. — S. F. WARD (Cranford).

A Ganged Tuner

HERE is a description of a simple method I adopted for building a .0001-.0002 ganged tuner from a .0005 tuning condenser. If the fixed plates of a .0005 tuner are divided into two equal unconnected sets, a ganged tuner having a capacity of .0002 is formed. I divided the fixed plates by



A simple dodge for making a ganged tuner out of a single condenser.

cutting the threaded brass rods on which the plates are strung, and inserted a section of threaded ebonite rod, as shown in the sketch. Thus two sets of plates are formed.

Not wanting the capacity to be .0002, but .00015, I took off a few plates from the moving and fixed plates, and filled the space on the spindle for the moving vanes with washers, to make a tight fit. As the introduction of the rod throws plates out of true, the sets of vanes must be adjusted so that the plates do not scrape. — F. R. GILSON (Tunbridge Wells).

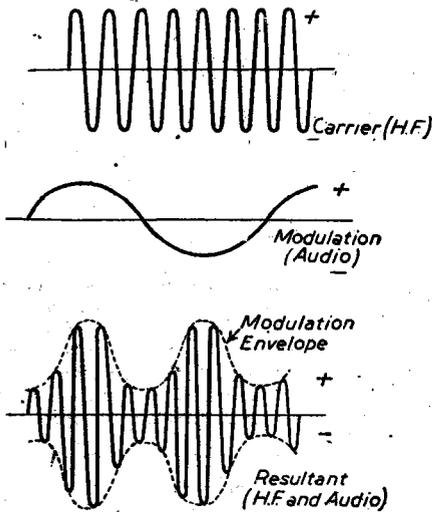


Fig. 1.—Diagrams showing how the modulation or audio-frequency voltages are "added" to the carrier voltages at the transmitter.

MANY of those readers who have written to us recently have made it quite clear that they are now taking a far greater interest in the "why and wherefore" than they did in pre-war days. One reason is, no doubt, that a large number of readers are joining one or other of the Services, and are anxious to gain admission to a branch in which their radio knowledge will be useful. A question which has frequently been asked concerns the mode of operation of a detector valve; in general it is the leaky-grid detector, which is referred to, but the diode and anode-bend detectors have come in for a certain amount of attention.

We can certainly recommend every reader who wishes to take up radio professionally (in the Services or elsewhere) to study detection, for it is of paramount importance. In fact, we may go so far as to state that no one could claim to have a sound knowledge of radio unless he had a clear understanding of the detection process.

Meaning of Detection

For the benefit of newer readers we should point out in passing that detection consists of separating the audible part of any signal from the H.F. or inaudible portion which constitutes the carrier wave. Confusion often exists between detection and rectification because the two have many points of similarity. For present purposes we may agree, however, that rectification consists of changing an alternating current into a direct current, and that the object of detection is to make radio signals audible.

Although it seems very remote from the detector stage, we can best start our investigations at the transmitter which, we will assume, is sending out telephony. In the first place an oscillator must produce a high-frequency wave at the frequency, or wavelength, of the transmission. This

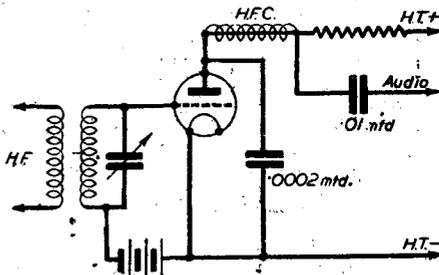


Fig. 4.—An anode-bend detector circuit.

wave is shown at the top in Fig. 1. The human ear cannot detect sounds which have a frequency in excess of, say, 20 kc/s, so it is apparent that the carrier frequency will be inaudible.

The Modulated Wave

As the name implies, however, the carrier is used to "carry" the audible sounds of the human voice, music, etc. Thus, we impress the electrical equivalents of those sounds on the carrier wave. A simple curve showing what we shall consider as an audio-frequency wave is shown in the centre diagram in Fig. 1, while below it is shown the combination of the carrier wave and the audio wave. It should be stressed that these wave-forms are not necessarily drawn to the same scale, but are merely shown in a convenient proportion for illustration purposes.

The combination of the two waves is described as a modulated wave, the outline of which (shown dotted in Fig. 1) is known as the envelope. Waves of this general form, but more complex due to the constant changes of audio-frequency in the studio, are broadcast from the transmitting aerial. When they strike the receiving aerial they are still inaudible, and would remain so even if passed through a simple rectifier, or one-way device. This is because the frequency of the pulses of rectified current would still be above audibility. It is the purpose of the detector stage in the receiver to separate the audio-frequency from the high- or radio-frequency, so that the audio-frequency impulses can be made to operate a loudspeaker or a pair of 'phones.

The Diode

There are various methods of providing the separation, or demodulation, but that

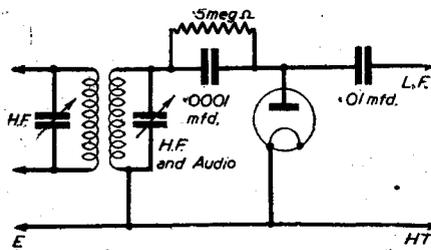


Fig. 2.—A simple diode second detector. This is not quite of the form generally used in practice.

consisting of the use of a diode valve may be considered as the simplest, although even that is too complex to describe in complete detail in the space at our disposal. A very simple form of diode circuit is shown in Fig. 2, where it will be seen that the valve is fed from an I.F. transformer, supplying the modulated carrier after amplification in the preceding stages. Apart from its being of greater amplitude, however, the modulated wave is of precisely the same form as that picked up by the aerial—if we ignore any small amount of distortion which may have occurred in the pre-detector stages.

When a positive half-cycle of the modulated carrier is applied to the fixed condenser between the I.F. transformer and the anode of the valve the condenser is charged up, so that the side connected to the anode is at negative potential. The charge starts to leak away through the fixed resistor, but before it has had time to do so the next

Detection

The First of Two Articles Explaining Anode-bend and Grid-leak Detectors Notes on the Choice of the Most

half-cycle has come along; this time a negative one. The charge on the condenser is thus reversed so that the anode is made positive. This means that current will flow from the cathode to the anode through the resistor. And when current flows there is a voltage drop across the resistor. Because electrons (or "particles of negative electricity") have flowed from the cathode to the anode, the anode has been made negative in respect of the cathode. As a result of this continued action the anode develops a negative potential, the value of this being proportional to the amplitude of the signal, and varying with the amplitude. It is also governed by the product of the values

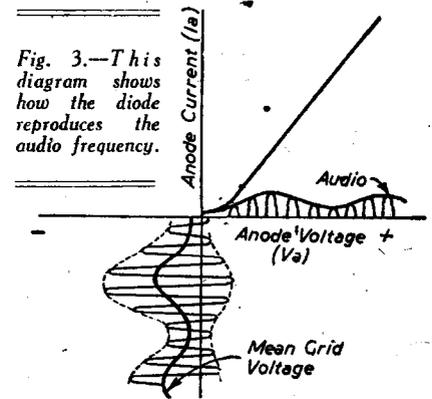


Fig. 3.—This diagram shows how the diode reproduces the audio frequency.

of resistance and capacity of the resistor and condenser in the anode circuit.

Self-bias

From this it will be seen that—to put it in the simplest possible terms—the wider the modulation envelope the greater the negative bias on the anode. This self-bias as it is usually called (not to be confused with automatic bias, which is maintained constant) thus varies at the audio-frequency, so that the modulated wave-form shown in Fig. 1 becomes modified as shown vertically in Fig. 3. In Fig. 3,

Omnidirectional R.C.

A NEW radio range beacon which makes possible air navigation by radio without restriction to predetermined courses between cities, has been developed in the R.C.A. research laboratories at Camden, New Jersey, U.S.A. The new device tells a pilot his exact direction at all times with relation to the radio beacon transmitter at his destination. If the plane deviates from its predetermined route, the drift is indicated on a dial on the instrument panel. The dial, furthermore, indicates a new route to the original destination as soon as the old course is left behind.

The new instrument operates on the ultra-high-frequency wavelengths, avoiding static and achieving greater reliability in storms or other atmospheric disturbances. Dr. Luck, who is chiefly responsible for the

Methods

by The Experimenters

in Simple Terms the Action of Diode, and Second Detectors, with Practical Suitable for Any Particular Receiver

it has been drawn as a varying-anode voltage as applied to the anode current-anode-voltage curve of a diode. Since the diode passes anode current only when its anode is positive the anode current takes the form of a series of pulses of varying amplitude. These are so close together that the mean or average anode current can be said to follow the outline of the tips of these pulses, as shown in Fig. 3. And this mean follows an audio-frequency wave-form similar to that shown in the centre diagram in Fig. 1.

This fluctuating current passing through the anode resistor produces an alternating voltage across the ends of the resistor (voltage equals current times resistance).

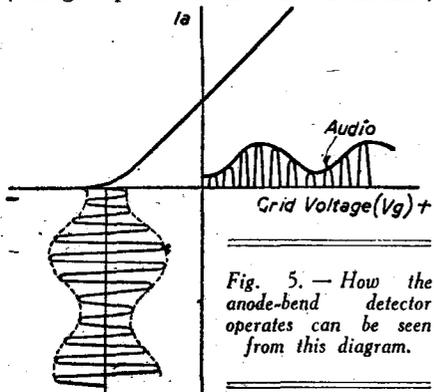


Fig. 5. — How the anode-bend detector operates can be seen from this diagram.

and this can be applied to the L.F. amplifier, and then to the loudspeaker. In practice, we should insert an H.F. choke or resistor-condenser filter in the A.F. lead to prevent any H.F. from passing into the A.F., or L.F., amplifier. It is not necessary to give a practical circuit here, since that has been done in the series entitled "Problems of Amateur Receiver Design."

Anode Bend

Now let us look at the anode-bend detector. Actually, there are two forms of this known as top and bottom bend, but we need consider only the latter since the

former is not used in practice. As the name suggests, this detector depends for its operation on the bend or sharp curve near the base of the anode current-grid volts

characteristic curve of a triode valve. Fig. 4 shows a representative anode bend circuit, where it will be seen that negative bias is applied to the grid, and that there is no grid condenser and leak.

Fig. 5 shows what happens to the anode current as the modulated signal is applied to the grid. Positive half-cycles result in the bias voltage being reduced in proportion to the amplitude of the signal, and negative half-cycles have little or no effect, since they come past the bend, where the slope of the curve is very slight, or even beyond the anode current cut-off point. The result is that we have pulses of anode current, as shown on the right in Fig. 5. These are similar in character to those in the anode circuit of the diode, and we have a corresponding curve representing the mean fluctuating anode current. This curve again corresponds to the original modulation frequency, so that we have an alternating voltage of the same frequency developed across the resistance or other load placed in the anode circuit of the valve. This voltage is applied to the low-frequency amplifier or to a pair of 'phones.

Anode By-pass Condenser

Referring back to Fig. 4 for a moment it will be seen that there is a small fixed

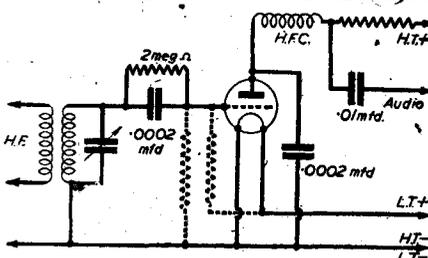


Fig. 6. — A grid-leak detector circuit. As with the anode-bend circuit shown in Fig. 4, the resistor in the anode circuit may be replaced by an L.F. choke, or the primary winding of an L.F. transformer.

condenser between the anode of the valve and earth. It is generally stated that this condenser is to by-pass the H.F., and so prevent it from reaching the L.F. portion of the receiver. It does this, but it also acts as a smoothing device and actually increases the output from the detector by discharging on the negative half-cycles, thereby giving additional anode-current pulses between those produced by the detection process already described.

Leaky-grid

When we come to the grid leak or leaky-grid detector, a simple circuit for which is shown in Fig. 6, we find a close resemblance in the action to that of a diode. In this case, however, the modulated signal voltage is applied to the grid of a triode, this grid acting in almost the same manner as the diode anode. Thus, it will be understood that as grid current flows on the negative half-cycles, a negative bias proportional to the amplitude of the modulated carrier is applied to the grid.

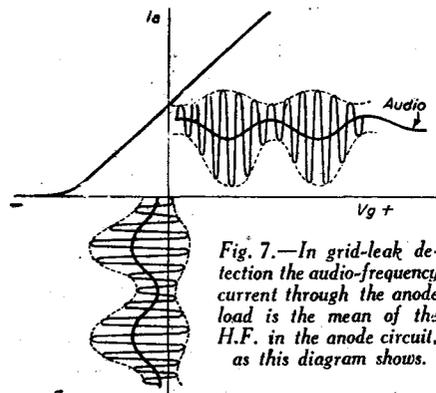


Fig. 7. — In grid-leak detection the audio-frequency current through the anode load is the mean of the H.F. in the anode circuit, as this diagram shows.

In consequence, we have a mean grid voltage varying at the audio frequency, and producing an anode-current envelope and mean anode-current wave similar in shape to the grid-voltage curves.

As will be appreciated from the action of a triode, the variation in grid voltage produces a corresponding variation in anode current. In consequence, we have a mean anode current variation at the audio frequency, as shown in Fig. 7. Again, the audio-frequency current produces an audio-frequency voltage across the load or anode resistor, and this is applied to the following L.F. stage. Alternatively, the anode resistor could be replaced by a pair of high-resistance 'phones, which would then constitute the load and reproduce the audio frequency. As in the case of anode bend, it is often found desirable to connect a small fixed condenser between the anode and earth to act as an H.F. by-pass. Another point indicated in Fig. 6 is that the grid leak may be connected directly across the grid condenser, between the grid and L.T., or between the grid and L.T. +.

Power Grid

There is a fourth method of valve detection which is not very often used today, but which was very popular a few years ago. This is power-grid detection, the circuit for which is the same as for leaky-grid, with the exception that a smaller capacity is used for the grid condenser and a lower resistance for the leak. Additionally, the anode is supplied with a higher voltage. The object of these modifications is to prevent distortion on very strong signals. If a signal of high amplitude is applied to a grid-leak detector the result is somewhat as shown in Fig. 8. The bottom of the envelope is "cut" and a "kink" appears in the line representing mean anode current variation. If we were to work on the power-grid characteristic represented by the chain line in Fig. 8 the whole of the signal voltage could be confined to the straight portion of the characteristic and distortion avoided.

(To be concluded.)

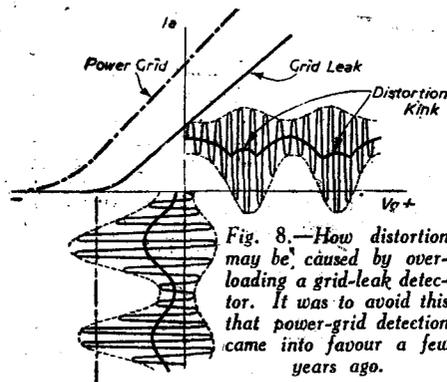


Fig. 8. — How distortion may be caused by overloading a grid-leak detector. It was to avoid this that power-grid detection came into favour a few years ago.

Radio Range Beacon

A new system, told a meeting of engineers recently that the present aviation guidance equipment on long waves gives only four paths in which navigation can be carried out, but if the pilot wishes to fly off the regular course, he must carry through a complicated sequence of manoeuvres to determine his exact position. In order to supplement the range, direction finders are used to show the direction of the beam from the transmitting station from the 'plane.

Dr. Luck explained that aircraft direction finders are not satisfactory on the ultra-high frequencies, so that in order to obtain static-free navigation in these frequencies the new system was developed with a range which marks paths in all directions, reducing the need for a direction finder or radio compass.

G.E.C. POWER SPEAKERS

THE General Electric Company have recently introduced a range of new power-type loudspeaker units, exponential horns for such speakers, and cabinet and omni-diffusion type speakers which are now available for installations of national service.

When the projection of acoustic energy over large areas out of doors is necessary,



Fig. 1.—Speaker unit in weatherproof case.

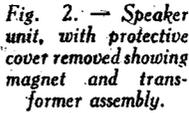


Fig. 2.—Speaker unit, with protective cover removed showing magnet and transformer assembly.

the directional type of loudspeaker is unsurpassed. Many who are likely to be faced with such a problem these forthcoming months will, therefore, be especially interested in the two speaker driving units and exponential horns shown in Figs. 1 to 4. The driving units and horns are interchangeable,



Fig. 3.—Senior exponential horn for use with the type of unit shown in Figs. 1 and 2.

able, so that four alternatives are available. In each a well-balanced frequency characteristic maintains the response from 150 to 10,000 cycles, but accentuation has been given to the voice frequency band to ensure incisive voice articulation.

The driving unit and transformer are completely shrouded in a streamlined weatherproof case. No terminals are exposed, and a watertight cable entry is provided. The throat is protected against dirt particles and driving rain, and since the throats are of identical gauge, each is suitable for use with either of the two horns illustrated.

For Motor-cars

For mounting on the bumpers of motor-cars, or other mobile use, there is a new folded type of horn (Fig. 5). Although its dimensions are only 8in. deep by 10½in. high (including mounting bracket), with a mouth diameter of 9in., this horn provides an air column of more than 20in. Complete with a low-impedance moving-coil driving unit, it is capable of handling a maximum of 4 watts input.

Three versions of a new service type cabinet speaker (Fig. 6) are also available. For use in internal address systems where a large number of speakers are required, and thus where price is likely to be a consideration, these speakers are sure to have special

appeal. As in the power and mobile speakers, good articulation of speech is ensured in the design by the appropriate choice of frequency response.

The chassis, which is obtainable separately, embodies a high-quality nickel aluminium alloy magnet providing a flux density of 10,500 lines per square centimetre, assembled on a 10in. diameter aluminium casting. A transformer is fitted for accurate matching to any speaker line of standard 600-ohm impedance, or to a voltage-matching of 60, 80, 100 or 120 volts. Tappings are provided to pre-set the audio output of the speaker to any chosen maximum wattage within its capacity. By this means the volume of each speaker in an extensive installation can be adjusted independently to suit the requirements of its location. The soundly constructed cabinet is of attractive appearance, finished in dull, polished oak. The handling capacity of these units is 8 watts.

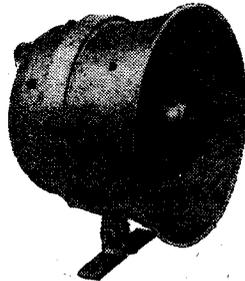


Fig. 5.—Folded horn for use on automobiles.

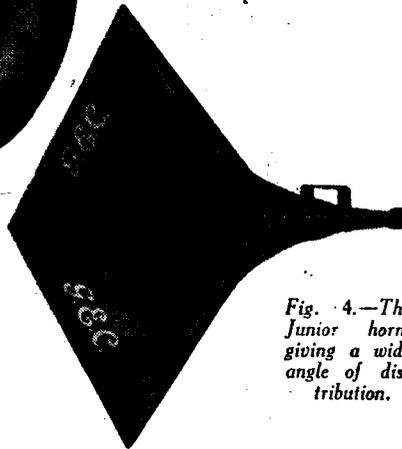


Fig. 4.—The Junior horn, giving a wide angle of distribution.

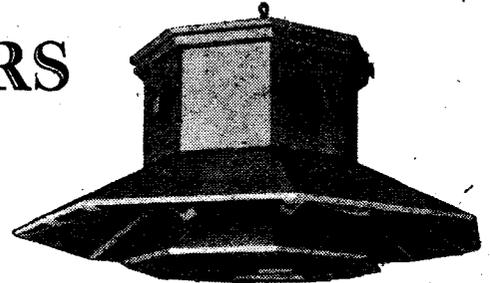


Fig. 7.—Junior omni-diffusion speaker.

For Internal Use

Another new model for internal use is the Junior Omni-Diffusion Speaker (Fig. 7). As its name implies, this is designed for sound radiation in all directions and is

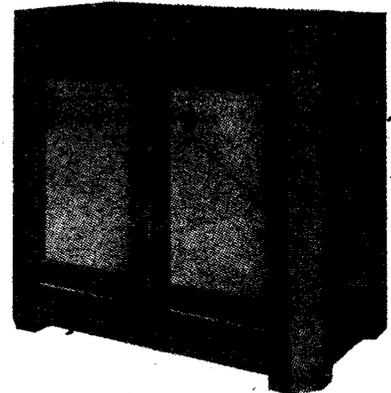


Fig. 6.—Cabinet speaker with high-fidelity moving-coil unit.

particularly applicable either singly or in numbers for announcements or music in public rooms or factories, etc., where the noise level is reasonably low. The driving unit is a P.M. cone speaker of high efficiency, and is fitted with a transformer to facilitate accurate matching to any speaker line of 600-ohm impedance, or to a voltage matching line of 60, 80, 100 or 120 volts. The maximum handling capacity is 10 watts. A folder entitled "G.E.C. Sound Production Power Speakers," giving further particulars and prices of these new speakers is available, and copies may be had on request from Magnet House, Kingsway, London, W.C.2.

It should be noted that supplies of this equipment are, at present, restricted to installation for which Government contract numbers and material authorisations are obtainable.

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0-75 milli-volts	0-5 volts	0-2.5 milli-amps.
0-5 volts	0-25 "	0-5 "
0-25 "	0-100 "	0-25 "
0-100 "	0-250 "	0-100 "
0-250 "	0-500 "	0-500 "
0-500 "		

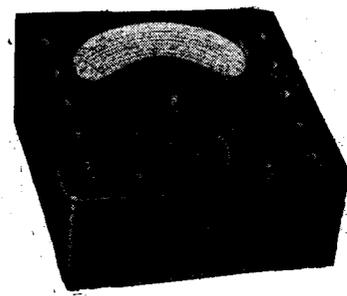
RESISTANCE

0-20,000 ohms	0-2 megohms
0-100,000 "	0-5 "
0-500,000 "	0-10 "

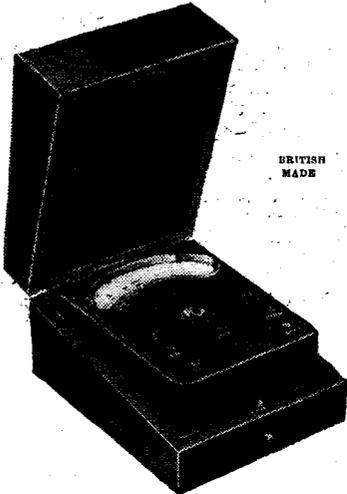
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Current milliamps	Voltage volts	Resistance ohms
0-6	0-6	0-10,000
0-30	0-12	0-60,000
0-120	0-120	0-1,200,000
	0-240	megohms
	0-800	0-8
	0-600	

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Included in the consignment are many types and sizes of Cathode Ray Tubes (magnetic type). Brand new in original cartons or mounted on unused chassis. As examples we quote the following prices, all subject to being unsold: Approx. 8in., £4; 10in., £5; 12in., £6. All tubes must be collected by buyer. No responsibility accepted for carriage.

COMPLETE RECEIVERS

We have a number of complete Television instruments housed in beautiful cabinets, complete and ready to switch on, covering the television sound wave-band only. Made to sell at 80 and 100 guineas, they will be cleared at a fraction of this price. The war may be short and these instruments would prove a very lucrative investment. Your enquiry is invited.

NEW CHASSIS

Beautifully finished, highly-polished new cadmium-plated chassis. Not the ordinary type but superbly made. 16in. x 13in. x 4in., drilled for 6 valves, transformer, etc. 4/- each. Postage and Packing, 1s. 40/-

MAINS TRANSFORMERS

We have handled many thousands of mains transformers, but truly these are one of the best jobs we have seen. Originally made for Television Power Packs where accuracy and robustness is essential. Weight 12 lb., size 5 1/2 in. x 4 1/2 in. overall. 350-0-350 volts, 120 m.a. Four tapings giving 4 volt 2 amps., 4 volt 8 amps., 3 volt 3 amps., and 20 volt 1 amp. Brand new and unused, 25/- each. Carriage forward. 25/-

★ This is the most amazing purchase in our many years of trading. We have cleared the warehouses of the most famous manufacturers of Television apparatus. Everything is offered, subject to being unsold, at prices far below cost of the raw material ★

REGULAR LINES STILL AVAILABLE

Soundly constructed 5-watt undistorted output Amplifiers for gramophone or m.c. Built from the best pre-war components and material. Streamline shock-proof heavy gauge chassis, 2 triodes output stage with a first-class 10in. energised moving coil speaker. Specially designed output transformer and volume control. A well-made first-class job at the right price. 5 WATT, 4 VALVE, 220-250v. A.C. LIMITED NUMBER ABSOLUTELY COMPLETE 6 GNS

Slightly used Gramophone Amplifiers, built for the R.A.F. to Government specifications. A sound, heavy job will stand hard use. For A.C. 220-250v. 3 valves 3-watt Pentode output. 3-position tone control. Complete in beautiful heavy polished mahogany cabinet 14in. x 14in., with decorative grille and chromium bar. Super P.M. loudspeaker giving clear, undistorted quality of music and speech. Only fifty available, unable to repeat. 5 GNS.

Heavy duty, double button type Microphones. Chromium-plated case. Gold plated electrodes. High output. Good quality. With mounting clips and springs, complete with Transformer. 30/-

SEE ALSO OUR BARGAIN LIST IN THE CLASSIFIED ADVERTISEMENTS ON PAGE iii OF COVER.

LONDON CENTRAL RADIO STORES
23, LISLE STREET, W.C.2 (GERRARD 2969)

ROUND THE WORLD OF WIRELESS

Cutting Out Germany

BEFORE and since the War Germany has been paying for broadcast programmes from South America, but this "entertainment" has now been scotched by a brilliant American business man. Behind the brief announcement recently from Washington that the United States will dominate future programmes lies the story of William S. Paley, President of the Columbia Broadcasting System.

Thirteen years ago, at the age of 27, William Paley left his father's cigar business and became president of a small network of radio stations. Within three months he gathered 22 more stations into his field. Gradually, the Columbia system spread into the 48 States, and Paley discovered artists who are now famous throughout the world.

B.B.C. Contests Raise £20,000

RECENT B.B.C. radio contests have brought in more than £20,000 in entrance fees—all in 2½d. stamps. Sold back to the Post Office, the money has been handed to the Red Cross.

Saved by Radio

ALTHOUGH his own plane had been damaged and become uncontrollable during a patrol, Sergeant Jack Mann, of No. 91 Squadron, warned his flight commander by radio telephone of the danger from a rear attack by enemy aircraft, and saved the commander from being shot down. For this, and other acts of gallantry in the air, Sergeant Mann has been awarded the D.F.M.

The I.A.R.U.

THE affiliation of the Brazilian amateur radio society, Liga de Amadores Brasileiros de Radio Emissao, to the International Amateur Radio Union was recently announced. Thirty-seven countries are now members, and in Brazil there are about 1,000 amateur operators, all of whom belong to the L.A.B.R.E.

Yugoslav Listeners

ACCORDING to a recent report there are about 185,000 licensed listeners in Yugoslavia, which is roughly 1.9 per cent. of the population. A receiving licence costs 300 dinar (approx. 30s.).

New High-power Station at Rio

ONE of the largest short-wave stations in the Western Hemisphere is being erected by the R.C.A. Manufacturing Company for the Brazilian Government at Rio de Janeiro. The new 50-kW transmitter will be linked with five directional and three non-directional aerials. Two of the directional arrays will be beamed on Europe, two on the U.S. and one on Asia. The station is scheduled to be ready for operation by next January.

Training Radio Operators

FOR training operators for the Services and the Mercantile Marine the North British Wireless College, of 21, West Maitland Street, Edinburgh, has equipped three main telegraphy rooms with 71 key points. Each point is fitted for duplex working. In order to assimilate working conditions a certain amount of interference is introduced.

French Programmes from WLWO

STATION WLWO, the international short-wave companion station to WLW (Cincinnati), is now featuring broad-

casts in the French language to supplement its Spanish, Portuguese and English programmes. These programmes, which comprise news summaries, are broadcast on Sundays from 6.15 to 6.30 p.m., E.S.T.

"Wooden-leg" Radio

AN enterprising American amateur, Ralph Veady, of California, has fitted a receiver, complete with loudspeaker, in one of his artificial legs.

transmission is directed. Britain, on the contrary, has no fear of any part of the world hearing what has been broadcast in any of the B.B.C. transmissions.

Nazi Propaganda Exposed

EVERY Monday at 18.40 G.M.T. and every other weekday at 18.55 G.M.T., a five-minute radio feature with the modest title, "The Seeker," is broadcast in the B.B.C.'s African Transmission. With the



The King and Queen interested in cadets undergoing instruction in inter-tank radio communication during a recent visit of their Majesties to an Officer Cadets Training Unit in Southern England.

Radio Men Defied U-Boat

SINCE the War began tales of heroism of radio operators at sea are told from time to time. Here is another one. Radio Officer Max R. Gerard and his assistant, Edward R. Campbell, refused to leave their unarmed ship when it was shelled by a U-boat. The boats with the rest of the crew had just got clear when the submarine surfaced and torpedoed the ship. Gerard and Campbell, sending out messages to the last, perished when the ship sank. Their names recently appeared in the list of awards of Lloyd's War Medal for bravery at sea.

Sports Commentator's Hobby

ROGER BAKER, sports commentator of Station WLW, Cincinnati, doesn't have to suppress the adult interest in model railways. He has an elaborate model railroad system, complete with drawbridges, freight yards, gadgets for loading coal and timber and all the rest of the accessories. The lay-out is located in his basement—where he's to be found most of the time when not getting ready for his broadcasts.

Calling the World

IN future the Talks period in the B.B.C. Empire Service, broadcast daily from 03.15 to 03.30 G.M.T. will have the general title of "Calling the World." In this feature North American listeners will have the opportunity of hearing talks that are being broadcast to other parts of the world. This makes a significant contrast with the German method of propaganda, which "does" the broadcast according to the part of the globe to which each

resources of the B.B.C.'s Monitoring Service behind it, this authoritative programme detects and exposes the aims and objects of the Nazi radio and Press propaganda.

America's Listeners

ACCORDING to a recent report 29,397,000 homes in the United States have broadcast receivers; and approximately 11,000,000 of these also have a second set. It is estimated that, including the 8,000,000 car radio receivers in use, there are approximately 48,000,000 sets in the United States. Of the 49 states, New York heads the list with 3,455,000 wireless-equipped homes and Pennsylvania comes second with 2,430,000.

Questions of the Hour

THE B.B.C. series of talks for overseas listeners "Questions of the Hour" is planned on a regular weekly basis. The plan is as follows: On Sundays, Economic, industrial and shipping questions (Donald Tyerman, John Price, shipping experts, etc.); Mondays, Military Commentary (Major Lewis Hastings); Tuesdays, Air Commentary (Major Oliver Stewart); Wednesdays, Occupied Territories, U.S.A., Far East, and other parts of the world (speakers will include Thomas Cadett, Colin Coote, R. H. Crossman, O. M. Green, and V. Stavridi); Thursdays, Military Commentary (Captain Cyril Falls); Fridays, Air Commentary (Major Oliver Stewart); Saturdays, Naval Commentary (H. C. Ferraby). The speakers on Sundays and Wednesdays will be booked from week to week, but the speakers on the other days will be booked for a series.

Building a Superhet with "Ordinary" Components

Progressive Stages in the Development and Construction of a Four-valve Superhet Receiver Using Standard Components

MANY amateurs hesitate to build a superheterodyne receiver because they think it too complicated, owing to confused thinking with regard to the coils employed, or from a number of other reasons.

Yet the basic circuit of a superhet is really very simple, and as this class of circuit gives such good results, it is well worth making up.

The class of amateur I have in mind is perfectly conversant with the 1-v-1 receiver, and as such is fully competent to under-

stand and build a superhet with "ordinary" components. The extra parts needed to convert a 1-v-1 receiver into a superhet are not many, and the modification can best be grasped by considering a conventional short-wave converter—which is used before the high-frequency stage of a set which is not a superhet, and which, in effect, converts it into this class of receiver.

receiver is really a superhet, for what emerges from the lead marked "A" on the converter is a heterodyne of the signal received by the aerial; it is, of course, an H.F. signal, and as such is applied to the first (high-frequency) valve of the receiver, where it is amplified, and thence to the detector valve, which rectifies it. Because the tuning is carried out on the converter, where it is amplified, and thence to the detector valve, which rectifies it. Because the tuning controls on the receiver are not touched, except to set them to a point on the long-wave or medium-wave range, which-

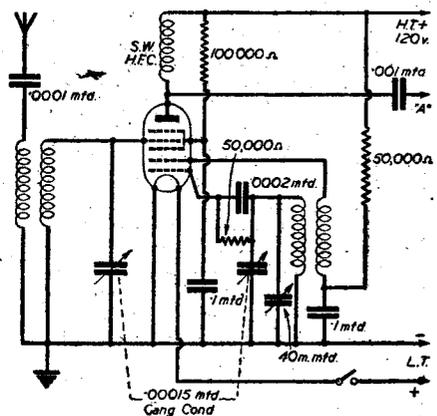


Fig. 1.—Theoretical circuit diagram of a short-wave converter.

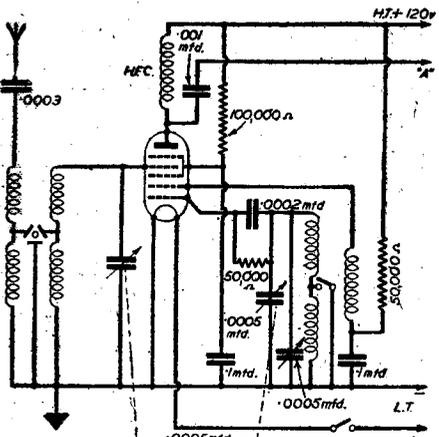


Fig. 2.—Circuit showing modifications to a S.W. converter for receiving the medium and long-wave band.

stand and build a superhet with "ordinary" components. The extra parts needed to convert a 1-v-1 receiver into a superhet are not many, and the modification can best be grasped by considering a conventional short-wave converter—which is used before the high-frequency stage of a set which is not a superhet, and which, in effect, converts it into this class of receiver.

S.W. Converter

First, consider Fig. 1. It represents a short-wave converter (not to be confused with a short-wave adapter, which plugs into the L.F. stages of a receiver) of which the lead marked "A" goes to the aerial of a conventional set with one high-frequency stage. The .00015 mfd. gang condenser tunes the grid and oscillator sections of the valve, the oscillator being the one on the right, associated with the .0002 mfd. grid condenser, and 50,000 ohms grid leak. The other coil connected to H.T. positive, and an "anode" in the valve (really a grid) is a reaction coil, which performs its usual function of feeding back energy until oscillation point is reached; in fact, it keeps this part of the valve oscillating all the time the set is in operation. The variable condenser of 40 m.f.d. (.0004 mfd.) is used to effect the necessary frequency shift between the two groups of coils, in order that the incoming signals (left-hand coil) may form a beat note or heterodyne with the locally applied "signal" due to the oscillator (right-hand coil).

This constitutes a short-wave converter, and the combination of converter and

On One Chassis

Suppose we now scrap the converter idea and build the entire receiver on one chassis. The sequence will then be as shown in Fig. 3. First we have the frequency-changer valve with its associated coils, about which we have already learned. Then we have the H.F. amplifying valve, called the intermediate, which is exactly the same as in the conventional 1-v-1 receiver, except that we scrap the gang condenser and employ instead two pre-set condensers which, after they have been set, do not require to be touched. Next comes the detector, or second detector, as it is called, the coils before which are tuned by one of the pre-set condensers just mentioned. The rest of the set is a straightforward L.F. affair. It will be seen that there are four valves in all, and most of the parts required will doubtless come out of the "junk" box, no special superhet parts being required; for all that it is a superhet receiver, just as much as if special parts had been obtained. There is nothing magical or mystifying about a superhet.

Operation

The adjustments necessary to get the receiver into full working trim are really quite simple, but they must be carried out slowly, and with care. A local oscillator is of great help, but use can be made of the local station to get them approximately right,

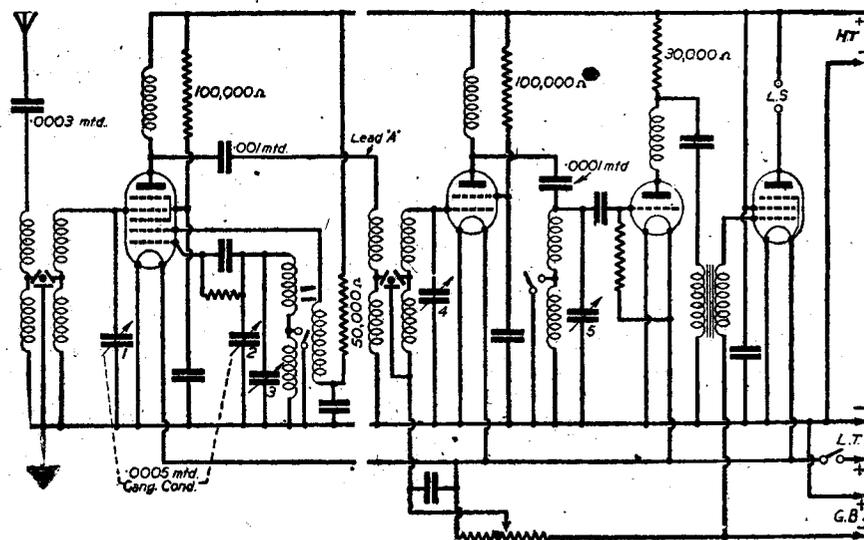


Fig. 3.—Circuit diagram of a 4-valve superhet, embodying the circuit shown in Fig. 2.

and then a weak station to get them more exact.

To receive the local station turn the gang condenser to where it is known to come in with the particular coils in use, and set the pre-set condenser (marked condenser No. 1 in Fig. 3) about 50 degrees away from the gang condenser in terms of capacity. Now turn to the other pre-sets (Nos. 4 and 5 in Fig. 3) and adjust them, retuning with the gang condenser while doing so. There should be no difficulty in receiving the local station.

The same procedure is carried out with a weak station in order to get the set accurately ganged, not forgetting the trimmers on the gang condenser. Once the set is ganged you will have one knob tuning, with all the other advantages of a superhet.

For increased range it is customary to add an H.F. stage before the mixer valve. This necessitates a three-gang condenser, and another coil. The circuit is then as shown in Fig. 4.

By viewing a superhet in this progressive manner the circuit loses much of its terrors, and has the advantage that one can use up standard material in building it.

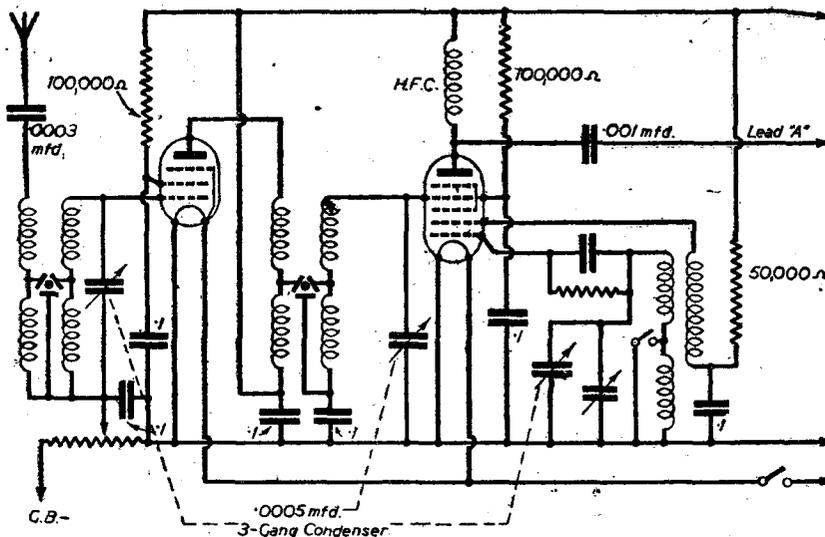


Fig. 4.—Circuit diagram showing the additional H.F. stage.

Station WLW's Twentieth Anniversary

A HUMMING transmitter with clear-channel power of 50,000 watts, and after-midnight experimental power of 500,000 watts, an 831-ft. aerial tower, and the largest independent broadcasting organization in America, is what Powel Crosley, Jr., possesses in Radio Station WLW (Cincinnati) in 1941, its twentieth anniversary year.

WLW to-day is a fabulous leap from the tiny 8CR of 1921, which Crosley constructed in his own home, in Cincinnati. This small station, predecessor of WLW, was an experimental station built from a few odds and ends of equipment, and Crosley tested it by playing a gramophone record, "Song of India," over and over again.

Crosley was taught the fundamentals of broadcast technique by Hamilton Fordyce, who owned a radio shop in Cincinnati, and his partner, Russell Blair, who for many years was one of Crosley's engineers. The spring of 1921 found him deep in experimental research, trying new valves and amplifiers, and building the knowledge of radio that was to eventuate in the far-flung operations that to-day include WLW, WSAI and short-wave station WLWO.

A few months after commencing experimental work at home, Crosley moved the transmitter of 8CR to his manufacturing plant. In March, 1922, the first licence under the call letters WLW was issued.

A year after that, he acquired controlling interest in the Precision Equipment Company, which as early as 1919 had owned and operated WMH, one of the first two broadcasting stations in America. Crosley, however, decided to concentrate his activity and discontinued operating WMH. At this time the various projects being sponsored by Crosley were unified through the organization of a new company—the Crosley Radio Corporation, which in 1939 became the Crosley Corporation.

It was Crosley's idea from the beginning that adequate power must be granted a radio station if it were to serve the public extensively and well. When WLW was moved to Crosley's Brighton plant in 1922, its power was increased to 500 watts by the United States Department of Commerce, and even then the broadcasting pioneer was energetically leading the fight that was to bring about the present era of high-power transmitters.

Anticipating permission to boost WLW's power to 5,000 watts, Crosley in 1924 had new studios constructed at his plant. When permission came the following year, he began operating a new transmitter at Harrison, Ohio, 22 miles from the studios in Cincinnati, which was the first remote-control broadcasting unit to be used in radio. Hitherto, transmitters had been adjacent to studios in ordinary practice.

With WLW established, and with plans going forward to build even a larger transmitter, Crosley in 1926 made an important addition to his broadcasting activity. It was the establishment of a short-wave station known as W8XAL, renamed WLWO last year when the Federal Communications Commission changed call letters on many international transmitters and gave permission for commercial broadcasting.

The station's first licence, in 1926, provided for power of 100 watts, which was increased to 250 watts in 1927, and then to 10,000 watts in 1931.

Power Increased to 75,000 Watts

The power of WLWO has been twice increased, first to 50,000 watts, and more recently to 75,000 watts, making it the most powerful station in the United States. Engineers perfected a special transmitter which enables the international station to operate on not one or two, but six frequencies, adapted to weather and solar conditions, and enabling the beam to reach any given South American country at any given time. Most of the programmes are sent to Latin America by means of a directional aerial shaped like a rhombus or diamond. Although operating on 75,000 watts, the transmitter produces the effect of 900,000 watts owing to the rhombic aerial which concentrates the beams at a small angle, and shoots them in a given direction, just as a reflector increases the brightness of an electric light in a particular direction. The station is being regarded as an important factor in the "good will" relations between the Americas.

In 1927 WLW marked up a red-letter day when it was granted a cleared channel on 700 kilocycles, and another year later when the then Federal Radio Commission increased its power to 50,000 watts. Five months after this permission was received, WLW's new Mason transmitter was put into operation, on October 4th, 1928.

Also in 1928, Crosley acquired control of WSAI, now known as "Cincinnati's Own Station." Founded in 1923, by the United States Playing Card Company, Norwood, Ohio, WSAI originally divided time on a wavelength of 970 kilocycles with WLW, and later with a new outlet known as WFBW. Later the wavelength was shifted to 930 kilocycles, and then to 830. In 1929, following the Crosley purchase, the frequency was set at 1,350 kilocycles. Its new position, under the Havana Treaty, is 1,360 kilocycles.

Until 1933, when it was granted permission to use a daylight strength of 2,500 watts, WSAI had been a low-power station. Its listening strength in the Cincinnati area was considerably increased in 1936 when the transmitter was removed from Mason, Ohio, to the suburb of Clifton Heights, where a high-fidelity transmitter was installed at Warner and Roh Streets. In 1937 its signal strength was increased to 5,000 watts during daytime, and 1,000 watts at night-time, and it was classified as a regional outlet.

The latest development in WSAI's technical progress was the permission granted, late in 1939, to increase night power from 1,000 to 5,000 watts, substantially improving service after sunset. A directional aerial system to be located north of Mount Healthy, using three towers, each 350 feet in height, is now in use.

500,000-watt Transmitter

In 1934 WLW engineers accomplished what until that time had been considered an engineering improbability, if not an impossibility, by building a transmitter that could send out a power of 500,000 watts. The transmitter's most spectacular part is an aerial tower at Mason soaring 831 feet into the air, topping the Washington Monument by 275 feet. The 500,000-watt transmitter is now operated from 12 midnight to 1 a.m. nightly under the experimental call-letters W8XO.

Further developments of vital importance to Cincinnati broadcasting may be expected this year. The Crosley Corporation has filed application with the Federal Communications Commission for a licence to build and operate a frequency modulation transmitter, said to eliminate receiver static, and for permission to operate a television station.

ITEMS OF INTEREST

More Radio Men Wanted for R.A.F.

NEW and forthcoming additions to Britain's bomber fleets have created an urgent demand for thousands of radio and wireless mechanics. They do not fly—they are the men behind the men who work the sets. Servicing the radio and wireless equipment is their job.

Much of the wireless gear used in the big bombers of the R.A.F. is of new and advanced design, and the Air Force is giving special training to keen young men in the work of maintaining and repairing this vital equipment.

Navigating the bombers out to their targets in Germany, and safely home again, depends largely on the radio aids and fixes which the signals members of the air crews obtain. Rescue, in the event of a forced landing on the sea, may well depend also on that vital radio link sustained by the business-like metal-cased sets in the "wireless bloke's" cabin.

Bright, intelligent young men who are keen on radio and have an elementary knowledge of electricity and a mechanic's touch are the type the R.A.F. want. Their training as Radio and Wireless mechanics is one of the most thorough in the Service, and likely to be of immense value to them afterwards in civil life.

The age limits are 18 to 34. And when proficient they pass to the highest paid trade group of the Air Force, with a minimum pay of 4s. 3d. a day.

A Present from France

A SCHOOLGIRL living in a small town on the line between occupied and unoccupied France has written to the B.B.C. enclosing some buttons with the flags of France and Great Britain printed on them. In the letter accompanying the gift the writer says: "In the town itself, which is occupied, there is a shop which even now is still selling buttons with the Anglo-French flags on them. I have sewn some on one of my bodices. They also sell boxes of notepaper on which there is a photograph of King George VI in his Air Marshal's uniform... I had a good laugh the other day when two Germans were looking at these boxes, and were just going to buy one. But in the end they decided they didn't like the colour of the paper. It was a great pity, it would have been lovely if they had gone off with a picture of the Head of the greatest Empire in the world—the Empire which is going to defeat them! In another window there is a picture of Her Majesty Queen Elizabeth. I feel quite proud every time I go past, and the Boches haven't even recognised it yet! Another window was full of Anglo-French badges up till a few days ago. All these little things will show you that the Anglo-French Alliance is still alive to-day in spite of the Boches who occupy our country. Soon our English friends will land in France to chase out the Boche—we await that day and, meanwhile, we resist as best we can."

RADIO ENGINEER'S VEST-POCKET BOOK

2nd Edition

By F. J. CAMM

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Open to Discussion

The Editor does not necessarily agree with the opinions expressed by his correspondents. All letters must be accompanied by the name and address of the sender (not necessarily for publication).

A Morse L.F. Oscillator

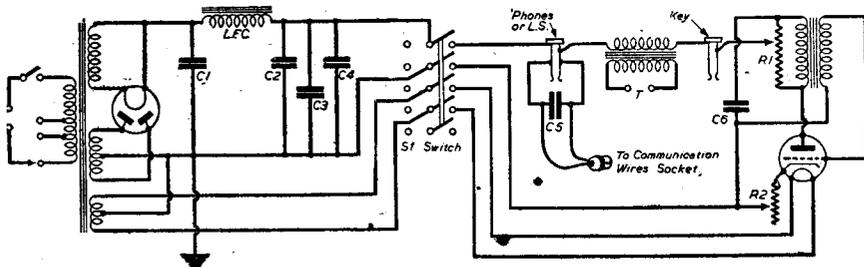
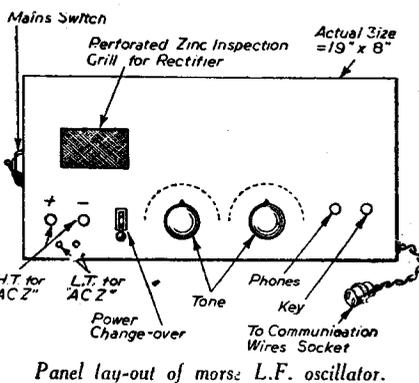
SIR,—I enclose herewith theoretical circuit and panel diagram of my all-mains morse L.F. oscillator, which may be of interest to other keen amateurs. About two weeks (evenings) have been spent on it, and the results amply justify the time put in. My friend (also a reader of your paper) and I have connected our shacks together with a twin wire, and we have morse practice, using my oscillator and his, with headphones in parallel across the respective outputs. Here is a brief description of the uses of the various components.

The B.T.H. L.F. transformer (sec. not used) replaces an L.F. choke, and stops key clicks in the domestic receiver. It also smooths the note and lifts its frequency. R2 was originally the tone control alone, but I found that it only varied the note over a small scale, so R1 was added with very pleasing results. C5 gives the note a "cushiony" effect; without it, the instrument cracks into oscillation when the key is pressed, but in circuit, the oscillations rise to a peak just quick enough so as not to clack the phones or vice versa, so as not to sound like a siren starting up. C6 prevents coarseness, and also lifts the frequency. The other set of switch contacts go to my "A.C.2," now in course of construction. To communicate with my friend I just plug a bayonet plug into an old lamp

8.30, 9.30 and 10.30 p.m., B.S.T." I am still at a loss as to the situation and nationality of this station, but I hope the information above will be of interest to your correspondent. In conclusion, I should like to express my appreciation of PRACTICAL WIRELESS for "carrying on."—F. WHALEY (Taunton).

Who is the Doyen?

SIR,—With reference to Thernion's query, "Who is the Doyen?", it certainly would be interesting to know who is the oldest wireless amateur. I am a proud possessor of the "Practical Wireless



Circuit diagram of W. G. Andrews' all-mains morse oscillator. Components are as follow: C1—16 mfd. (wet); C2—4 mfd.; C3 and C4—2 mfd.; C5—.25 mfd.; C6—.001 mfd.; S1—switch (Burndept 5 p. 2-way); Rect.—Philips 1821; R1— $\frac{1}{2}$ M Ω vol. control (Philco); R2—old filament rheo.; T—L.F.T. (B.T.H. 10-1); L.F.C. (Philips); Osc. valve—(Marconi MHL4); Osc. trans.—(Ferranti AF4).

socket and switch on. We call each other up in the Mercantile Marine style, and it is to this Service that I expect to be appointed shortly, in the capacity of radio officer.

I trust that other readers will benefit from this circuit.

"Torch's" poem in the May issue is noted. I think it is really the best he has produced yet. It amused me intensely.—W. G. ANDREWS (Liverpool).

S.W. Station Identification

SIR,—In reply to a letter from one of your correspondents (John Parkin, of Hull), I should like to mention that I have heard the station to which he refers. The station gave an English news programme and closed at 9 p.m., B.S.T. with the announcement: "This is the N.B.S. New Broadcasting System station broadcasting on wavelengths of 25.08, 30.77 and 41.07 metres. Our programmes are radiated at

Encyclopædia," "Radio Training Manual," "P.W. Service Manual," and "Wireless Transmission." I also have the data sheets which were issued with the first issue of PRACTICAL WIRELESS, and I think these are a fine collection. I am 47 years old.—T. W. HERBERT (Walthamstow).

SIR,—I made my first set (10 valves) in 1916, long before broadcasting began, with coloured soft Dutch valves and home-made bobbin transformers—panel 3ft. x 2ft.—and believe it or not, one pair of Army pattern headphones. I claim to be your oldest reader. I have yet to buy my first ready made receiver, and I must have made dozens of sets, but I am still just as keen as ever.

Good luck, Lawton, of Prestwich, I was your first customer when you opened up on Moston Lane, Blackley, about 1924. Remember my Three-Four?—C. WILLIAMS (Stockport).

Back Numbers Wanted

WILL any reader who has a spare copy of PRACTICAL WIRELESS dated December 28th, 1935, and of January 4th, 1936, please notify K. Fawcett, 18, Hovingham Grove, Harehills, Leeds, 8, who would be grateful for the loan of them.

Correspondents Wanted

A. REID, 41, Calshot Road, Gt. Barr, Birmingham 22, would like to correspond with another reader in any part of the British Isles who is interested in S.W. radio.

A. G. S. Cobb, Blencowe, Heath Street, Tamworth, Staffs, who is a beginner, is desirous of getting in touch with any young short-wave enthusiast.

MAINS-OPERATED APPARATUS FOR RADIO

THE British Standards Institution has recently issued a revision of the British Standard Specification for Electric Mains-Operated Radio and other Apparatus for Radio, Acoustic and Visual Reproduction (Safety Requirements—B.S. No. 415—1941).

This revision was undertaken chiefly as a result of the circulation by the International Electrotechnical Commission, of a draft-international specification for safety requirements for mains-operated radio apparatus. The present revision has incorporated as much of the material of that draft as has proved acceptable to the interests in this country.

The scope of the British specification is wider than that of the I.E.C. draft, for it includes television and public address equipment, but it can be said that the present issue of B.S. 415 differs little in principle from the I.E.C. proposals, so that when circumstances permit of the completion of the international draft, the British standard will be found to be in line on all fundamental questions, though differing in some important details. A new Section No. 7 has been added, dealing with the installation of the apparatus.

Copies of the revised specification may be obtained from the British Standards Institution, Publications Department, 28, Victoria Street, London, S.W.1, price 2s. 3d., post free.

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Comment, Chat and Criticism

Outline of Musical History—21

Beethoven's Life in Vienna.

By Our Music Critic, MAURICE REEVE

THERE was much to learn and much hard work to get through before Beethoven could master the intricacies of composition and orchestration to the extent that would enable him to write worthily in such forms as the symphony, concerto, sonata or quartet. So, brimful of confidence and self assurance, and possessing, at long last, a certain measure of financial independence, he left Bonn for Vienna by the post-chaise at 6 a.m. on November 3rd, 1792. Sure that he would conquer the musical world, he succeeded to a degree that must have reached beyond even his not inconsiderable vanity and personal egotism. The armies of the French Revolution were hard on the wheels of his carriage as it sped across Germany and Austria; Bonn soon fell under French government, and, shortly after his arrival in the famous city on the Danube, it, too, listened to the victorious tramp of Napoleon's soldiers.

Arrival in Vienna

Beethoven arrived in Vienna about the 10th November, 1792. As to the great city at the time of his arrival, we might do best by quoting M. M. Scott—"Beethoven." "At a period when music was fashionable in most great cities, Vienna stood high above all others by the splendour of its professional musicians, the cultivation of its connoisseurs and the prodigality of those princely patrons who vied with each other in the maintenance of house orchestras and chamber music organisations. If public concerts were few, opera was a constant factor, and the private concerts in the palaces of the nobility were an ideal ground on which to make music and meet musicians. Some idea of the prizes open to composers may be gained when we remember that Haydn's oratorio *The Creation* and Beethoven's *Eroica Symphony* both had their first performances in private, one at the Schwarzenberg Palace, the other by Prince Lichnowsky's orchestra."

He took up his abode, first in an attic, and then in a ground floor room, in Prince Lichnowsky's house. It was obvious that his friends in Bonn had arranged for his arrival, else how can it be explained that he found a prince's home to walk straight into, even though it was the top floor?

Few men in history have been the fortunate possessor of so many friends as Beethoven; friends in the highest walks of life and friends who were faithful to him through the greatest provocations. For few men, also, have treated their friends in worse taste, and often with disgraceful and unpardonable rudeness, than he did. Amongst those who honoured him with their confidence were Prince and Princess Lichnowsky firstly, who not only worshipped his music and practically placed their house at his disposal, but also provided him with a quartet of the finest instruments, and an annuity of six hundred guilden. Then there was Baron von Swieten, Prince Lobkowitz, Count Fries, Count Maurice Lichnowsky (the Prince's brother), Baron von Gleichenstein and von Domanowicz of the Foreign Office, who was so under the young despot's

spell that he would be perfectly content to cut his pens for him.

Gifts at Transposition

Beethoven was a splendid pianist and phenomenal at transposition and improvisation. But it was his playing of slow movements, and especially his own, which caused his audience to give him their allegiance once they had heard him. During his first year or so in Vienna, it was in this capacity that he was chiefly known. His gifts at transposition were truly remarkable in spite of the fact that Mozart, Mendelssohn, and a few others performed similar deeds. He transposed the whole of his Concerto in C at rehearsal into C sharp, owing to the piano being half a tone flat.

There were few public concerts and recitals then as we know them now. Most of the music had to be heard at the private functions given by the aristocracy, at which artists like Beethoven had ample opportunities for performance in conditions of quiet and before audiences of a greater degree of musical intelligence than could then be found in a public hall. Prince Lichnowsky and Baron von Swieten were the first to secure his services, the Prince for his regular Friday morning chamber performances, the latter for soirées, when he had "either to bring his nightcap in his pocket" or to stay after the other guests had gone. On these latter occasions, he would play half a dozen of Bach's Fugues for his host, as a parting "good night" and for "pleasant dreams." It never failed. We must not forget that it was on Bach's famous "48" that he built up his reputation as a pianist in Bonn.

Romantic Life

In 1795 he proposed to Magdalena Willmann, a charming and gifted singer, but she refused him because "he was ugly and half crazy." Strange, that one of the women who might have been among the first expected to be appreciative of his greatness and to have come under the spell that most people couldn't resist, being herself in the world of music, should have uttered such a strange remark! But he did not moan long over this pretty charmer, for he was called to give lessons to Giulietta Guicciardi, cousin of the Brunswick sisters, and the daughter of a court councillor. Giulietta was 17 and he was 30. Giulietta, however, married Count Gallenberg, a man in her own station of life, and the much thwarted and romantic master had to nurse his sorrows afresh. He dedicated the Rondo in G to her, and it was considered more than a coincidence that the key and her initial were the same letter. But he took it back and for some reason or other sent to Eleonora, only to exchange it with Giulietta for something much more famous and imposing, the Sonata in C sharp minor, Op. 27, No. 2, to which we are indebted to a publisher for its baptism as the "Moonlight."

In the autumn of 1803 he fell to the charms of the beautiful young countess, Josephine von Deym, who with her equally lovely sister, Countess Therese von Brunswick, were cousins of Giulietta Guicciardi,

and his pupils at the time he first met Giulietta.

Viennese Society

Winter of 1805-6 saw the three of them, Beethoven, Josephine and Therese, in the full whirl of Viennese society. It was at this time that he solved the problem of his deafness and gained his great victory over it, hence his emergence from his self-imposed solitude, and the splendour and magnificence of the great works which flowed from his pen. Each of the compositions from now till 1812 vied with one another in new marvels unknown in music before. Did Therese help him with the fight? It was at this time that he pencilled on a page of the sketches for the Rasoumovsky quartets: "Just as you are now plugging into the whirlpool of society—just so possible is it to compose operas in spite of social obstacles. Let your deafness no longer be a secret—even in art." There is something here that savours of Therese, the apostle of truth.

Threatened Deafness

In a letter to Giulietta mention is made of the commencement of what was undoubtedly the great tragedy of his life—his deafness. Other references made at the same time reveal the fact that he feared the oncoming of this terrible affliction with dread and consternation.

This great calamity must afford at least a partial excuse for his many otherwise unaccountable pieces of conduct. To a musician, striving to hear the threads of harmony as his patterns were woven in his mind, and then, a little later on and for the rest of his life being unable to hear them even on a piano, and in the end not at all, is a tragedy that can only be called overwhelming. To compare it to a painter losing his sight or anyone their hands can do nothing to emphasise the horror of it.

After settling down in Vienna, Ludwig got down to hard work under Haydn, with whom he studied for over a year. The lessons were not a success, and, as already mentioned, the two men, one so ripe in experience and the other so eager to burst into blossom of his own, and not of Haydn's, forcing, did not get on too well together. In fact, the lessons left Ludwig so dissatisfied that he went secretly to Schenk for some stricter ones.

When Haydn went to England in 1794, Beethoven strode off to Albrechtsburger, a famous pedagogue. These lessons lasted a year when he began to study vocal composition, verbal accent, rhythm, metre, etc., from Salieri, Mozart's old rival, and in quartet writing from Forstner. At the same time, he was gaining fame as a pianist, chiefly through his performances of Bach's 48 Preludes and Fugues, and as a teacher amongst the more progressive students and the young ladies of the noblesse, in whose salons he had such a firm foothold.

His first concert appearance was in 1795, playing his own Concerto No. 2 in B flat, Op. 19, at a charity concert and in the following year he went on tour, visiting Prague and Berlin amongst other places. On June 21st, he appeared at the Singakademie in Berlin where they sang in his honour.

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The British Long-Distance Listeners' Club

DURING the past few weeks several interesting letters have been received from members giving accounts of their activities, and other matters of interest. A selection of these letters is given on this page.

From an Old Member

MEMBER 1,775, whose QRA is in Palestine, sends us the following interesting letter:

"After noting the regular corner in PRACTICAL WIRELESS for Club news, I take this opportunity of writing to try and re-contact some members from whom I have not heard since I enrolled about four years ago.

"You will note from my membership number that I am a very old member of this Club, and if there are some good ex-hams who would like to contact me in view of exchanging ideas, I'll be delighted to respond. Please address, c/o The Editor.

"You might be interested to learn what type of equipment I am using. Well, I have one of the so-called communication sets, and it is a good RX for the short waves. On this set I have heard 85 countries (hams), mostly on 'phone, but have verified only 40, of which I have QSL cards. I have heard all continents, and verified the British Empire. The antenna in use at my QRA is 66ft. end-fed, and directed N.E.-S.W., and certainly brings in the DX. The W6, K6, KD6 and KB6 hams are regular 'customers' of my set, and I certainly enjoy them."

We were very interested in your long list of QSL's, No. 1,775, but pressure on our space prevents us from publishing it.

Experimental Work

MEMBER 6,313, whose rig is illustrated on this page, writes:

"I follow with great interest the reports in PRACTICAL WIRELESS on the activities of the B.L.D.L.C. For some months past I have been doing a great deal of experimenting, and have tried all kinds of circuits and different methods of coupling and decoupling in the L.F. and H.F. stages. In the accompanying photograph of my den the short-wave set (on the right) is now an untuned H.F. buffer stage connected by condenser to the coil, an ordinary regenerative detector stage feeding a pentode through a 10-1 Telsen coupling unit. Plug-in coils cover from 12-180 metres. The broadcast band set is a Cossor. Circuits are now being tried for another broadcast band set.

"Above the short-wave set is the speaker, and a microphone for inter-house communication is on one side of the set. On the left is the Cossor receiver."

Amateur Radio Conference in Manchester

MEMBERS residing in the Manchester district will be interested in the following letter from Member 32.

"Perhaps you will be surprised to hear from one who was and I hope still is an old member of the B.L.D.L.C. My membership number is 32 (March 14th, 1936), and the organisation which I was secretary of then (North Manchester Radio Society) was recognised as the Northern Headquarters of the B.L.D.L.C. This, however, was soon passed over, because at that time there were very few B.L.D.L.C. members anywhere near Manchester. I am still secretary, but the organisation is now called North Manchester Radiq and Television Society, and I am still interested in meeting members of the B.L.D.L.C., although I always find that they are rather shy at making themselves known. My purpose in writing this letter is to draw attention to an amateur radio conference which is to be held in Manchester on June 8th, and to assure all members of the B.L.D.L.C. who are able to attend that they will be specially welcomed.

"I should be interested to know if there



A corner of the den owned by Member 6,313.

are many members around the Manchester area, and if so I shall be pleased to see them if they will write me, c/o The Editor, arranging a date."

Small Frequency Meter

MEMBER 6,472, who has recently completed this handy unit, writes as follows:

"The frequency-meter described in your April issue has been constructed and is now in the calibration stage. It is most certainly a very useful piece of apparatus, not only as a frequency-meter but also as a separate heterodyne or beat-oscillator when receiving through heavy interference. This, of course, only applies to C.W. reception, as the introduction of a beat-note on a telephony station would be the same as trying to receive it with the detector valve oscillating. With regard to WGEO operating on 48.47 metres, I think I can safely say that the only 'G.E.' station operating on this wavelength is KGEE in San Francisco, Calif. Having heard local oscillations on the 14 mc. and the 7 mc. bands—from a S.W. enthusiast apparently—I should very much like to hear from any local S.W.L. in the Wandsworth district. All letters will find me at 81, Plymouth House, East Hill Estate, Wandsworth, London, S.W.18. In conclusion, my offer in the January issue, of aid or co-operation, still stands good—so let's hear from you, fellow-members."

PERSONAL PARAGRAPHS

The Committee of the wireless section of the Institution of Electrical Engineers make the following nominations to fill the vacancies which will occur on the committee on September 30th, 1941: Chairman, H. Bishop, C.B.E., B.Sc.(Eng.), member (British Broadcasting Corporation); Vice-Chairman, A. H. Mumford, B.Sc.(Eng.), member (Post Office Engineering Department); Ordinary members of committee (five vacancies), H. G. Beer, associate member (Post Office Engineering Department), F. P. Best, M.Sc., B.Eng., associate member (Marconi International Marine Communication Co., Ltd.), H. G. Hughes, M.Sc., associate member (H.M. Signal School), Prof. Willis Jackson, D.Sc., D.Phil., associate member (Manchester University), H. A. Thomas, D.Sc., member (National Physical Laboratory).

Mr. G. Parr

Fifteen momentous years in radio history are recalled in the news of the resignation from his post at Ediswan of Mr. G. Parr, where since 1926 he has been closely



Mr. G. Parr.

associated with the technical development of radio in practically every sphere of its application. Mr. Parr joined Ediswan in the boom days of radio when the component market, raked by a million amateur radio engineers, thrived even more richly than the receiver market.

He went into Ediswan from the Finsbury College, at which he was trained and where, except for a short period of service with the Navy Wireless Service in the last war, he worked as a demonstrator and lecturer in electrical engineering.

He started his Ediswan career as assistant in the lamp works laboratory at Ponders End. At that time the development of the oxide-coated filaments for radio valves was an all-important subject, and much of Mr. Parr's work was directly in connection with its application to Ediswan valves. He was later transferred to Radio Division at Charing Cross Road, in charge of the Technical Service section, and so placed in the position from which he has become so widely known. His work in connection with the cathode-ray tube took him all over the country as a lecturer and demonstrator. He is leaving Ediswan to become editor of "Electronic Engineering," and the news of his appointment will be received with interest in the radio and industrial world.

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P. 17.

Replies to Queries

Engersing Current for M.C. Speaker

"I have an M.C. loudspeaker with 1,250 ohms field, which I want to engersise from the 230 v. mains. I have various mains transformers and rectifiers on hand, mainly 350-0-350, and also V12 valves. I presume a power-pack made up with one of these will do, but I am at a loss to know how to get the correct current for engersising. Will you please put me on the right track?"—E. Stables, Junr. (Hemingbrough).

WE assume that the speaker requires an engersising wattage of 15. The wattage is the product of the resistance of the field winding and the square of the current in amps.; this means that the current required is about 110 mA. To be on the safe side, however, and to avoid over-heating, it would be best to connect a 5,000-ohm, 15-watt, semi-variable resistor in series with the field. You could then choose the highest value at which good sensitivity can be obtained. Take care that both speaker and resistor are mounted so that there is a good circulation of air round them, to avoid over-heating.

Using Outdoor Aerial with Portable

"I am constructing a 4-valve portable from the circuit published in 'Practical Wireless,' dated July 6th, 1940, and shall be glad if you can assist me on the following points: I want to use the set with an outdoor aerial, about 40ft. length with lead-in. If this will be satisfactory, will you please give me point to point connections—beyond screen grid valve to aerial and switch and earth. Also I have a small coil, wound as shown in rough sketch (not reproduced), with 6-pin connections, but do not know point to point connections. Will this be suitable?"—A. W. White (Southend-on-Sea).

IT is a very simple matter to use an outdoor aerial with any portable set having a frame aerial, by following one of two methods. The first is to wind about three turns of wire, of any convenient gauge and cotton covered, round the frame and connect one end of this extra winding to the aerial lead-in, and the other end to the earth lead, and to the earth line (generally L.T.—, H.T.—), in the set. It is worth while to try the effect of reversing the aerial and earth connections to find which gives better reception.

The other method is to connect the aerial lead to the grid of the first valve through a small fixed or variable condenser, a value between .00005 and .0001 mfd. being suitable. In this case also, the earth lead should be joined to the earth line in the set. A reasonable degree of selectivity control can be obtained by combining these two methods; that is, by using the extra few turns of aerial winding and connecting the aerial lead-in to one end of this through a small variable or pre-set condenser. We do not advise you to alter the wiring of the receiver nor to modify the circuit published.

It is quite impossible to make any really helpful suggestions concerning the proper connections to the coil of which you give a sketch, since this was probably taken from a commercial receiver, and was no doubt built to a special design for a special purpose. In view of this, the coil is probably useless to you as it stands, and would be better re-wound in accordance with one of the sets of instructions given in our book, "Wireless Coils, Chokes and Transformers," published

at 5s., or 5s. 6d. post paid from Tower House, Southampton Street, Strand, W.C.2.

Loading for Push-pull Output Stage

"I intend to convert my 2H.F. set from A.C.—D.C. to 'all A.C.' working. In this modification, advantage will be taken to replace the simple A.V.C. by delayed amplified A.V.C. and to replace the push-pull pentodes by triodes (C.P.X.4's). Will you please inform me how much amplification will be required between the duo-diode triode, and the output valves to load them fully, using R.C. coupling? These will be operated at about 40 mA. apiece, so as to operate the

RULES

We wish to draw the reader's attention to the fact that the Queries Service is intended only for the solution of problems or difficulties arising from the construction of receivers described in our pages, from articles appearing in our pages, or on general wireless matters. We regret that we cannot, for obvious reasons—

- (1) Supply circuit diagrams of complete multi-valve receivers.
- (2) Suggest alterations or modifications of receivers described in our contemporaries.
- (3) Suggest alterations or modifications to commercial receivers.
- (4) Answer queries over the telephone.
- (5) Grant interviews to querists.

A stamped, addressed envelope must be enclosed for the reply. All sketches and drawings which are sent to us should bear the name and address of the sender.

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whole affair from a 350v.-120mA. rectifier."—W. L. Young (Halifax).

TO enable you to load the two P.X.4 valves fully you will require a single stage of resistance-coupled L.F. between the double-diode-triode, and the push-pull output stages.

The most suitable valve for the intermediate stage is one with characteristics similar to those of the M.L.4. You will be interested to know that this particular combination is recommended by the makers of the P.X.4 and M.L.4.

Speaker Connections in Push-pull Circuit

"I am thinking of constructing a four-valve wireless set for broadcasting and short waves. It is just a straight detector L.F. and two valves in quiescent push-pull, and it is with this latter part of the set that I have had trouble. With this circuit, what are the proper connections to the loudspeaker? Are the two plate connections made a common lead to the speaker? On the other hand, I believe an output transformer can be included, and I shall be glad to know if this affects the quality of the reception much; and do you advise me to include this in the circuit?"—Denis E. Urry (Long Eaton).

THERE are two standard methods of connecting the speaker to a Q.P.P. or any other type of push-pull output circuit. One is by using a centre-tapped choke, the two end connections of which go to the two anodes, and the centre tapping to H.T. +. The speaker transformer (assuming the usual built-in transformer) is then connected through two 2-mfd. fixed condensers to the two "anode" ends of the output choke, or to appropriate tappings

on the choke. In this case, the output choke should be of a type specially designed for Q.P.P., and it will probably have two or three taps on each side of the centre tapping to allow for correct matching of the speaker.

The other method is to use a speaker with a Q.P.P. transformer, in which case the only connections to the set are from the three terminals marked "Anode," "Anode" and "H.T.+" respectively. These are connected in the manner described above in relation to the output choke. Provided that the choke and transformer are of suitable type for Q.P.P. output, either of the methods described is perfectly satisfactory, neither being better than the other. When the speaker has a built-in transformer of the ordinary type it is usually better to use the output-choke arrangement.

Hum in an Amplifier

"I have replaced the push-pull input transformer in my amplifier by a Mullard 354v. valve used as a phase inverter, but this has caused very loud hum, although the H.T. to this valve is decoupled. Will a separate heater winding help, and should it be earthed or otherwise connected to the cathode?"—W. S. Jaques (North Cheam).

SINCE you do not give the circuit of your modified amplifier; it is not possible to give any direct suggestions as to the possible cause of the hum. If, however, you have fed the input to the phase inverter between grid and the lower end of the bias resistor—instead of between grid and earth—this could be responsible, and we suggest that you try the alternative connections.

The hum could also be due to the capacity between the heater and cathode, which are at fairly widely-varying potentials. That could be overcome by using a separate heater winding, as you suggest, joining the centre tapping to the lower end of the bias resistor.

You do not state whether or not you have used a by-pass condenser across the bias resistor; this is not normally necessary, but is sometimes desirable if the phase-inverting valve is of low mu.

Voltage Dropping

"I have a diagram of an A.C.—D.C. two-valve short-wave set, but am uncertain of the value of the mains dropping resistance for use on 210 v. mains. Details are as follow: 76 det. and L.F. and 1223 half-wave rectifier 76s requiring 6.3 v. at .3 amp. and rectifier 12.6 v. at .3 amp. Am I correct in estimating dropping resistance so 24 v. from 210 v. = $\frac{186}{.9 \text{ amp.}} = 206 \text{ ohms?}$

Could other resistances in circuit be of 1-watt type, i.e., voltage divider, etc.?"—D. Dawe (Bristol).

THE total current passed by the dropping resistor will be .3 amp., since all the heaters are in series. The voltage to be dropped is 210 minus 25.2, or approximately 185. This means that the value of the resistor should be $\frac{185}{.3}$ or 617 ohms;

you could, therefore, use a 600-ohm fixed resistor in series with a 25-ohm variable.

To find the wattage required for resistors you multiply the resistance in ohms by the square of the current in amps. Without having complete details of your circuit we could not advise you as to the required ratings, but you can easily determine the figures by using the simple formula given above.

The coupon on page iii of cover must be attached to every query

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BLUEPRINT SERVICE

PRACTICAL WIRELESS

	Date of Issue.	No. of Blueprint.
CRYSTAL SETS		
Blueprints, 6d. each.		
1937 Crystal Receiver	—	PW71
The "Junior" Crystal Set	27.8.38	PW94
STRAIGHT SETS. Battery Operated.		
One-valve : Blueprints, 1s. each.		
All-Wave Unipen (Pentode)	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve : Blueprint, 1s.		
The Signet Two (D & LF)	24.9.38	PW76
Three-valve : Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow)	—	PW35
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	—	PW30
Hall-Mark Three (SG, D, Pow)	—	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	—	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	—	PW40
Cameo Midget Three (D, 2 LF (Trans))	—	PW51
1936 Sonotone Three-Four (HF Pen, HF Pen, Westector, Pen)	—	PW53
Battery All-Wave Three (D, 2 LF (RC))	—	PW55
The Monitor (HF Pen, D, Pen)	—	PW61
The Tutor Three (HF Pen, D, Pen)	—	PW62
The Centaur Three (SG, D, P)	—	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen)	—	PW69
The "Colt" All-Wave Three (D, 2 LF (RC & Trans))	18.2.39	PW72
The "Rapide" Straight 3 (D, 2 LF (RC & Trans))	—	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det, Pen)	—	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen)	—	PW84
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)	26.3.38	PW87
The "Hurricane" All-Wave Three (SG, D (Pen), Pen)	—	PW89
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	3.9.38	PW92
Four-valve : Blueprints, 1s. each.		
Fury Four (2 SG, D, Pen)	—	PW11
Beta Universal Four (SG, D, LF, Cl. B)	—	PW17
Nucleon Class B Four (SG, D (SG), LF, Cl. B)	—	PW34B
Fury Four Super (SG, SG, D, Pen)	—	PW34C
Battery Hall-Mark 4 (HF Pen, D, Push-Pull)	—	PW46
F. J. Camm's "Limit" All-Wave Four (HF Pen, D, LF, P)	—	PW67
"Acme" All-Wave 4 (HF Pen, D (Pen), LF, Cl. B)	12.2.38	EW83
The "Admiral" Four (HF Pen, HF Pen, D, Pen (RC))	3.9.38	PW90
Mains Operated.		
Two-valve : Blueprints, 1s. each.		
A.C. Twin (D (Pen), Pen)	—	PW18
A.C.-D.C. Two (SG, Pow)	—	PW31
Selectone A.C. Radiogram Two (D, Pow)	—	PW19
Three-valve : Blueprints, 1s. each.		
Double-Diode-Triode Three (HF Pen, DDT, Pen)	—	PW32
D.C. Ace (SG, D, Pen)	—	PW25
A.C. Three (SG, D, Pen)	—	PW29
A.C. Leader (HF Pen, D, Pow)	7.1.39	PW35C
D.C. Premier (HF Pen, D, Pen)	—	PW35B
Unique (HF Pen, D (Pen), Pen)	—	PW36A
Armada Mains Three (HF Pen, D, Pen)	—	PW38
F. J. Camm's A.C. All-Wave Silver Souvenir Three (HF Pen, D, Pen)	—	PW50
"All-Wave" A.C. Three (D, 2 LF (RC))	—	PW54
A.C. 1936 Sonotone (HF Pen, HF Pen, Westector, Pen)	—	PW56
Mains Record All-Wave 3 (HF Pen, D, Pen)	—	PW70
Four-valve : Blueprints, 1s. each.		
A.C. Fury Four (SG, SG, D, Pen)	—	PW20
A.C. Fury Four Super (SG, SG, D, Pen)	—	PW34D
A.C. Hall-Mark (HF Pen, D, Push-Pull)	—	PW45
Universal Hall-Mark (HF Pen, D, Push-Pull)	—	PW47

SUPERHETS.

Battery Sets : Blueprints, 1s. each.		
£5 Superhet (Three-valve)	—	PW40
F. J. Camm's 2-valve Superhet	—	PW52
Mains Sets : Blueprints, 1s. each.		
A.C. £5 Superhet (Three-valve)	—	PW43
D.C. £5 Superhet (Three-valve)	—	PW42
Universal £5 Superhet (Three valve)	—	PW44
F. J. Camm's A.C. Superhet 4	—	PW59
F. J. Camm's Universal £4 Superhet 4	—	PW60
"Qualitone" Universal Four	—	PW73
Four-valve : Double-sided Blueprint, 1s. 6d.		
Push Button 4, Battery Model	22.10.38	PW95
Push Button 4, A.C. Mains Model	—	—
SHORT-WAVE SETS. Battery Operated.		
One-valve : Blueprint, 1s.		
Simple S.W. One-valver	23.12.39	PW88
Two-valve : Blueprints, 1s. each.		
Midget Short-wave Two (D, Pen)	—	PW38A
The "Fleet" Short-wave Two (D (HF Pen), Pen)	27.8.38	PW91
Three-valve : Blueprints, 1s. each.		
Experimenter's Short-wave Three (SG, D, Pow)	—	PW30A
The Prefect 3 (D, 2 LF (RC and Trans))	—	PW63
The Band-Spread S.W. Three (HF Pen, D (Pen), Pen)	—	PW68
PORTABLES.		
Three-valve : Blueprints, 1s. each.		
F. J. Camm's ELF Three-valve Portable (HF Pen, D, Pen)	—	PW65
Parvo Plyweight Midget Portable (SG, D, Pen)	3.6.39	PW77
Four-valve : Blueprint, 1s.		
"Imp" Portable 4 (D, LF, LF (Pen))	—	PW86
MISCELLANEOUS.		
Blueprint, 1s.		
S.W. Converter-Adapter (1 valve)	—	PW48A
AMATEUR WIRELESS AND WIRELESS MAGAZINE CRYSTAL SETS.		
Blueprints, 6d. each.		
Four-station Crystal Set	23.7.38	AW427
1934 Crystal Set	—	AW444
150-mile Crystal Set	—	AW450
STRAIGHT SETS. Battery Operated		
One-valve : Blueprint, 1s.		
B.B.C. Special One-valver	—	AW387
Two-valve : Blueprints, 1s. each.		
Melody Ranger Two (D, Trans)	—	AW388
Full-volume Two (SG det, Pen)	—	AW392
Lucerne Minor (D, Pen)	—	AW426
A Modern Two-valver	—	WM409
Three-valve : Blueprints, 1s. each.		
£5 5s. S.G. 3 (SG, D, Trans)	—	AW412
Lucerne Ranger (SG, D, Trans)	—	AW422
£5 5s. Three : De Luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	—	AW437
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen)	—	WM327
Economy Pentode Three (SG, D Pen)	—	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans)	—	WM354
1935 £6 6s. Battery Three (SG, D, Pen)	—	WM371
PTP Three (Pen, D, Pen)	—	WM389
Certainty Three (SG, D, Pen)	—	WM393
Minute Three (SG, D, Trans)	Oct. '35	WM396
All-Wave Winning Three (SG, D, Pen)	—	WM400
Four-valve : Blueprints, 1s. 6d. each.		
6s. Four (SG, D, RC, Trans)	—	AW370
2HF Four (2 SG, D, Pen)	—	AW421
Self-contained Four (SG, D, LF, Cl. B)	Aug. '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	—	WM350
£5 5s. Battery Four (HF, D, 2 LF)	Feb. '35	WM381
The H.K. Four (SG, SG, D, Pen)	—	WM384
The Auto Straight Four (HF Pen, HF Pen, DDT, Pen)	Apr. '36	WM404
Five-valve : Blueprints, 1s. 6d. each.		
Super-quality Five (2 HF, D, RC, Trans)	—	WM320
Class B Quadrydne (2 SG, D, LF, Class B)	—	WM344
New Class B Five (2 SG, D, LF, Class B)	—	WM340

These Blueprints are drawn full size. Copies of appropriate issues containing descriptions of these sets can in some cases be supplied at the following prices which are additional to the cost of the Blueprint. A dash before the Blueprint Number indicates that the issue is out of print. Practical Wireless (issues dated prior to June 1st, 1940). 4d. Post Paid Issues dated June 1st to July 27th, 1940, 5d. Post Paid (Issues dated September, 1940 and after) 7d. Post Paid

Amateur Wireless ... 4d. " " Wireless Magazine ... 1d. " " The index letters which precede the Blueprint Number indicate the periodical in which the description appears: Thus P.W. refers to PRACTICAL WIRELESS, A.W. to Amateur Wireless, W.M. to Wireless Magazine.

Send (preferably) a postal order to cover the cost of the Blueprint, and the issue (stamps over 6d. unacceptable) to PRACTICAL WIRELESS Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

Mains Operated.		
Two-valve : Blueprints, 1s. each.		
Consoelectric Two (D, Pen) A.C.	—	AW403
Economy A.C. Two (D, Trans) A.C.	—	WM286
Unicorn A.C.-D.C. Two (D, Pen)	—	WM394
Three-valve : Blueprints, 1s. each.		
Home Lover's New All-Electric Three (SG, D, Trans) A.C.	—	AW383
Mantovani A.C. Three (HF, Pen, D, Pen)	—	WM374
£15 15s. 1936 A.C. Radiogram (HF, D, Pen)	Jan. '36	WM401
Four-valve : Blueprints, 1s. 6d. each.		
All Metal Four (2 SG, D, Pen)	—	WM329
Harris' Jubilee Radiogram (HF, Pen, D, LF, P)	May '35	WM386
SUPERHET.		
Battery Sets : Blueprints, 1s. 6d. each.		
Modern Super Senior	—	WM375
"Varsity" Four	Oct. '35	WM395
The Request All-Waver	June '36	WM407
1935 Super Five Battery (Superhet)	—	WM379
Mains Sets : Blueprints, 1s. each.		
Heptode Super Three A.C.	May '34	WM359
"W.M." Radiogram Super A.C.	—	WM366
PORTABLES.		
Four-valve : Blueprints, 1s. 6d. each.		
Holiday Portable (SG, D, LF, Class B)	—	AW393
Family Portable (HF, D, RC, Trans)	—	AW447
Two H.F. Portable (2 SG, D, QP21)	—	WM363
Tyers Portable (SG, D, 2 Trans.)	—	WM367
SHORT-WAVE SETS. Battery Operated.		
One-valve : Blueprints, 1s. each.		
S.W. One-valver for America	15.10.38	AW429
Roma Short-Waver	—	AW452
Two-valve : Blueprints, 1s. each.		
Ultra-short Battery Two (SG, det, Pen)	Feb. '36	WM402
Home-made Coil Two (D, Pen)	—	AW440
Three-valve : Blueprints, 1s. each.		
World-ranger Short-wave 3 (D, RC, Trans)	—	AW355
Experimenter's 5-metre Set (D, Trans, Super-regen)	30.6.34	AW438
The Carrier Short-waver (SG, D, P)	July '35	WM390
Four-valve : Blueprints, 1s. 6d. each.		
A.W. Short-wave World-beater (HF, Pen, D, RC, Trans)	—	AW436
Empire Short-waver (SG, D, RC, Trans)	—	WM313
Standard Four-valver Short-waver (SG, D, LF, P)	P.W. 22.7.39	WM382
Superhet : Blueprint, 1s. 6d.		
Simplified Short-wave Super	—	WM397
Mains Operated.		
Two-valve : Blueprints, 1s. each.		
Two-valve Mains Short-waver (D, Pen) A.C.	P.W. 13.1.40	AW453
"W.M." Long-wave Converter	—	WM380
Three-valve : Blueprint, 1s.		
Emigrator (SG, D, Pen) A.C.	—	WM352
Four-valve : Blueprint, 1s. 6d.		
Standard Four-valve A.C. Short-waver (SG, D, RC, Trans)	—	WM391
MISCELLANEOUS.		
S.W. One-valve Converter (Price 6d.)	—	AW329
Enthusiast's Power Amplifier (1/6)	—	WM387
Listener's 5-watt A.C. Amplifier (1/6)	—	WM392
Radio Unit (2v.) for WM 392 (1/-)	—	WM398
Harris Electrogram battery amplifier (1/-)	—	WM399
De Luxe Concert A.C. Electrogram (1/-)	—	WM403
New Style Short-wave Adapter (1/-)	—	WM388
Trickle Charger (6d.)	—	AW462
Short-wave Adapter (1/-)	—	AW456
Superhet Converter (1/-)	—	AW457
B.L.D.L.C. Short-wave Converter (1/-)	May '36	WM405
Wilson Tone Master (1/-)	June '36	WM406
The W.M. A.C. Short-wave Converter (1/-)	—	WM403

Classified Advertisements

ADVERTISEMENTS are accepted for these columns at the rate of 2s. per line, minimum charge 4s. All advertisements must be prepaid. Each paragraph will commence with the first word in bold face capitals. All communications should be addressed to the Advertisement Manager, "Practical Wireless," Tower House, Southampton Street, London, W.C.2.

CABINETS

A CABINET for every radio purpose. Send measurements of chassis, etc., and say what kind of cabinet required. Stamp for reply. Inspection invited.
H. L. SMITH AND CO., LTD., 289, Edgware Road, W.2. Tel.: Pad. 5891.

FOR SALE

PREMIER S.G.3, wired by maker, less coils, 3 months old, £2 10s.—Geddes, Kyd Street, Arbroath, Angus.

LITERATURE, MAPS, etc.

AMATEUR Radio Handbook. Second edition now on sale. 328 pages, price 4s.—Radio Society of Great Britain, 16, Ashridge Gardens, London, N.13.

WEBB'S Radio Map of the World. Locates any station heard. Size 40" by 30", 4/6, post 6d. On linen, 10/6, post 6d. **WEBB'S** Radio Globe—12" model. Radio prefixes, zones, etc., 27/6.—Webb's Radio, 14, Soho Street, London, W.1. Phone: GERrard 2089.

LOUDSPEAKER REPAIRS

LOUDSPEAKER repairs, British, American, any make, moderate prices.—Sinclair Speakers, Pulteney Terrace, Copenhagen Street, London, N.1.

MISCELLANEOUS

RADIO SOCIETY OF GREAT BRITAIN invites all keen amateurs to join. Reduced war-time subscriptions. Send 1s. for current issue "T. & R. Bulletin" and details.—16, Ashridge Gardens, London, N.13.

"**PRINT-A-SIGN**" Celluloid Stencils. Showcard printing outfit, 4/-; Poster, 6/-. Experience unnecessary.—"Print-a-Sign," 23, Blackburn Street, Glasgow.

24-HOUR Service on all makes, particularly home-constructed sets; also American multi-tube receivers.—R.A. Radio, 62, The Broadway, N.W.7. Phone: Mill Hill 4313.

MORSE EQUIPMENT

FULL range of Transmitting Keys, practice sets and other equipment for Morse training.—Webb's Radio, 14, Soho Street, London, W.1. Phone: GERrard 2089.

MORSE TRAINING

FREE. "Book of Facts," tells you all about the Candler System of Code training. Courses for Beginners and Operators.—Write: Candler System Co. (L.O.), 121, Kingsway, London, W.C.2.

NEW LOUDSPEAKERS

3,000 Speakers, P.M. and energised, 4in. to 14in., including several Epoch 18in.—Sinclair Speakers, Pulteney Terrace, Copenhagen Street, London, N.1.

PATENTS

THE owner of British Patents Nos. 481526, relating to "Improvements in or relating to Radio Receiving Systems," and 481527, relating to "Improvements in or relating to Multiplex Radio Signalling Systems," is desirous of entering into negotiations with one or more firms in Great Britain for the purpose of exploiting the inventions, by the grant of Licences on reasonable terms or by the sale of the Patent Rights. Interested parties who desire further particulars should apply to Albert L. Mond and Thiemann, 14-18, Holborn, London, E.C.1.

PUBLIC APPOINTMENTS

WIRELESS TECHNICAL INSTRUCTORS REQUIRED IN ARMY UNITS

Emoluments.—Pay 8s. 9d. per day (7 days a week). Clothing, rations and accommodation or, if this cannot be provided, allowances at authorised rates. If married and otherwise eligible family allowance payable in respect of wife and children, subject to allotment from pay.
Candidates should preferably be under 35 and over 24 and—

- (a) Hold one of the following qualifications:
Graduateship of the Institution of Electrical Engineers.
Final (Grade III) Certificate of City and Guilds of London Institute Examination in Radio Communication.
Higher National Certificate in Electrical Engineering.
Certificate of City and Guilds of London Institute in Radio Service Work.

(Continued in next column)

RADIO CLEARANCE, Ltd.

LOW-LOSS Ceramic Valve Holders, Lissen Hi-Q, baseband and chassis, 7-pin, 1/- each.

LOW-LOSS Short-wave Condensers, variable ceramic insulation brass vanes, Lissen Hi-Q, minimum capacity 5 microfarads, 20 mfd. List, 5/6 each; our price, 2/6 each.

PUSH-PULL Switch, Lissen 2-point, 4d. each; 3-point 6d. each.

YAXLEY type Switches, 4-pole, 3-way, 9d. each.
YAXLEY type Switches, 4-bank, 2-pole, 4-way, 2/6 each.

YAXLEY type Switches, 6-bank, 3/- each.

YAXLEY type Switches, 9-bank, 3/6 each.
ROLA P.M. Speakers, latest model, 7½ in. cone, with power and pentode transformer, boxed, 17/6 each.

STRAIGHT LINE 3-wave-band Dials, 1/11 each.
MAINS TRANSFORMER. 300-0-300v., 100 m.a. 5v. 2 amps. 6.3 5 amps. Drop-through chassis type, 12/6 each.

MAINS TRANSFORMERS. Wearite 100 watt, auto transformers, 100-110v., 200-250v., reversible, 14/11 each.

CHASSIS Mounting Valve Holders, American Octals, 6d. each.

CHASSIS Mounting Valve Holders, English Clix type, 4-5-7-pin, 3d. each.

CENTRALAB Volume Controls. Midget type, 2,000, 5,000, 25,000, 50,000, 100,000 ohms. Less switch, 2/9 each; 1,000, 25,000, with switch, 3/6 each.

8-WAY Push-button Switches, 1/3 each.

4-WAY Push-button Switches, 1/3 each.

DROPPING Resistances for all purposes total resistance 535 ohms, 5 taps in steps of 50 ohms, standard for Pye, Lissen, Ever Ready, etc., 3/6 each.

RESISTANCES, 100 ohms, 10 watt, 1/- each.

10FT. Coils Connecting Wire, 4d. each, glazed.

PUSH-ON Pilot Lamp Holders, 3d. each.

PLESSEY Single-gang 0.0005 Variable Condensers, 1/11 each. 2-gang .0005 Variable Condensers with Vernier Control, 1/11 each.

PERMEABILITY Tuned Press Button Units, 2/6 each.

B.I. Wire-end Bias Electrolytics, 50 mfd., 12v., 1/6 each.

TUBULARS, wire-end non-inductive paper condensers, all sizes up to .01, 5d. each; .1, 7d. each.

T.C.C. 2 mfd. Electrolytic Condensers, 200v. working, 1/3 each.

CONDENSERS, .0005 triple, 1/9 each.

1LB. REELS 20 gauge Tinned Copper Wire 2/6 each.

T.C.C. 1 mfd. paper condenser, 350v. working, 1/- each.

DOUBLE FUSE HOLDERS, complete with two 1 amp. fuses, 1/6 each.

All orders must include SUFFICIENT POSTAGE TO COVER. Hours of Business: Weekdays, 9-4.30. Saturdays, 9-1 p.m.

PLEASE WRITE YOUR NAME AND ADDRESS IN BLOCK LETTERS.

We cannot undertake to answer enquiries unless full postage is included (2½d.).

RADIO CLEARANCE, Ltd., 95, HIGH HOLBORN, LONDON, W.C.1.

Phone: HOL 4313.

PUBLIC APPOINTMENTS

(Continued from previous column)

OR

- (b) Be able to pass an examination on the following syllabus:

Simple algebra, including quadratic equations; simple trigonometrical ratios and identities; vectors.

Properties of electrical currents; heating of conductors; magnetic fields; unit of current; Ohm's Law; resistance in series and parallel; potentiometers.

Magnetic effect of current; fields due to parallel wires; field due to a solenoid; electro-magnets. Meters.

Induction; effect of rotating a coil in a magnetic field.

Mutual and self induction and inductance; effect of inductance on growth and delay of current.

Capacity; charging storage and discharge of condensers; through resistance and inductance.

Alternating currents; vector diagrams; effect of resistance variation; effects of L and C in A.C. circuit; phase difference of currents; resonance in a series circuit; parallel circuit of L and C; Q factor.

Elementary knowledge of valves; simple theory of amplifiers; oscillators and detectors; general principles of radio practice.

Suitable Candidates will be interviewed at local centres, and, if successful, will be enlisted and appointed Acting Sergeant Tradesman. For those who are on the Schedule of Reserved Occupations, special arrangements will be made to enable them to be enlisted. In the event of any applicant found to be reserved under Schedule of Reserved Occupations special application will be made or relaxation of the Schedule. No guarantee can be given that this application will be successful.

Application Forms may be obtained by post card from the Under Secretary of State, The War Office (A.G.6c), Whitehall, S.W.1.

RECEIVERS AND COMPONENTS

GOULPHONE Radio, New Longton, Preston. Prompt personal service. Brand new goods. Tungram English and American valves. Cosmocord Crystal Pick-ups. Goldring Pick-ups, with volume control, 17/6. 10" Rola P.M. speakers with transformer, 22/6. Goodman's 8" P.M., 17/6. Electrolytics, 8 mfd., 500v., 2/9; 8+8 mfd. (4 leads), 4/9; 16+8 mfd., 6/3; 50 mfd., 50v., 2/9. Erie and Dubilier 1-watt resistors. All values, 6/6 per doz. S.A.E. for New List.

RADIO, brand new in makers' sealed cartons with guarantees at reduced present prices. Also valves, send 2½d. stamp, Radio Bargains, 261-3, Lichfield Road, Aston, Birmingham, 6.

SOUTHERN Radio's Wireless Bargains. Most lines previously advertised still available. New list to be advertised shortly. Southern Radio, 46, Lisle Street, London, W.C. Phone: Gerrard 6653.

SURPLUS RADIO STORES,

46, NEW KENT ROAD, LONDON, S.E.

BARGAINS FROM THE BLITZ. FIRST-CLASS COMPONENTS COLLECTED FROM BOMBED WAREHOUSES. MANUFACTURERS' DISCONTINUED LINES. LOW PRICES FOR THE KEEN ENTHUSIAST.

WIRE, WIRE, WIRE. A further big purchase enables us to again reduce our prices. Mixed parcel of cotton and rubber-covered in 10-, 12-, 14-, 16-, etc. strand copper wire. Approx. 30ft. lengths, to clear, 3/- for 6 assorted coils. O.K. for aerials and a dozen other uses. Special line of 8-strand at 6d. per 30ft. coil. Huge assortment of 2-, 3- and 4-way battery leads at ridiculous price of 1/- doz., or 10/- gross.

COILS. Thousands of them to be cleared. Med. waveband, long waveband, I.F.'s. Some wound on paxolin formers, others on bakelite. Some with trimmers on ceramic bases. All stripped from manufacturers' chassis. A good line for experimenters and servicemen. Take your chance at the very low price of 3/9 for 3 dozen assorted.

SURPLUS COLLECTIONS. These have sold extremely well, and we are making larger parcels at the request of P.W. readers. Many repeat orders received. All components stripped from manufacturers' chassis. Coils, condensers, resistances, valveholders, paxolin sockets—in fact, all odd, unclassified components. Box of not less than 50 components, 5/-; for 120 items, 10/-; and the real bargain box of 175 is 15/-.

WARRANTEE satisfaction.

PUSH BUTTON UNITS. Spring loaded, die cast frame with 6 units. No trimmers, but are ideal for remote control. This is a good line. To clear at 1/- each.

VARIABLE CONDENSERS. Single .0005 mfd. at 1/- each, and well-made job with Ali vanes and die cast frame, 3 gang, .0005 mfd., at 2/- each.

TRIMMERS. Stripped from unused chassis, 30-115 m.mfd. guaranteed within 5% accurate. Silver on ceramic bases, 4d. each. 3/6 dozen.

L.F. TRANSFORMERS. Igranite midget type. These have sold well to P.W. readers. A few only remain to be cleared at 1/6 each.

SHORT-WAVE Oscillator and Aerial Coils for superhets. Stripped from new chassis, ex. important manufacturer. To clear, 9d. pair.

TUBULARS. Wire-end paper type, all assorted values. 1/9 doz. Also resistances, useful values, asstd., 2/- doz.

L.F. CHOKES. 20 h., 80 m.a., paper interleaved; a good line for service engineers, 1/6 each.

PRESS BUTTON UNITS (6). Ideal for meters and all forms of remote control. To clear, 1/3 each.

VOLUME CONTROLS. Get them now, supplies are difficult. Brand new, but shop soiled. Assorted values, some with switches. 2/- each; 20/- doz.

MICA silvered wire-end Padder condensers, for short, med. and long-wave work within 1% accuracy. Assorted values, 2/6 doz.

CONDENSERS. Tag-type bakelite moulded. Popular assorted values. Useful for replacements. 1/6 doz.

VALVE-HOLDERS. Paxolin skeleton chassis type, octal and 7-pin. 3d. each; 2/6 doz.

KNOBS. Assorted bakelite knobs, some milled, some plain, some engraved Vol., L., M., S., etc. 1/9 doz.

ROTARY SWITCHES. Two-way wave-change, heavy duty, many uses. Well made, 1/6 each. Also ordinary push-pull type at 6d. each; 5/- doz. Cheap line rotary 2-way, 6d. each; 5/- doz.

5-WAY line cords, 2/6 each. 4-way battery leads, 1/9 doz. Assorted terminals and wander plugs, 1/3 doz.

EBONITE PANELS. Difficult to replace. New supplies almost impossible. 8" x 7½"; various drillings. 6d. each; 5/- doz.

GOODMAN'S P.M. SPEAKERS. 8", with transformers. Give-away price. 12/6 each.

COIL-FORMERS. 4" x 7". 1/6 doz. Wafers for Yaxley type switches, 2/6 doz.

ELECTROLYTICS. Wire-end tubulars. Assorted 4, 8, 16, 25 and 50 mfd., various working voltages. Ideal for experimenters and replacements. 9/- doz.

SPEAKER CONES. Elliptical, 12" x 6½", for magnetic reed type. Gold mesh. 1/- each; 10/- doz.

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SURPLUS RADIO STORES,

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