MIDGET A.C./D.C. RECEIVERS

Practical Wireless

9D. EVERY MONTH

and PRACTICAL TELEVISION

Editor F. J. CAMM

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Practical Wireless
and PRACTICAL TELEVISION
EVERY MONTH
Vol. XVIII. No. 428. FEBRUARY, 1942.
Editor F. J. CAMM
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COMMENTS OF THE MONTH BY THE EDITOR

Technical Education and the Press

MR. JOHN PASCOE, one of our leading industrialists and head of a large firm, recently made an appeal for co-operation between the technical press and industry. The technical press, he said, helped to build successful businesses and he paid a compliment to the manner in which the technical press is doing its important war-time job amid difficult conditions of paper supply and man power. It is doing real and vital service to industry, and its work is an essential part of the drive for higher production. It is, in fact, an essential industry in itself, for all executives know how valuable it is to get together with fellow technicians. Technical journals stage a conference of the industries they serve once a week, bi-monthly or monthly. They give us news of the latest results of research, and the practical application of new production ideas. They abstract the essential points from overseas journals and save industry an immense amount of time and trouble in so doing. They assiduously work, issue by issue, to serve industry, executives and personnel.

News Service

THEY provide a valuable news service, and place before readers the services of skilled technicians who contribute to their pages. In articles we are able to read the views of experts, to talk with whom we would gladly travel from one end of the country to the other or pay many guineas for a conference. They act as an exchange of information on welfare and other works problems.

A technical journalist has to be doubly skilled; he has to be a good journalist to start with and a responsible one. He must also possess a high degree of technical knowledge covering a large number of subjects and a large number of industries. He must be *au fait* with the particular trade covered by his journal; he must understand trade agreements, trade politics, Board of Trade requirements; he must know all the important sources of information, the leaders of the industry, and where to check his facts. He must be on the *qui vive* for the whole time attending trade meetings and lectures, inspecting new inventions, visiting factories, telephoning here, interviewing there. He must give a prompt service to his readers otherwise his journal would show up badly by comparison with his competitors.

Technical periodicals and technical books exist for all industries, and the wise technician follows his trade and technical press. The great demand for technical books and technical periodicals exists to-day because there is an equivalent demand for technicians anxious to make up for lost time. They want to acquire technical knowledge quickly.

Technical Education

THE war has drawn attention to the national neglect of technical education, and the great shortage of men with technical knowledge and practical experience is an indictment of pre-war Government apathy. Attention was directed to this apathy in a recent paper read before the Royal Society of Arts by Mr. E. M. Rich, C.B.E. In this paper he dealt with the development of technical education—a subject upon which he is able to speak with great authority, for he was for 35 years closely associated with technical education in the Metropolis. It was Quintin Hogg who, by his philanthropy, made possible the development of the polytechnics as distinct from the monotechnics. The need for technical education arose from the changed conditions of production consequent mainly on the application of steam power to machinery, as well as upon the principle of the division of labour and the decay of apprenticeship. Existing schools could not provide technical education, and hence technical schools were created. Technical education has until comparatively recently received the least support from the powers-that-be. Now there is determination on the part of the Government that technical education shall be provided with funds to enable it to be developed in this country on a scale comparable with that of foreign countries. In this respect we have always been behind countries such as the U.S.A. and Germany.

The Imperial College, which in 1906 resulted from the fusion of the Central Technical College, the Royal College of Science, and the Royal School of Mines, is far behind the Boston Technical and Charlottenburg. Our teachers have never had the space, the equipment, nor the facilities which their foreign counterparts have possessed. In 1935 Mr. Oliver Stanley, then President of the Board of Education, announced that the Board were prepared to recognise for grant, loan charges on new technical school buildings to the extent of £12,000,000, but only a small fraction of this money has been spent.

Society of Arts

RECOGNITION of the need for technical education by the Government dates from the Technical Education Acts of 1889 and 1891 and the Local Taxation Act of 1890. Arising out of a meeting held at the Mansion House in 1896, there was formed the City and Guilds of London Institute for the Advancement of Technical Education. The Institute soon became famous under its four distinguished professors—Armstrong, Ayrton, Henrici and Unwin. Since 1873 the Society of Arts has been awarding certificates, later transferred to the Institute.

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The Editor will be pleased to consider articles of a practical nature suitable for publication in PRACTICAL WIRELESS. *Such articles should be written on one side of the paper only, and should contain the name and address of the sender. Whilst the Editor does not hold himself responsible for manuscripts, every effort will be made to return them if a stamped and addressed envelope is enclosed. All correspondence intended for the Editor should be addressed: The Editor,* PRACTICAL WIRELESS, *George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.*

Owing to the rapid progress in the design of wireless apparatus and to our efforts to keep our readers in touch with the latest developments, we give no warranty that apparatus described in our columns is not the subject of letters patent.

The fact that goods made of raw materials in short supply owing to war conditions are advertised in this paper should not be taken as an indication that they are necessarily available for export.

ROUND THE WORLD OF WIRELESS

B.B.C. Man a Prisoner

IT is reported that Edward Ward, the B.B.C.'s war correspondent, is a prisoner of war in Italian hands. He was one of a party of six newspaper men captured in a mix-up during the fighting in Libya. Before he became famous as a radio newsgatherer Ward was Reuter special correspondent in the Far East. He made his name by his vivid air-raid descriptions from Finland.

Vital Radio Sets

SIR LEONARD LYLE, M.P., recently stated that many radio sets vital in an invasion are at present unusable owing to the shortage of valves. He is to ask in the Commons what steps should be taken to see that all wireless sets are kept up to date to the maximum extent.

New Woman Announcer

ONE of the latest additions to the B.B.C. staff is Andrea Troubridge, an admiral's daughter, who was recently appointed an announcer.

Radio Set Causes a Fire

A SHORT-CIRCUIT in a radiogram is believed to have caused a fire which destroyed a room in North London recently. The owner of the house was awakened by a series of explosions caused by the valves of the radiogram bursting. He fought the flames with a stirrup pump till the fire brigade arrived.

B.B.C. Reject Economy Cuts

IT has been announced that the B.B.C. do not intend to combine the seven and eight o'clock morning news broadcasts, nor to close down at ten o'clock at night.

Sir Allan Powell, chairman of the Board of Governors, stated recently that the suggestion of the Committee on National Expenditure that some economy might thus be effected had been examined, but it was felt that a substitute bulletin at 7.30 would not reach nearly so many people.

If the nightly programmes ended at ten o'clock the gap would probably be taken over by the enemy. Such a change would not be popular with war workers.

U.S. Amateurs Close Down

SINCE the outbreak of war between Japan and the United States, all amateur radio in the latter country is placed under defence regulations, which means that amateur transmitters in America will be off the air for the duration.

G.E.C. Short-wave Station

THE international short-wave station of the General Electric Company, KGEI, on Treasure Island, San Francisco, has been granted permission to increase its power from 20 to 50 kW. Its location is changed to Belmont, California.

Educational F.M. Station

THERE are signs that the use of frequency modulation for educational broadcasting is extending rapidly in the United States. The seventh non-commercial educational F.M. station is to be erected by the Chicago Board of Education.

B.B.C. Kill Air Ghost

THE Nazi Ghost that walked into our news broadcasts is dead—killed by B.B.C. engineers. They had five secret plans for getting rid of it. Only one has been tried and it has worked.

So even if the enemy should master the secret there are four more in reserve.

British Listeners Hear War in Russia

MACHINE-GUN fire and the explosions of heavy guns and bursting bombs was heard by British listeners recently.

Moscow radio broadcast flashes from the battle raging at the approaches to the city. The noise at times drowned the announcer's voice.

The radio reporter said: "My microphone is placed in one of the sectors of the front defended by strong forces under General Beloborodov, and the fight rages in a landscape of small hills, ravines and fields covered in snow. The enemy is constantly throwing in infantry, tanks, artillery and 'planes. As I speak German 'planes are bombing our front lines. Our men are giving the enemy a warm welcome with heavy guns and we are shelling him hard."

"Free Vienna" Radio

A SECRET station, "Free Vienna"—the transmitter of the Austrian Socialists—was on the air recently. The woman announcer gave the wavelength as 31.5 metres.

Marconi's Tomb

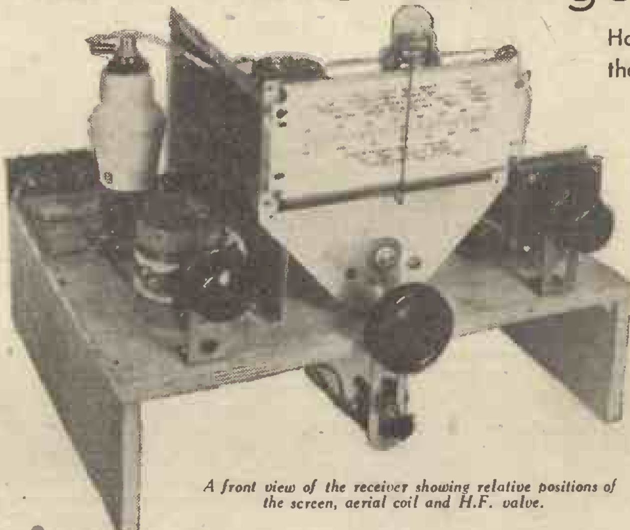
ACCORDING to a recent announcement from Rome the body of Marconi has been placed in a mausoleum on the site where he conducted his early wireless experiments.

Ferranti Employees' Gift

A SUM of £320 was received recently by the Lord Mayor of Manchester from Messrs. Ferranti's employees, for the city's Aid-to-Russia Fund.

The South-West Essex Training College is working under the Ministry of Labour radio training scheme for industry. This scheme includes the training of suitable boys and girls for positions as fault finders and testers in the testing department of leading radio manufacturers, and also tuition in radiolocation. Our illustration shows boys learning to detect faults in radio sets.

Three-valve Emergency Receiver



A front view of the receiver showing relative positions of the screen, aerial coil and H.F. valve.

How this Receiver, which was Described in the January Issue, can be Modified to Suit Almost Any Requirements

THE receiver, if built according to the instructions given in our previous issue, is capable of providing sufficient selectivity and sensitivity to ensure the reception of several medium-wave transmissions, at good volume, when it is used under normal conditions. It is possible, however, that a greater degree of sensitivity would be an advantage in some districts, where the problem of selectivity is not of primary importance. As already explained, these two qualities are so closely related that it is not possible, with a simple three-valver, to alter one without affecting the other.

To improve the sensitivity, it is necessary to increase the coupling between the aerial and the grid of the H.F. valve and, for still further gain, between the H.F. stage and the detector valve. It would be best to adopt the following procedure. 1. Increase the number of turns of the primary winding of the aerial coil. 2. Increase the number of turns on the primary of the R.F. coil, but this should be carried out with care and experiments made with, say, three turns at a time until maximum gain with perfect stability is obtained. 3. Use a screened-grid or "straight" H.F. pentode as the detector. 4. Replace the resistance-capacity coupling with an L.F. transformer.

Unless one wishes to use the set as a basis for experimental work, it is not likely that all these possible modifications will be made. However, we give sufficient details below to enable those who so desire to make the necessary alterations.

So far as 1 and 2 are concerned, the instructions given last month will enable the constructor to tackle any work connected with the coils, so we will pass on to the third suggestion.

An S.G. Valve as Detector

If a valve of the S.G. type having a four-pin base is selected, very little alteration to the wiring will be necessary. Remove the wires marked 1 and 2 on the wiring diagram shown on page 100. Make the new connections, and add the fixed condenser, indicated by the broken lines, the top cap of the valve being connected to one side of the H.F. choke by means of a short length of flexible insulated and screened wire, the screening sleeving, as in the case of the R.F. valve, being connected to the common negative-earth line.

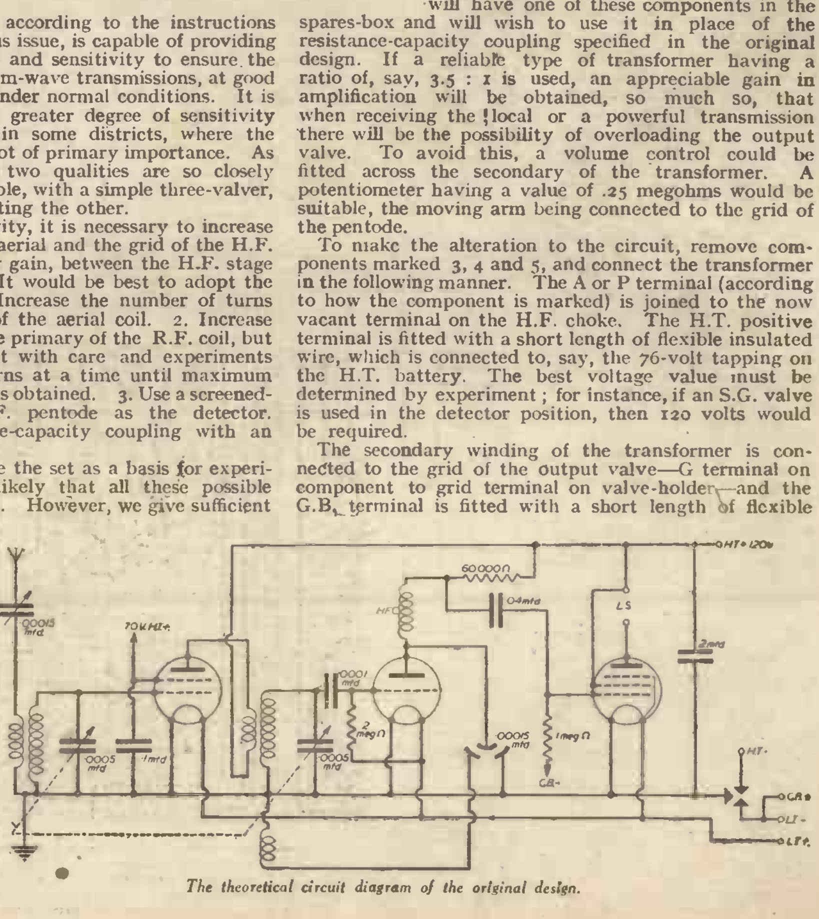
The flexible lead connected to the anode terminal of the valve-holder is taken to a suitable tapping on the H.T. battery. The actual value will depend on the valve, but in the majority of cases a voltage between 20 and 36 volts will be found quite satisfactory.

Using an L.F. Transformer

It is possible that many constructors will have one of these components in the spares-box and will wish to use it in place of the resistance-capacity coupling specified in the original design. If a reliable type of transformer having a ratio of, say, 3.5 : 1 is used, an appreciable gain in amplification will be obtained, so much so, that when receiving the local or a powerful transmission there will be the possibility of overloading the output valve. To avoid this, a volume control could be fitted across the secondary of the transformer. A potentiometer having a value of .25 megohms would be suitable, the moving arm being connected to the grid of the pentode.

To make the alteration to the circuit, remove components marked 3, 4 and 5, and connect the transformer in the following manner. The A or P terminal (according to how the component is marked) is joined to the now vacant terminal on the H.F. choke. The H.T. positive terminal is fitted with a short length of flexible insulated wire, which is connected to, say, the 76-volt tapping on the H.T. battery. The best voltage value must be determined by experiment; for instance, if an S.G. valve is used in the detector position, then 120 volts would be required.

The secondary winding of the transformer is connected to the grid of the output valve—G terminal on component to grid terminal on valve-holder—and the G.B. terminal is fitted with a short length of flexible



The theoretical circuit diagram of the original design.

wire for the connection to a suitable socket in the G.B. battery.

If the baseboard is fitted with the side runners used in the original design, the transformer could be fitted to the underside of the baseboard, so that it is located between H.F.C. and the output valve-holder positions. Two holes would have to be drilled through the baseboard to allow the connections to the H.F.C. and grid terminal to be made.

As a Two-valver

For those who have to economise on components, or live close to a transmitting station, a two-valve circuit would, no doubt, have greater appeal. The details given here explain how to proceed with the constructional work, the original three-valve circuit being used, so to speak, as a basis.

The following components will *not* be required (reference should be made to the wiring plan): The H.F. valve; its valve-holder; the 0.1 mfd. fixed condenser; the aerial coil; the two-gang tuning condenser; the metal screen; the screened lead between H.F. coil and top-cap of H.F. valve.

The *H.F.* coil will now be used as the *aerial* coil, therefore the aerial—as before—will still go to one side of the .00015 mfd. aerial series condenser, but the other side of that component will now have to go to the side of the primary on the H.F. coil which *was* connected to the top-cap of the H.F. valve. The other end of the primary must be disconnected from the H.T. side of the 2 mfd. fixed condenser and connected to the other terminal, i.e., *earth.*

The two-gang condenser can now be replaced by a single .0005 mfd. variable condenser which will have its moving vanes connected to earth and the fixed ones to the grid-winding of the H.F. coil, in exactly the same manner as the rear section of the two-gang component in the original circuit. Remove all connections connected with the components not now in use, but *be sure* to see that the *earth* terminal is connected to the *earth and L.T. negative side* of the 2 mfd. condenser.

The baseboard can, of course, be reduced in size to suit the new layout, and a compact little receiver should result.

For greater volume, the primary winding on the coil could be increased to 25 turns.

Circuit Refinements

To return to the original circuit, here are a few details of simple refinements which can be added by those who wish to make the best of the three-valve circuit.

The H.T. positive end of the primary of the H.F. coil can be connected to the common negative-earth line via a 0.1 mfd. fixed condenser. This provides a by-pass for H.F. currents to earth, and prevents, or at least reduces the possibility of, them getting into the H.T. circuit, thus making for greater stability.

Between the H.T. positive line and the 60,000 ohm resistor in the anode circuit of the detector, another resistor can be connected. It should have a value of 15,000 or 20,000 ohms, and the junction point between the two resistors is then connected to the earth line through a 2 or 4 mfd. fixed condenser. This simple modification constitutes anode decoupling, and, like the first suggestion, improves stability, but in this case from an L.F. point of view.

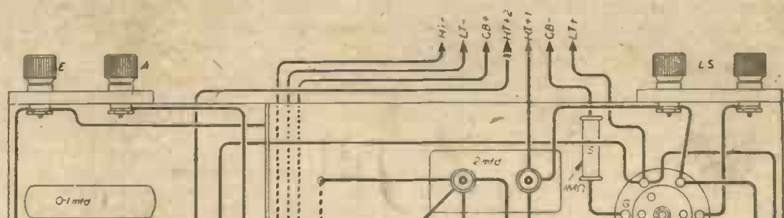
Another resistor can be inserted between the grid of the output pentode and its connection to the 0.04 mfd. coupling condenser and the 1 megohm grid-leak. A suitable value for this component would be 50,000 ohms.

For pentode tone correction, a 10,000 ohm fixed, or a 20,000 ohm variable resistance, in series with a 0.02 mfd. condenser, can be connected between the anode of the output valve and the common negative-earth line. The actual values will be governed to some extent by the characteristics of the speaker and individual taste.

WIRING DIAGRAM OF THREE-VALVE EMERGENCY RECEIVER

LIST OF COMPONENTS

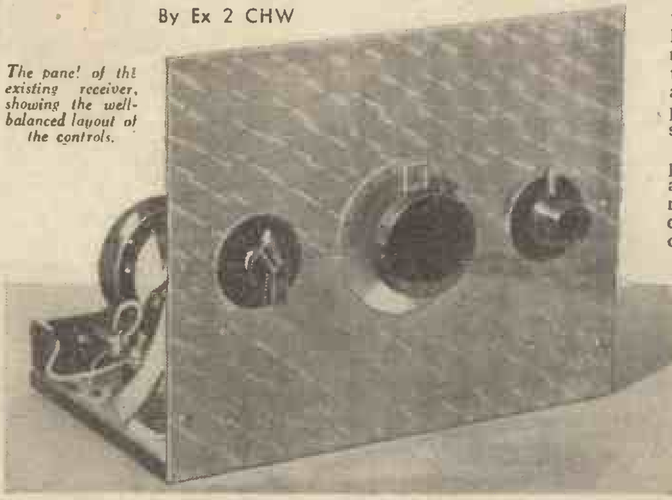
- Two medium wave coils (see text).
- One two-gang .0005 mfd. condenser.
- One .00015 mfd. variable differential condenser.
- One .00015 mfd. variable condenser.
- One slow-motion dial.
- Three component mounting brackets (if panel is not used).
- One 0.1 mfd. fixed condenser.
- One .0001 mfd. fixed condenser.
- One .04 mfd. fixed condenser.
- One 2.0 mfd. fixed condenser.
- One 2 megohm resistor, ½ watt.
- One 1 megohm resistor, ½ watt.
- One 60,000 ohm resistor, ½ watt.
- One screened H.F. choke.
- One three-point on-off switch.
- Two four-pin baseboard valve-holders.
- One five-pin baseboard valve-holder
- Two terminal strips.
- Four terminals A, E, and L.S. positive and negative.
- One baseboard 12 x 9ins.
- One metal screen 7⅞ x 4½ ins.
- One Cossor 210 S.P.T. (metallised).
- One Cossor 210 H.F. (metallised).
- One Cossor 220 H.P.T.
- One Exide 2-volt accumulator.
- One 120-volt H.T.
- One 9-volt G.B.
- Flexible wire, screws, tinned copper wire, soldering tags, Systoflex.



Notes from an Amateur's Log-book

A New Series of Articles Recording the Experiences and Constructional Activities of an Amateur S.W. Enthusiast Building Up and Operating a War-time Station

By Ex 2 CHW



The panel of the existing receiver, showing the well-balanced layout of the controls.

THERE must be many thousands of S.W. enthusiasts who have been forced to abandon—for the duration—their listening and/or transmitting stations owing to war duties. Some have been more fortunate than others; their war work enables them to have a permanent QRA in their new area of activities. This, to a S.W.L., means a lot; it provides the ever-sought opportunity to get some kind of "rig" in operation with which he is able to continue his S.W. work.

Starting Again

It is possible for circumstances to allow a new station to be gradually built up, modest in size and equipment, but, nevertheless, sufficient to form the nucleus of a listening and experimental post, capable of keeping the owner up to date and his interests alive. Much, of course, will depend on the facilities available and the ability—during these unusual days—to secure the gear required, but such items are not likely to deter the amateur; in fact, they will add interest to the game.

In my own case, once again I am starting from scratch. I am, however, one of the fortunate ones; I have been granted space—in a pleasant room—and the sole use of a narrow table, fitted with two drawers, on which will rest such gear as I am able to obtain, or construct, according to my needs, and the time I am able to devote to my new station. Other items of importance are: the table is situated near a window overlooking the garden, wherein I have been granted permission to erect an aerial. To the left of the table is a 5 amp. switch-plug for an A.C. supply, so I shall be all right for "juice" for mains equipment—when I reach that stage—an electric soldering-iron and a table lamp. A good earth connection is obtainable in the garden, via the window.

Equipment

The provision of such equipment as that required for an average station will take up a good number of my leisure hours, and, as I shall be building up the new station bit by bit, commencing with the minimum of parts, it is thought that a monthly record of my activities would prove useful to those who have not yet secured or completed their "den."

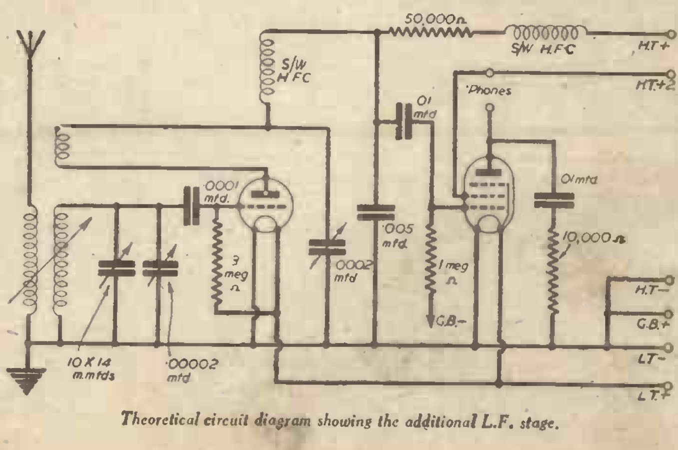
It is usual, in such circumstances, to prepare a rough plan of proposed work. I must admit that I am not good at sticking to a rigid "sked," especially if it is set out in detail. Something usually crops up which causes me to deviate from the programme, so I warn those interested not to expect me to go through the procedure in perfect sequence. Variety, the unexpected and the unknown, are the spices of an amateur's life. Here, briefly, is what I have in mind. Constructing a S.W. set which will be capable of giving good results on general DX work. Making such additional equipment as is necessary for normal satisfactory operation of a station, and, of course, the carrying out of experiments and tests with the object of securing improved efficiency. All this, will, naturally, involve a certain number of hours of listening, and from the readers' point of view these periods will not, it is hoped, be wasted, as I shall give details of my log and any particulars of such stations which are received.

Being anxious to get the 'phones on, I am not going to spend too much time making preliminary preparations, as refinements, etc., will follow with time and progress.

The Receiver

No, it is not an elaborate multi-valve communication job. During the present circumstances, I cannot *start* with anything more ambitious than a well-tried two-valver, and that battery operated. I think myself very fortunate to be able to get hold of the set described below, as I know from previous experience with it that, given a reasonable aerial and a decent pair of 'phones, results can be obtained which will put many more elaborate Rxs in the shade.

The set is not unknown to readers of PRACTICAL WIRELESS, as it has already been described, in its

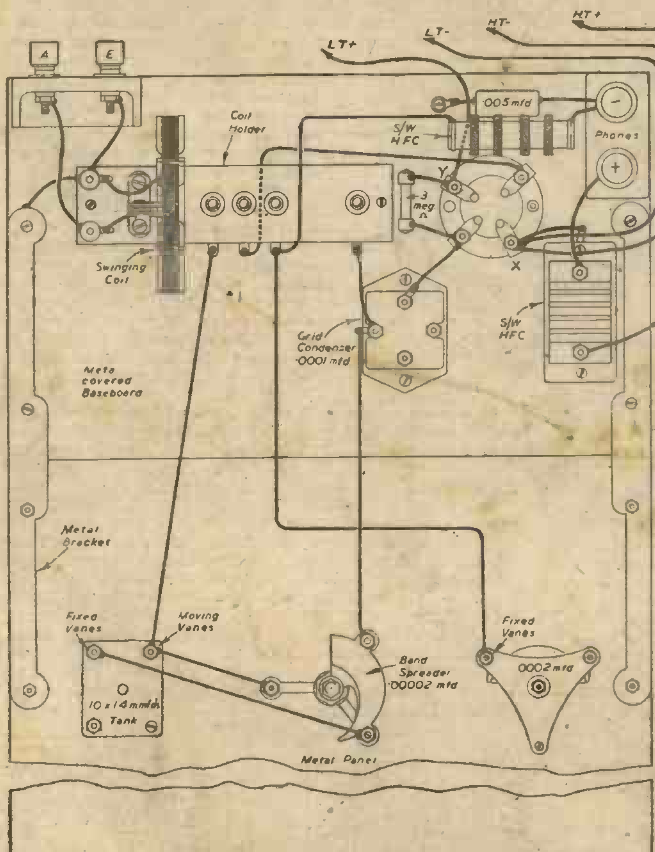


Theoretical circuit diagram showing the additional L.F. stage.

original form, in the October, 1940, issue, but since then a pentode output valve has been added, resistance-capacity coupling being used for the coupling between the detector and output stage.

The special feature of the set is the coil unit. It is an American product utilising large diameter air-spaced self-supporting coils which are coupled to the aerial by means of a swinging coil. The latter has a fixed inductance value, selected to suit the three grid coils provided, and is hinged to the coil holder, thus allowing the degree of coupling to be adjusted to suit operating conditions. If sufficient readers are interested in the unit, space might be devoted to its constructional details in a later issue.

The rest of the circuit is perfectly standard, a triode leaky-grid detector being used, reaction being "throttle" controlled and the grid circuit is tuned by a tank or band-setter condenser plus the usual band-spreader. Eddystone components were selected for this part of the assembly, and they are mounted on a stout aluminium panel which, in turn, is firmly supported by metal brackets.



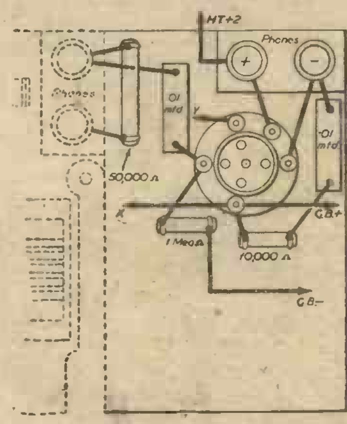
Wiring plan of the original receiver.

Mains or Battery

Although A.C. mains are handy, I do not propose modifying the set to all-electric in the normal meaning of the term. It never seems to me to be an economical proposition to construct a two-valver for mains, therefore, when I have been able to collect sufficient gear for a larger set, then will I make it A.C. operated. In the meantime, I propose using a trickle charger to keep the accumulator up to scratch and, incidentally, to save me visits to a charging station, and for the H.T. I think I shall be able to make up a small eliminator—with adequate de-coupling and smoothing for S.W. work—from some parts I have salvaged from a now defunct mains set.

A combination such as this has much to recommend it. If well designed—the eliminator I mean—it is as trouble free as one can expect radio to be, and from the point of view of maintenance it is economical and a mighty sight cheaper than batteries, even if you could get them.

Mind, I don't suppose, for one moment, that I shall be satisfied with the rig mentioned for long. Already, I feel that an H.F. stage would be a great advantage; in fact, I have got as far as deciding that when I do add it, its circuit shall be such that I can use it as a tuned or un-tuned stage by the simple twist of a switch, according to the frequency-band being covered. In the meantime I am keeping my eyes open for the bits and pieces for



The components and wiring necessary for the pentode stage.

and A.C. job, but whether I shall be able to construct a set according to the specification I have drawn up, I cannot say, as so much depends on the gear and valves obtainable.

Aerial

To commence operations, I am erecting a simple inverted L system, as this is quick to prepare and suspend and finally, it will mean the minimum of poaching beyond the privileges already granted me. A mast, a relic from the times when my landlord used an outside aerial, still stands at a point approximately 50ft. from the house, so I shall be able to get a horizontal portion of, say, 42ft. and a downlead of 22ft., figures which are just about right. The line of the aerial will be west to east.

I wish that the mast had been another 15ft. away from the house, as a di-pole system has much in its favour, especially if electrical interference is bad. I have yet to find out what S.W. reception conditions are like in this area; if they are as good as those prevailing round my peace-time station, I shall be quite content.

The earth lead will be ideal. It will not have a length greater than 10ft., and will terminate at an earth tube driven into moist earth.

My notes this month are, necessarily, of an introductory nature, but in future I hope they will be of practical use to those building and operating an S.W. listening station, as I intend keeping in my log-book a record of all my constructional, experimental and listening activities.

Midget A.C./D.C. Receivers

Some Practical Pointers by FRANK PRESTON

MIDGET receivers did not achieve a very great measure of popularity in this country before the war, although there were a fair number in use. The position is entirely different now, and sets of this type are at a premium—probably because of their particular usefulness to members of H.M. Forces. Unfortunately, however, a good number of the midget sets which have recently come into use have not been as trouble-free as their owners would wish. Actually, where a mains-operated midget is concerned, there are many difficulties in design due to the fairly large amount of electrical power which has to be dissipated, and to the essential "paring-down" of components.

Another reason for much of the trouble which is experienced is that the majority of these small receivers are of American origin, and spares cannot easily be obtained. To make matters worse, a circuit diagram is seldom available. Most of my comments in this article will therefore be devoted to this class of receiver, since the few British midgets which have been produced are not prone to faults, and when trouble does arise it is generally possible to communicate with the makers or one of their agents.

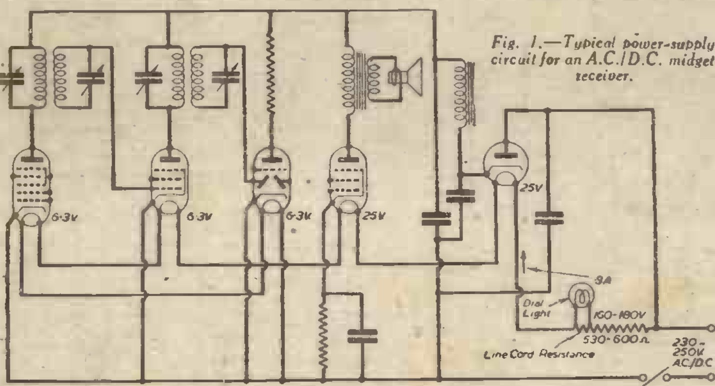


Fig. 1.—Typical power-supply circuit for an A.C./D.C. midget receiver.

Four-valve Superhets

Let us first obtain an impression of the usual circuit arrangement of these sets. The better-class jobs are usually of the superhet type and have four valves plus rectifier. In general, the circuit is similar to that of an ordinary standard-sized receiver, but the power-supply system differs. Fig. 1 shows the customary arrangement of the power-supply circuits, and also shows the types of valves normally employed; a frequency-changer is followed by an H.F. pentode I.F. amplifier, a double diode-triode and an output pentode, whilst a half-wave rectifier is used for rectification of A.C. When connected to a D.C. supply the rectifier merely acts as a simple limiting resistance of low value.

All valves require the same L.T. current, and the heaters are wired in series, as shown. Octal-base valves are most often employed, and the heaters of all except output and rectifier valves are rated at 6.3 volts; the two last-mentioned types have 25-volt heaters. When all these are wired in series, the total voltage drop across them is only about 70, and therefore additional voltage-dropping is required. In a receiver of the normal type this would be provided for by the inclusion in series with the heaters of a barretter, or possibly a high-power resistor. Either of these devices is ruled out in the case of a midget set, because the heat developed would be sufficient to make the inside of the receiver so much like a small oven that components may literally melt.

Voltage-dropping for L.T.

This difficulty is normally overcome by the use of a so-called line-cord resistance, which consists of a length of resistance wire wound around an asbestos cord and covered with asbestos string or tape. This is laid alongside the twin flexible leads forming the mains connector, and the usual name for this connector is the line cord. From this it will be appreciated why the mains lead of a set of the type under discussion normally becomes extremely hot to the touch; I have often had sets brought in for "repair" because the owner has suddenly noticed that the mains lead becomes hot when the set is switched on. But when it is realised that the resistor normally dissipates something like 50 watts, the heat is not surprising.

The above explanation will also show why, if the mains plug is examined, it will be found that there are two leads to one of the pins, and only one to the other: the two leads are the normal flex and the line-cord resistance. Since the length of the resistance wire is so arranged that it will just drop the difference in voltage between that at which the valves are rated and the mains voltage, it will be clear why the mains lead should not be shortened. In the event of failure of the line-cord resistance it is normally necessary to obtain a new one complete.

Broken L.T. Circuit

Breakdown of this resistance may be indicated by the fact that the cord is cold or that no light can be seen from the upper tips of the valve heaters when the set is switched on, but it should be remembered that a single burnt-out valve may produce exactly the same effect. This is, of course, because all heaters are in series with one another and with the line-cord resistance, and therefore a break at any point in the circuit will result in a cessation of current. When failure of the set to operate leads to the detection of a cold line cord, therefore, the first step should be to test the valve heaters for continuity. If a meter is not available, this can be done by means of a flash-lamp bulb and battery, as shown in

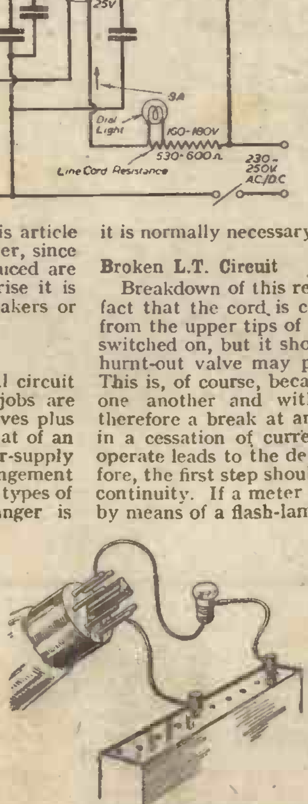


Fig. 2.—Method of checking valve heaters for continuity. An international octal is shown, since this is generally used.

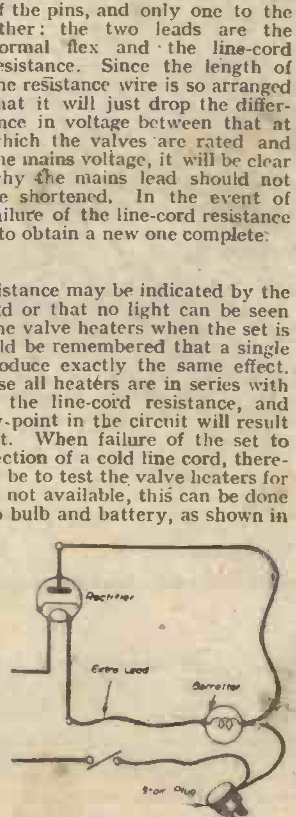


Fig. 3.—Connections for a barretter Compare with Fig. 1.

Fig. 2. Remember that the battery should be tapped down to about 7.5 volts when testing a 6.3-volt valve, and to about 27 volts when testing a 25-volt valve.

External Barretter

If all heaters are found to be continuous, the line-cord resistance must be suspected. Occasionally, the break in the resistance wire will be found to be close to the point at which it is connected to the mains plug, and a repair can then be effected. But it is unwise to cut more than a couple of inches or so from the line-cord resistance, because that may reduce the resistance to a sufficient extent for an excess voltage to be applied to the valve heaters.

In most cases, the best procedure is to buy a new line cord if this is possible. If not, it may not be inconvenient to mount a barretter outside the receiver box and to bring a third flex lead out to it from the rectifier heater, as shown in Fig. 3. Before buying a barretter, make quite sure of the heater voltage taken by the valves in the set, and ascertain the L.T. current consumption. By subtracting the total heater voltage from 250, the maximum voltage to be dropped by the barretter can be found and the particular type of barretter decided upon.

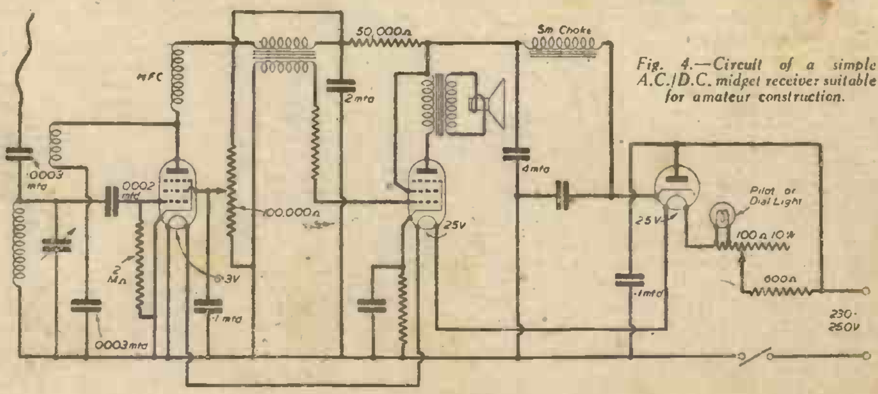


Fig. 4.—Circuit of a simple A.C./D.C. midget receiver suitable for amateur construction.

As an example, it will be seen in Fig. 1 that the maximum voltage to be dropped is 180, and reference to an Osram valve list, for instance, shows that the type 302 barretter is rated at .3 amp. and has a voltage range of 112 to 195; this would be eminently suitable. As an alternative to a barretter, and if the receiver is to be operated from only one mains supply, it may be possible to make use of an ordinary electric lamp, preferably in series with semi-variable (wire-wound) 100 volt, 10-watt resistor. For instance, a 220-volt, 75-watt lamp has a resistance of approximately 650 ohms; the exact figure for any voltage and wattage can easily be worked out by applying Ohm's Law. The lamp could replace the 600-ohm resistor shown in Fig. 4, and the semi-variable resistor would occupy the position indicated. Since the 10-watt resistor would not dissipate any very great amount of heat, it could be mounted inside the receiver, provided that it was near the perforated or open back, so that there was ample air circulation round it.

The Speaker

Many of these commercial midget receivers have an energised moving-coil speaker, where the field coil takes the place of the smoothing choke shown in Fig. 1. Faults sometimes arise here due to burning out of the field windings. In most cases, failure of the windings can be recognised by feeling them after switching off the set when it has been on for a short time; if the field is practically cold, failure of the winding is suggested. It should be remembered, however, that a break in any other part of the H.T. system, or a faulty contact to the anode or cathode of the rectifying valve could produce the same effect.

Most of the faults likely to be experienced with a midget receiver, other than those referred to above, are the same as those in a larger receiver having a similar circuit arrangement. For that reason it is not proposed to deal with them here.

A Home-constructor Circuit

There may be some readers who would like to build a midget mains receiver, and provided that the possible difficulties are known there is no reason why this should not be done with reasonable success. But since special miniature components are normally not obtainable, it will be wise to keep to a very simple circuit arrangement. That shown in Fig. 4 should prove fairly satisfactory for most purposes. It will be seen that an H.F. pentode and an L.F. pentode are used along with a half-wave A.C./D.C. rectifier. There is a throw-out type of aerial consisting of about 12ft. of single flex, and reaction is controlled by means of the screening-grid potentiometer. A small, good-quality L.F. transformer may be used, and it will probably be simplest to use a midget P.M. speaker in addition to a 20-henry smoothing choke. The two 4-mfd. condensers on the "cathode" side of the rectifier may be in the form of a double electrolytic of the cardboard-cased type, which is compact. A "paper" condenser should be used across the mains supply.

Practical Details

If an energised speaker of suitable size, and with a field resistance not exceeding 1,000 ohms, is available it may be possible to use this to replace the P.M. speaker and also the smoothing choke, using the field winding for smoothing purposes. A small metal chassis is to be preferred, and components such as fixed condensers and resistors should be mounted on the underside of this, with valves and dropping resistor (all of which will become warm in use) on top. Fig. 4 does not give all component values, since these are largely dependent upon the valves employed, but it should provide all the information necessary for an experienced constructor to plan his own receiver. It should be borne in mind that, since there is no transformer to isolate the mains supply, insulation throughout should receive careful attention.

The S.G. volume control might well be a potentiometer with on-off switch, so that the switch can be used for making and breaking the mains supply. Make sure, however, that the switch is of the Q.M.B. type, and is suitable for use in a mains circuit.

Midget Tuning Coil

The pilot light is simply a flash-lamp bulb wired across about one-tenth of the semi-variable mains resistor. This means that the voltage across the bulb will be in the region of 3 volts. It is worthy of mention that a midget tuning coil can easily be made by winding 120 turns of 28-gauge enamelled wire on a 1in. diameter Paxolin former. This tuning winding should be covered with a layer of waxed paper over which 60 turns of similar wire should be wound for reaction. Details of tuning-coil construction were given in the December issue of PRACTICAL WIRELESS, and reference to these will supply any additional information required.

A Refresher Course in Mathematics

By F. J. CAMM

MATHEMATICS, which is really arithmetic with a university education, is, like music, an international language which enables technicians in any country to convey ideas to those in other countries free from the difficulties imposed by language; the digits and the mathematical signs and the methods of calculation are common to all countries and all sciences. We are all taught arithmetic, and to a certain extent mathematics, according to the school we attend, but it is a fact, which this war has illumined, that few people retain a knowledge of anything but the simplest calculations. My war-time correspondence from readers of my various journals has impressed this fact upon me. Some thousands of letters have passed through my hands from those who desire to enter some technical branch of the Services, but have found the inevitable stumbling block in the form of an examination which includes a mathematical paper; practical knowledge is insufficient for the examiners. Some indeed have failed in the examination on the simplest of arithmetical problems. Alas, the mathematical knowledge gained at school, so often considered by the student as a painful interlude in his studies to be scrambled through and forgotten at the earliest possible moment, cannot be quickly acquired after a lapse of several years. A knowledge of methods of calculating is nowadays essential for the better paid responsible posts.

I have been asked, therefore, to write a series of articles in the form of a refresher course on arithmetic and mathematics to assist those who desire to enter examinations, or who wish for promotion. These requests come from those who are unable because of war-time duties to attend evening classes.

It is a matter for regretful reflection that many of the technical institutes and continuation classes supported by Government funds closed down many years before the war for lack of support. I taught machine drawing and mathematics some years ago, and I found that if the lessons were made sufficiently interesting by dealing with practical problems and applications, the students assimilated the knowledge and passed examinations easily. I pointed out that any fool could become adept at figures, and I drew attention to the famous phrase in Prof. Thompson's "Calculus Made Easy," *What One Fool Can Do Another Can!*

This series, therefore, is planned to take you through a reminder or refresher course, and it must necessarily go over ground which you have covered before. It will, I hope, also act as an *aide mémoire*.

Before we can use figures to arrive at correct results we must possess certain tools in the form of the standard *symbols*. These symbols are used all over the world and it is very necessary to memorise them, because they are, in effect, the shorthand of calculation. Here they are:

$+$ Plus, or add.
$-$ Minus, or subtract.
$\times$ Multiply by.
$\div$ Divide by.
$/$ Divide by.
$=$ Is equal to.
$\equiv$ Is always equal to. Identical with.
$\triangleq$ Approximately equal to.
$\doteqdot$ or $\fallingdotseq$ Approximately equal to.
$\therefore$ Therefore.
$\because$ Since, because.
(Single bracket.
{ Double bracket, or brace.
[Square bracket.
$\backsim$ Difference of.
$<$ Less than.
$>$ Greater than.
$\leqq$ Equal to, or less than.
$\geqq$ Equal to, or greater than.
$\nless$ Not less than.
$\ngtr$ Not greater than.
$\propto$ Varies as.
∞ Infinity.
$\parallel$ Parallel with.
$\perp$ Perpendicular to.
$\overline{}$ Vinculum or bar (but the use of brackets is preferable).
$\pm$ Plus or minus, i.e., either plus or minus, according to circumstances.
$+\!\!\!+$ Modified plus sign, indicates that direction is taken into account as well as addition as in obtaining the vector sum of two forces.
$\forall$ Sign of vector subtraction.
Σ Sigma, the sum, or "summation of the products of."
π Pi, the ratio of circumference to diameter, also 180° in circular measure.
θ Theta, any angle from the horizontal.
ϕ Phi, any angle from the vertical.
$\odot$ Circle, or station point. $\triangle$ Triangle, or trig station.
$\sqrt{}$ Square root. $\sqrt[3]{}$ Cube root. $\sqrt[4]{}$ Fourth root.
$\lfloor 5$ means continued product up to $5 = 1 \times 2 \times 3 \times 4 \times 5$.
$\Pi\ \pi$ = continued product of numbers up to $n = 1 \times 2 \times 3 \ldots\ldots n$.
a, *b*, *c* used for known quantities; *x*, *y*, *z* for unknown quantities. n is used in place of any whole number.
A full stop (.) is sometimes used instead of the multiplication sign.
$\neq$ Unequal to.
$::$ Is to
$:$ As; so is (ratio)
$\nparallel$ Not parallel.
$\angle$ Angle.
$\llcorner$ Right angle.
▭ Parallelogram.
□ Square.
○ Circumference.
◓ Semi-circle.
◔ Quadrant.
⌒ Arc.
( ), [ ], { } Vincula.

Fractions

A *fraction* consists of two numbers divided by a horizontal line. The one above the line is known as the *numerator*, and the one below is the *denominator*. Thus, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{3}{4}$, $\frac{3}{8}$, $\frac{5}{8}$, $\frac{7}{8}$ are fractions. The denominator indicates the number of parts the *unit* has been divided into, whilst the numerator indicates the number of those parts we are considering. Thus half-a-crown is $\frac{1}{8}$th of a pound, but in relation to 5s. it is $\frac{1}{2}$. There are various sorts of fractions. A *proper* fraction is one which is less than unity (one). The fractions given above are all proper fractions. An *improper* fraction is one which is more than unity, such as $\frac{27}{6}$, $\frac{13}{4}$.

When the numerator and denominator of a fraction are each multiplied or divided by the same number the value of the fraction is unaltered. For example, $\frac{1}{4}$ is the same as $\frac{4}{16}$, or $\frac{25}{100}$.

When adding, subtracting, or comparing fractions each having the same denominator, it is only necessary to add, subtract, or compare the numerator of such fractions, but when the denominators are not similar the fractions must first be reduced to equivalent fractions each having the same denominator. Hence, to add $\frac{3}{7}$ths and $\frac{2}{7}$ths together it is merely necessary to add the numerators $= \frac{5}{7}$ths. In order to add together $\frac{3}{4}$ and $\frac{1}{16}$ we must convert $\frac{3}{4}$ into 16ths, by multiplying the numerator and denominator by 4, producing $\frac{12}{16}$ths, which added to the $\frac{1}{16}$ gives $\frac{13}{16}$ths as the answer. Or again, to add together $\frac{3}{7}$ and $\frac{5}{9}$ we can multiply the denominators together, making 63rds. Hence, $\frac{3}{7} = \frac{27}{63}$, and $\frac{5}{9} = \frac{35}{63}$. We can now add the numerators together, making $\frac{62}{63}$. We could obtain exactly the same result by what is known as cross multiplication, thus taking the two fractions $\frac{3}{7}$ and $\frac{5}{9}$ we obtain 9 times 3 as 27, and 7 times $5 = 35$. We now multiply the denominators together, thus obtaining $\frac{27}{63}$ plus $\frac{35}{63}$, which $= \frac{62}{63}$. It is always necessary when adding fractions to convert each of them to a *common denominator*. It is important to note that any whole number can always be expressed in a fractional form, thus $9 = \frac{9}{1}$.

A *mixed number* is one consisting of a whole number and a fraction, thus $5\frac{1}{2}$, $6\frac{1}{3}$, $2\frac{1}{8}$, are mixed numbers. These can be expressed as fractions: $5\frac{1}{2}=\frac{11}{2}$, $2\frac{1}{8}=\frac{17}{8}$, and $6\frac{1}{3}=\frac{19}{3}$. Observe that in order to convert a mixed number into a fraction the denominator is multiplied by the whole number and the numerator added.

It is often convenient when adding up mixed numbers to add the whole numbers first, but in multiplication and division it is best to reduce the mixed number to an improper fraction.

Multiplying and Dividing Fractions

To multiply a fraction by a number either *multiply its numerator by the number or divide its denominator by the number*. For example, multiply $\frac{5}{16}$ by 4. Multiplying the numerator we get $\frac{20}{16}$, which equals $1\frac{1}{4}$. Alternatively, divide 16 by 4 and so obtain $\frac{5}{4}$. To divide a fraction by a whole number either *divide the numerator by the number or multiply the denominator by it*. Example: Divide $\frac{3}{16}$ by 4. Multiplying the denominator by 4 we get $\frac{3}{64}$. But $\frac{3}{16}=\frac{12}{64}$, and dividing 12 by 4 we obtain $\frac{3}{64}$ in the same way.

To multiply a fraction by a fraction, multiply the numerators together and the denominators together. Thus, $\frac{5}{8}\times\frac{3}{4}=\frac{15}{32}$.

Cancelling

When a number of fractions have to be multiplied together the *product of the numerators and the denominators is obtained, thus providing the numerator and the denominator of the result*. Before doing this, however, it is useful to cancel out as far as possible in order to avoid unwieldy multiplication sums and final cancelling. For example:

$$\frac{3}{4}\times\frac{\overset{4}{\cancel{32}}}{\cancel{8}}\times\frac{\cancel{23}}{\cancel{16}}\times\frac{\cancel{16}}{\cancel{23}}\times\frac{\cancel{5}}{\cancel{4}}\times\frac{3}{\underset{4}{\cancel{20}}}=\frac{3}{4}\times\frac{3}{4}=\frac{9}{16}$$

From this it will be noticed that the 23's and the 16's cancel out, numerator 5 divides into the 20, leaving 4, denominator 8 divides into numerator 32 leaving 4, which cancels out the denominator of the fraction $\frac{5}{4}$, leaving $\frac{3}{4}\times\frac{3}{4}$, which equals $\frac{9}{16}$.

Dividing One Fraction by Another

To divide one fraction by another invert the divisor and multiply the remaining fraction by it. Example: Divide $\frac{9}{32}$ by $\frac{27}{16}$. Inverting $\frac{27}{16}$ we get $\frac{16}{27}$ and multiplying $\frac{9}{32}$ by $\frac{16}{27}$ obtain $\frac{144}{864}$. This will cancel down to $\frac{1}{6}$, because 864 is exactly six times 144. We could, and in practice would, have arrived at this result by cancelling the fractions themselves, thus:

$$\frac{\cancel{9}}{\underset{2}{\cancel{32}}}\times\frac{\cancel{16}}{\underset{3}{\cancel{27}}}=\frac{1}{2}\times\frac{1}{3}=\frac{1}{6}.$$

Decimal Fractions

Any fraction in which the denominator is 10, or some multiple of 10, is known as a *decimal fraction*. We know that in whole numbers each digit to the left increases in value by ten times. Thus the number 6,843,291 means

1 unit
9 tens
2 hundreds
3 thousands
4 ten thousands
8 one-hundred thousands
6 millions

Each move to the left signifies a value ten times greater than that of the place preceding it. Conversely, each move to the right reduces the value of the digits to one tenth.

This system is the basis of *decimals*, and it is also employed to express numbers which are less than unity. We use a *decimal point* to separate the whole numbers from the fraction, putting the whole numbers (if any) to the left of the decimal point, and the fractional number to the right of it. Thus 192.375 means one hundred and ninety-two whole units, plus $\frac{3}{10}$ths of a unit, plus $\frac{7}{100}$ths of a unit, plus $\frac{5}{1000}$ths of a unit, and such a decimal would be expressed verbally as *one hundred and ninety-two, point three seven five.*

Subtraction and Addition of Decimals

The ordinary rules of arithmetical multiplication and division apply to decimals, but it is important to *keep the decimal points of the quantities being added or subtracted under one another*. Here is an example of decimal addition:

```
 39.0625
 14.31975
  2.47113
125.00139
---------
180.85477
```

Subtraction is, of course, the reverse:

```
187.923875
 63.198362
----------
124.725513
```

Multiplication of Decimals

In multiplication *treat the two quantities as whole numbers*. The position of the decimal point is obtained *by counting the number of fractional digits in the multiplicand and the multiplier, adding these together, and counting off from the right of the product this number of digits*; the decimal point is placed to the left of the digit so counted off. For example: Multiply together 39.675 by 84.2163.

```
     84.2163
     39.675
 -----------
     4210815
    58951410
   505297800
  7579467000
 25264890000
 -----------
 33412817025
```

There are four decimal places in one quantity, and three in the other: 4+3=7, so there will be seven decimal places in the product, and the latter thus becomes, counting off seven places *from the right*,

3341.2817025

The same method applies irrespective of the number of decimal quantities which are to be multiplied together.

Decimal Approximations

Now, 3341.2817025 for all practical purposes can be shortened to 3341.292, rejecting the remainder of the decimal. Such a shortened result is said to be approximately *correct to three decimal places or to three significant figures*. There is a rule concerning this shortening process. If a rejected or discarded decimal is 5 or over, one is added to the next figure to the left. Thus, in the decimal given above, 7 being greater than 5 is rejected, and the figure 1 to the left of it is increased to 2.

If the result were required approximately correct to one decimal place, the answer would be 3341.3. If required correct to one, two, three, etc., decimal places the decimals beyond are merely discarded, thus:

3341.291
3341.29
3341.2

are correct to three, two and one decimal places respectively.

If the decimal is purely fractional and contains a number of noughts after the decimal point, at least one significant figure must, of course, be left. For example, in the decimal fraction—

.0000063192

we may shorten it only to .000006.

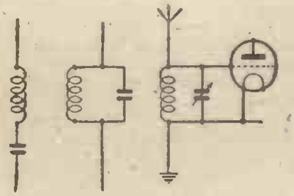
When multiplying decimals by ten, or any multiple or submultiple of ten, *it is merely necessary to move the decimal point* one place for each power of ten in the multiplier.

(To be continued.)

Resonant Circuits

The Two Most Common Forms, Acceptor and Rejector Circuits, are Discussed in This Article

THE phenomenon of "resonance" is perhaps the most important of all the electrical effects which are exploited in both radio transmission and reception; in fact, it is not too much to say that if such things as resonant circuits were unknown, radio would be quite impossible of achievement. A circuit is said to be "resonant" to a particular frequency when it is particularly sensitive to that frequency and less sensitive to all other frequencies. This may need a little further explanation, which is furnished by the statement that a coil or inductance offers an opposition to *changes of current*, and that this opposition, or "impedance" as it is called, becomes greater as the frequency increases, while a condenser offers an opposition to *changes in voltage*, this opposition, which is now called "reactance," or "reactive impedance," being smaller as the frequency rises.



Figs. 1, 2 and 3.—A series tuned, or acceptor, circuit; a parallel tuned, or rejector, circuit; and an ordinary tuning circuit respectively.

Two Kinds

The effect of an inductance is to cause the alternations of current in an A.C. circuit to lag behind the alternations of voltage, while the effect of a condenser is the reverse, making the current alternations tend to lead the voltage alternations. For any combination of inductance and capacity in a circuit there is one particular frequency at which the net result of impedance and reactance is most marked, and the peculiar properties of circuits tuned to resonance with signals—either "wanted" or "unwanted"—are of the greatest value in radio engineering.

Broadly speaking, there are two kinds of resonant circuit—that in which the inductance is in series with the capacity, as in Fig. 1, and that in which the inductance is in parallel with the condenser, as in Fig. 2. It is these two types of circuit which are called "acceptor" and "rejector" circuits respectively, and as these two terms are frequently employed in radio articles, and as the circuits themselves have such wide uses and important effects in receiving equipments, it is necessary to learn something about their properties.

The Acceptor

Consider first the series resonant circuit, or "acceptor," of Fig. 1. Since the effect of the inductance is to make the current lag, and of the condenser to make the current lead, it is clear that their respective effects are in opposition to one another. Actually the net impedance of such a circuit is equal to the difference between the impedance of the coil and the reactance of the condenser. Now since the impedance of the coil rises with the frequency and that of the condenser decreases with the frequency, obviously there must be one frequency at which the two quantities are exactly equal, and therefore cancel each other out. In other words, the impedance of an acceptor circuit at resonant frequency is zero. This means, in effect, that a theoretically perfect acceptor circuit would offer no opposition at all to currents having a frequency equal to the critical or natural frequency to which the circuit is tuned, but would offer some impedance to currents of all other frequencies, this impedance being greater as the frequency of the applied impulses differed in increasing amount from the resonant frequency.

The Rejector

The parallel-tuned circuit, or rejector, Fig. 2, on the other hand, has entirely different properties, as the currents in the two branches of such a circuit are in opposite phase—that in the inductive arm lagging approximately a quarter of a period behind the voltage alternation, and that in the condenser arm leading the voltage by approximately a quarter of a period—a very curious effect takes place. If we consider a current as a stream of electrons, it is possible to secure a very clear idea of what takes place. Imagine the electrons arriving at the top end of the rejector circuit at one particular instant. Owing to the opposition to changes of current offered by the inductance, the electrons will rush into the condenser and charge it up, but at the end of the first quarter period, when the voltage wave has reached its maximum and is beginning to decrease, the condenser commences to discharge through the inductance, and the electrons now pass into the condenser from the bottom end and charge it in the opposite direction. At one particular frequency, the "resonant" frequency of the circuit which depends upon the values of the inductance and the capacity, the interchange of current between the condenser and the inductance will occur at a rate exactly equal to the frequency of the incoming impulses, with the result that the current will continually circulate in the resonant circuit. In a perfect resonant circuit, therefore, a very high oscillating voltage is built up at resonance. Such a circuit would have an infinitely great impedance at resonant frequency.

It will now be seen why the terms "acceptor" and "rejector" are applied to these two kinds of circuit. A series-tuned circuit allows currents of resonant frequency to pass through it—"accepts" such currents, in other words; while a parallel-tuned circuit permits very little current at resonant frequency to pass or, in other words, "rejects" such currents.

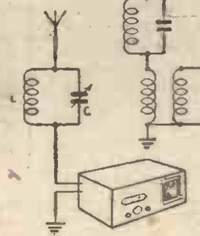


Fig. 4.—A simple rejector wavetrap for eliminating a powerful interference.

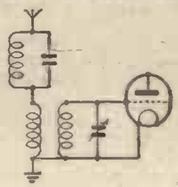


Fig. 5.—One method of arresting "image" frequency in a superhet by using a rejector.

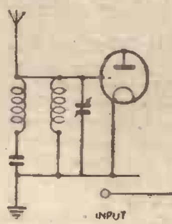


Fig. 6.—An alternative method to Fig. 5, using in this case an acceptor.

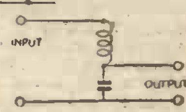


Fig. 7—Tone corrector filter in the form of an acceptor to give a sharp cut off above a certain frequency.

Examples

The ordinary radio tuner is, of course, a familiar and simple example of a rejector circuit. It is shown in basic form in Fig. 3, and owing to its high impedance to signals of the frequency to which it is tuned, a much greater voltage at that frequency is developed across it for application to the grid of the first valve than is developed for signals of other frequencies.

A rejector is also useful as a wavetrap to cut out or reduce the signal from a particularly strong unwanted station. A simple wavetrap is shown at L.C. in Fig. 4, this circuit being connected in series with the aerial and tuned to the unwanted signal. By offering a high impedance to the interfering frequency, the unwanted signal is very greatly reduced. A wavetrap of this kind is not often necessary with a modern receiver, which should be sufficiently selective for all normal purposes, but in the case of simple straight sets with only two tuned circuits, used within the "swamp area" of a powerful local station, a trap is often useful for eliminating the local station when foreign listening is required.

In superhet receivers there is a possibility of interference from signals of a frequency equal to the intermediate frequency, and this is commonly avoided by the use of what are, in effect, wavetraps of either the acceptor or rejector type tuned to the intermediate frequency. A rejector could be connected in series with the aerial coil as in Fig. 5, and would act as a stopper,

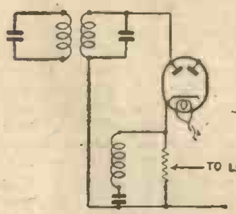


Fig. 8.—An I.F. by-pass to diode load in the second detector circuit of a superhet.

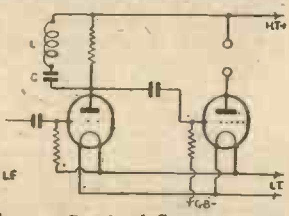


Fig. 9.—L.C. is an acceptor tuned to 5000/6000 cycles for use as a heterodyne whistle filter.

or an acceptor circuit could be connected in parallel with the aerial coil as shown in Fig. 6 and form a kind of short circuit for the interfering signal, which would be by-passed to earth. Another interesting use of an acceptor circuit, tuned to the intermediate frequency of a superhet, is shown in Fig. 8, where the acceptor is connected in parallel with the diode detector load to by-pass the intermediate frequency and prevent it being impressed on the following low-frequency stages.

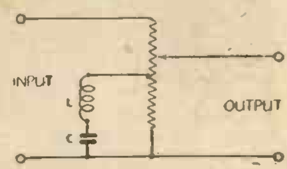
An Annoying Effect

One of the minor annoyances experienced by the users of fairly simple and unselective straight receivers, such as the popular H.F.-detector-output combination, is the presence of heterodyne whistles, due to two stations of only slightly differing wavelength "beating" together to produce a high-pitched note usually in the region of 5,000 or 6,000 cycles. It is not possible to prevent the production of such whistles in a receiver of this type, but it is a comparatively easy matter to prevent them from being reproduced in the loudspeaker. All that is required is an acceptor circuit, tuned to about 5,000 cycles, connected in parallel with one of the components carrying the low-frequency signal, such as the anode resistance in an R.C. amplifying stage. This will act as a virtual short circuit for the whistles, with the result that no voltage corresponding to their frequency will be developed for transfer to the grid of the following valve. A whistle filter circuit is indicated in Fig. 9, and appropriate values for the choke and condenser are 0.5 henry and .001 mfd. respectively.

Tone Correction

Closely related to the whistle filter is the tone corrector filter, which is used in various guises in different parts of certain receivers in order to give a reproduction more nearly approaching the original microphone performance than would otherwise be possible, or to modify the results of unequal frequency response in some other part of the circuit. A crude form is a condenser and resistance in series, connected across, say, a loudspeaker to short circuit part of the upper register and thus give a more mellow tone, but this is not a true acceptor circuit, and its effect increases with the frequency. If, however, it is desired to make a fairly sharp cut-off above a certain frequency, a form of acceptor circuit, similar to that shown in Fig. 7, is often used. It will be noted that the

Fig. 10.—Tone compensated volume control giving uniform frequency response. L.C. is an acceptor tuned broadly to 1000 cycles.



output is taken across the condenser only, and the principle is that if a condenser alone and no inductance were employed, the voltage developed across the condenser would be high for low frequencies and small for high frequencies, the drop being uniform. Since the action of the choke is, however, in opposition to that of the condenser, a substantially constant response is obtained to all frequencies up to the resonant frequency, above which the whole of the audio-frequency energy is diverted through the condenser and thus it is possible to obtain a clearly defined cut off.

Compensated Volume Control

It is well known that in using an ordinary potentiometer volume control there is serious attenuation at both the upper and lower ends of the musical scale at small volume levels. This can be overcome to a large extent by a tone compensated volume control such as that shown in Fig. 10, in which an acceptor circuit, roughly tuned to 1,000 cycles, is shunted across a portion of the potentiometer, thus reducing the response for the middle frequencies and maintaining the normal tonal balance. The design of a satisfactory control of this type offers scope for interesting experiment. A condenser of 0.5 mfd., and a choke of 50 milli-henries may be taken as approximate values, and the best position for tapping them across the volume control could be found by trial.

PRIZE PROBLEMS

Problem No. 428.

HARRIS was keen on quality reproduction, and took a great interest in working things out for himself. He decided to use an output choke-filter system for the speaker feed, and selected an L.F. choke having an inductance of 25 henries and a condenser of 4 mfds. What would be the reactances of these components at 50 cycles per second and 10,000 cycles per second? Show how you arrive at the values and how the filter would be connected.

Three books will be awarded for the first three correct solutions opened. Entries should 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. 428 in the top left-hand corner, and must be posted to reach this office not later than the first post on Monday, January 19th, 1942.

Solution to Problem No. 427.

The total H.T. current consumption of the receiver was 34mA's, and the formula to use is $R = \frac{E}{I} \times 1,000$ when R equals the resistance required, E equals the bias voltage required, and I the total anode current in mA's. Applying this for the first L.F. stage, we get $R = \frac{2 \times 1,000}{34} = \frac{2,000}{34} = 58.8$. For the output valve we have $R = \frac{7 \times 1,000}{34} = 205.8$. Taking these to the nearest standard resistor values we could say 60 ohms and 200 ohms. The network would, therefore, consist of two resistors having the following values—60 ohms and (200 - 60), which equals 140 ohms. These would be joined in series and connected between the H.T. and L.T. negatives. The bias for the first L.F. would be taken from the junction of the two resistors, i.e., 60 ohms from the L.T. negative end, and the bias for the output stage from the H.T. negative end of the two resistors, i.e., 200 ohms from the L.T. negative. Each bias line should be decoupled by a large condenser connected between bias line and L.T. negative.

The following three readers successfully solved Problem No. 426, and books have accordingly been forwarded to them: No. 1953918 A. C. Byrne, Signals Section, R.A.F.; J. Bell, 86, Boston Road, West Croydon, Surrey; A. B. Bennett, 36, Simmondley Lane, Glossop.

ON YOUR WAVELENGTH

By THERMION

Picafarad Again

YOU will remember that last month I gave it as my opinion that *picafarad* as an abbreviated word indicating micro-microfarad was derived from the printing term *pica*, which means 12 point. As one micro-microfarad equals .000000000001 microfarad (12 decimal places—12 *points*) it seemed to me logical to assume that the word was coined from that printing term. I have had a number of interesting letters on the subject, but none of them essay to give the derivation. These letters, however, bring to light the interesting fact that various books have used the term or one of its variants since 1916. Mr. Philip R. Coursey, B.Sc., writes: "The introduction of *pico* as a standard abbreviation for use in place of *micro-micro* is by no means new. It has, in fact, taken over a quarter of a century for it to approach general use. I can refer you to at least one old wireless textbook that lists this abbreviation—viz., the Handbook of Wireless Telegraphy and Telephony by Dr. W. H. Eccles. This was published in 1916, and gives *pico* as the only name for the sub-multiple of 10^{-12} with the alternative symbols of p or $\mu\mu$.

"Unfortunately, innovations in nomenclature seem to catch on and to be used much less readily than older and often undesirable names and abbreviations. Witness, for example, the still too-common use of Mfd. (or MFD, or MF), which is not merely undesirable but definitely incorrect."

Another reader, Mr. A. O. Griffiths, of Wrexham, informs me that the word picofarad appears in "Experimental Wireless" for April, 1925, having been used by Prof. Fortescue in a lecture to the R.S.G.B. in February of that year. The lecture was entitled "Resistance in Wireless Circuits."

Other readers have drawn my attention to the variants such as picrofarad and picofarad.

Mr. Coursey has mentioned the earliest date at which the word was used, and so I must presume that it was coined by Dr. Eccles. However, I repeat what I said last month, that we shall standardise the spelling as picafarad. If Dr. Eccles should read these notes perhaps he could contribute something useful to the discussion in the form of a statement as to how he arrived at the word.

One dictionary lists pico as well as pica as prefixes to farad.

Professor Joad Listens to Himself!

I SEE that Prof. Joad, in an interview with a Sunday newspaper, stated that he had been listening in to a recorded version of one of his broadcasts. He says that he doesn't like his voice, as it sounds affected and that he is often ungrammatical. He makes a number of other uncomplimentary remarks about himself, and is wise enough to perceive his imperfections, and to acknowledge them. It is a wise man who knows himself, but Prof. Joad is indeed fortunate in that he has been unable to give the B.B.C. his ear as well as his voice, contrary to the advice given by Shakespeare: "Give every man thine ear but few thy voice." I hope that Prof. Joad has profited from the experiment of listening to his own broadcasts, and will amend them accordingly.

Another member of the Brains Trust, Huxley, has been the subject of newspaper comment. He is visiting America and, as he says, has suffered misquotation at the hands of American reporters, which only goes to show that professors should not be caught off their guard!

They were certainly caught off their guard when asked the question whether cats could see in the dark. This is one of those stupid fallacies which are accepted without question. It used to be held, for example, that the horse and the elephant were docile animals because their eyes magnified everything they saw and thus a human being appeared to be a giant to them. It never occurred to the stupid teachers of the day that a horse would merely need to compare the size of its own hoofs with that of a human being to realise that it was still the more massive creature. There are other anserine beliefs. For example, there are many who think that the sun shining on a fire will put it out!

Another is that bats are blind. I did not hear any of the professors question whether a cat *could* see in the dark. They proceeded to find reasons for it doing so. Now it is my view that a cat could not see in a completely-darkened room any more than you or I. What is popularly considered as darkness is not complete darkness. There is a small amount of light which will enable an animal to see. In a completely-darkened room a cat may feel its way around by means of its whiskers which act as a gauge for its body. I am still dissatisfied with the answers given to the questions submitted to the Brains Trust. I know that they have no prior intimation of the question, but neither have I, yet I have up to the moment always been able spontaneously to give answers to the questions which I know to be more accurate than those given by the Brains Trust.

Accent

MR. WILFRID PICKLES, who is from the north, is a new B.B.C. announcer, and much play has been made in the public press on the accent of Mr. Pickles in comparison with the announcer whose place he has taken. Personally, I do not like a northern accent, and I am unrepentant in my view that the southerner speaks the purest King's English. I am not, of course, referring to local dialect, such as Cockney, but the English spoken, say, by the average southern school-teacher. I cannot understand why school-teachers in the north of England, for instance, are not first trained in enunciation and pronunciation. For example, school-teachers in the north pronounce *book* as boooook, the double "o" being pronounced as in *move*. That is merely one example out of many which I could give. There is little wonder, therefore, that students use the same pronunciation, which cannot be supported by any dictionary; where there is a divergence of opinion there could be some excuse. As I have mentioned before, I think that the etymology and pronunciation of the English language should be a task undertaken by the Government instead of being left to anyone who cares to print and publish a dictionary. Such a standard work would make it far easier for those foreigners who wish to learn our language. I know that the B.B.C. has a committee deciding the pronunciation of words, and that the results up to the moment have been somewhat unhappy. At present common usage decides spelling and pronunciation. The B.B.C. will never persuade the British public to say *respit* or *cumbat*. In fact, I have observed that the B.B.C. announcers are themselves using the commonly-accepted pronunciation.

Wireless Mechanics and the R.A.F.

I AM asked by the Air Ministry to point out that since we went to press with the January issue, in which we published a paragraph dealing with recruiting in the Royal Air Force, recruiting for all Ground Trades in the Royal Air Force has been suspended.

Radio Examination Papers—3

Another Set of Sample Questions, with Suitable Answers. The Questions Should be Read and Attempted Before Reading the Answers Given by THE EXPERIMENTERS

SPECIMEN QUESTIONS.

1.—*Why does a frame aerial have directional properties and from which direction does it pick up the strongest signals?*

2.—*Give simple diagrams to illustrate resistance-capacity and transformer coupling for an L.F. amplifier. State briefly the practical advantages and disadvantages of each.*

3.—*In what circumstances is an energised moving-coil speaker preferable to one of the P.M. type?*

4.—*What is the main advantage of a beam tetrode by comparison with a pentode, in the output stage of a receiver?*

5.—*Calculate the required inductance of a coil to tune over the 40-metre band in conjunction with a 100 mmfd. variable condenser.*

1.—Frame Aerials

WHEN a frame aerial is set with its plane in line with an imaginary line to the transmitter, a different potential is induced into each side of the frame as the "wave-front" passes it. But if the frame is set so that its plane is at right angles to a line between the frame and the transmitter, a similar potential is induced in each side of the winding.

It will be seen that in the former case H.F. currents are caused to flow through the winding, while in the latter no current could flow because of the equality of potential. When a current does flow there will be a difference of potential between the ends of the winding and therefore a signal will be "picked up." From this it is evident that when the frame is connected to a receiver, maximum signal strength will be obtained with the frame edge-on to the transmitter, and minimum when the frame is turned through a right angle from this position. Theoretically, there should be a complete absence of signal when the frame is "face-on" to the transmitter, although in practice a small signal may be picked up due to slight out-of-balance effects and due to the turns of the frame being side by side.

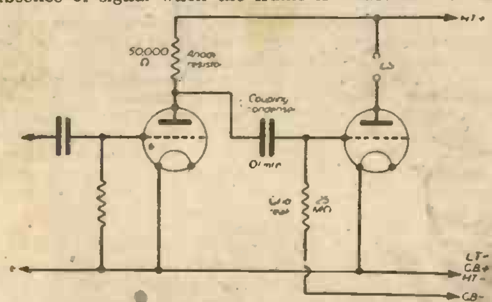


Fig. 1.—Simplified circuit of a resistance-capacity coupled amplifier. The values shown are average for two battery valves of the L.F. and small-power types.

Between the two positions mentioned, the pick-up will bear a relation to the angle at which the frame is set to the line from it to the transmitter. Because of this, a frame can be used for direction finding, and also for eliminating interference from one transmitter while receiving from another in a different direction.

2.—R.C. and Transformer Coupling

Figs. 1 and 2 show simplified circuit diagrams of resistance-capacity and transformer coupling respectively. In the former case, a resistor forms the anode load of the first valve, while audio-frequency voltages developed across it are passed on to the following valve through a fixed condenser. In the latter case, the reactance of the primary winding of the transformer forms the anode load, and the second valve is fed from the secondary, into which the audio-frequency voltages are induced.

The principal advantage of the R.C. system of coupling is that the anode load remains constant irrespective of frequency; by comparison, the reactance of the transformer primary increases with frequency. Because of this, the R.C. coupling should normally give better reproduction at low audio frequencies. At the same time, it should be remembered that the reactance of the coupling condenser increases as the frequency falls, so that the advantage of the resistance may not be fully maintained.

A disadvantage of R.C.C. is that the coupling resistor reduces the H.T. voltage actually applied to the anode of the valve, so that a higher initial voltage is required to ensure that a sufficiently high voltage is applied to the anode. This is explained by the fact that the D.C. resistance of the transformer primary may be in the region of only a few hundred ohms, although the reactance at average frequencies may be several thousand ohms.

Transformer coupling has the advantage that a voltage step-up may be obtained between the valves by placing a greater number of turns on the secondary than on the primary. The irregular response due to variation of reactance with frequency may also be an advantage in certain cases in compensating for losses in other parts of the circuit.

Provided that a good transformer is properly used, it need not show any serious disadvantages over R.C.C. in a modern set, although it is more costly than the components required for R.C.C., and it can cause serious distortion if used incorrectly, or if it is of poor design. When using very high-mu valves instability may result from using a high-ratio transformer, and in such cases R.C.C. can be used to advantage.

3.—Energised and P.M. Speakers

In cases where sufficient energising current is available an energised type of moving-coil speaker can, in general, be said to be somewhat more sensitive than a permanent-

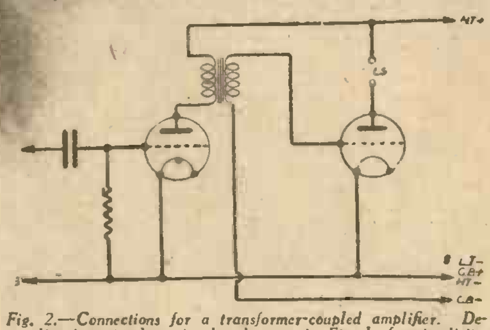


Fig. 2.—Connections for a transformer-coupled amplifier. Decoupling is omitted, as is also the case in Fig. 1, for simplicity.

magnet speaker of similar size and power-handling capacity. The difference in sensitivity between the two types of speaker, however, is not always very marked when considering P.M. speakers of modern type with a permanent magnet constructed from one of the special alloy steels. Nevertheless, a P.M. speaker magnet does deteriorate slightly in use due to the gradual falling off in magnetic flux. As a result, an energised speaker is generally more sensitive than a corresponding P.M. speaker after a period of use.

A practical advantage of the energised speaker is that the field winding can be used also as a smoothing choke in a mains receiver if the anode current taken by the valves is sufficient to energise the electro-magnet to a suitable degree. By using the winding in this manner the cost of an additional smoothing choke is obviated, while the speaker itself is generally rather less expensive than a good one of the P.M. type.

In general, a small energised speaker having a field winding of about 2,500 ohms requires a current of not less than 60 mA; this gives an energising power of 9 watts. Power is found from the simple formula: $W=I^2R$, where W is in watts, I in amps and R in ohms. For larger speakers a higher energising power is required.

An objection to the energised type of speaker is that it cannot normally be used externally to the receiver unless a separate power supply is provided for it.

4.—Tetrodes and Pentodes

The beam tetrode is similar to the well-known screen-grid valve except that the mesh of the control and screening grids is in alignment. In addition, there are generally two deflector screens for the purpose of "focusing" the electron stream from the cathode on to the anode. In the case of a pentode the meshing is not in alignment, and an extra grid is interposed between the screening grid and the anode, this being connected to a point which is at or very near earth potential.

Due to the electrode construction, a pentode gives a fair proportion of third-harmonic distortion, whereas the beam tetrode causes only second-harmonic distortion. This brings into account two important factors. One of these is that third-harmonic distortion (often to be recognised by high-pitched reproduction) is more offensive to the ear than is second-harmonic distortion. The second is that second-harmonic distortion due to two valves cancels out when these valves are arranged in push-pull; this is not the case with third harmonic.

The amplification obtainable from beam tetrodes and pentodes of corresponding size is similar. Because of the advantages enumerated, the beam tetrode is largely supplanting the pentode in the output stage of receivers.

5.—Inductance Calculation

The resonant frequency of a tuning circuit is given by the formula: $f=\frac{1}{2\pi\sqrt{L\times C}}$ where f is the frequency in cycles per second, π is 3.14, L is the inductance of the coil in henries, and C is the capacity of the tuning condenser in farads. For practical purposes, this formula can be simplified to read: $f=\frac{10^6}{2\pi\sqrt{L\times C}}$ Due to multiplying the expression by ten to the sixth (one million) we obtain our answer in kilocycles, and L and C are expressed in microhenries and microfarads respectively, all of which are more convenient units.

If we substitute the figures given in the question in this formula we can easily determine the inductance value required. In the first place, however, we must convert the wavelength into frequency. This is easy enough, since we know that 300 metres corresponds to 1,000 kilocycles; thus, 40 metres is 7.5 times 1,000 kilocycles. And as we are to cover a band of frequencies, it will be best to take the capacity as being just half that of the tuning condenser, so that we shall tune to 40 metres when the condenser is set to its midway position. (This is not strictly accurate because it is being assumed then that the minimum capacity is zero. The approximation is, however, within practical limits.)

Now let us work it out.

By substituting we get:

$$7.5\times10^3=\frac{10^6}{6.28\sqrt{L\times C}}$$

Squaring the whole expression to remove the square-root sign we have:

$$56.25\times10^6=\frac{10^{12}}{39.4\times50L}$$

This we can re-write as:

$$L=\frac{10^{12}}{50\times56.25\times10^6\times39.4}$$

If this is worked out it will be found to come to approximately 9, so that the inductance of the coil should be about 9 microhenries.

The same formula can be used to find the frequency covered by a given coil and condenser, or to find the required capacity of tuning condenser. When it is necessary to find the frequency *range*, the accurate minimum and maximum capacities of the tuning condenser should be taken into consideration.

Short-wave Transmissions

ESSENTIAL details are given below of a selection of the short-wave transmissions from overseas. These will enable you to check your dial settings and complete the records in the log-book.

Station	Call Sign	Mc/s	Metres	kW.
13-Metre Band (21.450-21.750 Mc/s)				
Boston (U.S.A.)	WRUL	21.460	13.98	50
Schenectady (U.S.A.) ..	WGEA	21.500	13.95	50
Philadelphia (U.S.A.) ..	WCAB	21.520	13.94	10
Hull (U.S.A.)	WBOS	21.540	13.93	50
Wayne (U.S.A.)	WCBX	21.570	13.91	10
Schenectady (U.S.A.) ..	WGEA/O	21.590	13.89	50-100
Bound Brook (U.S.A.) ..	WRCA	21.630	13.87	50
16-Metre Band (17.750-17.850 Mc/s)				
Boston (U.S.A.)	WRUL	17.750	16.90	50
Bound Brook (U.S.A.) ..	WRCA	17.780	16.87	50
Hull (U.S.A.)	WBOS	17.780	16.87	50
Chungking (China) ..	XGOX	17.800	16.85	35
Guatemala City	TGWA	17.800	16.85	10
Sydney (Australia) ..	VLQ8	17.800	16.85	—
Wayne (U.S.A.)	WCBX	17.830	16.83	10
Moscow (U.S.S.R.) ..	—	17.910	16.75	20-100
Lourenco Marques (Mozambique)	CR7BI	17.915	16.63	10
Geneva (Switzerland) ..	HBF	18.450	16.26	20
Geneva (Switzerland) ..	HBH	18.480	16.23	20-100
Moscow (U.S.S.R.) ..	—	18.540	16.18	20
Bangkok (Thailand) ..	HS6PJ	19.020	15.77	10

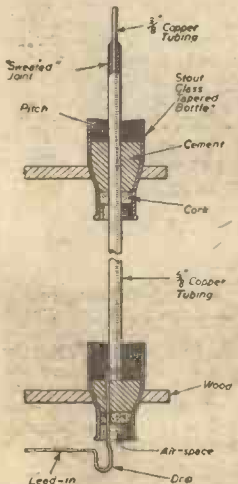
Station	Call Sign	Mc/s	Metres	kW.
19-Metre Band (15.100-15.350 Mc/s)				
Moscow (U.S.S.R.) ..	RKI	15.040	19.95	20-100
Teheran (Iran)	EPB	15.100	19.87	14
Vatican City	HVJ	15.120	19.84	25
Boston (U.S.A.)	WRUL	15.130	19.83	50
Motala (Sweden)	SBT	15.150	19.80	12
Bandoeng (Dutch E. Indies)	YDC	15.150	19.80	—
Guatemala City	TGWA	15.170	19.78	10
Moscow (U.S.S.R.) ..	RW96	15.180	19.76	20-100
Ankara (Turkey)	TAQ	15.195	19.74	20
Hull (U.S.A.)	WBOS	15.210	19.72	50
Lisbon (Portugal)	CSW4	15.215	19.72	10
Cincinnati (U.S.A.) ..	WLWO	15.250	19.67	75
Wayne (U.S.A.)	WCBX	15.270	19.65	10
Delhi (India)	VUD3	15.290	19.62	10
Buenos Aires (Argentina)	LRU	15.290	19.62	7
Sydney (Australia) ..	VLQ3	15.315	19.59	—
Soerabaya (Dutch E. Indies)	YDB	15.315	19.59	—
Schenectady (U.S.A.) ..	WGEA/O	15.330	19.57	50-100
Treasure Island (U.S.A.) ..	KGEI	15.330	19.57	20
Boston (U.S.A.)	WRUL	15.350	19.54	50
Moscow (U.S.S.R.) ..	RW96	15.410	19.47	20-100
Moscow (U.S.S.R.) ..	—	15.715	19.09	20-100

(To be continued.)

Practical Hints

A Novel Vertical Aerial

THE accompanying sketch shows my method of erecting a vertical aerial, which is proving itself extremely efficient for S.W. work, and in view of the recent high winds, very rigid. The lower half is composed of 12ft. of ⅝in. copper tubing, and the upper part consists of 6ft. of ⅜in. copper tubing. I used two very strong tapered glass bottles of ¼in. glass and removed the bottoms, using a file, and then a hot oven and cold water. The tapered holes in the wood supports (which are "stayed") I made with a large bit, and then a gouge. Before the lower end is fixed in position the upper bottle and cork must be pushed on. The lower end is fixed about 15ft. from the ground, and the upper end projects well above the roof. At first, the actual erection seemed complicated, but it turned out to be surprisingly easy. As I am only a constructor of eight months' experience (due to PRACTICAL WIRELESS) I am very pleased with my first short-wave aerial, and hope it will prove of practical value to other readers.—J. W. BARTON (Sheffield).

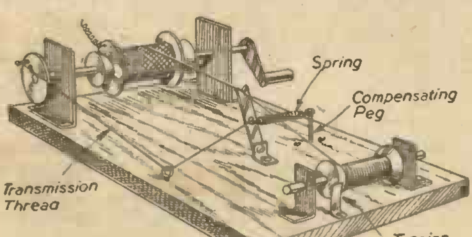


Sectional view showing method of erecting a vertical aerial.

Winder for Honeycomb Coils

RECENTLY requiring a tuning coil of the honeycomb pattern, I devised the following simple honeycomb coil winder. The advantage of the device is that it can be adjusted to wind any size coil, within limits.

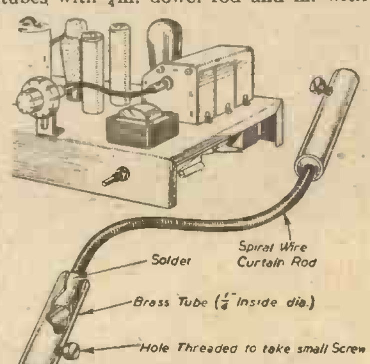
The base of the winder is a piece of wood about ½in. thick and approximately 6ins. wide and 9ins. long. The large bearings can be made of sheet brass of suitable thickness. The angle bracket and guide can be made of the same material. The guide is fixed to the angle bracket loosely by a small screw and lock nuts, and the angle bracket is then screwed to the base. The small bearings to hold the spool of wire can also be made out of sheet brass, but I used two small transformer clamps which make quite effective bearings. A tension spring was screwed to the base and made to rub on the spool containing the wire. A spindle is made from suitable material and the large bearings drilled to take it. A removable handle is fitted to one end of the spindle and cones made from wood fixed friction tight on the spindle to hold the former of the coil to be wound. A disc is soldered to the other end which acts as a crank to pull the thread through a screw eye and work the guide. The disc, which is made of ⅛in. brass, is about 2ins. diameter and is drilled at intervals of ¼in. along the radius. A peg to fit these holes was made by cutting the point off a nail. Another peg to compensate for the shifting of the peg in the cam is made in the same way, and holes are also drilled in the base at ¼in. intervals, a spiral spring being soldered to the compensating peg and the other end soldered to the guide. The end of the thread is looped and slipped over crank-pin. The transmission thread then goes through the screw-eye and is tied on to the guide. The thread must be adjusted so that when the crank pin is back, it pulls the guide back.—J. F. RIDGWAY (Edgware).



A simple winder for honeycomb coils.

A Flexible Coupler

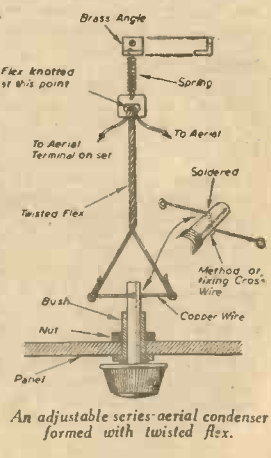
WITH a suitable length of spiral curtain rail and two brass tubes (¼in. inside diameter) 2ins. in length, a simple flexible coupler can easily be made. Plug the brass tubes with ¼in. dowel rod and fill with solder (and flux). Place the ends of the wire curtain rail into the ends of the tubes for ½in. and allow to set. Remove the dowel plugs and bore holes ½in. from the open ends of the tubes. Tap these holes to take small bolts. This coupler is very suitable between S.M. drives and condensers.—G. H. WHALEN (Warrington).



A useful flexible coupling shaft.

Aerial-series Condenser

DETAILS of a novel variable aerial-series condenser are given in the accompanying sketch. It will be seen that part of the aerial lead-in is formed of twisted flex, one end of which is anchored to a coiled spring, the other end being divided and attached to a short piece of copper wire, soldered to a brass rod. The ends of the flex must be insulated from the copper wire, which should be about 2ins. long. Other particulars will be clear from the sketch.—D. C. DENMAN (Cullercoats).



An adjustable series-aerial condenser formed with twisted flex.

P.A. EQUIPMENT—8

Wiring Networks. By "SERVICE"

THE wiring up of a small temporary P.A. installation, whether for indoor or outdoor work, must be carried out to suit existing conditions. It is not possible in the time available for installing temporary equipment to cut the various lengths of cable to the correct length, and make permanent connections.

One method which is convenient and economical is to have made up ready for rush jobs various lengths of cable, each fitted with a triple plug at one end and a triple socket at the other end. The prongs of the plug must be kept clean, and periodically opened out so that they are always a tight fit in the socket.

The three-pin plug comprises two thin pins and one thick one. The small pins are connected to the conductors in the cable, and the large pin is connected to the metal screening of the cable which is ultimately earthed to the amplifier chassis.

Varying Lengths of Cable

By having lengths of, say, 25, 50, 75 and 100 feet, practically any length of cable up to 250 feet may be obtained, and yet if only a short run is needed, one of the small lengths may be used so that there are no large coils of loose cable lying about. This arrangement also facilitates clearing up after the evening's work is done

Another use for these lengths of cable is for assisting in giving demonstrations of amplifiers and equipment. Often a client who proposes to fit P.A. equipment into his factory or office prefers to have a demonstration before actually signing up for a complete and permanent installation. The various lengths of neatly terminated cable enable temporary wiring of this nature to be carried out neatly, and without constant scrapping of material.

Wherever possible the very shortest length of cable should be used in order to keep down losses, and to prevent the pick-up of extraneous noises due to electrical interference. Screened cable of the flexible type such as is required for temporary installation must have a good outer covering of insulating material to protect the metal braiding and to prevent background noises in the reproduction, which would occur if the unprotected metal braiding is allowed to rub against anything.

Conduit System

Permanent installations should be carried out in conduit, and, as a matter of fact, the whole system may be wired up in accordance with normal electrical installation procedure. Instead of having a twin cable, two single insulated wires may be employed inside tubing with junction boxes, tee pieces and inspection elbows, so that in the event of a breakdown of the wiring, tests may be carried out quickly from point to point to discover where the fault has occurred.

In the case of very large installations, similar to that illustrated in Fig. 2 it is not regarded as being uneconomical, taking the long view, to feed each group of loudspeakers on each floor in a factory by means of a separate cable feeding directly to the output amplifier.

This layout is far better than the cheaper method of taking the cable right round the whole of the establishment in a continuous line, and connecting each loudspeaker to it. The reason is that should a fault occur in the cable, say close to the amplifier, the whole of the installation would be put out of service. This may be a serious consequence when important announcements or A.R.P. instructions are being issued over the network.

Locating Faults

With the first method of wiring layout, if a fault occurs in one of the cables, only one group of loudspeakers is affected, and the engineer in charge would quickly connect up a length of temporary cable from one of the unaffected networks to a point beyond the break in the faulty network so as to allow a certain amount of speakers to be used. In many large amplifiers a monitor loudspeaker is incorporated with a switch which allows the speaker to be connected to all outgoing lines. The engineer then knows that if he gets results from a loudspeaker when the switch is rotated quickly, the fault which has been reported to him must be on the network or in the main distribution board.

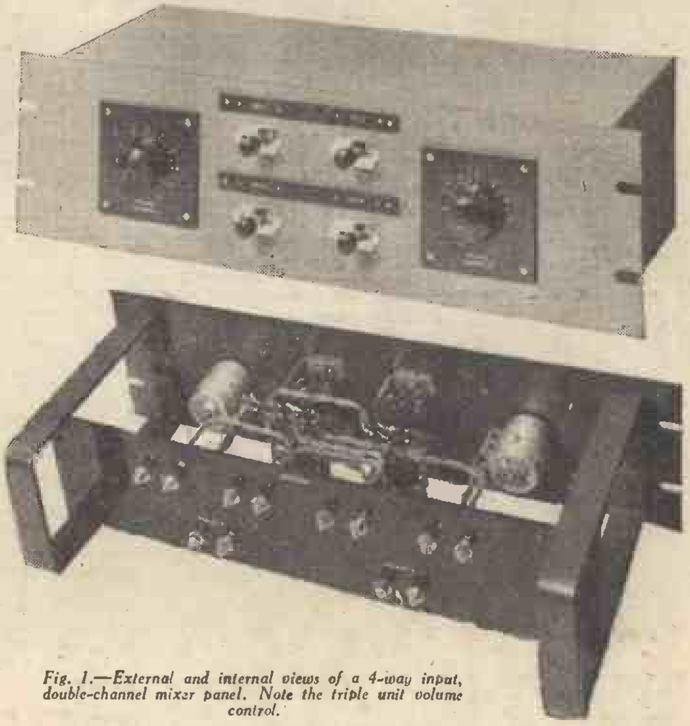


Fig. 1.—External and internal views of a 4-way input, double-channel mixer panel. Note the triple unit volume control.

He will then pick up a portable loudspeaker and proceed along the faulty network plugging the test loudspeaker into the various cable inspection elbows and junction boxes until he reaches the one at which he cannot obtain any results. He will then know that the fault lies between that point and the last point at which he obtained a signal.

If the matter was urgent he would disconnect the cable at the two test points, and run two leads outside the conduit and connect up the two leads in place of the faulty length of cable, thus maintaining the service. The temporary wire would be kept in place while the faulty wiring was being withdrawn from the conduit, and fresh wire put in.

Dual-channel Network

In the case of dual-channel networks a breakdown in one of the cables is not so serious, as any urgent A.R.P. announcements would normally be put over on both channels so as to be reproduced on any loudspeakers on the system no matter to which channel they were switched. The maintenance engineer would then have more time to locate the fault and to repair it.

With regard to the load imposed by the network on the output stages of the power amplifier, this load must be maintained at a constant level, otherwise the reproduction from the various loudspeakers will fluctuate.

In installations carried out in factories, railway stations, etc., where the loudspeakers permanently wired into the system cannot be switched off at each loudspeaker position, this trouble does not present itself, but in blocks of flats, where the speakers may be switched on or off according to the requirements of the tenant of any particular flat, compensating resistances must be put into the circuit.

This is quite easy to achieve by making the loudspeaker switch a double-pole, double-throw type. In one position the loudspeaker speech coil is connected to the network, while in the other position, which would be marked "Off," a resistance approximately equal to that of the speech coil would be connected to the network.

The resistance may take either the form of a small carbon resistance of a slightly higher value than the D.C. resistance of the loudspeaker speech coil, or it would be made up from a few turns of wire which would make the resistance inductive, and the ohmic resistance of the wire would be made equal to that of the speech coil.

Volume Controls

In addition to enabling the tenant to switch the loudspeaker completely on and off, arrangements are generally made for a volume control to be incorporated in the loudspeaker cabinet so that the volume of reproduction may be adjusted as desired.

The volume control must be of the constant impedance type, as described in the third article in this series (July, 1941, p. 305). As was explained in this article, no matter to what position the control is adjusted, there is always the same resistance presented to the loudspeaker and to the network. It will be appreciated that if a simple variable resistance were connected across the speech coil of the loudspeaker, it would alter the volume of any other loudspeakers connected to the network, as the resistance would be in parallel with them, as well as with the loudspeaker in the cabinet incorporating the volume control.

Plugs and Sockets

Similar safeguards for maintaining the load on the amplifier must be incorporated in any system of network in which the loudspeakers or headphones may be plugged in and out of sockets. This method is often employed in cinemas for deaf-aid equipment, or in hospitals where, although each bed may have a socket adjacent to it, there will be only a certain number of headphones for distribution amongst the patients. Anybody wishing to have the headphones is provided with a pair, and the jack on the end of the headphone cord is plugged into the socket.

The socket, as is usual with a jack of this type, would have contacts which are opened and closed as the plug is pushed into the socket. Matters will be so arranged that when the plug is pushed well into the socket the headphones would be connected to the wiring system, but when the headphone plug is withdrawn, contacts in the socket would move and connect a resistance in place of the headphones across the network.

Resistances Across Network

With open sockets of this type, often all along the wall of a hospital, it may be appreciated that sometimes a child or mentally weak patient may insert some metallic object into the socket which would short out the contacts, and thus put a short circuit on the system. To minimise trouble due to this sort of thing happening a resistance equal in value to that of the headphones is often inserted in each lead between the network wiring and the socket position. When the contacts are shorted there will be a high resistance across the network which will not affect to any audible degree the reproduction from other headphones on the circuit.

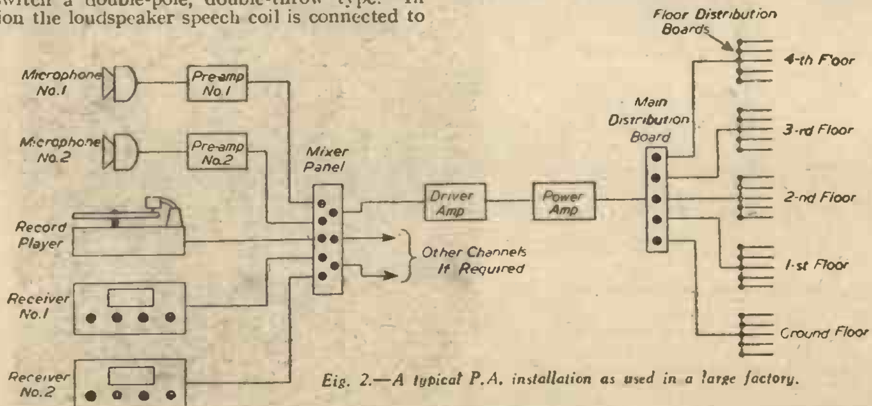


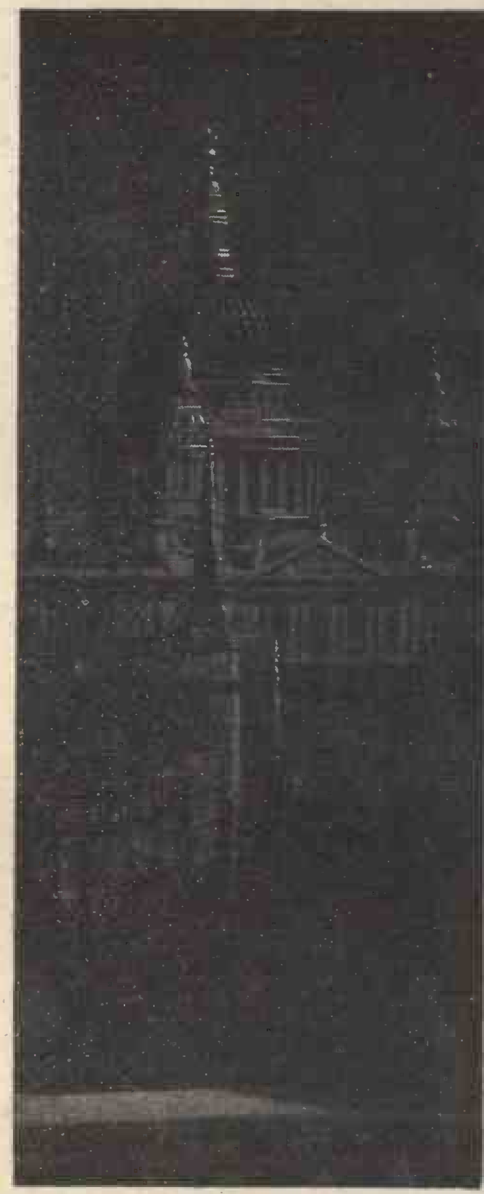
Fig. 2.—A typical P.A. installation as used in a large factory.

Attenuator Pads

Another form of resistance termination to supply points on the network takes the form of permanent volume controls, or attenuator pads as they are often termed. It may be that one or more loudspeakers are required to operate at a low volume level, and the management would not desire to have volume controls on the loudspeakers which could be altered by unauthorised people. To save the cost of many volume controls, and also to achieve the above purpose where many supply points are concerned, three cheap little resistances wired into the sockets so as to form a potentiometer arrangement may be used.

For example, if a 50 per cent. cut in volume is required, two 100-ohm resistors could be connected in series across the network, and the loudspeaker leads could be connected across one of the resistors. This is the theoretical arrangement to cut down the voltage, but in practice, as stated above, three resistors would be used to form a constant impedance attenuator pad so as to preserve the quality of reproduction at the lower volume level. This was explained in the third article in this series.

The actual location of loudspeaker points in systems, and how the speakers may be hidden in installations carried out in places such as municipal buildings, churches, ballrooms, etc., will be explained in the next article.



Experimenting With Reaction and Tuning Circuits

Some Ideas for Experimental Work Which Will Prove Interesting and Instructive

By "PIONEER"

SYSTEMS of tuning and of applying reaction have become so stereotyped during recent years that many of the newer constructors probably do not realise that there are many possible variations. As an example, look at Fig. 1; here you have a skeleton circuit for a regenerative detector valve, or detector valve with reaction, if you prefer it that way. There is a standard two-range (medium and long-wave) coil,

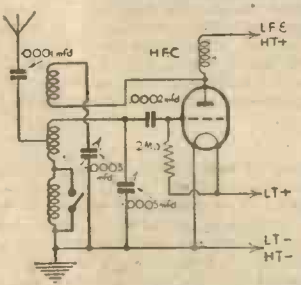


Fig. 1.—The type of tuning and reaction circuits generally used in a present-day Det.-L.F. receiver.

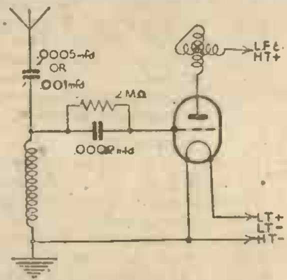


Fig. 2.—Here is quite a different arrangement that used to be popular. Tuning condenser is in series with the coil, and a variometer is used in the reaction circuit.

with a .0005 mfd. variable condenser in parallel with it for tuning purposes; the aerial is joined to a tapping on the coil through a fixed condenser; reaction is applied by means of a winding placed close to the tuned winding, and is controlled by means of a second variable condenser connected between one end of the reaction winding and earth.

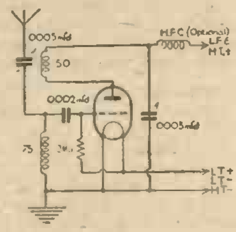


Fig. 3.—In this circuit there is series tuning and throttle-control reaction.

Convenient and Conventional

That is, to-day, a perfectly standard arrangement that works tolerably well. It is convenient, and it is conventional, so it is good enough for most people. But now look at the circuit in Fig. 2. This is for a similar basic circuit, but it appears vastly different. Twelve to fifteen years ago this arrangement was considered very highly efficient. And it is, even now probably far more efficient than many of the more conventional circuits that are widely used. Still, nobody uses it. Why? The main reason is that few constructors know that such a circuit is workable, but another reason is that it is suitable only for use on the medium waves; it might, however, be modified for short-wave use.

Pioneer Days

From 1922 to 1924 I employed this and similar circuits with what I have always considered great success. With a single valve (less efficient than those obtainable nowadays) I was able to receive U.S.A. medium-wave transmissions, by staying up until the early hours of the morning, and I received every one of the B.B.C. stations then in operation. In addition, there were several amateurs that could be brought in, whilst Brussels and the French P.T.T. transmissions were well within range. And then there was Barcelona, and a few other pioneer stations whose names I have long-since forgotten.

But do not misunderstand me. I do not say that if you employ the same circuit to-day you will obtain similar results. Conditions are vastly different; greater selectivity is required, electrical interference is far more prevalent, and the vastly greater number of receivers in use has a greater sponge-like effect in "mopping-up' the etheric waves. At the same time, a circuit such as this is worth trying, especially by those who are comparatively new to radio experimental work.

Series Tuning Condenser

As will be seen from Fig. 2, tuning is carried out by means of a variable condenser connected in *series* with the tuning coil, no parallel condenser being used. This is conducive to greater efficiency, since the inductance-capacity ratio is greatly increased. That is because the coil used must have an inductance value about 50 per cent. greater than that required with a parallel tuning condenser. In the days of plug-in coils we used a number 75 for this circuit, whereas a 35 or 50 coil was required with the parallel-condenser connections. The numbers, incidentally, applied to the number of turns on the honeycomb or basket-type plug-in coils.

Variometer Reaction

Now examine the reaction circuit, which is quite different from that you see to-day. A variometer is simply connected between the plate of the detector and the 'phones or L.F. circuit. It should be explained that a variometer consists of two coils in series arranged so that one can be moved in relation to the other. As a result, the total inductance can be varied between the difference in inductances of the two coils and the sum of the inductances (in theory—practice does not quite agree).

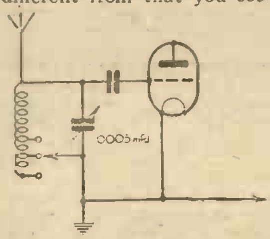


Fig. 4.—When a tapped coil was used there were "dead-end" losses in the portion of the winding not in use.

The variometer has little capacity, and if it is tuned

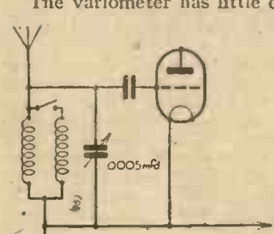


Fig. 5.—One method of overcoming "dead-end" losses on medium waves is to arrange for two windings to be in parallel. A refinement was to use series-parallel switching for long and medium waves.

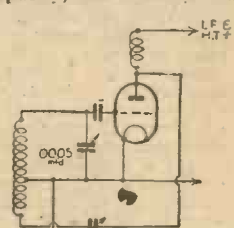


Fig. 6.—The original Reinartz circuit, which shows the correct "sense" of the tuning—and reaction—coil connections.

to the wavelength of the received signal, it acts as an almost complete barrier to the signal frequency. This means that H.F. currents in the plate circuit cannot leak away; instead, they "jump" across the capacity between the plate and grid and pass through the valve again. Consequently, we get the effect of reaction or feed-back.

If you have a few old plug-in coils and a variometer you will find it interesting to revive this old circuit. If not, you can try the arrangement in Fig. 3, which is similar. In this case there are two plug-in coils mounted about 1in. apart, and reaction is "throttle-controlled" by means of the .0003 mfd. condenser shown. When using the variometer for reaction, oscillation sets in

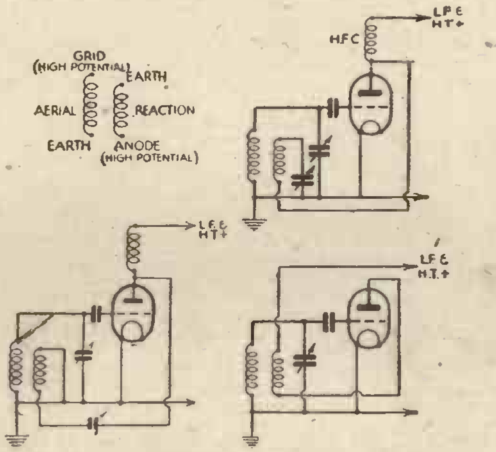


Fig. 7.—Assuming that both tuning and reaction windings run in the same direction, proper connections are shown here for a few simple circuit arrangements.

when the anode circuit is brought into resonance with the grid circuit. When using two plug-in coils, oscillation starts as the capacity of the .0003 mfd. condenser is reduced.

Should you wish to reproduce this old circuit and have no plug-in coils, you can easily place two windings of 26-gauge d.c.c. or enamelled wire on a 2in. diameter cardboard tube, using the number of turns indicated, and placing the windings about ¼in. apart. Run both windings in the same direction, and connect the ends in the same "sense" as indicated in the diagram. You might well find that this circuit is more satisfactory than the more standard arrangement that you are probably using now. In any case, you will find a good deal of interest in making the experiment. For both of the old circuits referred to it is best to use a valve of the small-power type, but other types can be employed.

Coils in Parallel

Generally speaking, present-day tuning coils are far from efficient, although for most modern circuits no great benefits would accrue from the use of coils of higher efficiency. At the same time, you might care to experiment with a coil idea that achieved a fair measure of popularity in the early days of broadcasting. It was then not unusual to employ tapped coils in conjunction with a parallel tuning condenser, as shown in Fig. 4. Efficiency was sacrificed, although the advantage of using a single coil instead of two or three plug-in coils was obtained. The trouble was that a portion of the coil was out of use most of the time; this gave rise to what were known as "dead-end" losses.

One solution of the problem was to employ a coil like that shown in Fig. 5. There are two windings, as there are on the present-day medium and long-wave coil, but these are arranged so that the long-wave winding can be used alone, or so that both windings can be placed in parallel for medium-wave reception. Thus, there are no dead-end losses on medium waves, and what small losses there are on long waves are of little importance The long-wave winding has about 25 per cent. more turns than is the case with the type of coil used to-day, and the medium-wave coil having about 20 per cent. more turns than on the normal broadcast coil. Both windings are arranged end-to-end on a former, or one might be wound on a former placed inside the former carrying the second winding.

An alternative to the method of connection shown in Fig. 5 was to use a switch for connecting the two windings in series for the long waves and in parallel for medium waves. Theoretically, at least, that is an ideal system.

Reaction "Sense"

Probably nearly every reader knows that with any type of coil reaction can be obtained only when the connections to the tuning and reaction winding are in the correct "sense." In other words, if the leads to one of the coils are transposed, reaction cannot be obtained. This is simply because for reaction to occur, H.F. currents must pass back from the reaction or anode circuit into the grid circuit. This happens due to the linking of the magnetic fields round the two windings. If you are rather hazy concerning the technical side of this matter you need not worry, since it is not important for present purposes.

How to Tell

The matter can easily be understood by referring to Fig. 7. Here you see two windings; both are in the same direction, and both are assumed to be placed fairly close together. If the top of the first winding is connected to the grid of the valve, the bottom of the second winding must be connected to the anode. Another way of explaining this is by saying that the opposite ends of the two windings must be connected to the points of high potential. In this respect, high potential refers to H.F. and not to any battery voltage.

In Fig. 7 are shown a few alternative correct methods of connection, all of which agree with the condition set out. If the connections to either winding in any of the examples shown were reversed, reaction could not be obtained. In the same way, if the direction of any one winding were reversed, reaction would be impossible. On the other hand, if both direction of winding and method of connection of any one winding were reversed, reaction would be obtainable.

Reinartz Circuit

As this matter is of importance, especially to those who make their own coils, or who have to use coils whose connections are not known, it is justifiable to give another method of recognising the correct "sense." Fig. 6 shows the original Reinartz circuit, where use was made of a single tapped coil for aerial tuning and reaction. Clearly all turns are in the same direction, and it can be seen that the two outer ends of the complete winding are points of high potential. This circuit is identical in principle to that shown in Fig. 1, although in Fig. 1 the reaction condenser is placed between one end of the reaction winding and earth, instead of between the other end and plate. The reaction-condenser position shown in Fig. 1 is generally to be preferred, because the moving vanes of the reaction condenser can be at earth potential. This means that hand-capacity effects are less likely to be troublesome.

With regard to the connections shown in Fig. 7, it should be mentioned that coils wound with the reaction winding over the tuned winding would not be as efficient as they should be. This is because of the capacity between the earthed and high-potential points. For coils wound in that manner it would be better to reverse the direction and connections of one winding.

Mains and Output Transformers

Some Facts and Figures Which Are Not Sufficiently Understood by the Amateur Constructor.

By L. O. SPARKS

THE number of queries received from readers attempting to construct transformers indicates that sufficient attention is not given to essential elementary considerations. This might not be a serious matter when dealing with inter-valve and output transformers, but with components used in mains rectifying equipment, it can become dangerous and costly.

The outstanding fault with most constructors is that they appear to ignore wattage and its connection with the general design of the transformer. Rather than attempt to enumerate the individual factors, let us follow the normal and safe procedure governing the construction of a mains transformer having the following specification. Mains (A.C.) voltage 200 volts. H.T. secondary 250-0-250 volts at 60 mA.s. L.T. secondaries, 4 volts at 1 ampere and 4 volts at 3 amperes.

Total Load

Before any constructional work can be started, it is essential to calculate the total load on the transformer. This is determined in the following manner:

Secondary loads:
250 volts × 60 mA.s = 15 watts.
4 volts × 1 amp. = 4 watts.
4 volts × 3 amp. = 12 watts.
Total = 31 watts.

Now, that would be the figure if a transformer were 100 per cent. efficient, but, unfortunately, this is not so. With the type with which we are concerned it would be safe to take an average figure of 75 per cent., though 80 and 85 per cent. are obtainable with well-designed units. To allow for this loss of efficiency we must increase the original figure thus:

$$\frac{31 \times 100}{75} = 41.3 \text{ watts.}$$

This figure now represents the primary input or load, and is used later to enable other values to be calculated.

Knowing the wattage load, the next item is to select stampings to provide a cross-sectional core area capable of handling it, and it is in ignoring this item that so many amateurs make a big mistake.

For loads up to 50 watts a cross-sectional core area of 1.5 sq. in. will be quite satisfactory; in fact, it will be well on the safe side.

The next item is to determine the "turns-per-volt" required to provide the necessary secondary voltages and the correct primary winding. This "turns-per-volt" figure is directly connected with the cross-sectional area of the core, and it is possible to refer to tables which will give the figure for the core areas in general use. If, however, such a table is not to hand, it is worth remembering that (turns-per-volt) × (cross-sectional area of core) = 8, or, giving it a twist it can be written

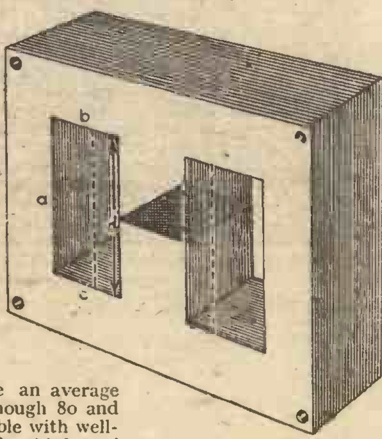
$$\frac{8}{\text{cross-sectional area}} = \text{turns-per-volt.}$$

Having decided on a core of 1.5 sq. ins. we can now find the turns-per-volt from $\frac{8}{1.5}$ which equals 5.3, so the number of turns for the primary and the secondaries can be determined. If the primary has to be in use on 200-volt mains, it will require 200 × 5.3 turns, i.e., 1,060. The H.T. secondary, 250-0-250 volts (equivalent to 500 volts centre-tapped), will need 500 × 5.3, which equals 2,650 turns *centre-tapped*. For the L.T. sections, each will require 21.2 turns. For these windings, it would be advisable to use 22 turns to compensate for load losses.

It is now necessary to decide on the wire gauges for the various windings. The current output of the secondaries is known, but that of the primary has to be calculated. The wattage load on that winding has already been determined, therefore, knowing that the mains voltage is 200 volts, the current can be found by dividing the wattage by the voltage, so:

$$\text{Primary current} = \frac{\text{Primary wattage}}{\text{Primary voltage}} = \text{say, } \frac{42}{200} = 0.21 \text{ amp.}$$

Reference should now be made to a wire gauge table, to determine the most suitable gauge for this current. The column under which such details will be found, will be headed "Maximum current at 1,000 amps. per sq. in." So far as the transformers under discussion are concerned, the figures given in that column can be doubled. For example, 30 S.W.G. wire is rated at 0.1208 amps., therefore, it will be permissible to give it the new rating of 0.2416 amps., which makes it suitable for the primary winding carrying an estimated current of 0.21 amps.



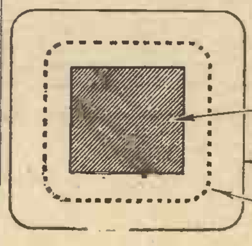


Fig. 1.—(Left) Details of the winding area. Fig. 2.—(Below) Calculating average turn length.

From the same wire table, the diameter of the wire and the number of turns per inch can be obtained, thus it will not be a difficult matter to calculate how many turns will make up one layer of winding on the bobbin, and how many layers will be required to secure the 1,060 turns. From these details, the actual area which the complete winding will occupy can be deduced.

Fig. 1 shows the laminated body of a transformer. The heavily shaded rectangle represents the cross-sectional area of the core; the rectangle formed by a, b, c, etc., is known as the "window space," and the area enclosed forms the space which the windings occupy. Allowance must, of course, be made for the bobbin, the thickness of its former and cheeks, and for the strips of insulating material (Empire cloth, bakelised paper or hot-pressed brown paper) inserted between layers of turns of each winding and between each separate winding. It is advisable to allow, say, 50 per cent. of the estimated total area of the complete winding.

The wire table reference procedure must be repeated for the other windings, always selecting the larger gauge of wire if any doubt exists.

A final word of warning. Don't use a core having an area too small for the loading likely to be imposed; don't select stampings having a "window space" just too small for the windings to be put on in a proper manner with adequate use of strips of insulating material; always use stampings whose shape is more square than oblong and, finally, pay particular attention to the insulation covering of the wire.

Output Transformers

During the last few months, many readers have requested details of output transformers. Some confusion exists regarding the matching of the primary winding to the valve, and the calculation of the number of turns required for a given ratio.

The rule given for mains transformers does not apply in such instances, as one is concerned with impedance matching or changing in the strictest sense of the term. (A mains or L.F. transformer is "an impedance changer," but for the purpose of this explanation, the term is being used to denote valve and speaker considerations.)

The optimum load of a valve is normally specified in ohms. A great number of readers have the impression that that value was connected with the D.C. resistance of the primary winding. This is not so. The D.C. resistance is comparatively low, and bears no relationship to the matching problem.

We can state that impedance is measured as the ratio of voltage to current in a circuit, and, when one is concerned with transformers, that the square of the turns ratio is equal to the impedance ratio.

Supposing an output transformer has connected across its secondary terminals a load equal to Rs ohms. (This could be the impedance or resistance of a speech coil.) If the transformer has a turns ratio of $\frac{Tp}{Ts}$, when Tp is the turns on the primary and Ts those on the secondary, then the effective resistance across the primary would be $Rs \times \left(\frac{Tp}{Ts}\right)^2$. This effective resistance is more correctly termed the "referred resistance" or the resistance "looking into" the primary, and it is this value which has to be equal to the specified optimum load of the valve.

A multi-coil-winding machine used for the production of transformer windings and other inductances.

Books Received

RADIO UPKEEP AND REPAIRS FOR AMATEURS. By Alfred T. Witts, A.M.I.E.E. Published by Sir Isaac Pitman and Sons, Ltd. 216 pages. Price 6s. 6d. net.

THIS practical handbook, which is a fifth edition, has been compiled for the use of the average amateur and the radio mechanic without theoretical knowledge. Although a wireless receiver can develop all kinds of faults, it only needs a little knowledge to track quickly the great majority of them, and the object of this book is to impart just the knowledge required. In this edition the first chapter has been re-written under its new title of Test Equipment: How to Make and Use. Amongst the subjects covered in the other twelve chapters are Aerials and Earths; Common Faults and How to Clear Them; Tracing Faults in Mains Supply Units; How to Test Components; Mains Receivers; Accumulator Notes; and Short-wave Receivers. The book is well illustrated, and in its present form is a helpful introduction to practical radio servicing for mechanics and others entering the Services.

ELEMENTARY MATHEMATICS FOR WIRELESS OPERATORS. By W. E. Crook, A.M.I.E.E. Published by Sir Isaac Pitman and Sons, Ltd. 64 pages. Price 3s. 6d. net.

AS the author rightly remarks in his preface, "you cannot understand, or even study, wireless without some knowledge of simple mathematics." This applies particularly to those who are undergoing radio training at the present time, and such trainees will find this handbook a great help to them in their studies. The contents of this book provide the prospective radio operator with all the mathematics he needs to know on his course.

THERMIONIC VALVES IN MODERN RADIO RECEIVERS. By Alfred T. Witts, A.M.I.E.E. Published by Sir Isaac Pitman and Sons, Ltd. 218 pages. Price 10s. 6d. net.

AN outline of the theory and practice of the application of thermionic valves to modern radio receivers is presented in this book, which should appeal particularly to students, service engineers, and keen radio experimenters. In this second edition notes have been added on a large number of subjects, such as the use of aligned grids, output tetrodes and negative feedback. There is also a new chapter on Mains Rectifier Valves and Equipment. The book is illustrated with numerous line diagrams.

Our Roll of Merit

Readers on Active Service—Twenty-second List

L. E. Cheeseman (L/Bdr., No. 5 T.T.G.), Oakdale.
L. F. Halliday (A.B., R.N.), c/o G.P.O.
J. Monteverde (Signalman, 23rd Field Regt.), Uffculme.
D. Royston (L/Cpl. R.E.), Heathfield.
G. A. Cuppleditch (Cpl. Sigs.), Hitchin.
F. V. Wolley (Armourer/Cpl., Cheshire Regt.), Wirral.

Small Portab

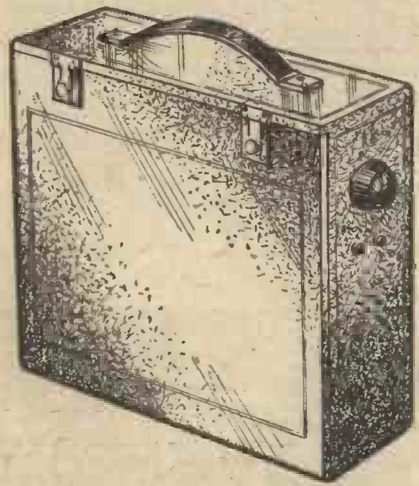
Constructional Details of an Efficien

By A. MELVILL

IN introducing this receiver no exaggerated claims are made as to what may be expected from it. It is claimed, however, that it is in the truest sense of the word "portable" (it weighs just over 4 lbs.), and that it may be constructed from components which are not too difficult to obtain, that is, if they are not already to be found in the constructor's "junk box."

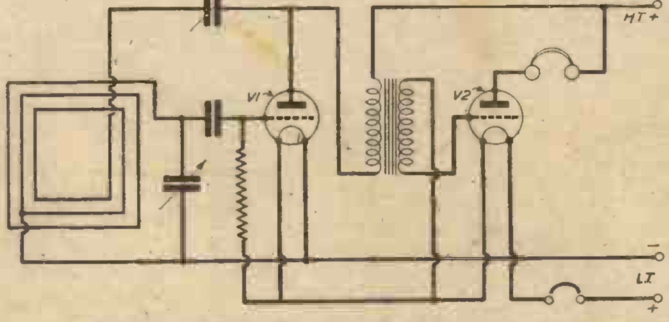
Perhaps "junk box" is a misnomer, because in these days of national effort nothing should be wasted.

At the present time, obviously, it is not in the national interest that substantial sums should be spent on the making of new receivers, when all the resources of the radio industry must be placed at the disposal of the Government. However, there cannot be objection to anybody obtaining a little relaxation in the construction of, and experimenting with, such a set as described.



This illustration shows the neat appearance of the finished portable.

The size of the set, as will be seen from the illustrations, is an added attraction. Nothing has been stinted to achieve this. Neither midget parts nor even midget valves are used, and the average pair of headphones will pack away in the case without having to be taken to pieces beforehand, which is the usual necessity with small portables. You do not run the risk, therefore, of losing nuts, bolts or washers under the table just as you want to switch on. It could be said that the set is built round the headphones. It would be useful for a lonely person billeted away from home, and it can be packed away in a suitcase, or in a small haversack.



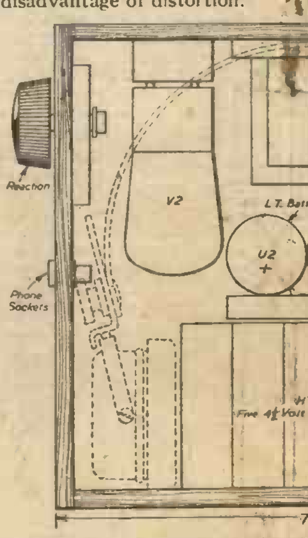
Theoretical circuit diagram Note that the filaments are connected in series.

Range

As to its range, the receiver has been used close to a large town where B.B.C. signal strength is normally well up to pre-war level. Here the set can bring in Home and Forces programmes at such a strength that when full reaction is applied it is too loud to be comfortable and overloads the headphones. The set has also been tested a good distance away in a coastal town in a hilly district. The programmes were received on the same wavelengths at a strength good enough to make the programme enjoyable. It must be admitted, however, that there was the drawback of fading after dusk. Fortunately, I was able to compare this performance with that of a good mains-driven superhet at the same address which had the advantage of a good outside aerial. Fading was just as pronounced on the superhet, in spite of its A.V.C., and it also suffered from the added disadvantage of distortion. Therefore, I think it is safe to say that this set will give a good account of itself anywhere.

Foreign stations were also received, including the notorious Lord Haw Haw, but I never listened to him long enough to know whether he is subject to fading.

The circuit is quite common, and is made to operate on low voltages derived from torch batteries, which are easy to obtain. Reaction is ensured because the grid and reaction windings of the frame aerial are closely coupled. H.T. is supplied by five 4½-volt flashlamp batteries, making 22½ volts in all. Four such batteries may be used, but the set is then not quite so sensitive. L.T. is provided by two U.2 batteries connected in series, making 3 volts.



Front view (lid removed) and

Frame Aerial

The frame aerial is wound on a sheet of cardboard 7ins. square. Slits are cut in the cardboard, as shown in the diagram. There must be an odd number of slits, for reasons that will become apparent later. The aerial wire is wound in and out of the slits, basket-work fashion, 36 turns in all, and a centre tap at the 18th turn. This tap is the "earthy" point, the inner 18 turns form the reaction winding, and the second 18 compose the grid winding.

This will bring back some memories to older readers, many of whom will remember winding "basket coils" in the crystal and catswhisker days.

This makes a neat and nearly flat frame aerial that is tucked right out of the way at the back of the cabinet. Do not use wire which is too thin. Something about 26 S.W.G. D.C.C. will do. If you have any Litz stranded wire that is better still.

ole Receiver

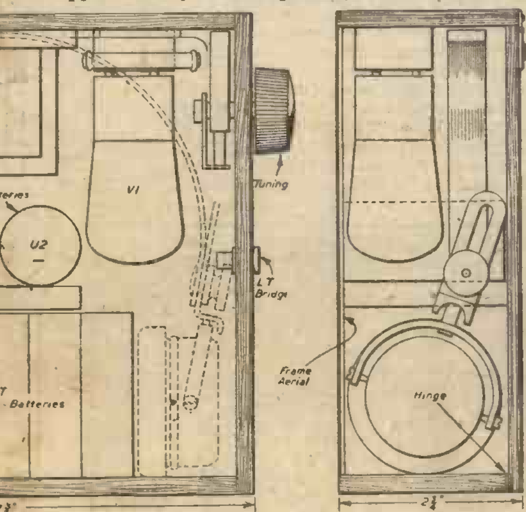
t All-dry Lightweight Two-valver

ELLIOTT

The common practice, especially in home-made portables, is for the aerial to be wound around a frame which has to be strong, and is, therefore, usually cumbersome. Amongst its other drawbacks is the fact that it takes up too much space. This has been overcome in this design, and readers who have paid attention to past issues of PRACTICAL WIRELESS will realise that in theory an aerial wound in the manner described is the more efficient. This is amply borne out in practice. It is an obvious arrangement, but to my knowledge it has never been adopted before.

Switching

The next uncommon feature is the method of switching on and off. An ordinary switch may be used if one is available, but the device adopted is cheaper and improves the appearance by balancing the symmetry of the set.



side view, showing position of main components and headphones.

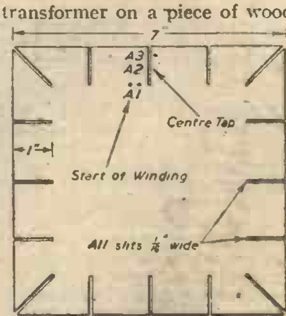
The filament circuit is interrupted, and two sockets inserted. Two plugs are joined together by a piece of thick wire 1½in. long and bent U-shape. When this device is plugged into the sockets the filament circuit is closed, and the set is "switched on." When the plugs are removed, of course, the set is off.

This has the advantage over an ordinary switch in that if the set were knocked, or if it were packed in a suitcase and got bumped, it could not be switched on accidentally and the batteries wasted. The cost of two plugs and two sockets is 6d.—far cheaper than a switch.

When not in use the plugs can be kept in your pocket and nobody else can use the set, unless, of course, they are smart enough to think of using a bent hairpin. Further, if you wish to experiment with different valves, and using higher voltage for L.T., then between the two sockets there is a convenient point for inserting a resistance in the L.T. circuit.

The ratio of the intervalve transformer may be 5 : 1 or 3 : 1, the former for preference. The size is more important. One of the small nickel alloy type is ideal, and it was found that an R.I. Hypermite is a suitable size. However, if you have a transformer of larger dimensions the difficulty may be overcome in two ways.

One is to mount the transformer on a piece of wood so that there is a space between the base of the transformer and the top of the cabinet giving sufficient clearance for the band of the headphones when packed. The other method is to take the transformer proper out of its casing. If you do this you will find that considerable space is saved.



Frame aerial former.

Condensers

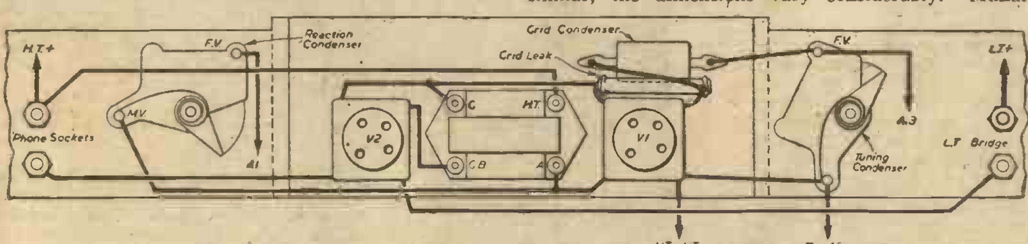
The tuning and reaction condensers should be the small solid dielectric type. The one for tuning should have a maximum capacity of .0003 mfd. In the original model a .0005 mfd. was used but this was found to cover a wide wavelength range, the top part of which was not very interesting. Therefore there is no objection to the use of one with .0003mfd. capacity, and then tuning would be broader. The reaction is .0005 mfd.

The capacity of the grid condenser may be anything between .0001 and .0003 mfd., in this case the latter for preference.

The grid leak 1 or 2 meg., again the latter for preference.

Two-volt battery valves are used. The detector should be of the H.L. type and the second valve an L.F. one, or, alternatively, another H.L. valve could be used. Care should be taken to see that they each consume the same amount of filament current, otherwise the filament circuit will have to be altered so that the filaments are in parallel and not series. If this is done, slightly more filament current will be used, and a small series resistor inserted.

The size of the valves is important because, although the characteristics of the different manufactures are similar, the dimensions vary considerably. Mullard



Wiring diagram and layout of components. The leads A1, A2 and A3 form the connections to the frame aerial.

valves, for instance, will fit easily, as they are made with small bulbs. Room is provided for larger ones of other makes, but in some cases the position of the other components may have to be varied. There is room to do this, however. This point should be studied before the set is finally made up.

Constructional Details

The first step in construction is to fix together the bottom, top and sides of the cabinet. The position of the various components should then be adjusted in the frame, finally fixed and wired up. When this has been done and the set operates satisfactorily, the back can be fixed, and the front screwed on to its hinges. The front is plywood, but the back can be cardboard pinned to the frame. When covered with leatherette this is quite strong, and adds to the lightness of the set.

The connections of the five $4\frac{1}{2}$-volt flat batteries that comprise the H.T. must be linked in series, long terminal strips to short strips. The free long strip is the negative point and the short one is the positive. Unless you can devise some method of joining these batteries up with clips you will find it best to solder the connections. An elastic band will keep them together, and two small screws in the bottom of the cabinet will keep them in position.

For the two U.2 batteries for L.T. it is best to make a cradle to hold them with brass strips to make the contacts. This is because it is rather irksome soldering the connections as they will have to be renewed more frequently than the H.T. batteries.

To give the set a professional appearance it is covered with leatherette. Here again there may be some difficulty in obtaining this. A satisfactory solution is to buy a rexine shopping bag, which can be cut up and used in its place. A handle for the set can be made of the same leatherette or rexine. Two spring clips to fasten the front can be bought at a handicrafts shop.

ITEMS OF INTEREST

Radio Lifeline

IT is " Radio to the Rescue " when aircraft are in difficulties or flying under adverse weather conditions. It is then that the radio man on the ground feels that his job is an essential one, for without him the pilot could obtain neither instructions nor navigational assistance.

Yet these essential life-saving services are still being hampered for lack of staff. There is, in fact, an urgent need for civilian radio operators at ground stations in this country where modern radio equipment is being used for work of national importance. This work is not only of absorbing interest in itself, but, in addition, it provides practical experience which should be of great value in post-war days, when flying for business or pleasure will surely be within the reach of everyone, and will call for the provision of radio ground services on an extensive scale.

Any qualified man who is interested in this work can obtain further information from the Under-Secretary of State, Air Ministry, 37, Julian Road, Bristol, 9.

25,000,000 British News " Ambassadors "

ALONG with Britain's annual war-time output of more than twenty-five million books for overseas goes a reminder that the B.B.C. provides up-to-the-minute news for every corner of the world.

" Wherever you are, London calls you daily on the radio with times and wavelengths specially chosen for your own region," begins a message on the flap of the book jackets.

Readers are told, too, how " full details of the coming week's broadcasts in English are transmitted every Sunday morning, in Morse code, to the British authorities nearest to you."

The Publishers' Association, headed by its president, Mr. Walter Harrap, has co-operated to ensure that books for abroad should carry this reference to the B.B.C. Overseas Service. In this way the books are ambassadors not only for Britain but for the cause for which free men everywhere are battling.

The Tick of Death

EVERY few seconds a Hun dies in Russia. The German people are being told of the mounting casualty lists in a new dramatic " tick-tock " feature in the B.B.C. German transmission.

A clock ticks. " Can you hear the ticking ? " asks the speaker. " Can you hear the ticking of the seconds on the clock in your own room ? " (Tick-tock, up and down.)

" One, two . . . every seventh second a German soldier dies in Russia. . . . According to reliable neutral reports, during the first four months of the Russian campaign more than a million German soldiers died in Russia : eighty thousand every week—five hundred every hour : eight dead every minute . . . every seventh second a German died in Russia . . . hour by hour, day and night . . . day and night every seventh second. . . .

" Is it your son ? Your husband ? Your brother ? Every seventh second—shot . . . drowned . . . frozen to death. Every seventh second . . . how much longer ? "

Girl students being trained as radio operators are here seen practising with outside broadcast apparatus.

A Service Engineer's Log

A Record of Various Receiver Faults and Their Remedies as Recorded by a Service Man

Distortion with "All-dry" Receivers

A GOOD deal of my work during recent weeks has been in connection with portable superhets of the type fitted with 1.4-volt filament valves. This is not suggesting that this type of valve is unsatisfactory, since it often proves completely reliable, and has certainly much to recommend it. But these receivers are coming into increased use, and they have now been on the market just long enough for faults to develop.

One of these receivers recently serviced was brought in with the complaint that reception was generally poor, distortion was pronounced, and it appeared to be completely "dead" over the upper part of the medium-wave range.

The faults were confirmed, and then the H.T. and L.T. battery supplies (actually a unit comprising both H.T. and L.T. cells) were checked for voltage on load; that is, while the set was switched on. Both voltages were in order at 90 and slightly under 1.5. A check was made to see that H.T. was reaching all valves; as it was, the anode-circuit components were apparently in order. Another speaker was tried as a test of that built into the set, but this did not make any difference.

It was when the valves were tested individually for emission in working conditions that the fault came to light. In every case the emission was appreciably less than it should have been. This was fair proof that the valve filaments had at some time been run at too high a voltage. When pressed on this point the owner confessed that he had run the set from a two-volt accumulator for a few hours when the L.T. cell of the combined battery unit was run down. This had caused the filaments to reach too high a temperature and thereby lose some of their emission.

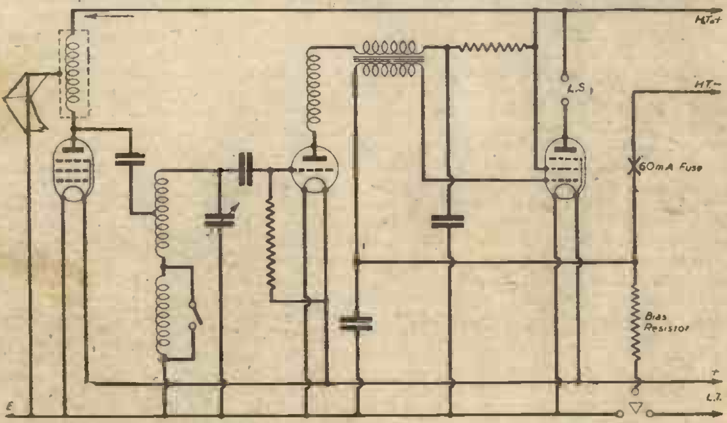
I explained to the owner that the proper course was to buy a new set of valves. Since, however, this was difficult, and he did not wish to go to the expense at the time, I suggested that he might use the accumulator with a 5-ohm variable resistor in series. If the resistor were kept at the highest possible value compatible with decent reception the valves would probably last for some time longer. If the variable resistor had not been available I should have wound a small resistor to about one ohm and left this in series with the accumulator; the optimum value would have been found by trial and error. When this modification had been made the set appeared to work almost as well as when new. But the valves could not be expected to have a very long life!

Failure of Superhet

Another of these "all-dry" portables was completely "dead" in all circumstances. Valves and voltages were found to be in order, and the impression was gained after making a preliminary test that the trouble was in the frequency-changer, probably due to the oscillator section failing to oscillate. Tests were made with this idea in mind, and it was eventually discovered that the oscillator grid condenser was open-circuited, so breaking the grid circuit. The condenser was of the tubular type with wire ends, and one of these connecting wires was found to be quite loose—it could, in fact, be pulled right out of the condenser without effort. No doubt the condenser was not in perfect condition when first fitted in the set, but the lead probably just managed to make contact. Vibration must have been responsible for the wire connector working loose.

A Speaker Fault

A mains-operated transportable receiver, with small built-in energised speaker, recently came in for test. It was not completely "dead," but reproduction was so faint as to be inaudible unless the ear were held very close to the speaker. It was found that all the valves became warm after the set had been switched on for a short time, as also did the field coil of the speaker. That seemed to indicate that L.T. and H.T. were reaching the valves, so it seemed likely that the fault was somewhere in the output circuit; had it been "earlier" in the set there would have been a certain amount of hum and general valve noise.



Skeleton circuit of a three-valve battery receiver in which it was found that the bias resistor was burnt out due to a short-circuit at the point marked with an arrow. The fitting of a fuse in the H.T. negative lead (indicated by a cross) would have prevented the trouble.

The output valve was replaced by another of similar type, but this did not make the slightest difference to the lack of reception. When another speaker (a P.M.) was connected in the anode circuit of this valve in place of the built-in speaker, however, there was a good response and plenty of output. This brought the fault down to either the speaker transformer or the speech coil, since the field coil was still in circuit, carrying the H.T. supply, when the external speaker was fitted.

Continuity tests of the primary and secondary windings of the transformer were made without removing the speaker from the cabinet. Both showed suitable resistance and were quite in order. It was therefore necessary to remove the speaker to make a closer examination of it. A simple test showed that there was no continuity through the speech coil, when the two flexible leads were removed from the transformer secondary. It was thought likely that this showed that one of the flexible leads running to the speech coil was broken—as sometimes happens during use—but there was nothing wrong in this respect.

It was not until the speaker was dismantled that it was found that the speech coil itself was the cause of the trouble, although how or why the fine-wire winding had broken was something of a mystery. Eventually it was concluded that there must have been some sort of electrolytic action which had caused the wire to corrode and break. Anyhow, a repair was effected by carefully removing damaged winding, counting the number of turns, and then replacing by a similar number of turns of enamelled wire of the same gauge as that removed (38 s.w.g.). After winding, the coil was given a light coat of shellac to secure the turns of wire, and the flexible leads soldered to fine tags at the end of the former.

Broken H.T. Circuit

A simple three-valve battery set recently brought in for test caused a good deal of trouble. The owner explained that it had worked well for a long time—ever since it was new, in fact—and then had suddenly failed one evening. It had later been found that the H.T. battery was very low in voltage, so this had been replaced without effect. He had had the valves tested, and all had been found to be in normal condition.

He did explain that just before the set had "gone off" he had dusted out the interior with a soft brush, but had been careful not to damage anything, and had removed all batteries before dusting.

I first made a general inspection of the set, and since it did not bear the name of the maker I had to run through the wiring to form an idea of the circuit arrangement employed. Actually, this was very simple, comprising three valves used as H.F., detector and output pentode. A skeleton circuit is given on page 123, from which it will be seen that there was a three-point on-off switch, and that bias was provided automatically by means of a fixed resistor included in the H.T.— lead.

When a milliammeter was wired in the H.T.—lead it showed that current was not being passed although the battery was well "up," and the accumulator was fully charged. An inspection then showed that the bias resistor—a small wire-wound one—had clearly been very hot and was probably burnt out. A test proved that it was burnt out.

There would not be much point in replacing this component if the fault which had caused it to become over-heated still remained, so a voltmeter was wired across the terminals of the resistor and the set switched on. The voltmeter indicated the full H.T. voltage, even though it was not a very-high resistance instrument. That meant that there was a short-circuit somewhere, and it was fairly obvious that the H.T. voltage had been put directly across the bias resistor, so causing its failure. This can perhaps better be appreciated by reference to the diagram.

General Tests

After making a few general tests and checks it was found that the H.T.+ lead to the H.F. choke in the anode circuit of the H.F. pentode was touching the screening can of the choke, so connecting H.T.+ to the earth line. This completed the H.T. circuit to the lower end of the bias resistor. (The bared lead must have been pressed against the screen when the set was being dusted.)

After this lead had been modified—and the end suitably insulated!—the tests were repeated, when the short-circuit was found to have been removed. At this stage a new resistor was made up, after estimating the required resistance from a knowledge of the total H.T. current consumption and the bias required by the output pentode. The correct gauge and length of wire were found by consulting page 78 of "Radio Engineer's Vest-Pocket Book."

To prevent any possibility of a similar fault recurring a 60 mA fuse was inserted in the H.T. negative lead at the point indicated in the accompanying diagram.

Prolonging H.T. Battery Life

Many readers have no doubt experienced a good deal of difficulty recently in obtaining new H.T. batteries. They are certainly scarce and anything that can be done to prolong the life of an old one is worth while. A very old hint which is worthy of revival is as follows.

When the battery voltage is low (do not wait until the voltage is right down) remove the cardboard base of the battery and carefully pierce the bottom of each zinc container with a sharp pricker. Then make up a saturated solution of sal-ammoniac and place it in the bottom of a bowl or flat dish just large enough to hold the battery. With the solution about ½in. deep put the battery into it and allow it to stand for 24 hours or more. Then remove the battery, allow any surplus solution to drain off and replace the cardboard base. With luck, the voltage will have risen and the battery can be used for another week or two.

It should be emphasised that this treatment is not always successful, and cannot be expected to be if several zinc containers are corroded away. But when only one small batch of containers is faulty it is often a good plan to remove them and then to fit a wire between the positive and negative respectively of the cells on each side of the faulty batch. The practice of shorting-out faulty cells is not to be recommended because this hastens the corrosion of the cells shorted, and this corrosion affects the other cells, which may be in usable condition.

It is scarcely necessary to remind readers that the life of H.T. batteries can be prolonged by always using the highest G.B. voltage which permits of good reception. The higher the G.B. the lower the H.T. current and the longer the life of the battery. This is also a reminder that G.B. batteries require to be replaced at intervals; it is often advised that the G.B. battery should be replaced whenever a new H.T. battery is fitted so that there can be no doubt as to its condition.

W.A.A.F. charging board operators using a hydrometer to test aircraft batteries.

Reducing H.T. Current Consumption

Battery Shortage Necessitates H.T. Current Economy. Practical Suggestions to Achieve This are Given

IT is not possible to obtain a regular supply of H.T. batteries in all districts; therefore, it is worth while to consider possible means of reducing the current as much as possible without impairing results to any marked extent.

For the normal type of three-valve set having H.F., detector and L.F. valves, it is nearly always possible to bring the total current consumed down to 10 mA or less without sacrificing either sensitivity or quality, but in order to ensure this, care must be taken in every stage of the set. It is the output valve which is responsible for the major portion of the current load, and it should be remembered that the higher the grid-bias voltage which is applied to this valve, the lower the H.T. consumption becomes. There is a limit, of course, because if the bias is increased too much, distortion results, whilst the output volume is curtailed. In very many instances,

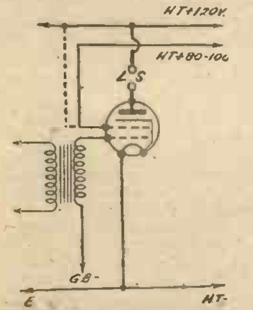


Fig. 1.—An economy in H.T. can often be effected by using a separate H.T.+ lead for the pentode auxiliary grid, instead of the direct lead shown by a broken line.

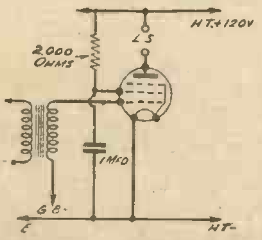


Fig. 2.—An alternative arrangement to that shown in Fig. 1, where a voltage-dropping and decoupling system is used.

though, the total available grid swing of the valve is not required, due to the fact that the input to the valve is insufficient to warrant it. There is then every justification for using a G.B. voltage appreciably higher than the average figure quoted by the makers.

Alternative Valves

When a pentode valve is used in the output stage the voltage applied to the auxiliary grid also has a profound influence on the H.T. current consumption. For simplicity it is common to connect the auxiliary grid direct to the maximum-voltage H.T. tapping, but it is certainly worth while to try a lower voltage by adding an extra tapping, as shown in Fig. 1, or by including a 2,000-ohm fixed resistance, with a 1-mfd. by-pass condenser, as shown in Fig. 2.

In the case of a single L.F.-stage receiver having a small power valve, or even a super-power valve in the last stage, it is frequently possible to reduce the H.T. current by replacing this by a pentode. The reason is that a modern high-efficiency pentode, such as the Cossor 220 H.P.T., actually takes less current than the triode, despite the greater degree of amplification which is afforded. As a matter of fact, the pentode mentioned will operate very satisfactorily in most simple sets with a total H.T. consumption—both anode and auxiliary grid—of slightly more than 6 mA. This is when using the circuit shown in Fig. 2, applying 120 volts to the anode, and using a G.B. voltage of 6. With this arrangement, however, it might be found that a certain amount of distortion occurs when the H.T. battery begins to run down, but this can be rectified by reducing the G.B. voltage accordingly; the current can still be kept at about the figure mentioned. A still better method is to use automatic grid-bias, for then the G.B. voltage is regulated automatically according to the H.T. voltage actually applied to the valve. The circuit for this is given in Fig. 3, where a 1,000-ohm variable bias resistance is indicated, this being by-passed by means of a 25-mfd. electrolytic condenser. The setting of the resistance depends upon the total current taken by all of the valves together, but the highest resistance which provides satisfactory quality should be employed. Once the resistance has been adjusted in this manner it can be left entirely alone.

One Pentode for Two Triodes

When two L.F. valves are employed it is frequently possible to replace both of these by a single pentode, when the saving in current is still more noticeable, although the output may remain practically unchanged. All that is necessary is to remove the second transformer and replace the four-pin valve-holder used for the first L.F. stage by a five-pin one, of which the fifth pin is joined to a tapping on the H.T. battery. This is shown in Fig. 4, where the parts to be removed are indicated by broken lines. In some cases it might be better to use an L.F. transformer providing a slightly higher step-up ratio. On the other hand, if resistance-capacity coupling were used for the first stage, the transformer no longer required can be added to this, as shown in Fig. 5. In that illustration it will be seen that the transformer is wired to provide a step-up ratio greater than that at which the transformer is nominally rated. If the transformer were rated at 1:3 the ratio provided would be 1:4.

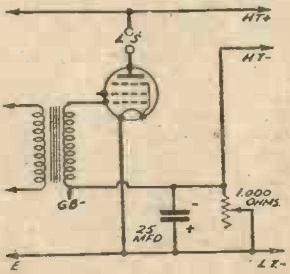


Fig. 3.—When using a high G.B. voltage for the output valve it is preferable to obtain the bias automatically as shown.

The Economiser Circuit

When an output of 500 milliwatts or more is required it becomes necessary to employ a super-power pentode,

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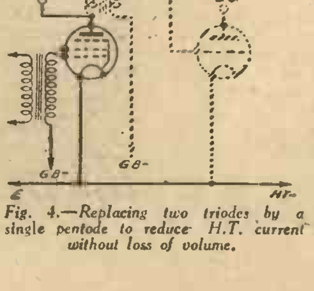

Fig. 4.—Replacing two triodes by a single pentode to reduce H.T. current without loss of volume.

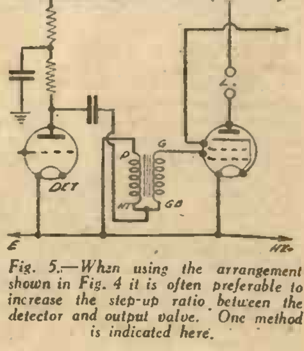

Fig. 5.—When using the arrangement shown in Fig. 4 it is often preferable to increase the step-up ratio between the detector and output valve. One method is indicated here.

REDUCING H.T. CURRENT CONSUMPTION

(Continued from previous page)

and this naturally passes a fairly high H.T. current—probably in the region of 15 mA at 120 volts. But this current can be reduced to an appreciable extent by employing an economiser device comprising a WX "Westector," a couple of fixed condensers and three fixed resistances, wired as shown in Fig. 6. In this case it is also necessary to use a separate G.B. battery for the output valve if bias is also applied to the H.F. valve. Altogether, the initial cost of the modification is fairly high, but it serves to reduce the H.T. current passed to a marked extent by increasing the grid-bias voltage when the valve is handling quiet passages, and thus the expense is soon saved. Values are given for all except one of the resistances, and this is governed by the particular output valve employed. For the Cossor 220 P.T., the Mazda Pen 220A and similar pentodes, the value of Rx should be 100,000 ohms, whilst for the 220 H.P.T. the appropriate resistance is 150,000 ohms. The system can also be used in conjunction with triode power valves, when suitable values for the resistance are 20,000 ohms for the Osram P.2, or 60,000 ohms for the Cossor 220 P.A. The G.B. voltage used should be about twice the ordinary value.

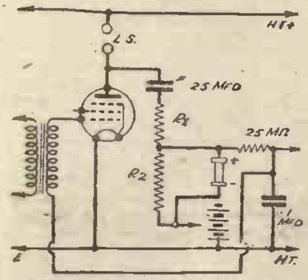

Fig. 6—Connections for a "Westector" used as a current economiser. The G.B. voltage should be almost double the usual value, and resistance Rx must be chosen according to the particular valve employed.

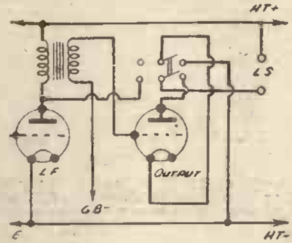

Fig. 7.—One way of switching out the last valve and transferring the speaker to that preceding it.

Switching Out One Valve

Another method of reducing the H.T. current when using two L.F. valves is to arrange a method of switching the second valve out of circuit when only a modest volume is required. One simple method of doing this is indicated in Fig. 7, where a two-pole change-over switch is used to transfer the speaker to the first L.F. valve, and at the same time to break the filament circuit of the last valve; by doing this a saving of L.T. current is also obtained. An ordinary Q.M.B. switch can be used, and the alteration is perfectly simple. It is most satisfactory when the L.F. transformer between the last two valves has a high primary impedance, because this is left in parallel with the speaker transformer and tends to reduce the volume by acting as a by-pass. For this reason, a better arrangement is to use a plug and jack for the speaker, this being wired as shown in Fig. 8. A simple two-point jack is used in the anode circuit of the last valve, but the other one is of the three-point make-and-break type, and is wired so that the speaker is parallel-fed, and also so that the filament circuit of the last valve is broken when the speaker is joined to that preceding it.

Biasing the H.F. Valve

Although the output valve consumes the greater part of the total anode current, it is worth while considering means of reducing the consumption of the others in the receiver. With the variable-mu H.F. valve this is easy, for it simply means that the volume control must be turned towards its minimum volume position. It is obvious that a loss of sensitivity must accrue from this, but for the local stations, at any rate, this will be unimportant if a good aerial system is employed, and if full use is made of reaction. It is possible to arrange a switch to cut out the H.F. valve, but this is not advised, because it might introduce losses when the valve is in use.

When the H.F. valve is not of the variable-mu type it is worth while to connect it as such so that the bias applied to the grid can be increased when full sensitivity is not required. As an alternative a switch could be provided for applying bias to the grid when amplification of the valve is unnecessary, as in Fig. 9.

In nearly every case the anode-current consumption of the detector valve is very small compared with that of the other valves in the set, but it might still be worth while to experiment with methods of reducing it still further. One simple arrangement is to increase the value of the decoupling resistance—and this might improve results rather than the reverse. Another method is to replace the special detector or L.F. type of valve, when used, by one of the H.F. type, which operates more efficiently with a lower-anode voltage, besides having a greater impedance and thus passing a smaller amount of current.

Current Measurements

All of the above modifications can be made simply by trial and without actually measuring the current consumption, but it is a good plan, when a milliammeter is available, to take readings with this in order to verify the results. In most instances it will be sufficient merely to join the meter between the H.F. negative lead from the battery and the corresponding terminal of the set. So that the resistance of the meter will not cause instability, a 2-mfd. condenser should be connected directly between its two terminals, to act as a by-pass.

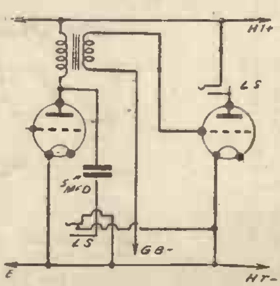

Fig. 8.—A better method of transferring the speaker—using a pair of jacks.

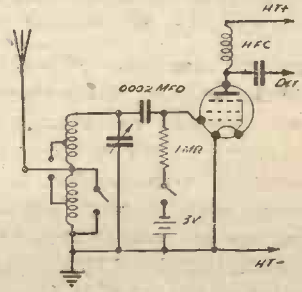

Fig. 9.—Showing how the H.F. valve can be biased when high sensitivity is not required.

Interference Reducing Systems

An Interesting Discussion About the Interference so Often Experienced When Receiving S.W. Transmissions

DESPITE the great improvements which have been effected in short-wave working the interference problem is still one which calls for a good deal of attention. This is the case on short waves, in particular, because many forms of electrical disturbance which are quite inaudible on a broadcast set are "received" strongly with a short-waver. The reason for this is obvious, for it is simply that the electrical charges are roughly tuned to a frequency corresponding to a wave-length on the short-wave band.

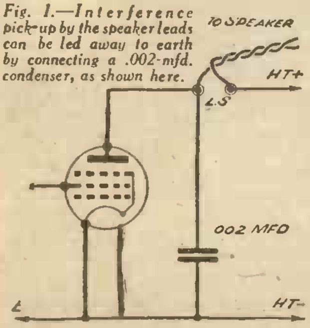

Fig. 1.—Interference pick-up by the speaker leads can be led away to earth by connecting a .002-mfd. condenser, as shown here.

A case in point is the crackling heard when a car passes fairly close to the aerial. In the case of the average broadcast set the radiation from the ignition equipment passes entirely unnoticed. But tune the receiver to 20 metres, for example, and the interference is easily picked up. When the receiver is tuned to a still lower wavelength the interference very often increases in intensity, so that on seven metres its field strength might be greater than that of the signal it is wished to receive. In every case, the most important factor is the ratio between signal strength and the strength of the oscillations comprising the interference. Thus, even in the face of powerful interference pick-up, good reception might be obtained from the local station—because signal strength is much greater than "interference strength," if such a term can be accepted.

Signal-interference Ratio

There are two important reasons for this, one of which is that a strong signal has the effect of "wiping out" weaker interference in just the same manner as a loud noise tends to "kill" one of lesser intensity. The other reason is that, when the signal is sufficiently powerful, the volume control can be turned down to such an extent that the receiver does not respond to any measurable extent to the interference.

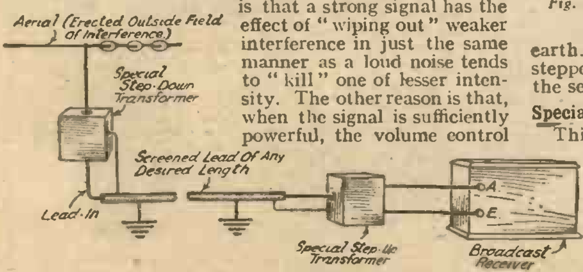

Fig. 2.—A system of impedance-matching transformers used in conjunction with a screened down-lead.

Lead-in "Pick-up"

In referring above to interference it has been assumed that this is of the type which is radiated; not transmitted along the mains leads into the power supply portion of the set. The latter form of interference must be treated differently, and methods of suppressing it have frequently been described in these pages. Radiated interference is picked up, as a rule, by the aerial-earth system, although long speaker leads, battery leads or unscreened connecting wires might occasionally act as "collectors."

If it is assumed that the receiver has been properly designed so that connecting leads are short, and if a by-pass condenser has been fitted (Fig. 1) to lead away to earth any interference picked up by the speaker leads, it will nearly always be found that by far the most prolific "collector" of interference is the aerial lead-in. It must not be overlooked, however, that a long earth lead—especially if it has a fair resistance and is insulated—might prove equally troublesome. This is a point which is often overlooked, but it is evident that an earth lead a few yards long can have a very high resistance to high frequencies (short wavelengths), and thus a strong "interference signal" might be built up along it.

Screened Down-lead

Having seen that the lead-in is responsible for most of the interference pick-up—because it is nearest to the various sources of interference—it would appear that all that should be necessary would be to screen it. On medium and long waves this does not usually present any very great difficulty, but on short waves the capacity between the lead-in and the screen is generally so great as to be very detrimental. In fact, this capacity might be sufficiently high to allow the signals picked up by the aerial to leak away to earth.

Aerial-matching Transformers

One method of overcoming this trouble is to use a pair of high-frequency transformers connected as shown in Fig. 2. These are of special design and are made by several manufacturers. The transformer connected between the aerial and the lead-in provides a step-down ratio, whilst that between the lead-in and the set steps up the signal voltages. Roughly, the consequence is that the low voltage (H.F.) passing down the screened lead-in has less tendency to leak away through the screen to earth. On reaching the second transformer the voltage is stepped up to its original figure before being applied to, the set.

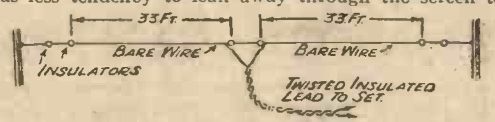

Fig. 3.—Showing the essentials of a doublet aerial. Dimensions are for 40-metre reception.

Special Aerial Systems

This arrangement has proved extremely successful but improved systems have more recently been developed which are more satisfactory for short-wave work. In fact, the question of short-wave aerial design as a whole has been very thoroughly investigated during the past few years, and several novel systems have been developed. A good deal of rather advanced mathematics is involved in working out the ideal aerial system for no-loss, anti-interference reception, for which reason several manufacturers have now placed on the market complete aerial systems designed after considerable research in their laboratories. These special aerials are definitely worth while, although they are rather expensive, and prove that our old ideas of aerials were rather crude.

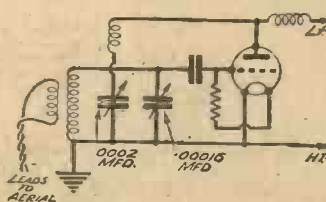

Fig. 4.—Instead of using a special matching transformer the aerial leads can be joined to a separate winding on the first coil.

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This coupon is available until February 7th, 1942, and must accompany all Queries and Hints.
PRACTICAL WIRELESS, February, 1942.

The experimenter who is familiar with mathematics might work out his own design, but most readers have no great liking for calculations and prefer to experiment with more "rule-of-thumb" methods.

The Doublet Aerial

There is no reason why this should not be done satisfactorily once the main features are understood. It has been found that the best type of simple aerial for the amateur is that known as the doublet, and which is arranged as shown in Fig. 3. It will be seen that the aerial is a mixture of a T and an inverted L. There are actually two inverted-L aerials arranged end to end, the two lead-in wires being twisted together, and the most important point is that the length of the two horizontal portions be correctly chosen. Theoretically, this length should be different for every wavelength, but it is obvious that this could not be arranged except in the case of a transmitter. Each of the horizontal portions should be one-quarter wavelength long, or, in other words, their combined length should be one-half wavelength. As an example, if the aerial were to be designed for 20-metre use, each horizontal span should be 5 metres, or approximately 16½ft.; for 30 metres, each would be about 25ft. long, and so on.

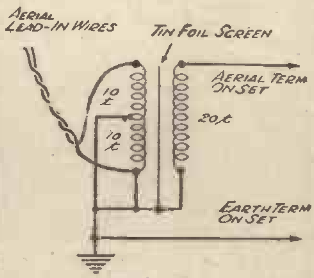


Fig. 5.—This diagram shows how a simple, screened transformer can be fitted between the lead-in and the set to eliminate residual interference.

It is worth noting, however, that a 40-metre doublet will also operate at almost maximum efficiency at 20 metres and 10 metres. But although an aerial of this type is most sensitive at half its resonant frequency, it can be used satisfactorily at other frequencies within a good range. Because of this, a doublet made for 40-metre working is satisfactory for all the most frequently used short wavelengths, which are the bands around 19, 20, 31 and 40 metres. The first and third wavelengths mentioned are those used by broadcasting stations, the second and fourth being those employed very largely by amateur transmitters.

Simple Matching

Even when using a doublet aerial it is sometimes preferable to insert some form of matching device, in the shape of an H.F. transformer, but this can be avoided simply by connecting the two lead-in wires to the ends of a separate aerial winding on the input coil, as shown in Fig. 4. It is, however, very well worth while to experiment with different numbers of turns for this winding, whilst it is a good plan for the experimenter to make a few alternative tappings, so that the best can be found for any particular wavelength. For most purposes it will be found that the most suitable number of turns on the aerial winding is about half that on the grid winding, but it is definitely worth while to experiment.

Another point is that for theoretically-best results the lead-in should be of approximately the combined length of the two horizontal spans, but this must very largely be governed by circumstances.

The Lead-in

As to the practical arrangement of the aerial, it should be pointed out that the twisted lead-in should consist of vulcanised-rubber wire which is not affected by the atmosphere, although another system which is just as good is to use bare wire supported by the special separating blocks which are now made by two or three firms.

A pair of these is shown in Fig. 6, from which it may be seen that the wires are crossed at intervals and are insulated by the blocks. It is generally satisfactory to place the separators at about 18in. intervals in the run from the aerial to the leading-in point, from which the lead to the set can be of ordinary good-quality twisted flex.

Despite the fact that the top spans of the aerial are shown, and have been described as horizontal, it is not essential that excessive care should be taken in this respect, and it is often more convenient to allow the complete aerial to slope from the house to a convenient post or other fixing. It is better that the two spans should be in a straight line, but it has been found that efficiency is not seriously impaired by mounting them at right-angles; other angles are not recommended and are rarely as good.

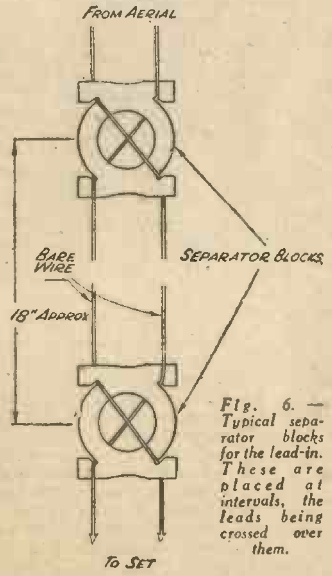


Fig. 6. — Typical separator blocks for the lead-in. These are placed at intervals, the leads being crossed over them.

Screened Transformer

When interference is in evidence, despite the use of a doublet, a simple shielded-primary transformer can be used as shown in Fig. 5. This can be made by winding 20 turns of 22-gauge d.c.c. wire on a 2in. diameter paxolin former, and taking a tapping at the exact centre. This winding should be covered, except for a gap of about ½in., with tinfoil, after which the secondary —consisting of 20 turns of the same wire—can be wound over it. The tinfoil acts as an electrostatic screen, with the result that the coupling between the two windings is purely inductive. Notice that the screen, as well as the centre tap of the primary and one end of the secondary, is earthed.

H.T. Eliminator Output

THE discharge rate of an eliminator varies considerably with the current, and, as a consequence, the voltage from a tapping intended to be taken to a screen-grid valve may be much higher than the normal value. For instance, when the eliminator is giving a total of 25 milliamps. the voltage of the screen-grid tap may be 65 and the output voltage of the power tapping 120, which is about right for normal working. If, however, the current is reduced to, say, 15 milliamps., the voltage at the screen-grid tapping may rise to about 85, which would cause instability in some sets.

In mains units having fixed tappings it is as well to arrange for the voltages to be brought down if necessary. Usually a bigger power-valve will have the desired effect of increasing the load and reducing the pressure, but if this is not a desirable change, a resistance can be connected between the power-output tap and the negative terminal. An "artificial" load, which will produce the same effect as a larger power-valve, might take the form of a resistance in parallel with the H.T. supply.

COURSE IN RADIO MANAGEMENT FOR TEACHERS

PLANS have been announced for the joint participation of the Ohio Department of Education, the Bureau of Educational Research, Ohio State University, and Station WLW for a spring short course of study in practical radio station operation for elementary and high school teachers.

The project, suggested by James D. Shouse, vice-president of the Crosley Corporation in charge of broadcasting, was developed by Kenneth C. Ray, State Director of Education; Dr. I. Keith Tyler, director of the radio division of the Bureau of Radio Research; Cecil Carmichael, assistant to Shouse; and William L. Barlow, of the WLW public service staff.

Meeting in Columbus, Ohio, the group worked out a comprehensive schedule covering a three-day period from June 17-19, 1942, directed by noted figures in the world of education and department heads of the WLW-WSAI-WLWO organisation.

Dr. Tyler, whose work with the Ohio State Institution for Education by Radio has made him a leader in the field of educational broadcasting, observed that the plan is the first attempt to bring together the practical and theoretical aspects of radio broadcasting.

Director Ray gained state-wide recognition for his work in educational radio while he was superintendent of schools in Zanesville, Ohio. In that capacity he founded a radio forum for teachers which is now being copied in several cities of the state. This established, he toured throughout Ohio lecturing on the advantages of radio in the educational system.

Shouse, a member of the National Association of Broadcasters and one of the outstanding radio executives in the country, conceived the idea of the short course for teachers after Carmichael reported to him the increasing volume of letters asking for information about the operation of a station.

"It is evident," said Shouse, "that the need for a wide dissemination of such information was imperative, both from our point of view, and that of teachers. The public's interest in radio is natural, since our medium has come to be an accepted and established necessity in the lives of so many millions of people. By means of a three-day course for high school and elementary teachers, we intend to acquaint as many people as possible with the opportunities they have to serve and learn through radio, and how schools can adapt to their own uses what is available to them with little or no effort on their part."

The three-day short course will be divided into four phases:

1. Management and Sales Problems.
2. Programme and Schedule Problems.
3. Public Service Programming.
4. Utilisation of Commercial Programmes in Class-rooms; Use of Radio Workshops in Employment of Sustaining Time.

Stabilised Oscillators

How Frequency Drift can be Minimised by Using Oscillators Having Good Frequency Stability

ONE common cause of frequency drift is the change of the effective inter-electrode capacities of the valve due to variation of electrode potentials, or even due to variation of temperature. This drift can obviously be reduced by the use of a tuned circuit having a large capacity so that the relatively small changes of the inter-electrode capacities have little effect upon frequency, but in general this calls for the use of large condensers which are cumbersome and liable to give rise to microphonic effects.

It is, of course, known that providing the feedback coupling is tight, and only just sufficient to maintain oscillations, frequency stability is very much the same for all values of tuning capacity providing that the L/R ratio of the tuning inductance is always the same. Thus, good stability may be obtained with a small value of tuning capacity by using a large inductance with a good L/R ratio, providing that the feedback coupling can be kept to a minimum. In general, it is found that in such cases parasitic oscillations of high frequency are likely to arise, and, consequently, damping resistances have to be introduced, so that the feedback coupling has to be increased and the frequency stability is again reduced.

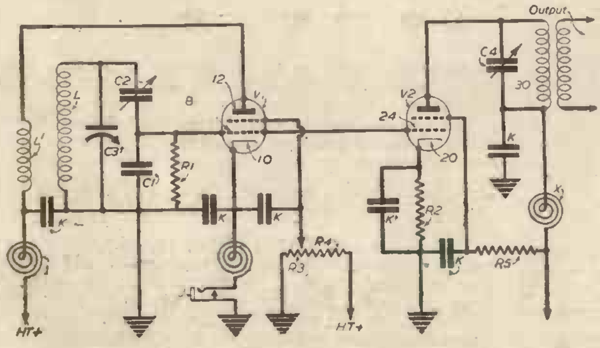


Fig. 1.—An oscillator circuit incorporating a separate amplifying valve.

Dual Feedback

In the circuits to be described this difficulty is overcome by the use of a dual feedback, one feedback being capacitative, and the other inductive, the result being that the desired minimum feedback can be obtained without the use of damping resistances to stop parasitic oscillations. The use of the two different forms of coupling results in the elimination of the principal parasitic oscillations. Any ultra high frequency parasitic oscillations appearing on the valve leads may be suppressed by resistances or choke coils too small to affect the fundamental frequency.

In Fig. 1 the coil L is chosen to have any value required to co-operate with convenient values of condensers C3 and C2, as determined by the requirements of range of tuning and convenience of dimensions for these condensers. C1 is of the order of 10 to 100 times C2, so that the effect of C1 upon the resonant frequency is small and only a very small fraction of the total voltage developed across the coil is impressed between the grid 8 and cathode 10 of the valve V1. The output circuit of the valve V1 consisting of the anode 12, inductance L^1, by-pass condenser K and cathode 10 is coupled to the coil L magnetically. When using a screen-grid valve having high internal anode impedance, it is desirable to make the coupling between the anode circuit and the tuned circuit somewhat tighter than that between the tuned circuit and the grid circuit since impedance variations in the anode circuit are likely to be less than in the grid circuit. Satisfactory results in stabilisation of frequency have been obtained by using components of the following dimensions: C3—50 mmf.; C2—100 mmf.; and C1—2,000 mmf. L. is a coil 2¼ins. in diameter, 2ins. long, and having 40 turns of wire wound with about one half of one wire diameter spacing between turns. L^1 is 4 turns wound over the lower end of coil L.

Minimising Reaction

In order to minimise reaction from the load circuit upon the oscillator, a separate amplifier V2 is shown in Fig. 1, and cathode self bias is used to cause this valve to draw normal plate current in the absence of excitation. The grid 24 of V2 is directly connected to the grid 8 of valve V1, whereby the total bias of valve V2 is always greater than that of V1 by the amount of drop through cathode resistor R2. In this way the grid loss of valve V2 may be kept smaller at all times than the necessary grid loss in the oscillator so that the loading on the oscillator is negligible. If V2 and its output circuit 30 are thoroughly shielded the output circuit may be tuned to the same frequency as the oscillator without appreciable effect upon the oscillator frequency. What little effect there may be can be greatly reduced by tuning the output circuit of valve V2 to a harmonic of the oscillator frequency.

Fig. 2 shows the method applied to an electron-coupled oscillator, and the operation is the same as that

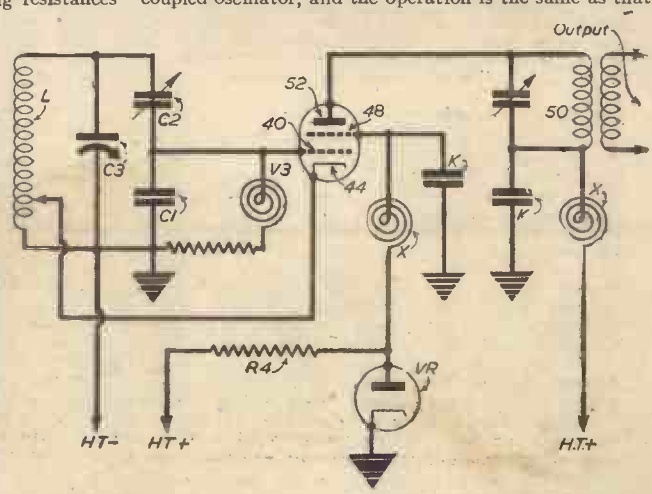


Fig. 2.—The system applied to an oscillator of the electron-coupled type.

which would be expected of the usual arrangement in which the grid and cathode are connected across the inductance if in the latter the grid connection were brought down from the top of the coil to a position only slightly above the cathode connection. However, since the grid is connected to a point between two condensers, C2 and C1, for reasons already pointed out, the arrangement shown in Fig. 2 is free of the parasitic oscillations that occur when the grid is connected to the coil at a point below its top. The oscillations are generated in the tank circuit 50 connected to the anode 52. As the electron-coupled oscillator is of the nature of a triode oscillator circuit so far as the generation of oscillations is concerned, it is perhaps slightly inferior to the screen-grid oscillator of Fig. 1 with respect to stability, and for this reason there is included in the direct current supply circuit for the screen-grid 48 a voltage regulator valve VR in shunt to that portion of the source connected between the screen-grid 48 and cathode 44.

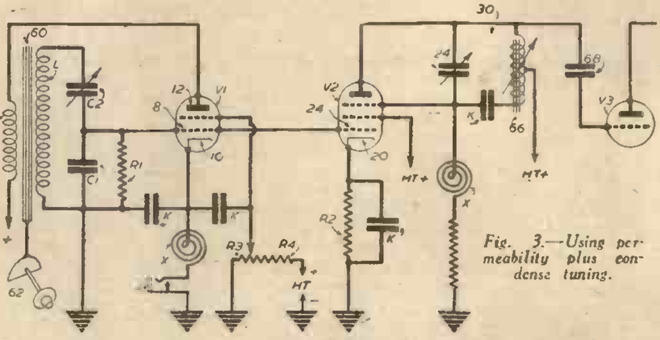


Fig. 3.—Using permeability plus condense tuning.

Frequency Shift

In the case of frequency multiplication, the frequency shift produced by a given change in capacity in the oscillator circuit is inversely proportional to the inductance to resistance ratio as measured at the fundamental frequency. The optimum oscillator frequency is that for which a coil of maximum ratio of inductance to resistance is obtainable. If a very low oscillator frequency is selected it is impractical to use variable condensers for tuning owing to their size, and the microphonic effects introduced, and Fig. 3 shows an arrangement using fixed condensers and a magnetic core 60 for tuning. The valve V2 in Fig. 3 is operated as a frequency multiplier, and since the fundamental frequency developed in V1 is relatively low, the output circuit 30 tuned by a core 66 is tuned to a harmonic of a higher order. The oscillating voltages set up in 30 may be impressed by coupling condenser 68 on the grid of an additional frequency multiplier V3 followed, if desired, by still other multipliers.

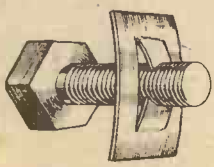
These circuits have been developed in the laboratories of the Radio Corporation of America.

TRADE NOTES

Spear Tension Lock Nuts

A FASTENING device, the efficiency and simplicity of which is likely to have a revolutionary effect on previous methods of assembly, is shown below. It is known as the Spear Tension Lock Nut, and is produced by Simmonds Aerocessories Ltd., Great West Road, London.

The illustration shows how the device obtains its screw and tension locking actions, and renders any description of the numerous advantages it offers, when compared with screws and bolts of normal design, unnecessary.



A Spear tension lock nut.

The Spear Tension Locking Nuts are produced in many forms; in fact, new types are constantly being evolved to meet special requirements. Owing to their special features, they are playing an important part in an ever-increasing number of industries.

The Battery Position

IT has been difficult to obtain high tension batteries but manufacturers have been asked to increase the production of them to the limit of capacity in order to relieve the present shortage. Rural areas are to be given preference. This request has been made largely as the result of a meeting between battery manufacturers and the Board of Trade. Unfortunately the Government has not yet released the materials necessary for such increased production. There is a general complaint amongst dealers that supplies are not being equitably distributed. It is said that the chain stores are getting an unfair share of the supplies available.

Women Wireless Mechanics

OWING to representations made by the National Association of Radio Retailers Ltd., the Association has been informed by the Ministry of Labour and National Service that women who are wireless mechanics and who are wholly or mainly engaged in servicing work, should not be considered as being employed in retail distribution.

This means that women in the registered age groups who are proved to be wireless mechanics will be dealt with in accordance with the general procedure under the Registration for Employment Order, and as they will be covered for the present by the Schedule of Reserved Occupations, they will not, for the time being, be called for selection interviews.

Is That So, Doctor!

COMMENT is not necessary about this extract quoted by the B.B.C. Director-General from the *Das Reich*:

"There are people who cannot desist from tuning in to the B.B.C. in the evening, behind closed doors and very quietly. What do they expect to get out of it? Apart from the criminal character of such behaviour, is it really worth while to listen to the British? We have to do this professionally, but should be very pleased if we were released from this tiresome duty. It is all so stupid that we are slowly getting fed up with it. . . . It is despicable, ungrateful, contemptible; it shows a lack of the most primitive respect for the work and responsibility of the Fuehrer."

Meico Microphone

A MOVING-COIL microphone of remarkable construction, having an output voltage sufficient for use with low-gain amplifiers, is produced by the Micramatic Electrical Instrument Co., 360, Station Road, Harrow, Middlesex.

Its impedance is 25 ohms, sensitivity in the order of 56 dB, and the standard finish is chromium. The list price is £5 5s. 0d.

We understand that the unit incorporates a small diaphragm of unique construction, and the general characteristics are such that the frequency response is good over the whole audio range.

In these days of delayed deliveries, it is refreshing to note that, owing to improved production methods the makers are able to give prompt attention to orders.

Analysing a Simple Circuit—2

More Symbols and Circuit Arrangements Common to the Majority of Sets are Discussed This Month

WE have seen how a three-valve circuit can be split up into three distinct sections, so now we can consider other circuit arrangements which are in common use. The original circuit (Fig. 1, page 55) has now been re-drawn in the form shown by Fig. 2. The beginner should compare the two diagrams to understand the changes made, and to study the modifications to find out how the new circuit functions. The need to study and examine every theoretical circuit, if the beginner is anxious to make progress in that direction, cannot be stressed too much, as it is the *only* way to master this essential part of a constructor's qualifications.

H.F. Pentode

Starting at the aerial and H.F. circuits, Fig. 2, there are three important changes. The tuned aerial circuit now consists of a single-circuit dual-range coil, no coupling coil winding—as in the previous circuit—being used.

To *reduce the loading* imposed by the aerial and to increase the *selectivity*, the aerial is *tapped* into the tuning coil so many turns of the winding down the coil from the grid end. The number of turns between the top end of the coil and the tapping determining the degree of selectivity obtainable; the lower the tapping point the greater the selectivity. The aerial tuning circuit is completed by the variable condenser C.1, which provides the means of tuning the circuit to the wavelength or *frequency* of the signal to be received.

The valve shown in the H.F. position in Fig. 1 is known as a screened-grid valve, owing to the arrangement of the electrodes inside the glass envelope. As it has four electrodes, namely, filament, control-grid, screening-grid and anode, it is often referred to as a *tetrode*, and it should be remembered that that name can apply to a valve used in an H.F. or L.F. circuit.

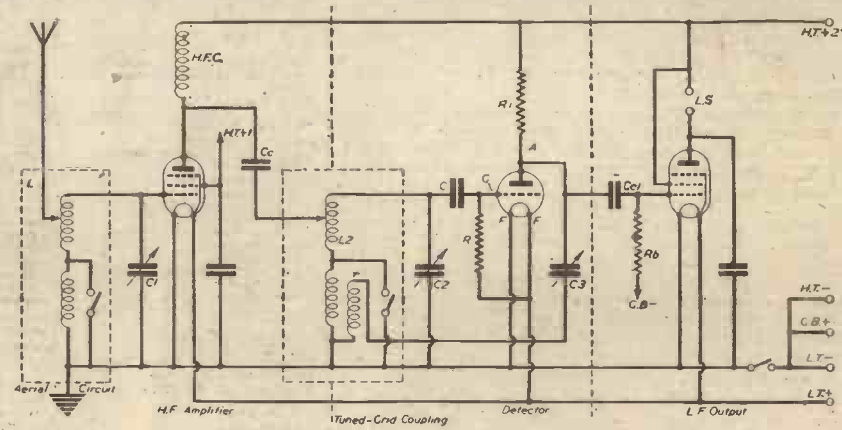


Fig. 2.—Compare this with Fig. 1 (Jan. issue) and note modifications. The circuit should be studied and the three sections memorised.

In Fig. 2 the H.F. valve has five electrodes, and is, therefore, classified as a *pentode*, the full description being H.F. pentode, to prevent it being confused with a pentode valve, which, by having different qualities or *characteristics*, but still the same number of electrodes, is used in the output stage, and is known as an L.F. pentode. The extra electrode takes the form of another grid located between the screening-grid and the anode, and, owing to its particular function, it is called the *suppressor-grid*. Some of these valves have this extra grid connected internally to the filament (in the case of battery operation, and the cathode in mains valves), whilst others, fitted with a multi-pin base, have the connection brought out to a separate pin.

H.F. Coupling

If we now compare the anode circuits of the H.F. stages of Figs. 1 and 2, the third change in the first section of the receiver will be noticed. In Fig. 1 an H.F. transformer was included, but in Fig. 2 this has been replaced by a method known as "*tuned-grid*" coupling. This system is quite widely used, so it should be studied carefully.

In the anode circuit a *high-frequency choke* (H.F.C.) is inserted between the anode of the valve and the positive lead going to the high-tension battery. The object of this choke is to allow the anode to receive the *high-tension voltage* necessary for the operation of the valve, but, at the same time, prevent the *signal* from passing into the battery. This means that the signal voltages are trapped at the point where the anode joins the H.F. choke, therefore, if the fixed condenser C.c. is connected to that point and the coil L.2, the signal will pass into the tuned circuit L.2, C.2 and so to the grid circuit of the detector. To allow the greatest signal voltage to be developed *across* the tuned-grid circuit, the latter *must* be tuned to the same frequency as the aerial circuit or, in other words, the two tuned circuits must be in *resonance*.

It is essential to note one point about the coupling condenser C.c.; this component has what could be called an opposite effect in a circuit to a H.F. choke The latter allows direct-current D.C. (that from the H.T. battery) to pass through it, but it will not—if it is a good component—allow the signal which is H.F. alternating current to pass. Now a condenser will *not* permit a steady direct current to flow through it, but it will allow alternating current to transfer its energy from one side to the other, thus, in the case in question, it is capable of passing the signal from the anode of the H.F. valve to the tuned-grid circuit. Examine the diagram and note that if this were not so, the high-tension battery would be short-circuited.

Resistance-capacity Coupling

The next alteration which has been made to the original circuit is in the L.F. coupling between the detector valve and the output pentode. The L.F. transformer has been removed, and a coupling known as "*resistance-capacity*" has been substituted.

The anode of the detector is now connected to the main H.T. positive supply line via a *resistor* having a high value of *resistance*. Note that the component should be called a resistor; resistance is the quality it has of opposing the flow of an electric current, and it is denoted or measured—so far as we are concerned—in ohms and megohms (1,000,000 ohms) the ohm being the unit. This resistor R.1 forms the *load* resistance, and it is across this resistor that low-frequency signal voltages are developed, a process which will be explained in detail in a later article. It should be remembered, at this stage, that high-frequency modulated alternating currents of the signal have been "rectified," so we are now concerned with the L.F. component or signal.

To allow the signals to reach the grid of the output valve use is again made of a fixed condenser C.c.1, but its capacity will have to be larger than that used for the H.F. stage, otherwise there will be the risk of effecting the tonal response of the circuit. The grid of the output valve must receive a certain grid-bias voltage, and to enable this to be achieved without short-circuiting the signals to earth, a resistor is connected in the manner shown by R.b. For suitable values of the components mentioned, reference should be made to the various circuits which appear on other pages.

Battery Connections

Items connected with the various battery supplies should be noted, as these are common to the majority of battery-operated receivers, therefore, if the essential methods of connection are known the testing and tracing of a circuit is greatly simplified.

There is one part of a circuit which is common to the three batteries: this is often called "the common negative-earth line," and the reason for this will be obvious if the diagram is examined. On the right-hand side, it will be noted that the H.T. negative, the L.T. negative and the G.B. *positive* are connected together. These three points are also connected to the earth terminal and the remaining parts of the circuit which have to be at earth potential. The connecting line is shown as that between the earth symbol and the on-off switch, and it is that line to which the name "common negative-earth line" is given. If any break existed between H.T. and L.T. negative, *no H.T. current would flow* and the receiver would be dead. A fuse is often inserted between these two points—to protect the filaments from an H.T./L.T. short-circuit, therefore, if testing a set in which a fuse is incorporated, and no anode current is flowing, it is always wise to make sure that the fuse is intact.

The G.B. positive has to be connected to the L.T. negative to complete the bias circuit, and to allow the grid of the L.F. valve to be made *negative* with respect to the filament, by means of the G.B. battery, and the G.B. negative lead.

H.T. Positive

In all circuits the anodes of the valves are always connected to the positive side of the H.T. supply. The connections are not always direct; certain components might be in between the H.T. and anode of any valve, in which case they are stated to be in series with the H.T. and/or anode, but, if the circuit is traced it will always be found that there is a connection between the two points.

If this is fully appreciated and remembered, it will help to simplify the tracing and checking of a circuit. The same statement applies to the screening-grid of S.G. and pentode valves.

Impressions on the Wax

Review of the Latest Gramophone Records

IF you find any difficulty in choosing suitable gifts, as many doubtless will in these days of coupons and shortages, record tokens are the answer to at least one of your problems. No gift is more acceptable to the music lover than recorded music. He may be a collector of symphonies, or just the average person who likes a good song well sung, or a dance number played by a famous band. All you do is to go to your nearest dealer and purchase a Record Token Stamp to the value of the gift you wish to make. These are priced at 3s., 4s., 6s., 12s., 15s., and £1 each (plus the appropriate Purchase Tax). In due course the receiver of the token takes it to the nearest Token Dealer and exchanges it for the record or records he most needs, up to the value of the gift.

H.M.V.

"THE Promise of Life" on *H.M.V. BD977* augments the distinguished list of "His Master's Voice" recordings by the famous Kentucky Minstrels. Arranged by Doris Arnold, it is sung in that beautiful style which we have come to associate with the choir of this popular radio entertainment. Special mention must be made of the outstanding work of the soloist, John Duncan, also to Leslie Woodgate who handles these voices.

"I'll Walk Beside You," and this is Alvar Lidell singing it. Yes, the B.B.C. news announcer has broken into song, and his first record of "Passing By" and "I'll Walk Beside You" on *H.M.V. B9233* is released this month. Other vocal recordings are supplied by Webster Booth with two old favourites "Trees" and "Song of Songs" on *H.M.V. B9205*, Dennis Nobel who sings "The Mountains O' Mourne" and "Old Father Thames" on *H.M.V. B9232*, and Allan Jones with "Intermezzo" from the film "Escape to Happiness" coupled with "Sylvia" on *H.M.V. B9234*.

One of the most popular records of recent months is Bea Wain's singing of "My Sister and I," a sentimental song which our leading dance bands have adopted, coupled with "I'm the Lonesomest Gal in Town" on *H.M.V. BD954*. Another American singer, Joan Merrill, makes her appearance this month. She is heard frequently on the American radio networks and has recorded "As if you Didn't Know" and "Twiddlin' my Thumbs," both from the film "Time out for Rhythm," on *H.M.V. BD975*.

"Hutch" departs from his customary piano accompaniments in his two new records, and is supported by a full orchestra. The tunes he has chosen are "Yours" and "You Stepped out of a Dream" on *H.M.V. BD971*, and "I Don't Want to Set the World on Fire" and "I Guess I'll have to Dream the Rest" on *H.M.V. BD972*.

Peter Dawson's popularity as a singer of rollicking songs has never diminished, and his rich voice is as robust as ever in "Waltzing Matilda," the Australian hill-billy song. On the reverse is "The Winding Road," one of the open-air numbers in which he excels. The number of the record is *H.M.V. B9191*.

There have been many requests for further recordings of Max Miller's quick-fire comedy, so H.M.V. have obliged with Max Miller Entertains the War Workers, a set of two records which were recorded at a canteen concert. The records are *H.M.V. BD980-1*.

For dance fans there is a popular selection of all the latest tunes played by famous dance bands.

Columbia

AN interesting record issued this month is Dimitri Mitropoulos conducting the Minneapolis Symphony Orchestra in a recording of Mozart-Thomas, King of Egypt, two entr'acte pieces on *Columbia LX930*. This work calls for string, double wood-wind, two horns, two trumpets, three trombones and percussion—in short, the usual orchestra for a Beethoven symphony. The two excerpts, here recorded for the first time, were designed to be played after the first and second acts respectively.

Millions listen in to "Happidrome" every week, so why not purchase a record of the stars of "Happidrome" issued in the Columbia "Let Me Tell You" series? Their latest record is "Out in Indian," featuring Harry Korris (Mr. Lovejoy), Robby Vincent (Enoch) and Cecil Frederick (Ramsbottom), which was recorded at the Grand Theatre, Blackpool. On the other side is another comedy sketch—"Napoleon's Retreat" with Harry Korris as Napoleon and Eleanor Vincent as Josephine. The number of the record is *Columbia FB2717*.

Monte Rey, a free-lance broadcaster, has been heard on the radio in most types of songs, ballads, opera, folk-songs and current hits. For his latest recording he has chosen two current hits—"Russian Rose" and "We Both Told a Lie"—*Columbia FB2726*.

There is an interesting selection of dance tunes in the Columbia releases from which you can take your choice. Victor Silvester, popular for his Dancing Club broadcasts, has a new recording in strict dance tempo on *Columbia FB2730*. The tunes he plays are "You and I" and "We Both Told a Lie."

Parlophone

RICHARD TAUBER features songs from his new stage show "Blossom Time" for his new releases. On *Parlophone RO20504* he sings "Love Comes at Blossom Time" with chorus and "First Love is Best Love," and on *Parlophone RO20505* he has recorded "Impatience (Thine is my Heart)" with "Red Rose." All these songs are sung in English with orchestral accompaniment.

Oscar Grasso is one of the outstanding instrumentalists recording at the present day. In his latest record he shares the honours with Robinson Cleaver, thus we have a duet between the violin and the organ. This record, *Parlophone F1877*, features "Intermezzo" and "Shadow Serenade."

For many years the Orchestra Mascotte has been recognised as one of the best recording light orchestras. It specialises in those lovely old waltzes that are always so welcome, and plays them with novel instrumentation that makes them just that bit different from those rendered by similar combinations. This month they have recorded "Les Millions d'Arlequin" and "Mimosa" from "The Geisha" on *Parlophone F1878*.

Ivor Moreton and Dave Kaye, those two popular pianists, have made yet another "Tin Pan Alley Medley" on *Parlophone F1879*. They introduce such hit tunes as "Aurora," "It always Rains before the Rainbow," "Ridin' Home on the Buggy," "Cornsilk," "Maria Elena" and "Yours."

In the 1941 Super Rhythm style series Red Allen and his orchestra contribute "A Sheridan 'Square'" and "Indiana" on *Parlophone R2824*.

Decca and Brunswick

SOME really delightful recordings have been made in the Decca "Red Label Series" for this month. First we have Ida Haendel, the violinist, with Ivor Newton at the piano, playing Ravel's "Tzigane" on *Decca K1013*, followed by Astra Desmond's pleasing contralto voice singing the ever popular "Ave Maria" coupled with "Agnus Dei" on *Decca K1014*. With this record Gerald Moore supplies the piano accompaniment and violin obligato is by Edward Silverman. Elsie Suddaby, the soprano, is also in this series with a recording of that famous Scottish air "Loch Lomond," on *Decca M510*. On the reverse side she sings two more delightful songs—"Where the Bee Sucks" and "It was a Lover and his Lass."

BRITISH LONG DISTANCE LISTENERS' CLUB

AN IMPORTANT ANNOUNCEMENT

All Members are Requested to Give the Following Announcement Their Immediate Attention

MUCH has been written in the past in favour of all members in a town or district getting together to form a B.L.D.L.C. Group. The objects behind the many suggestions put forward being: (*a*) To secure greater co-operation between headquarters and members; (*b*) to extend the scope and activities of the Club, and (*c*) to provide greater facilities for the closer co-operation between all members, thus making possible effective assistance and encouragement to individual members. These details are but the outline of the possibilities, but they should be sufficient to show that organised collaboration between all concerned will result in increased interest in the hobby common to us all and better prospects of the Club, as a body, making useful contributions to the development of radio and the welfare of the amateur.

The British Long Distance Listeners' Club is now one of the largest radio clubs in *the world*. It is a representative power in the sphere of practical radio and, as such, it is essential for its members to take an active part in its operation if it is to further the interests of, and speak for, the many thousands of enthusiastic amateurs whose names appear on the ever-increasing roll of membership. This can only be achieved by the formation of Groups, and it is suggested that each town having twenty-four or more members should form its own Group. These Groups would have their own officials, elected by common vote, and they would arrange a programme of activities to suit their own requirements. In *close contact* with them would be Headquarters, which would act in a controlling and advisory capacity and provide help in such items as inter-Group fixtures, competitions, etc.

To avoid any misunderstanding, it is stressed here that such Groups would have to consist of keen, active members of the B.L.D.L.C., of which they would form a vital section and still retain all existing facilities. They must not be thought of as isolated half-hearted radio clubs.

Act Now

WE must now know, at once, your views. Paper is scarce and the P.O. authorities overworked, so please don't trouble to write your opinion in letter form. Just send us a postcard showing your name, membership number and full address, and state briefly whether you support the idea, only do it now.

It is pointed out that the B.L.D.L.C. is a non-profit-making concern, there being no entrance fee or contributions of any kind.

Awarded the A.C.R.

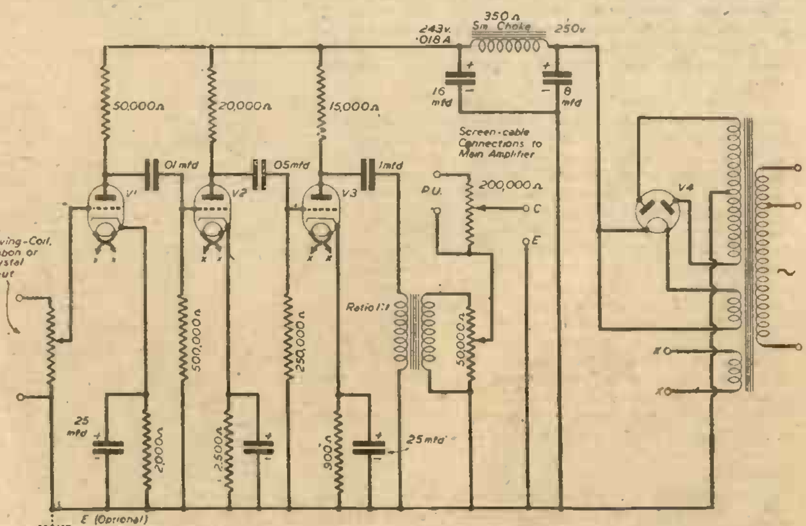
H. F. BUGGINS (No. 6,478), of Wootton, Oxford, has been awarded the A.C.R. Certificate. We offer him our congratulations and best wishes for continued success with his DX work.

A Pre-amplifier

Z. PREECE (No. 6,227), of Harlington, Hayes, Middlesex, has sent in details of an A.C. operated pre-amplifier he has designed and constructed for microphone and P.U. work. Here is his description of the unit:—

"When experimenting with home-broadcasting and P.A. work, I found I required a unit which would act as a pre-amplifier for microphones, and also provide a means of coupling the P.U., without having to use separate pairs of leads, to the main amplifier. I would mention that the mikes, etc., were usually operated some distance from the power amplifier.

"The unit is self-contained, and utilises three triode valves (plus full-wave rectifier), resistance-capacity coupled throughout. The output is taken from a parallel-fed transformer having a ratio of 1 : 1, to which is connected a simple mixer resistance network. With the valve arrangement shown, ample amplification is obtained to provide good loading of the input circuit of the main or power amplifier, when a crystal, moving-coil or ribbon microphone is used. If a transverse-current model has to be connected, then one stage of L.F.



The pre-amplifier described by No. 6,227. The valve sequence is V1, 6F5; V2, 37; V3, 6J5; V4, 84. We would suggest that a "humdinger" across L.T. supply X X would be an advantage.

amplification should be omitted, as these 'mikes' have a much greater output than the non-carbon types."

Photographs

WE are always pleased to receive photos of members' shacks and apparatus, but if we are to reproduce them on this page, it is essential for them to be perfect in detail and, preferably, good black-and-white prints. Member No. 6,801, of Glasgow, N.W., has been good enough to send us a photo of his den, but unfortunately it is slightly out of focus, so we are unable to use it to illustrate this extract from his letter. "Owing to fire-watching, A.R.P. and extra work at the office, I have not been able to do any serious S.W. work during the past few months. My Rx is a Sky Buddy which covers 8 to 565 metres, and I use it in conjunction with a 12ft. steel-rod vertical aerial which I find cuts out all Q.R.M. . . . Wishing all members the best of luck. . . ."

A Word from Warrington

MEMBER 6,769 writes as follows :—

"As a member of the B.L.D.L.C. for over a year, I think that it's time I wrote about my activities. Well, the Rx here is a 1-v-2 A.C. mains, a H.F. pentode (MSP4), followed by a 'Osram MH4' as detector, trans. coupled to two 'PX25's' in push-pull. The H.F. stage is untuned and I use 'Raymart' 4-pin S.W. coils for detector stage. At present my aerial is 30ft. vertical, which I find quite satisfactory. My idea of S.W listening is much the same as Member 6,940 stated in the October issue. I listen quite regularly to American commercial stations, for an hour or so to one station, and have derived much enjoyment from them. This does not mean that I am not interested in DX ; on the contrary, I have searched the ether to hear just the faintest signal from the other side of the globe, but for full enjoyment give me R6-9, QSA5 signals."

Palestine Calling

IT is not often that we hear from our members out East, but here is an extract from a letter from Reuben Sokolovsky (No. 1,775—one of the pioneer members), of 4, Nachlat-Benjamin Street, Tel-Aviv, Palestine, and other members in that part of the world are invited to get in touch with him. He would like to contact Mahmoud Hosni, of Daher, Cairo, Egypt (No. 5,871), so will that member please note.

In his letter, Member 1,775 says :

"You will certainly be surprised to receive this letter from such an old member of the B.L.D.L.C. living in this part of the globe, but it's nearly four years since I've last heard from the B.L.D.L.C., and being a regular reader of PRACTICAL WIRELESS, I was willing to write to you a long time ago, but hadn't had the opportunity.

"I must tell you, first of all, how much I enjoy reading *our* page in PRACTICAL WIRELESS, for it really gives a clear view of and about members, their activities, their hobbies beside radio, and their will to co-operate with other members, and secondly, you are certainly doing very nicely in spite of the war conditions which curtailed radio activities. I'm sorry for not having taken a photo of my den, but shall do it as soon as possible. My receiving apparatus is a 'Sky-Champion' S20 Rx which is still in good shape, although I'm intending to get one of the latest 1941 Communication Receivers as soon as I can lay my hand on one. With the aid of a 66ft. Windom, 33ft. Doublet and a Half Wave antenna for 28-30 Mc/s, I have been able to get and verify reception of 42 countries, mostly real DX, on 3.5, 7.00, 14.00 and 28.00 Mc/s bands, *those stations which I only* hear *without proving and supplying a verification, I do not count.*

"As I am feeling a bit 'lonely' over here, I shall be most thankful if you will be kind enough as to supply me with some QRAs of members residing or on Service in this part of the world (Palestine, Egypt, Syria and Lebanon, India)."

Weston-super-Mare

IN a letter full of news from Member 6,384, of 13, Holland Street, Latchford, Weston-super-Mare, we read with appreciation the following remarks :

"I have just read the November issue of *ours*, and I think that Group working should be encouraged. I would like all members in this district to call on me, so that we can get together and swap experiences, etc. I am, at present, a 'lone wolf,' and I think more could be learnt about the hobby if it were possible to talk things over with other enthusiasts. For example, I find it very difficult to master the morse code alone, and this is but one of the many disadvantages of being a 'lone wolf.'"

How About Vibrator H.T. Units ?

THE lack of H.T. batteries is holding up the activities of Member No. 8,011 of 5/45, Grove Road, King's Heath, Birmingham, 14, as his letter, reproduced below, tells. Surely this is a chance for experiments with, and construction of, Vibrator H.T. units !

"The shortage of H.T. batteries in my district has curtailed my activities for the time being. Up till recently, I have derived much pleasure listening to many interesting and entertaining broadcasts from U.S.A., but until the H.T.s appear again, I shall have to spend my time reading, and that is where my old copies of PRACTICAL WIRELESS are going to prove useful. It's surprising the enjoyment that can be had from some of these 'used' copies ; that's more than we can say for the H.T.s anyway.

"I have recently built the battery version of the Premier S.G.3, as advertised in your columns, and I would like to correspond with any member who has done likewise, compare notes, etc."

We Acknowledge

LETTERS have been received from the members mentioned below, and to them we extend our thanks for the interest they have shown. We feel sure that they will appreciate that lack of space prevents us from publishing all letters each month.

Members 7,007 (Wareham), 6,975 (Penrith), 8,004 (Plaistow, E.13), 8,019 (Long Eaton), 7,068 (Salisbury), W. Thompson (Number, please), (East Barnet), 8,090 (Kensal Rise), 6,948 (Harrow Weald).

Contacts Wanted

BEDFORD.—Member 6,956, 8A, Clapham Road. (Interested in the Candler Code Course.)

Southall, Middx.—Member 6,906, 65, Dudley Road.

Long Eaton, Notts.—Member 8,019, 75, Breedon Street.

What Do You Think ?

MEMBER No. 7,007 writes from Wareham, Dorset, and makes a suggestion concerning constructional details of the equipment required in an average S.W.L.'s station. We give an extract from his letter below, so let us know what you think of the idea.

"In the last issue of PRACTICAL WIRELESS the B.L.D.L.C. page interested me greatly. I think your ideas about station equipment are very sound, and I feel sure that most of the items necessary could be made by most members. I expect a great many of us have been unable to make much progress with such work, owing to the fact that we are without sufficient constructional details to guide us, therefore, might I suggest that you consider devoting a page of PRACTICAL WIRELESS each month to the description of simple test apparatus ? "

Northampton Members

WE hear from No. 6,897, 9, Peverals Way, St. James, Northampton, that he recently inserted an appeal in his local paper for contacts. He had *one* reply, and now that enthusiastic "ham" has joined the R.A.F. so he (6,897) is still working as a "lone wolf."

What about it, Northampton members ? Where is the spirit of co-operation ? This is but one of the cases which stresses the need for Group working, but unless more local support was forthcoming than that which appears to exist at the moment in that area, it looks doubtful whether a Group could be formed. We shall look out for the post-cards from the Northampton district.

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).

Inductance Formula

SIR,—I was greatly interested in an article, "Making Your Own Coils," in the December issue of your fine magazine.

I think, however, that the accuracy of the formula for finding the inductance of a coil is questionable.

It was given as $L=\frac{0.2\ A^2\ N^2}{3A+9B}$; whereas the usual formula is $L=\frac{0.2\ A^2\ N^2}{3.5\ A+8\ B}$.

I support some of your readers in asking for some consideration of frequency modulation in your pages.

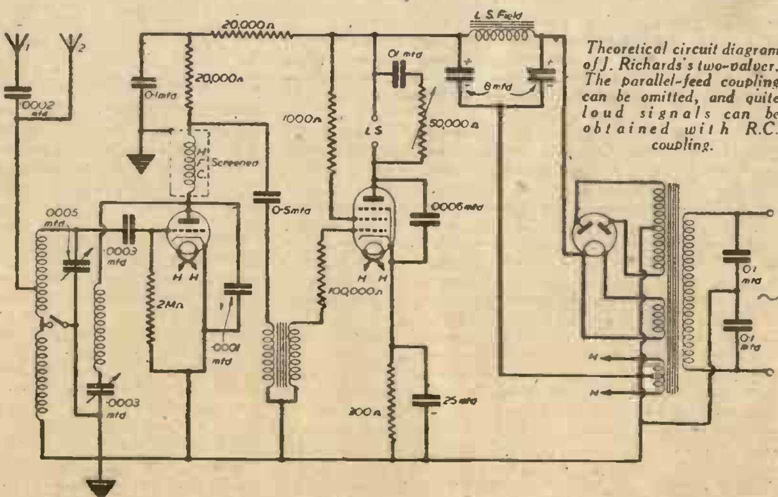
I like the new series of PRACTICAL WIRELESS. Keep up the fine standard already maintained.—C. J. MOORE (Maidenhead).

An Efficient A.C. Two-valver

SIR,—Regarding the theoretical circuit of the A.C. Midget receiver as described in the December issue of the PRACTICAL WIRELESS, I have no doubt that its performance is rather outstanding, but regarding the types of valves which are no longer available, i.e., the triode-pentode, how many of your readers possess spares, and valves of the type specified? Further, coils which are perfectly matched are not quite as available as one imagines. However, I think that here is a chance for the much-ridiculed T.R.F. receiver to come into its own. I have found that by experimenting with a good dual-range coil, preferably of the wave-wound iron-cored type, that an efficient receiver can be built with a good metalised triode and output pentode, the two valves being coupled by a parallel-fed transformer.

The circuit shown in the accompanying circuit diagram has proved very satisfactory; it is very simple to build, and can be built by standard parts as found in the keen amateur's junk-box. Only the minimum of parts are necessary. In my original model only two controls were used. The original reaction circuit, which I have now in operation, is omitted from the circuit. It included a high resistance placed across the tuning, with a fixed capacity from anode of the triode to earth. The addition of the suppressor circuit in the A.C. mains, believe it or not, in my case actually increased the sensitivity of the circuit, as well as prevented, to a minimum extent, external mains interference. From this circuit the undistorted output was two watts, whilst on the medium wavelength no fewer than 25 stations were received at loudspeaker strength. The alternative aerial connections along with the experimental moving of the centre-tap on the coil provided adequate separation and selectivity.

With this circuit I have no external aerial or earth leads. I have, instead, used four lengths of flex. A length of power flex (3 leads) is used for mains, and mains A, whilst another lead makes the E lead connected to the E pin on the plug.—J. RICHARDS (Blackburn).



Theoretical circuit diagram of J. Richards's two-valver. The parallel-feed coupling can be omitted, and quite loud signals can be obtained with R.C. coupling.

A Friendly Challenge

SIR,—I should very much like to see the logs of listeners who use *proper* S.W. sets. The following log is mine for Sunday, November 9th:

25.2 m. (approx.).—"The Voice of China." QSA 2-4. News 10.15 a.m.

25.3 m. (approx.).—Saigon, French I.C. QSA 3-4. News 4 p.m.

48.72 m.—Teheran, Iran. QSA 2-3. News 6.50 p.m.

41 m. (approx.).—Tokio. QSA 4. News 6.55 p.m.

25.22 m. (approx.).—VLR3, Sydney. QSA 2-3. 9.30 a.m.

The Chungking broadcast (11,900 kc/s) is intended for Australia. The following stations are usually easy to receive: Brazzaville (QSA 3-4), Cairo, Vatican, WRCA etc. (QSA 5). Times are G.M.T.

It will be seen that this log includes all continents. The nearest I have ever got to South America is Porto Rico, and I think this is probably because I do not "burn the midnight oil."

The above reception was on an R.C.C. 0-v-1 (two detector valves). It has no low-loss components or H.F.C., and the coils are home-made. The aerial is an ordinary broadcast one, pointing due north.

The set has a bandspreading arrangement which divides the tuning condenser (.0005) readings into 4,000. It is delightfully easy to tune.

I do not like transformer coupling or pentode L.F. when using 'phones and I am not particularly fond of H.F. stages.

Incidentally, in an old commercial set I came across a time ago there were two untuned H.F. stages. (It was a medium- and long-wave set and they were triodes!) As the owner wished to reduce current consumption I removed these, leaving a det., 2 L.F.—there was a definite increase in volume!—F. RAYER (Longdon).

Approval

SIR,—I take this opportunity as a regular reader of your valuable paper, PRACTICAL WIRELESS, to say that I think the new form is excellent. I sincerely hope it will continue the same size after the war, as it is most convenient.

If I might make a suggestion, I think it's a good time to run a "Beginner's Course" now that so many people are joining sections of the Forces which require a little knowledge of wireless.—S. J. BANGAY (Barnehurst).

SIR,—I would like to offer my congratulations on the general appearance, size and interesting contents of the current issue of PRACTICAL WIRELESS. In its present form I think it is very neat, easy to handle and not at all cumbersome to carry about or put in one's pocket. I trust that you will not revert to the former size, even after the war!

The articles on Receiver Maintenance and Testing, and Radio Examination Papers, etc., are very good, and I am sure that many readers will appreciate the continuation of such articles.—E. H. TROWELL (Sheerness).

Station Identification

SIR,—In the December issue of PRACTICAL WIRELESS, on page 44, a Mr. K. R. Veasy requests information on some unidentified stations he had heard. For his benefit I am glad to be able to furnish the following information: The K45LA station referred to is a frequency-modulated station that normally operates on 44,500 kc/s and what it was doing on amplitude-modulation in the 19 metre band I cannot conceive—unless, of course, it was testing. It is situated in Los Angeles, California, U.S.A.

"The Voice of the Andes" is HCJB in Quito, Ecuador, on 12,455 kc/s. The other station is either TAP or DJA on 31.7 and 31.38 metres respectively, as both of these stations contact WDA after the official broadcasting schedule.—LEONARD F. CROSBY (Clapham).

SIR,—I was interested to read in your "Open to Discussion" columns in the December issue that Mr. K. R. Veasy, of Halesworth, has received the station which calls itself "The Voice of the Andes," and wishes to have more information about it. The station is situated at Quito, Ecuador, South America, and its call sign is HCJB. The wavelength is 24.08 metres. There are two programmes radiated in English, at 24.00 B.S.T. a programme entitled "Ecuadorean Echoes," and at 03.00 B.S.T. "Friendship Hour." Broadcasting every night except Mondays. The address of the station is: Station HCJB, Castilla 691, Quito, Ecuador, S. America.

I have been a regular reader of your paper for over two years, and from it I have obtained a goldmine of information which, incidentally, has been of great assistance to me in understanding my correspondence courses in radio and television.—D. H. WILLIAMS (New Malden).

Radio Andorra

SIR,—With reference to Mr. Marshall's letter in a recent issue of PRACTICAL WIRELESS about Radio Andorra, I would like to state that I have recently been listening to this station on a wavelength 48.59 metres, and on the medium wavelength of 364 metres.

Reception of this station is usually very good on short-wave, but not so good on the medium band.—G. A. LOCKIE (Kelso).

Misread Call-signs

SIR,—Since the publication of your monthly issues I intended to write and let you know how much I appreciate your efforts in these hard days to continue with the publication of your splendid paper, but hadn't had the opportunity till now, so I wish you the very best of luck.

Whilst passing on some of the last copies I have noticed some queries and would like to add my remarks. In Mr. G. J. Smith's letter in the January issue I noticed some misread call-signs and here is my version of them: HC4USA should read KC4USA; this is one of Admiral Beard's Stations in Little America. K6NYB should read K6NYD, this station is owned and operated by Lt. "jg" A. W. Greenlee, U.S.N., at Honolulu, Hawaii. His rig is: 6F6-6L6-807-2/250th PP Final, and 805's Mod.—1 KW. Secondly, will Mr. J. Moss, of Mytholmroyd, Yorks, get in touch with me, for I see that the pictures of his den, taken with the aid of 2DTX, of Sheffield, are quite good, and as I am wanting to take some snapshots of my den, I shall appreciate any advice.

In the June issue I noticed a query by Mr. M. Gorsky, of Rhyl, who inquires about a station playing oriental music on roughly 10.3 mc/s., then calling London. This particular station is situated in Cairo, Egypt, which operates now, by the way, on several frequencies as in the list given below. The English-speaking voice calling London was meant to establish communication in order to effect a relay from the Egyptian station. It operates on 10.55 mc/s. or 29.83 metres.

Cairo, Egypt, now operates as follows: Medium waveband: 620 kc/s, 483.9 metres, 20 kW.; 1,429 kc/s, 209.9 metres, 0.5 kW.; 731 kc/s, 410 metres, 0.15 kW.; 1,348 kc/s, 222.6 metres, 0.5 kW.; 1,122 kc/s, 267.4 metres, 0.5 kW. Short Waveband: 7.865 mc/s., 38.13 metres; 10.55 mc/s., 29.83 metres; 6.270 mc/s., 47.85 metres.—REUBEN SOKOLOVSKY, 4, Nachlat-Benjamin Street, Tel-Aviv, Palestine.

Station HPJ ?

SIR,—On November 30th last I received station HPJ calling Geneva on the 14 m/c band. I believe this station to be Panama, but am not certain. In addition I have received TAP, WVOF, WGEO, WGEA, WLWO, VQ7LO, WRUL and SUX.—P. DOWD (Drogheda).

An Offer

SIR,—In response to your request for letters regarding the new PRACTICAL WIRELESS, my opinion is that it does not matter about size, shape or cost, so long as the material inside is interesting, and, to me, it is very much so.

My real object in writing this note is to offer, through PRACTICAL WIRELESS, about 300 copies of PRACTICAL WIRELESS dating from January, 1935, to the beginning of 1941. These are available, post free, to any reader in the Services, or anybody likely to join soon, to whom they would prove to be of some use. I am past service myself, having served during 1914-1918. Keep up the present quality of PRACTICAL WIRELESS and I for one will be satisfied.—H. G. NICHOLLS (Southgate).

[*Any reader wishing to avail himself of this offer should send in his application to the Editor at Tower House, Southampton Street, Strand, W.C.2. The first application received will be forwarded to Mr. Nicholls.*—ED.]

Photo-electric Cell

SIR,—With reference to James Hamilton's letter in the January issue of PRACTICAL WIRELESS, the phenomenon which he observed when using sunlight to excite a photo-electric cell could only have been due to variations in the amount of light reaching the cell.

I suggest that this could be caused by air currents of different densities interposing between the sun and the cell, causing different refraction of the sun's rays from moment to moment, thus causing a varying amount of light to reach the cell. The effect would be intensified by the use of a lens.—BERNARD S. BAKER (Coventry).

Replies to Queries

Replacement Choke

"The field winding of my energised moving-coil speaker has burnt out, and as I have been given a good permanent-magnet speaker I should like to use this in place of the energised model. The field winding resistance was 2,500 ohms."—P. Hewitson (Poole).

IF the transformer attached to the permanent-magnet speaker has been designed to match the output valve in your receiver the speaker may be used in place of the energised model. The leads at present joined to the terminals of the field winding should be connected to the terminals of a choke having a resistance of 2,500 ohms and a current-carrying capacity slightly higher than the actual current to be passed. If a choke of this resistance cannot easily be obtained, a standard 1,000 ohms choke connected in series with a 1,500 ohms resistance may be used.

P.A. Equipment

"In your issue of July, 1941, page 305, you describe a mixer, in Fig. 2, which employs two 3-ganged variable resistances.

"I am anxious to know the values of same, and I would be indebted to you if you would kindly oblige me with this information."—N. Warnock (Killearn).

EACH element of the triple volume controls shown in the illustration on page 305 is of 600 ohms D.C. resistance. This is because the particular instrument described is for use with lines of 600 ohms impedance.

Anode By-pass Condenser

"Can you tell me why, in some circuits, a fixed condenser is connected between the anode of the detector and the earth-negative line? It does not appear in all designs, even when the rest of the circuit appears to be identical. Does its inclusion depend on the reaction system or does the type of detector valve govern its use?"—H. Thompson (Crewe).

H.F. currents are present at the anode of a detector valve, and to prevent these from passing to the L.F. circuits it is customary to include an H.F. choke in the anode circuit. If this performs its designed function it will prevent the passage of H.F. currents, but these cannot be left at the anode and must be provided with a leakage path to earth. Thus, a fixed condenser is included between anode and earth. It is sometimes assumed that the reaction circuit (*via* the reaction condenser) offers this alternative path, but when the minimum capacity of the condenser is very small, insufficient by-pass effects are obtained, therefore, an additional fixed condenser is essential.

Attaching an Outside Aerial to a Portable

"I have a 3-valve Portable Receiver, which gives fairly good reception from the local stations, but is very poor on any others. There is no provision for connecting an outside aerial, but I am told that the set could be modified in some way so that an aerial could be used when greater volume was required on more distant stations. Will you please advise?"—T. Gale (Luton).

THE simplest way to connect an aerial would be to take it to one terminal of a .0001 mfd. pre-set condenser of which the other terminal was joined to the grid terminal of the first valve-holder. An earth connection would also be desirable, and should be made to L.T. negative. This method would certainly give increased volume, but it might not afford sufficient selectivity to enable the "local" to be eliminated. A better way is to wind two or three turns of 24-gauge double cotton-covered wire round the frame aerial, and connect the ends to aerial and earth respectively. The optimum position for the winding will be somewhere between the long- and medium-wave aerial windings, but it can best be found by trial. A position should be obtained which will give a balance between maximum volume and maximum selectivity. In this case also stability will probably be improved by taking a lead from the "earth" end of the new winding to L.T. negative.

Frame Aerial Windings

"I am building a 4-valve portable receiver of my own design, but am at a loss to know how many turns are required on the frame aerial. Is there any simple method of determining the correct number of turns without using advanced mathematics?" R. Howe (Hull).

YES, there is! It is sufficiently accurate for frames from about 1ft. to 3ft. square to allow a winding length of 240ft. of wire for long waves and 75ft. for medium waves. Tuned by a .0005 mfd. condenser, windings of these sizes will cover tuning ranges of from approximately 1,000 to 2,000 and 250 to 500 metres. In practice it is found best to arrange the windings in two parts, one of 75ft. and the other of 165ft. For long-wave reception both windings are connected in series, but for medium waves the larger winding is short circuited by means of a push-pull switch. The medium-wave winding should for preference consist of side-by-side turns, whilst the larger winding can be accommodated in three sections placed in convenient slots or notches.

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.

Requests for Blueprints must not be enclosed with queries, as they are dealt with by a separate department.

Send your queries to the Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. The Coupon on page 139 must be enclosed with every query.

H.F. Volume Control

"When using a variable bias potentiometer for H.F. pentode I gather one should be able to note the effect produced. Having put together one three-valve set from your pages which incorporates this I get nothing but harsh grating noise, which finally cuts out reproduction when turned less than half its rotation. I have tried leads reversed with same effect. Set O.K. if left alone. Can you suggest an antidote for the trouble?"—L. Kirby (Ashton).

THE effect of the control should certainly be noticeable, and should be noiseless and smooth in action. At one setting there should be practically dead silence, and as turned towards maximum the signals should gradually increase in volume. A poor component will give rise to grating or scratching noises as the arm travels across the resistance track, but the component you have should certainly not do this as it is well designed and should be perfectly noiseless in action. If the grid bias applied is too high the change in volume would be sudden, whilst if too low there would be a cut-off point as mentioned by you. It would therefore appear that you are using the wrong bias and you should ascertain whether the valve in question is of the short base or long base type, and use the correct value of bias. It may also be advisable to have the control tested in case it is faulty.

Faulty Pick-up

"I have a radiogram of a well-known commercial make which incorporates a magnetic type of pick-up, and when I tried to play a record recently I could not obtain any reproduction other than that of the needle scratch. The radio side is quite satisfactory, and from the tests I have been able to make it does not appear that any faults exist in the switching arrangements or the amplifier. Although it is a commercial product, I wonder, if in this instance, you could assist me?"—L. Harris (Liverpool).

WE make an exception in this case, as the query is one which we think is of general interest, owing to the trouble mentioned being quite common, especially with radiograms which have already given a few years' service. As the needle scratch is apparently being reproduced, and as the reader seems convinced that the amplifier and switch are in order, we would advise a careful examination of the pick-up movement. It will, no doubt, be found that the needle armature is held fast to one of the small pole-pieces of the magnet system, and is, therefore, prevented from performing its normal movement in the magnetic gap. Such trouble could be caused by the armature becoming magnetised or the damping material becoming perished. It should not be a difficult matter to rectify the trouble.

REPLIES IN BRIEF

T. Y. (Bolton).—The blueprint is now out of print.
H. H. (Yeovil).—The coils are of the dual-range type.
S. J. (Bournemouth).—The low reading meter would be best.
V. F. (Highbury).—Blueprint No. P.W.82 would suit.
P. S. (Catford).—The circuit is in order. We would advise a pentode output.
T. H. (Slough).—We cannot supply sketch diagrams.

Classified Advertisements

ADVERTISEMENTS are accepted for these columns at the rate of 2s. per line or part of a line. Minimum charge 4s. All advertisements must be prepaid and addressed to Advertisement Manager, "Practical Wireless," Tower House, Southampton Street, London, W.C.2.

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(Continued at top of column 3.)

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(Continued from column 1.)

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.

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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 Tradesmen. 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 for relaxation of the Schedule. No guarantee can be given that this application will be successful.

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(Continued top of column 1, overleaf.)

RECEIVERS AND COMPONENTS

(Continued from previous page)

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"H.A.C." Short-wave Receivers.—Famous for over 8 years. Improved one-valve model now available. Complete kit of precision components, accessories, with full instructions, requiring no soldering, only 16/-, postage 6d. Immediate despatch. Illustrated catalogue free.—A. L. Bacchus, 109, Hartington Road, S.W.8.

RECEIVERS AND COMPONENTS

LONDON CENTRAL RADIO STORES. ENGLAND'S GREATEST BUYERS OF SURPLUS RADIO AND ELECTRICAL GEAR. ASSEMBLED FROM GOVERNMENT, G.P.O., ARMY, R.A.F., AND PROMINENT MANUFACTURERS.

GOODMAN'S 8" P.M. Speakers, brand new, boxed, complete with universal transformer, 22/6 each.
ROLA 10" Energised Speakers, 300 ohms, less transformer. With field coil, 15/-.
PHILIPS Speech transformers for pentode output, 4/6 each.
UNIVERSAL, "TEMPOVOX." Chassis, 5-valve, less valves and speaker, 22/6.
MORSE KEYS. Don't confuse these with inferior junk. It's a super job. 8/6 each.
VALVES are in short supply. Stock of Mullard TSP 4's and HVR 2's to be cleared at 17/6 each. First come, first served.
TELEVISION diode valves. Unused Mullard EA50, 69 mm. x 12 mm. overall. 6.3 v. heater at .15 amp., 10/6 each.
CONDENSERS. Special offer of brand new metal-cased paper condensers, 300 v. working. All brand new and unused. .2 mfd., 1/9; 1 mfd. x 1 mfd., 1/9; 1 mfd., 1/-; .5, .25 and .1 mfd., 8d.
RESISTORS, 10 watt, 100 ohm vitreous enamelled mains resistors, 1/9 each.
VOLUME controls, 1 ohm, 200 ohm, 600 ohm, all values, 3/6 each.
FLEXIBLE DRIVES. Well made, shielded cable drives for remote control. Ideal for radiogramophones. Approx. 2' long. To clear, 4/- each.
ELECTRO-MAGNETIC COUNTERS. Resistance 500 ohms. From 1-12,999. Size 4½" x 2" x 1½". Ex-G.P.O. Invaluable for countless purposes, 9/6 each. A smaller type, 1-1,999, size 4½" x 1½" x 1½", 5/6.
VALVEHOLDERS. Belling-Lee special H.F. 5-pin, chassis mounting in black bakelite, 1/- each, 10/6 doz.
PLESSEY small block type condensers, two tappings, .0005 and 0.1 mfd., 350 v. test. 1/- each, 10/6 doz.
VARIABLE CONDENSERS. 2 and 3 gang. Die cast frames in first-class condition. 5/6 each.
YAXLEY type switches, 2-way, 1/-; 2 bank 3-way, 2/9; 4-way, 5/-.
SCREENING shields in aluminium, 6½" x 5" x 5¼", brand new and unused, 2/6 pair.
OUTPUT TRANSFORMERS. Primary 300 ohms D.C. Secondary .5 ohm D.C. Brand new, 6/6. Also new chokes, 30 henry, 150 ohms, 3/6 each.
B.I. CONDENSERS. Block type oil filled in metal cases with terminals. High quality components. .1 mfd. 1,000 v. D.C. test, 3/6 each.
RELAYS. Small relays for operation on 2 v. D.C. with 6-way make and break switches. Brand new, 5/- each.
TRIMMERS. Twin trimmers on ceramic base, new, to clear, 6d. each, 5/- doz.
COIL FORMERS. Cardboard and Paxolin. Assorted sizes, 2/9.
CONDENSERS. Metal-cased non-inductive, .5 mfd., 1/6; 1 mfd., 1/9; 1 mfd. x 1 mfd., 2/-; 2 mfd., 2/-.
CHARGERS. Trickle chargers, metal rectification. Input 200/220v. A.C. Output 2v. ½ amp. Shockproof, 17/6. Ditto in metal case, for mounting, 19/6.
TUBULAR Wire-end condensers. Brand new, first quality components, .0003 mfd., 8d.; .005 mfd., 9d.; .01 mfd., 10d.; .1 mfd., 1/- each.
CHASSIS. Beautifully finished, new cadmium-plated Chassis. 16½" x 13½" x 4". Drilled for 6 valves, transformer, etc., 5/- each. Also heavy gauge metal chassis, battleship grey, 12" x 5½" x 2½", 1/6 each. Also 9" x 10" x 2", 1/3 each. All drilled for valves, etc.

(Continued top of next column)

RECEIVERS AND COMPONENTS

REMOTE CONTROLS made by Murphy Radio. Complete with motor and all accessories in full working order. Made to sell at £££'s. To clear, 35/-.
SMALL Bayonet cap lamp-holders, three position focus, screw fitting, 1/3 each.
TUBULAR condensers, .1 mfd. 6,000v. D.C., 9/6 each.
MINIATURE Rotary switch on porcelain base, 1/3 each.
DOUBLE-THROW Panel knife switches, new, 1/9 each.
AUTO-TRANSFORMERS. 100/220 volt 60 watt, 19/6 each.
G.E.C. Fractional H.P. Motors, 225 volts, single phase, 50 cycles, 1/100 h.p., 1,400 r.p.m. To clear, 47/6 each.
PAXOLIN PANELS. 7½" x 2¾" x ⅛" thick, 7/6 doz., also thin panels, similar size, 5/6 doz.
SEE ADVT. PAGE 128. ADD POSTAGE. NO C.O.D. ORDERS.
LONDON CENTRAL RADIO STORES, 23, LISLE STREET, LONDON, W.C.2.
'Phone: Gerrard 2969.

PATENTS

THE owner of British Patent No. 380,876, relating to "Improvements in or Relating to Signalling Systems," is desirous of entering into negotiations with one or more firms in Great Britain for the purpose of exploiting the invention either by sale of the Patent Rights or by the grant of Licences on reasonable terms. Interested parties who desire further particulars should apply to Albert L. Mond & Thiemann, 14 to 18, Holborn, London, E.C.1.

TUITION

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

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PRACTICAL Postal Radio Courses; coaching for I.P.R.E. exams.; qualifying for R.A.F. and A.I.D. posts; booklet free.—Secretary, I.P.R.E., Bush House, Walton Avenue, Henley-on-Thames.

WANTED

COILS.—Colvern 3-gang type, K.G.O., K.G.O., K.G.R. or Telsen W. 288.—Hughes, Savoy Café, Congleton.

MIGHTY Gem (or Majestic) midget superhet: loudspeaker, valves, from same.—"Capri," Woodhall Spa, Lincs.

HARTLEY TURNER RF41 Feeder unit, valves optional.—Fudge, 51, Fairway, Stafford.

WATCHMAKER'S or small engineer's lathe; also book on clockmaking.—Stanbury, Hexworthy, Lawhitton, Launceston.

UNIVERSAL Avominor, or Avometer or similar good Universal Meter.—Young, 134, Old Shoreham Road, Southwick, Sussex.

MISCELLANEOUS

GOLD-PLATED fountain pen nibs, 14/- gross. Sample 2 doz., 2/6.—Printasign, 23, Blackburn St., Glasgow, S.W.1

Practical Wireless
BLUEPRINT SERVICE

PRACTICAL WIRELESS

CRYSTAL SETS

	Date of Issue.	No. of Blueprint.
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
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	—	PW39
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)	—	PW49
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	PW83
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)	—	PW23
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	22.10.38	PW95

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 Flyweight 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	—	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
Lucern 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
Minitube Three (SG, D, Trans)	Oct. '35	WM396
All-Wave Winning Three (SG, D, Pen)	—	WM400
Four-valve : Blueprints, 1s. 6d. each		
65s. 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 Quadradyne (2 SG, D, LF, Class B)	—	WM344
New Class B Five (2 SG, D, LF, Class B)	—	WM340

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

SUPERHETS.

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	P.W.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.		
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	WM383
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 : Blueprints, 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/-)	—	WM408

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Wireless Magazine.. .. 1/4 " "

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