MAKING AN ALL SUPERHET—

See page 52

A NEWNES PUBLICATION

Edited by F. J. CAMM

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6D.

EVERY MONTH

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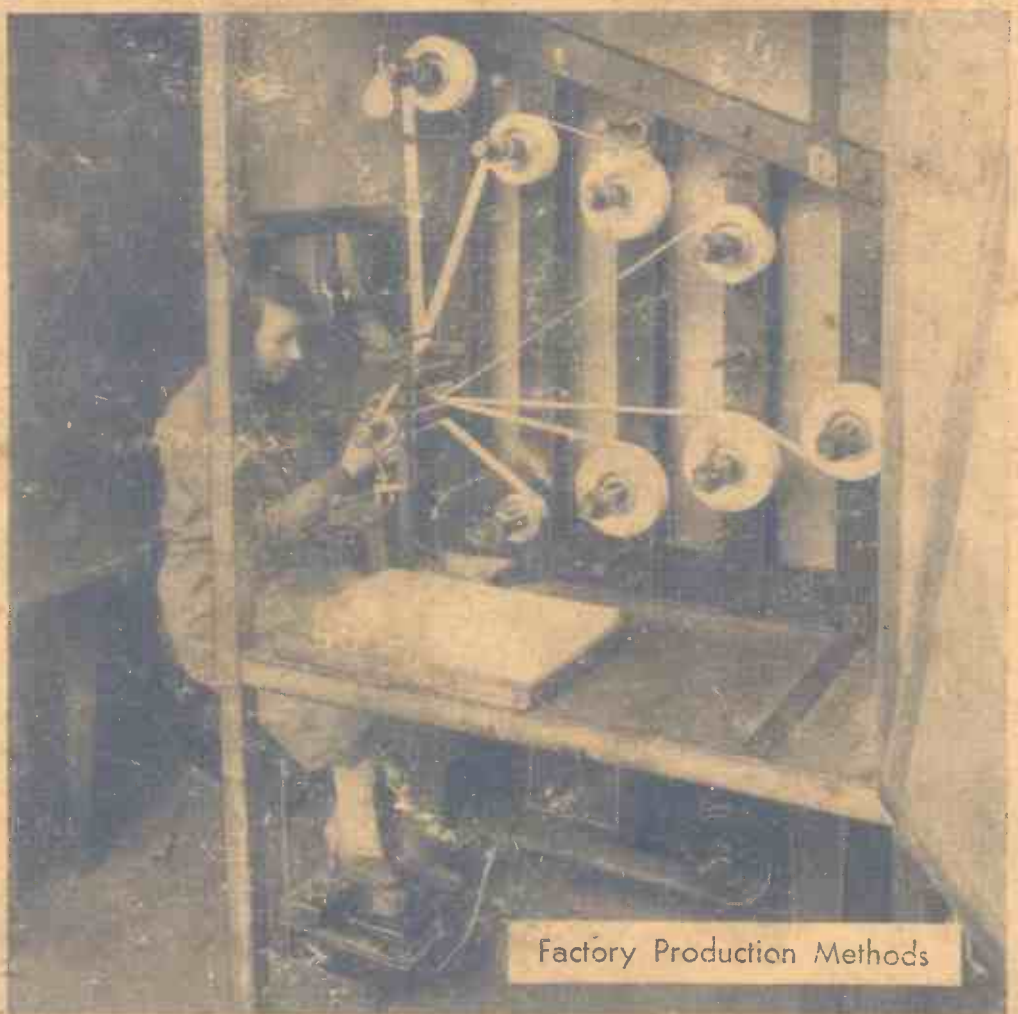
Contents



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Staff
W.J. DELANEY, FRANK PRESTON.
H. J. BARTON CHAPPLE, B.Sc.

COMMENTS OF THE MONTH

Broadcast Propaganda

SINCE Capt. Plugge raised the matter in Parliament, as reported in last month's issue, Government spokesmen have announced the intention to improve not only upon the quantity, but the quality of our broadcasts in foreign languages. Germany has taken over many dozens of stations in the lands of the vanquished, and by cunning adroitness, prevarication and carelessness with the truth, she is endeavouring to convince the few neutral countries remaining that her cause is just. Our case, supported by truth and far stronger arguments than anything Germany can invent, may not have been well presented in the past.

We must now, however, overlook the fact that the final result is not always affected by the propaganda which takes place before it. There is a somewhat parallel case in the newspaper articles which precede any national sporting event such as a football match or a boxing contest. Each side breathes optimism, and endeavours to instil fear in the opponent. Newspaper critics add their opinions as to why one side or the other must win or lose. Read after the event this propaganda appears ridiculous. No doubt when this war is over the German propaganda will read equally quaint, for as a large lie it will lie exposed. You cannot win battles by words alone, but as the Germans continue to lie with diabolical consistency it is necessary for us forcefully to tell the truth and with greater assiduity. A lie told sufficiently often and left unchallenged may be believed on the basis that silence conveys consent.

We agree with the speaker in the House of Lords who said that we must appoint to the task an expert newspaper man who knows how to assimilate facts, and also how to present them in a telling way. It is not sufficient to appoint someone who has merely written occasional articles for the press. Such are not journalists. We must appoint someone who has been trained in the inside routine of newspaper production.

Music at Work

NEARLY three months ago the Music While You Work feature was inaugurated by the B.B.C., and a daily programme of this type has been radiated. Since that time the Minister of Supply and the Minister of Aircraft Production have each announced satisfactory increases in production. It would be impossible, of course, to ascribe this increase entirely to the radio programmes, but we believe that it has had a good deal to do with it.

If such a system is found successful in war it should be found equally so in peace, and the lesson needs to be borne in mind when normality returns.

Illegal

ACCORDING to a recent decision it is illegal to remove a radio set in a car from house to house, or to take it in a car to be repaired. The case in which this was announced was tried at the Norwich bench when a man was fined 2s. 6d. for "Installing a wireless receiving apparatus in his car." He had carried the set to the dealer to be repaired, but collected it in his car. The Superintendent of Police said that the repairers would have to apply for a permit to return it by car. The bench apparently took a dim view of the attitude of the police by imposing such a small fine. They were evidently anxious to stretch the law in order to make a case. It is monstrous that the time of courts should be wasted in this way. The law concerned was designed against the Germans and Fifth Columnists, not against honest British citizens.

The Sponsored Programmes

NOW that the sponsored radio programmes have ceased owing to Hitler's invasion of the countries which permitted commercial broadcasting, listeners have perforce to listen mostly to our own programmes. These have been so improved that it is unlikely that when the war is over sponsored programmes will regain their audiences. This is all to the good. If this country does want sponsored programmes let us erect a special station in this country to radiate them. This will keep the money in the country instead of allowing it to percolate to foreign powers who use it directly and indirectly to make munitions to use against us.

Sponsored programmes were tried by the B.B.C. some years ago, but they were so hampered by restrictions that they ceased to have any value to the sponsor from an advertising point of view. The programmes were merely prefaced by an announcement that they were sponsored by particular firms. If listeners want sponsored programmes let them have them, but do not make the conditions so onerous that the advertiser is merely paying for the programme, and thereby reducing B.B.C. expenses without gaining publicity in return.

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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 A.C. Four-wave Three

Introducing a Design Specifically Produced to Meet the Numerous Demands We Have Received for a Mains-operated All-wave Receiver

MANY letters have been received from those readers who wish to secure an efficient mains-operated receiver capable of receiving long, medium and short waves without sacrificing any one particular band. The majority of enthusiasts appreciate that such a specification is approaching the ideal, and that speaking in a general sense, one usually expects to tolerate a slight loss of efficiency on, say, the higher frequencies. The degree of loss varies with the design, locality in which the receiver is used and, of course, prevailing conditions. Therefore, it is hardly fair to condemn, sweepingly, all-wave receivers because one particular model might not be as efficient on the short waves as a receiver built for reception of such frequencies.

With the design about to be described, we have endeavoured to satisfy all the suggestions we have received and, after giving all considerations our very careful attention, we decided on a design which, whilst being ideal for those requiring something simple in construction and easy to operate, also lends itself to easy conversion at a later date to a superhet. circuit. In its final state, the design will place in the hands of those who follow it to its ultimate state, a receiver capable of reaching out to those more distant transmissions, the reception of which provide the real thrill for the S.W. enthusiast.

The Circuit

For the initial design we have selected the tried and trusty three-valve arrangement which is universally recognised as being the best combination for a very limited number of valves. The theoretical circuit diagram is given on this page and it will be noted that for the sake of clearness all switching arrangements have been omitted.

Many will be pleased to note that the variable-mu H.F. stage is tuned on all bands, thus allowing the maximum selectivity to be obtained over the total frequency coverage. Every precaution has been taken to render the circuit as stable as possible so that a generous figure of overall amplification is secured; in fact, on the average station on the medium and long waves, and incidentally, quite a number on the short waves, the volume control serves its essential purpose of controlling the signal intensity fed to the detector, thus avoiding overloading of the output pentode.

For various reasons, tuned-grid coupling was ultimately selected for the inter-valve coupling between the H.F. and leaky-grid detector, and with careful use of the reaction circuit, the gain and selectivity can be controlled to a nicety. Experienced S.W. constructors will appreciate that the effect of such controls can be varied by the characteristics of the detector valve in use but, unfortunately, thanks to the consistent characteristics now provided by the valve manufacturers for any given type of valve, there is little fear of the results obtained being widely different from those secured with our original design.

For amplification of the rectified signal, resistance-capacity coupling is used to feed the signal into the output valve, and it will be noted that all reasonable precautions have been taken to prevent L.F. instability and unwanted background noises. A fixed tone-control is provided between output valve anode and earth but, if so desired, it will be quite permissible to convert it into a variable one by replacing the 10,000 fixed resistance with a variable of, say, 25,000 ohms.

Mains Equipment

For this design, we have chosen a Westinghouse Metal Rectifier for the conversion of the A.C. mains supply to D.C., the unit being the H.T.16. This has a generous output, and in addition to being very simple to connect, it also provides a practically indestructible rectifying device, thus eliminating, within reason, the possibilities of a breakdown in this particular part of the circuit.

The rectifier is used in a voltage-doubling arrangement, necessitating the use of two 4 mfd. fixed condensers and, at this stage, it should be noted that other values must not be used.

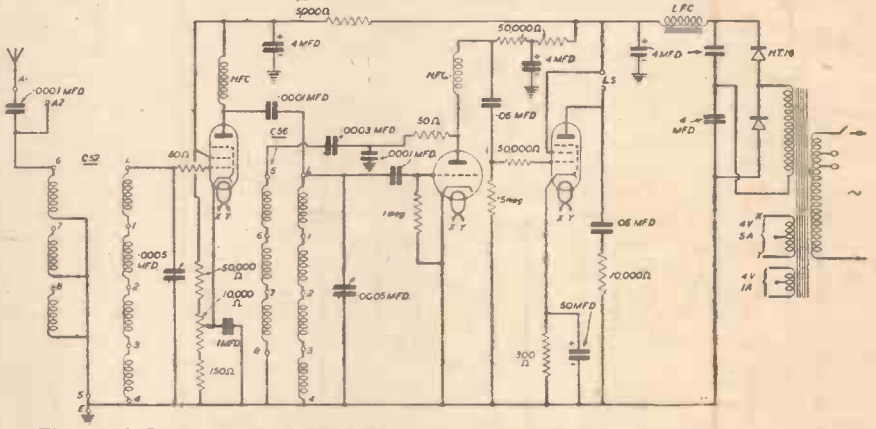
Smoothing of the rectified output is taken care of by a Premier L.F. choke, type No. 60/400, which in itself is a very compact component, thus occupying very little space, in conjunction with another 4 mfd. condenser. To save unnecessary fixings, an electrolytic block condenser has been selected for the provision of the three 4 mfd. condensers shown in the circuit diagram. Two being used for anode decoupling purposes, and the third for the smoothing mentioned above. The condenser block (Dubilier type 370) is fitted with three red leads and one black, the former being the positive sides of the three 4 mfd. sections and the latter the common negative connection. As usual with all electrolytic condensers, particular care must be taken to see that the correct polarity of connections is observed.

Mains Transformer

To avoid any queries about the L.T. windings, we will state here that the model selected, namely, a Heayberd Type W.33, is a stock line, and no difficulty should be experienced in obtaining supplies; and secondly, the additional amperage output shown will be wanted when the final design is utilised. The primary is provided with suitable tapping points, thus rendering the component suitable for any A.C. mains having the usual range between 200-250 volts at 50 cycles.

Construction

Complete constructional details will, of course, be given in our next issue, which will also contain a full-plan drawing of the layout and all wiring. We would add here that such detailed information makes it possible for the veriest beginner to construct the set with satisfaction, therefore there is no need for those not experienced in set making to get the impression that the work is beyond their capabilities.



Theoretical Circuit Diagram of the A.C. Four-wave Three. The switching arrangements have been omitted to avoid complications when studying the circuit details.

A metal chassis, obtainable from Premier Supply Stores, is used as a basis for all the constructional work and, if normal care is taken with the drilling, assembly and wiring of all the components, a receiver having a first-class finish and comparable with a commercial product can be secured at a very reasonable cost.

A complete list of the specified components is given on this page and, in view of possible delays, we would strongly advise all those who wish to construct this very efficient receiver to place their orders at the earliest moment,

LIST OF COMPONENTS

Mains transformer, type W33 (Heayberd).
Rectifier, type H.T.16 (Westinghouse).
Fixed condensers: three .0001 mfd. (4601/S); two .05 mfd. (4602/S); one .1 mfd. (4603/S; three 4 mfd. (307C); two separate 4 mfd. (B.E.355); one 50 mfd. (3004) (Dubilier).
Resistances: One 1 watt 5,000 ohm; three 1 watt 50,000 ohm; one 1 watt 300 ohm; one 1 watt 150 ohm; one ½ watt 1 megohm; one ½ watt 50,000 ohm; one ½ watt 500,000 ohm; one ½ watt 10,000 ohm; two ½ watt 50 ohm; one potentiometer, 10,000 ohm with switch (Erie).
Variable condenser, one bar-type 2-gang .0005 mfd. (J. B.).
Variable condenser, one Dilecon, .0003 (J. B.).
Tuning dial, Square Airplane (J. B.).
L.F. choke, type 60/400 (Premier).
H.F. choke, two, type H.F.15 (Bulgin).
Coils, one type 52, one type 56 (Bulgin).
Switch, type (Bulgin).
Valve-holders, one 5-pin, two 7-pin (Clix).
Socket strips, one A1, A2, and E, one L.S. (Clix).
Chassis, metal (Premier).
Valves, V.M.P.4.Q.; M.H.4; M.K.T. (Osram).

Problems of Amateur Receiver Design—3

Switching Arrangements : Ganging Wave-change Switches : Combined Wave-change and On-off Switching : The use of Potentiometer Volume Controls with Built-in Switches

By FRANK PRESTON

WITH other than the simplest types of receiver, the question of wave-change and on-off switching is often an important one, particularly in a set designed for reception on three or more wave-bands. It is, of course, an easy enough matter to fit a wave-change switch for each coil, and then to have a separate switch for switching the batteries or mains on and off. But that would be very cumbersome in a receiver of the two-H.F. type, in which there are three tuning units; the same would apply to a single-stage-H.F. receiver if there were a band-pass filter.

In the first place it will be best to take the case of a fairly straightforward set of the type represented by the skeleton circuit shown in Fig. 1. Here there is a band-pass filter in the input circuit, a tuned-grid coupling between the H.F. and detector valves and a battery on-off switch. For simplicity it is assumed that the receiver covers only two wave-bands. That means that a single-pole switch can be used for wave-changing on each of the coils. If the coils were bought as a ganged set they would probably have W/C switches built into them, but we will assume that separate coils (probably home-made) are to be used.

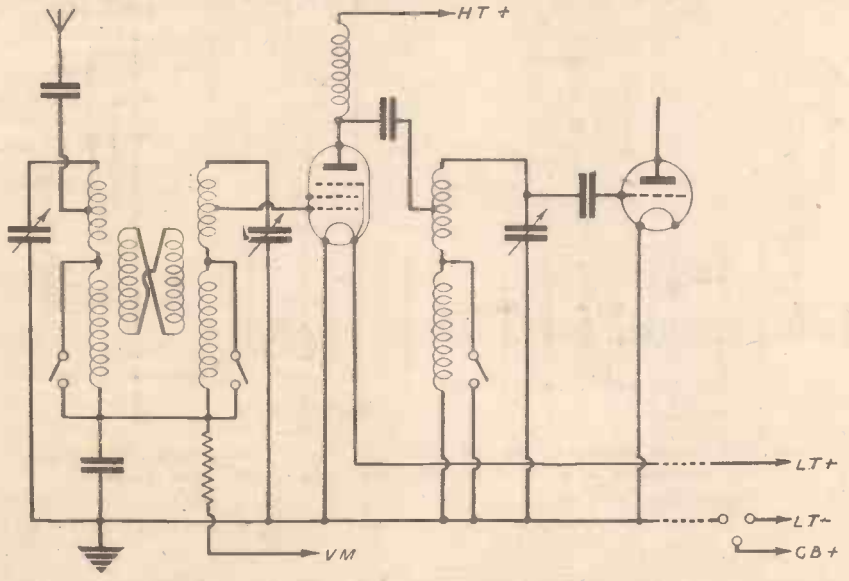


Fig. 1.—A simple H.F. arrangement with band-pass where three wave-change switches are used.

Ganged Toggle Switches

As far as wave-change switching is concerned it would be simple enough to use three on-off switches ganged together. Thus, baseboard-mounting toggle switches of the type shown in Fig. 2 could be employed. Each switch would be placed as near as possible to its own coil, the three would be arranged accurately in line and a single rod, carrying a knob, would be passed through them before tightening the locking grub screws. In following this arrangement it is important in the first place to make sure that all three switches are in the same position—that is, that the contacts of each are either open or closed. If this were not done, it would be found after fitting the ganging spindle, that it could not be turned.

Earthing

Another important practical point concerning this arrangement is that the spindle should be well earthed to the chassis or to nearby terminals which are themselves connected to earth. This can be done by making a couple of L-shaped arms from springy brass and mounting them on the baseboard so that the upright "leaves" press against the spindle; Fig. 2 shows the idea. If the chassis or baseboard is metallised nothing further need be done, but if it is insulated (wooden, for example) earth leads must be taken from the screws used to mount the contact plates. Failure to take this precaution may in some instances result in instability or serious hand-capacity effects.

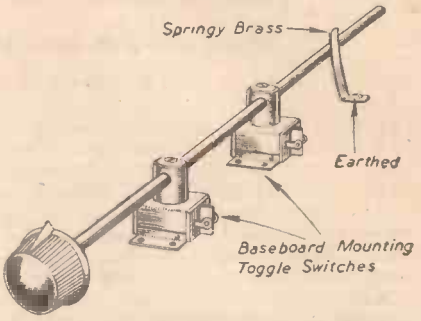


Fig. 2.—How baseboard-mounting toggle switches can be used for a circuit of the type shown in Fig. 1. Only two of the three switches are shown, but any number could be ganged together.

Double-purpose Switch

When adopting this method of wave-change switching it is still necessary to have a separate on-off switch, since it cannot well be ganged with the other three. When only two coils are used in the receiver wave-changing and on-off switching can often be combined by using a three-pole change-over switch of the so-called anti-capacity type, as shown in Fig. 3. Other forms of switch of this type could be used, but it is desirable that the capacity should be low and therefore many forms of multi-point switch are ruled out. Even when using the anti-capacity switch it should be close to both coils if trouble due to instability and loss of efficiency is to be avoided. That is why a four-pole change-over switch is not recommended when there are three coils in the receiver; it would be a practical impossibility to have the switch close to all three coils and at the same time to place the coils so that the grid and anode leads are all short.

It will be noticed that the type of switch mentioned has a central "off" position. Thus when the knob is in its central position the L.T. circuit is broken. When it is turned in one direction the set is switched on and the W/C switch sections are adjusted for M.W. reception; when it is turned in the opposite direction the L.T. circuit is again completed but the W/C-switch sections are set for long waves. It should be noted that this type of switch is unsuitable for mains-circuit connection where a quick-make-break action is essential.

Inset in Fig. 3 is shown a flat rotary-type switch of the three-pole, three-way type which *could* be used in some cases to replace the more bulky anti-capacity switch. The alternative connections to it are shown in broken lines.

(Continued on next page)

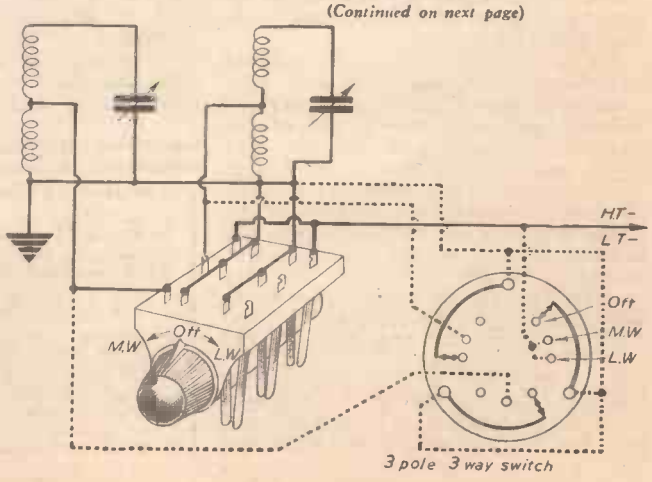


Fig. 3.—How a three-pole two-way "anti-capacity" switch of the old type can be used for on-off and wave-change switching. Connections are also shown in broken lines for three-pole, three-way rotary switch.

PROBLEMS OF AMATEUR RECEIVER DESIGN

(Continued from previous page.)

Ganged Q.M.B. Switch

When using coils with built-in wave-change switches it is often possible to gang a Q.M.B. or toggle on-off switch by fitting a metal "finger" on the end of the switch spindle, as shown in Fig. 4. The switch arm is slotted, and switches with an arm of this type are available; in fact, the arrangement illustrated has been used on many ready-made tuning-coil assemblies. The metal "finger" is situated so that the first short clockwise movement of the wave-change switch knocks the switch on. After that, the "finger" leaves the toggle arm and serves only for wave-changing until the spindle is moved back to its original position, when it knocks the switch off. If it is necessary to convert an existing coil assembly to this arrangement a certain amount of practical ability is necessary to make the "finger" and also to mount the toggle switch so that it is properly operated. A small metal bracket can be used for the switch mounting and the "finger" can be made from a piece of brass measuring about ¼in. by ⅜in., by ¾in. long. It should be filed to the approximate shape illustrated and then drilled to fit over the end of the spindle; after that a small hole should be drilled at right-angles to the latter and tapped to take a small grub screw.

Rotary Switch Units

A form of switching which is probably more widely used than any other at the present time is that in which a number of rotary units are ganged together by means of a square-section spindle. By using a little ingenuity, a set of switches of this type can be used, with one-knob control, to provide wave-changing and on-off switching with almost any combination of coils. The method is especially useful when multi-range coils are used, or when a series of coils is used in each tuning circuit —one for each of the wave-bands covered.

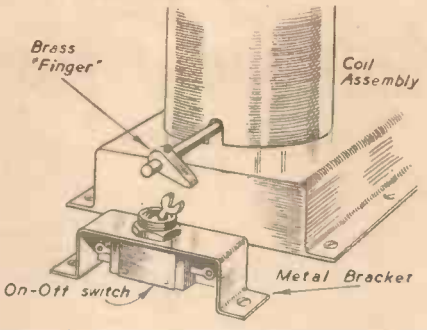


Fig. 4.—A method of operating a toggle on-off (battery or mains) switch from the spindle of built-in wave-change switches.

As an example we might consider the circuit shown in Fig. 5, where there are three different tuning units of similar type. They provide four-range tuning in conjunction with a three-gang condenser. Four switches are shown, of which one is for on-off battery switching. The first three switches are wired as shown inset, the fourth being wired for on-off switching only. It is often possible to employ a system simpler even than this by having rotary switching with a double-ended contact arm, so that one switch can be used on two coils. Additionally, there are various double-sided rotary switches, each side of which acts as a separate switch unit. These have many applications, but before choosing them the question of capacity between connecting leads of necessity placed close together must be considered.

Potentiometer-switch Units

Reference has been made above to combining the on-off switch with the wave-change switch. This is not always the best arrangement, however, and it is often preferable to combine the on-off switch with a volume-control potentiometer. The latter may be used as a variable-mu control or may (if connected in series with a .0003 to .0005 mfd. fixed condenser) be used to replace the customary variable condenser in the reaction circuit. Provided that the potentiometer is a good one, with electrically-quiet action, this form of reaction control is an excellent one. All switches built in unit with volume controls are of the Q.M.B. type, and can therefore be used equally well on either mains or battery receivers.

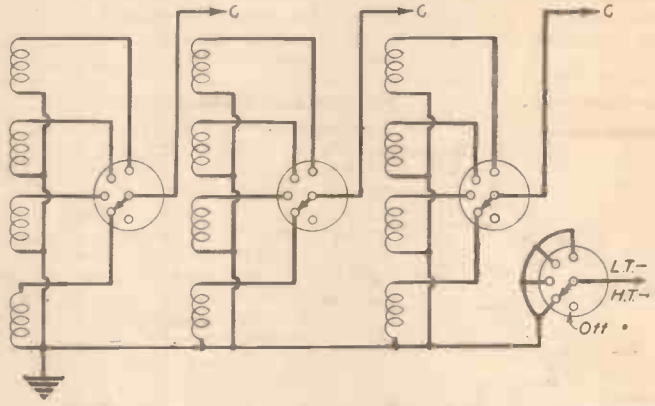


Fig. 5.—Four five-way rotary switches for on-off and wave-change switching in a four-range receiver with three tuning circuits. Various slightly-modified types of switch may be used, but separate units are to be preferred if the coils are not close together.

New Director of Telecommunications

THE Postmaster-General has appointed Mr. J. Innes, B.Sc., M.I.E.E., Principal Assistant Secretary, to be Director of Telecommunications on the retirement of Mr. F. W. Phillips, C.M.G., last September. Mr. Innes has also been appointed a member of the Post Office Board.

Biographical Notes

Mr. J. Innes, who is 51 years of age, was educated at the Royal High School and Heriot Watt College, Edinburgh, and after training as a Civil Engineer entered the Post Office Engineering Department by examination in 1913. For most of his earlier years of service he was engaged on telegraph and telephone engineering in the field, including a period of service on communications required by the Admiralty n the North of Scotland, Orkney and Shetland, during the last war. Subsequently he returned to Edinburgh where he took charge of the work of converting the Edinburgh telephone system to automatic working.

In 1929, Mr. Innes was lent to the South African Government as an adviser on automatic telephone systems, and was responsible for the schemes installed in Johannesburg and the Cape Peninsula. He visited the United States in 1933 as a member of a special mission on communications, and has visited Germany and Poland in a similar capacity.

As Staff Engineer and Assistant Engineer-in-Chief, he was employed in Engineering Headquarters on problems affecting the development of the British Telephone System, and in 1936 he was transferred to administrative duties as Assistant Secretary. Since that time, Mr. Innes has been responsible for the administration of the telephone service in this country, and in 1939 became a Principal Assistant Secretary when the war activities of the Post Office on communications were greatly increased and were placed under his charge. He will continue in charge of these functions in his new capacity.

BOOK RECEIVED

RADIO-FREQUENCY MEASUREMENTS BY BRIDGE AND RESONANCE METHODS. By L. Hartshorn, D.Sc., A.R.C.S., D.I.C. 265 pp. 99 illus. Published by Chapman and Hall, price 21s.

THIS is Volume X of a series of Monographs on Electrical Engineering and deals with the main principles of R.F. measurements. There are, of course, many schemes available, but the majority are merely modifications of certain basic schemes which are detailed in this book. The chapters are Impedance and Related Quantities; General Principles of Impedance Measurement; Resonance Methods; The General Principles of Screening and the Radio-Frequency Bridge; Generators; Detectors; Standards of Capacitance; Resistors; Standard Inductors; Measurement of Capacitance and Inductance by Resonance Methods; Resistance, Power Factor, Decrement, etc., by Resonance Methods; Bridge Methods; and Methods for Very Short Waves. These titles will give some idea of the scope of the book which s well written and although, naturally, mathematics have to be entered into, the work is not complicated. There is a list of symbols and a useful bibliography. All students of modern radio should get a copy for reference.

A Service Engineer's Log

A Further Selection of Simple Faults and Their Remedies

A RECEIVER which I had to attend to last week was of the "straight" H.F.-Det.-Pen. type, and the fault was lack of signal strength and marked reduction in selectivity. It was a fairly old set, but was of good make, and had been running well for a number of years. In making a preliminary test the first thing I noticed was that the reaction condenser had no appreciable effect. That at once gave me an idea, but before following up my train of thought I checked the H.T. battery connections and took a voltage reading of both this and the L.T. accumulator; both were reasonable.

H.F. Choke Shorted

I was therefore convinced that my first idea was correct. With a short piece of wire I short-circuited the H.F. choke in the detector anode circuit—that gave an immediate improvement and the set could be made to oscillate, but only just. When

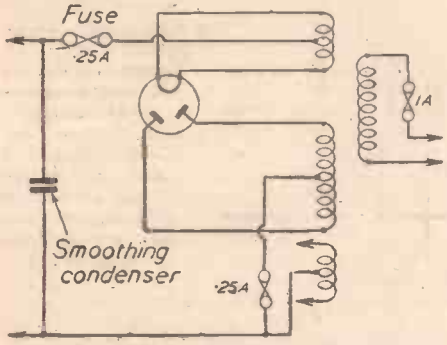


Fig. 1.—Alternative positions for a safety fuse in the rectifier circuit. The fuse in the mains lead should be used in addition. Indicated values are approximate only, and depend largely on the rectifier output.

the choke was replaced by a new one everything was as it should be. The choke had, apparently, developed an open circuit—or, at least, a very high internal resistance—with the result that scarcely any H.T. was able to reach the detector anode. That made the detector extremely inefficient and entirely incapable of oscillating. Where R.C.C. coupling is used it is often found that the same form of trouble as that described above is due to the detector anode resistor being defective. If shorting the choke does not make any alteration, therefore, the next step should be to try a replacement resistor. If that is not available a fair test can be made by placing a short length of moistened string between the resistor terminals; this provides the necessary resistance, although the value may be entirely unsuitable. But having discovered that the resistor is faulty it is an easy matter to obtain a new one of correct rating.

Poor Quality with Bias

Another fault recently traced in a battery set was shown by the fact that signal strength was extremely poor and quality was lacking unless the G.B. negative connection was removed from the battery. This suggested to the owner of the set (which was home-made) that the H.T. battery was at fault, although it had not been in use for very long. He tested with an H.R. voltmeter, and found that the nominally 108-volt battery showed 85 volts, which was not considered to be too bad. Unfortunately, however, he had made the test when the set was switched off; had he made it while it was in use he would have found that the voltage shown was lower.

The battery had a number of tapping points, and by testing between each of these in turn it was soon found that the cells between one particular pair were practically exhausted. This was probably because an exposed piece of metal had carelessly been left touching them at some time. To effect a simple cure the defective cells were cut out by short-circuiting the two sockets. It should be mentioned, however, that this is not a procedure to be strongly recommended, since the shorted cells soon burst open, make a nasty mess of the battery and eventually damage other adjacent cells.

Hot Mains Transformer

Another owner, this time of a mains superhet of doubtful origin, brought in his set for test, pointing out that the mains transformer was probably in need of replacement. This was because it had obviously been running very hot and the pitch filling had run on to the chassis. The "hot smell" had been noticed for some time before the set finally ceased to operate, but had been ignored. It was not considered wise to connect the set to the mains until a few tests had been made, because this might have resulted in further damage. In making a scrutiny of the set after removal from the cabinet it was noticed that a cardboard-cased electrolytic smoothing condenser looked as if it had been rather "under the weather," for the wax had run from it and the case appeared to be slightly charred.

Continuity and Resistance Tests

A simple insulation test was made by means of a multi-purpose meter set for resistance readings. This showed that there was practically a dead short through the condenser, which was at once replaced. Similar tests made across the transformer windings and between the windings and the core showed that this component had not suffered to any marked extent. The mains supply was therefore connected so that a further test could be made. But the set would not work, although there was no further sign of excessive heating. It was not until the rectifying valve had been replaced that the receiver be-

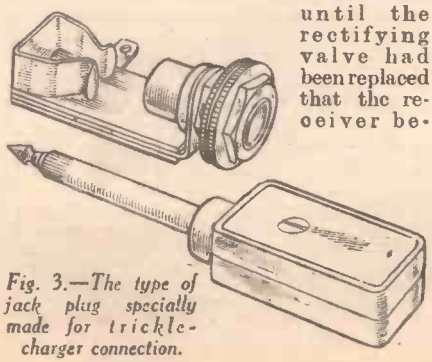


Fig. 3.—The type of jack plug specially made for trickle-charger connection.

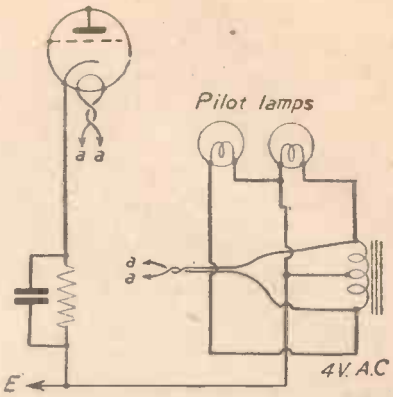


Fig. 2.—Small 3.5-volt flashlamp bulbs, used as pilot lights, may be wired as shown above. If they were merely in series, failure of either bulb would cause both lights to go out.

haved normally. The valve had no doubt been damaged due to the output from it having been short-circuited.

Correct Fusing

There are at least two morals to this experience: if a good, branded condenser of 350 volts working (the H.T. was 250 volts) had been used it would have been very unlikely to break down; if a fuse had been inserted between the rectifier and the condenser, failure of the condenser would not have resulted in damage to the rectifier. Alternative positions for the fuse are shown in Fig. 1.

Pilot-lamp Bulbs

What to many will seem a foolish point was raised recently by a complaint from the owner of an efficient home-made mains receiver that the dial-light bulbs burnt out very quickly—generally after being in use for only an hour or so. They were, as is fairly general, fed from the 4-volt winding of the mains transformer and were of the type intended for use with a 3.5-volt flashlamp battery. The owner was surprised when told that these were entirely unsuitable, since they were being seriously over-run. He overlooked the fact that there is an appreciable voltage drop across a small dry battery when it is supplying .3 amp. (the usual rating of these bulbs) whereas the voltage from the transformer winding is A.C. and remains at the full rating when the set is switched on.

Not only is it desirable to use specially robust bulbs for mains-set pilot lights, but it is also generally desirable to use 6-volt bulbs for connection to the 4-volt heater winding. An alternative method which is sometimes satisfactory is to feed one 3.5-volt flashlamp bulb from each half of the 4-volt winding; that is, to connect one side of each to the centre tap (or earth line in nearly every case) and to connect the other sides to the ends of the winding, or to each of the heater terminals on a nearby valveholder. See Fig. 2.

Trickle-charger Connection

A constructor had decided to fit a neat jack on the cabinet of his set for the connection of a plug connected to the trickle charger. The jack was, of course, permanently connected to the accumulator inside the set, so that to charge the battery it was necessary only to insert the plug after switching on the mains supply to the charger. He was very concerned, however, because he noticed that every time the plug was inserted there were various sparks

(Continued overleaf)

A SERVICE ENGINEER'S LOG

(*Continued from previous page*)

between the plug tips and the jack. The reason for this was that he had used an ordinary ball-ended plug; when this was inserted into the bush of the jack the ball tip and shank were short-circuited.

The trouble could be overcome by inserting the plug before switching on the charger, but the proper method is to use a special type of plug, as shown in Fig. 3. This has a small-diameter tip which is pointed; thus it cannot make contact with the bush of the jack when the shank has been inserted.

Faulty Volume Control

Volume controls are often a source of trouble after they have been in use for some time. In most cases the fault is shown by the fact that the control operates smoothly for part of the movement of the knob, after which it becomes erratic. Thus, when the knob is turned to about its midway position, there is a sudden "cut-off," but if the control is advanced through another few degrees full volume is given. It is generally best to replace the component when faults of this kind are experienced, but before doing so make sure that the knob is tightly clamped on its spindle and that the potentiometer is secure on the panel or mounting bracket. This is mentioned because in a recent case which came up for investigation it was soon found that the trouble was due only to one connection being loose and to the component not being tightly fitted to the panel. In consequence, the body of the control turned and occasionally caused the terminal contact to break.

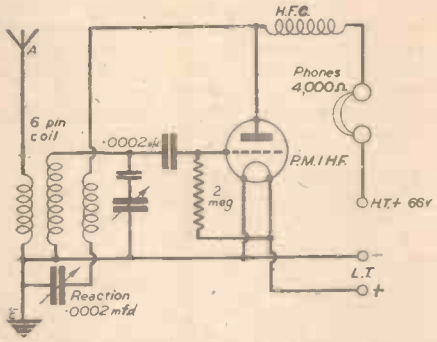
Cleaning Method

In other instances it had been found that either the slider arm or the potentiometer element is dirty, so that a bad contact is made at certain settings. A good and generally "safe" method of cleaning is to apply a spot of carbon tetrachloride to the element and then to move the arm backward and forward a few times. After that, wipe the whole with a piece of silk waste to remove any dirt which may have been loosened.

The British Long-Distance Listeners' Club

B.L.D.L.C.

IN view of the correspondence we have received concerning super one-valvers, we do not feel that it is necessary to offer any apologies for returning to the subject once again in these columns. As a matter of fact, one member has been good enough to send in sufficient working details about the little set he has been using with such success to enable others to have a shot at getting similar results. We are indebted to Member No. 6,032 (P. Yeates, of Bedford), for the following particulars, and we sincerely hope that other members will take this as a cue to send in practical details of their own particular pet set or circuit. P. Y.'s letter reads: "I have been



The circuit appears to be quite ordinary, but the careful selection of components and the lay-out make it a real Dx'er.

reading lately in the B.L.D.L.C. page about your inquiries for details of super one-valve receivers, particularly as regards construction and circuit. I note that you say many letters have been received on the subject, but the details that matter are conspicuous by their absence; in view of this, I am sending full details of my own.

Results Obtained

"I have received with it transmissions from 101 countries on 'phone (mostly amateurs) and have verifications, which I am willing to send as proof, from the following:—VR6AY, Pitcairn Island, K6NZQ, K6OQE, K6BNR, Hawaii, VLQ, Australia, HS8PT, Siam, VS2AK, Malaya, KA1BH, Philippines, ZS6AT, S. Africa, W9XF, Chicago, HJ1ABE, Colombia, PY5Q, PY2BA, Brazil, LU1HI, Argentina, TF3C, Iceland, and one from Barcelona, Spain.

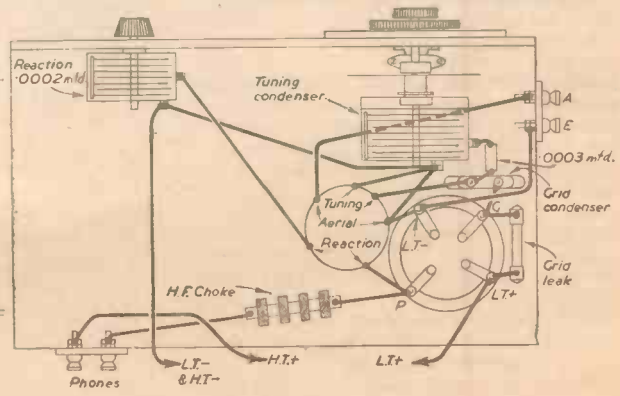
Wise Remarks

"I have kept a detailed log-book (a very wise procedure, and one which we are always advocating—Hon. Sec.), giving the date, call-sign, R., Q.S.A., Q.R.M., Q.R.N., Q.S.B., country, time during which the transmission was heard and whether it was calling C.Q. or Test, etc." (Then follows a fine list of the stations logged during a recent month, but space prevents us, or should I say the lack of space, from giving it in detail—H. S.) "The secret lies," continues P. Y., "not so very much with what you listen to, *but how you listen*. First, the ability to tune in an elusive signal and second, *great patience is essential*. I often used to spend half an hour glued to one spot on the 20-metre band trying to identify an amateur, and I am confident that if I hadn't adopted such methods I shouldn't have logged all the countries mentioned above, i.e., 101. I think that in my RX I happened to strike on a lucky combination of parts and layout, but I would mention in passing that I was experimenting for about 12 or so months before being satisfied with the results.

"The accompanying theoretical circuit tells its own story. It is a perfectly straightforward arrangement, the usual series reaction control, and a 6-pin coil for the three windings. The reaction condenser is an Eddystone incorporating a 10 : 1 slow-motion drive, whilst the tuning is carried out by an ordinary .0005 mfd. variable which has connected in series with it a fixed condenser having a capacity of .0003 mfd., the idea being taken from an article in PRACTICAL WIRELESS.

"The coil constructional data was also given in the journal, and, in spite of its simplicity, it seems very efficient. The coil-former consists of a short length of 1½in. diameter cardboard tube which had previously been well dried. All winding was carried out with 22 S.W.G. enamelled wire, the aerial coupling section having 1½ turns, the grid coil 6½ turns, and the reaction winding 8½ turns. For tuning control an Eddystone dial giving ratios of 120 : 1 and 20 : 1 is used; the valve-holder (of the low-loss type) and the H.F. choke are both products of the same maker. (Eddystone.)

"The plan of the set is not strictly to scale, but I think it explains itself. The battery leads are connected directly to their respective points without any intermediate terminals. It will be seen that room has been left on the baseboard for the addition of an L.F. stage if and when required."



This plan shows how the constructor has endeavoured to keep H.F. leads as short as possible. Ample space is left for an L.F. stage.

ON YOUR WAVELENGTH

By Thermion

The New Interval Signal

AFTER a lot of discussion about the comparatively trifling matter of the interval signal the B.B.C. has decided on the musical notes B.B.C. This is an improvement upon those monotonous bells introduced during Reith's time. I suppose in view of the B.B.C.'s well-known predilection for religious music and programmes it was inevitable that sometime during their career they would choose church bells. They were not joybells and their effect upon me was one of depression and gloom. No doubt this is a reflex action from my youth, when all church programmes were made as miserable as possible. Church bells to me meant miserable church services. As long as an interval is distinctive, however, it does not much matter what it is. There is a certain sadness however about the new signal which is pitched one octave higher than middle C. My waggish mind immediately thought how appropriate the new signal was since most people turn a D.E.F. ear to many of the programmes. B.B.C.—D.E.F. Got it ?

The Late Sir Oliver Lodge

THAT picturesque character Sir Oliver Lodge has passed away. Throughout his life he enjoyed a reputation as a scientist, but, and he would have been the first to admit it, he was not a scientist in the accepted sense of the term. He was a student of science, and having studied a particular branch of it, he had the happy knack of being able to re-present what he had assimilated in popular language. His contribution to wireless telegraphy was the production of the tuning circuit. I will not say that he invented it, because so many others had much to do with it. There is very little that can be associated with Lodge's name from the point of view of invention. Nothing readily jumps to the mind as it does with Fleming, Hertz, Newton, Edison, Graham Bell and others. You may gauge from his writings that he was not an inventor. Few inventors are, for example, interested as he was in spiritualism, for inventors, engineers, and scientists are practical people who do not believe in nebulous improbabilities. Here are the titles of a few of his books : "Evolution and Creation" ; "Why I believe in Personal Immortality" ; "The Reality of a Spiritual World" ; "Life and Matter" ; "The Substance of Faith" ; "The Survival of Man" ; "Parent and Child" ; "Reason and Belief" ; and so on. They are all subjects on which anyone could write anything, and they are subjects on which we can each have our own viewpoints ; as the subject is intangible no one can prove or disprove the views of the author. His scientific works were of a somewhat similar character in that they dealt with opinions, and were of somewhat simple and non-scientific character. I give you the titles of a few of them : "Elementary Mechanics" ; "Modern Views of Electricity" (note that the book was only an expression of views, not necessarily his own) ; "Pioneers of Science" (this was something of a pot boiler) ; "Modern Problems" ; "Signalling without Wires" ; "Lightning Conductors and Lightning Guards" ; "School Teaching and School Reform" ; and "Atoms and Rays." None of these books could really be called a scientific work. They were popular presentations of known ideas, to which Sir Oliver contributed very little.

Therefore. it is as a teacher and a student that I prefer to regard the late Sir Oliver Lodge. It is wrong for the world to regard him as a scientist. He was a popular presenter of the discoveries and inventions and theses of others. When asked to lecture or speak he nearly always chose a subject on which it would be fairly safe to express an opinion without fear of contradiction. He was born on June 12th, 1851, at Penkhull, near Stoke-on-Trent. He was educated at Newport Grammar School, matriculated and entered University College, London, to study mathematics and physics. He was an Hon. D.Sc. of Oxford, and lectured on Physics at the Bedford College for Women and was appointed a Professor at the University College. In 1881 he was elected Professor of Physics at Liverpool, and in 1887 became a Fellow of the Royal Society. In 1900 he was appointed Principal of the University of Birmingham. His book "Raymond" caused great controversy for it dealt with spiritualism and life after death. In it he suggested that they smoked cigars in heaven ! As one biographer has said : "Nobody ever solved the problem of how a scientist accustomed to the most rigorous methods of evidence and proof should have accepted evidence of such a different nature for the existence of Life after Death."

He himself deposited in a sealed envelope certain statements so that when he died mediums could endeavour to find some means of contacting him. Reports say that in the envelope is a formula with a mistake in it, the names of two towns, quotations from three of his favourite songs, the name of a cliff, and some childish idiosyncrasy. There are many who thought that his somewhat childish beliefs in such matters ill befitted one who claimed to be a scientist. The mediums have the answer. Other scientists have died before Sir Oliver, and it is unthinkable that if they are still able to exercise their scientific attainments they would not be able to communicate with us. Hertz and Newton, Galileo and Archimedes —these are a few names that have gone before.

It is, however, beyond all doubt that Sir Oliver spent his life in an endeavour to present scientific facts so that they could be understood by the millions.

Our Roll of Merit

Our Readers on Active Service—Eighth List.

H. C. P. Stacey
(L/Cpl., R.A.),
Edinburgh.

A. E. Coleman
(L.A.C., R.A.F.),
Halton, Bucks.

D. Dudding
(Pte., I.T.C.),
York.

H. Summons
(Leading Stoker, R.N.),
C/o G.P.O.

The Radio War

NO doubt following the remarks of Capt. Plugge in the House of Commons, I learn that the Government now intend to take steps to combat Germany's radio superiority. Lord Caldecote, the Dominions Secretary, assured the House of Lords on this point recently. Germany has the advantage at present because she has appropriated practically all the broadcasting stations in the vanquished countries, whilst we are confined to stations operating mainly from Britain. Already Great Britain is issuing 72 news bulletins in 29 languages. Good, but it is not regarding the number but the quality that I am concerned. There should be bite, enthusiasm, adroitness, and topicality about news in foreign languages. We do not merely require a recitative of news ; such must be presented in a propaganda manner. We have a better case than the Nazis, but we do not present it so well. We want a Ministry of Inspiration as well as a Ministry of Information. We have plenty of material available, and I suggest that the Ministry engages some of the vast army of expert copy writers who are at present disengaged to promote our case over the air. As Lord Addison said during the debate : "I am always afraid of newspaper people. They give me a sort of creepy feeling that they have been brought up in a world of which I know next to nothing. But if you want a case presented you have got to employ someone who is an expert at the job, give him plenty of money, and a free hand." According to Lord Caldecote the Treasury were parsimonious about the use of cables and wireless for propaganda.

A Reader's Offer

L. F. H., of Stourbridge, has a number of copies of this journal—all those issued from January, 1938, to July, 1939—for which he has no further use. The first applicant gets them. If the first applicant is serving with His Majesty's Forces L. F. H. will pay the carriage. Applications should be made on a postcard addressed to me and marked in the left-hand corner L. F. H.

Comment, Chat and Criticism

Outline of Musical History—13

A Brief Sketch of the Life and Works of Wagner. By Our Music Critic, MAURICE REEVE

THE name of Richard Wagner—born in Leipzig in 1813, and died in Venice 1883—towers over the century as its greatest figure. His is, in fact, the only other name which might challenge Beethoven's for supremacy; but we won't bring that discussion in now! His contribution to music was so personal, so revolutionary, and so exclusive to one particular form that he can scarcely be classed with anyone else, or with any particular movement or current of opinion; he was, in short, just Wagner.

With the exception of two overtures and one immortal concert-piece—the "Siegfried Idyll"—his work lay entirely in the one sphere of opera, or what he himself designated, music drama. He never wrote a symphony, a sonata or a quartet, but his collection of operas form a fabulous page in musical history, and his peer in that particular domain—as Beethoven's in his—has yet to be born. He was the last great figure in German musical history, only the early to middle period Strauss who, in those days closely resembled him, counts for anything.

Wilhelm Richard was the ninth child of his parents. Shortly after his birth, however, his father caught typhoid—it was during the siege of Vienna—from the many unburied corpses lying about, and died. His much harassed mother, in dire want, then married one Ludwig Geyer, an actor, and gave birth to yet another child, Cacelie.

Early Love of Stage

The master himself tells us that he had a love of the stage from his earliest recollections. Even the orchestra tuning-up at Geyer's theatre used to speak to him of another world of ghosts and shadows.

After a year with his elder brother, who was apprenticed to a goldsmith brother of Geyer's, Richard returned to the theatrical atmosphere of Dresden. Almost all the huge family were either on the stage or training for it. But Richard's passion was to write, not to act. Greek tragedy was his favourite subject at school, and he would invent dramatic scenes by dressing up his sisters' dolls.

Many interesting details of his youth and education must of necessity be passed over. But he tells us himself that it was not long ere he realised that, if the dramatic plots and schemes which were then seething through his mind were to arrive at complete fruition, they could only do so through music. So, at fifteen, his musical studies began in earnest with one Meuller, a violinist in the Dresden orchestra.

As with Greek, he found harmony and counterpoint "bothersome obstacles," and he tells us in his autobiography that he preferred to pore over the scores of "Don Giovanni" or of a Haydn or a Beethoven quartet. But it was performances of Beethoven's Seventh Symphony, "Egmont," and Mozart's Requiem, which made him realise that "music was far more than an adjunct to drama."

In 1829 Meuller advised him to take up the violin, but he soon dropped it—and Meuller. He spent all his time poring over Beethoven's Fifth and Ninth Symphonies. At that time the Ninth was deemed incomprehensible and unplayable, and a product of the master's deaf dotage. But to Wagner it was the most wondrous music he had ever heard. He made piano arrangements of both works and sent them to Schott, who gave the young master a copy of the "Missa Solemnis" by way of payment. He did *not* publish them.

Student Days

Some riotous adventures as a student (1830 was a year of revolution, and Wagner's enthusiasms could only be restrained with great difficulty), and a spate of compositions culminated in his first opera, "Die Hochzeit"—the Wedding—begun in 1832. It was the result of a thwarted passion for one Jenny Pachber, and the crude libretto told of a girl who pushed her unwanted lover out of her bedroom window to meet his death below. It symbolised a theme that was to haunt Wagner all his life, and which was to occasion some of his most marvellous music—the conflict of love and duty.

In 1833 he wrote his second opera, "Die Feen"—The Fairies. Excerpts were successfully performed, and his actress sister Rosalie managed to get the whole work produced at Leipzig. Though closely modelled on various prototypes, Wagner could at last claim to have learned to write music for the stage, and to win the esteem and forgiveness of his mother and Rosalie for the dissipations of his youth.

Followed a few years during which he travelled about, expressed various opinions on opera, violently changing sides as between Weber and Marschner on the one hand, and Rossini and the Italians on the other; having various amorous adventures, hearing the famous Wilhelmine Schroder-Devrient in "Fidelio" and Italian operas and being greatly moved thereby, commencing his third opera on the Italian model, "Das Liebesverbot"—the Love Ban, the offer of the directorship of the Magdeburg Theatrical Company, and, finally, his marriage to Minna Planer.

"Don Giovanni"

His season at the theatre began with "Don Giovanni," but his extravagance and love of the good things of life soon landed him in trouble as they were to do all his life. Schroder-Devrient appeared as guest artist at two performances, but the public, not thinking that the young Herr Direktor could possibly be serious in making such an announcement, failed to respond. The hall was half empty and Wagner saddled with a considerable debt.

He married Minna in 1836. She, too, had had her adventures, but, unlike Wagner, she was totally without culture or interest in it, and her outlook on life was the most materialistic imaginable. No more ill-assorted match was ever made. Imagine her rage when, on the first morning of her marriage, she discovered her husband's creditors' notes nailed to the door! The theatre had gone bankrupt, and he only married her largely out of jealousy over her outrageous conduct with various members of the company. Possession was evidently ten parts of the law.

It was a wretched failure, and at the second attempt Minna succeeded in running away with one Dietrich. Wagner took refuge in Dresden with his sister Ottalie and her husband. Here he read Bulwer Lytton's "Rienzi," and deemed it an ideal subject for a libretto.

At Riga

Taking up a post in Riga, Wagner was for a time at peace with himself financially. Shortly after, Minna rejoined him. Deserted by Dietrich, she asked his forgiveness, which he readily gave, promising not to mention the man's name. There was apparently a strong attraction between them in spite of incompatibilities of temperament, and they settled down to a much more stable existence.

Debts began to pile up again when he was suddenly dismissed—the result of an intrigue. This didn't worry him unduly, however, as he was pinning all his faith on "Rienzi," with which he was going to conquer the world, via Paris. And to Paris he went, determined not to waste time whilst the thing was being published and getting known, but to conquer even as Rienzi himself conquered.

They left Russia in June, 1839. Few more adventurous journeys can ever have been undertaken. Their passport had been impounded and they had to smuggle themselves over the frontier, past sentries a thousand yards apart. They sheltered in the hut of a bribed sentry out on duty, and finally boarded a tiny merchant ship bound for England. Instead of a four-day journey they took four weeks and, amongst other things, got driven up a Norwegian fjord in a storm. After striking a sandbank and other minor reefs and shoals, they finally sailed up the Thames. They spent a week at the King's Arms in Old Compton Street.

Wagner's wiles and ingenuity in earning some money for himself and Minna whilst waiting for the production of "Rienzi," whilst contracting new debts and holding the creditors at bay, bordered on the fabulous. They cannot be detailed here. A performance of Beethoven's Ninth reawakened his love for that great master. He also wrote "Eine Faust" Overture. But "Rienzi" brought him bitter disappointment; they would not produce it.

"The Flying Dutchman"

Some readers may have guessed that it was the tempestuous journey to England which gave birth to the plot of "The Flying Dutchman." The score was finished in December, 1840. He offered it to Dresden—not Paris—as a one-act opera, for which he received 500 francs. With this he worked on the full-length score we now know. Dresden produced it. Berlin staged "Rienzi." Triumph at last!

There was a wonderful part for Schroder-Devrient and for Tichatschek, the famous Dresden tenor. The "Dutchman" was the turning point in Wagner's artistic career as the production of "Rienzi" was materially. It marked the end of their stay in Paris, but not without one more disappointment. Schroder-Devrient, at the last moment, decided to do Gluck's "Armide" first, and the "Dutchman" had to be put back a season.

Modern Factory Production Methods—2

Notes on the Various Tests which a New Receiver Undergoes Before Being Issued to the Public. By "SERVICE"

MANY designers evolve their ideas and put these on to paper in the form of the completed chassis before they even start wiring up an experimental model. From their sketches proper drawings are made, and the major parts constructed in a small workshop. The men operating in these workshops are capable of putting their hand to any type of work and can bend a chassis, turn up an ebonite knob, wind a coil or do any other of the hundred and one jobs demanded by the designer's plans.

The receiver designer even lays out the wiring theoretically, but of course when the first model is made up he will find many problems of instability, hum, etc., to be attended to by rearranging wires here and there. This aspect of the job will be discussed more fully in a later article, as the process layout engineers will also have to modify the wiring and, perhaps, the component positions slightly to make the receiver suitable for mass production.

Components

In the meantime, however, the question of components must be considered. Just as a chain is only as strong as its weakest link, so is a radio receiver no better than its worst component. The most elaborate set will be a costly failure if a particular component consistently gives trouble. No matter how well the set performs between the breakdowns and irrespective of its fine appearance, reasonable price and other attractive sales features, the model and its manufacturers will suffer severely in reputation simply because one small part has been allowed to creep into the assembly without thorough tests or conscientious inspection.

It will be appreciated, therefore, that the component designers have a great responsibility to maintain, and they guard this by a constant vigil over the parts and the materials from which they are made. In addition, they must have available for immediate reference past histories of components similar to those they are at the moment considering. It is here that the service department can, and should, render invaluable assistance.

Designers seldom leave their laboratories, and are rather inclined to lose touch with the practical side of things. The service engineer, on the other hand, is for ever running into troubles and solving them in a practical way, and his experiences must be collected by a responsible person whose job it is to edit the serviceman's reports and bring the troubles that are due to design or manufacturing weaknesses to the notice of those concerned. This function will be fully dealt with under the heading of Service later on in this series.

Life Tests for Components

An, example, however, will demonstrate the necessity for a close liaison between the designs and service departments. A combined volume and tone control passed all life tests satisfactorily, but had a comparatively short life in the field, as many were returned for replacement. On investigation it was found that the tone control section was faulty, due to the fact that the carbon track was burnt out at one spot. This position was where the moving contact of the control remained when full top cut was used. In other words, the receiver's high note response was such that most users found it too brilliant, and operated the set constantly with a "mellow" reproduction. All the unwanted power of the high notes passed through the one portion of the tone control track and burnt it out, and this fault decided the designers to modify the audio-frequency characteristics of the receiver which resulted in public approval and no more tone control complaints.

Reverting to the progress of the receiver design, the next step is to submit a list of the components to people who have specialised in small parts designs, and to obtain a report on each one that the designer proposes to use. The component designer can tell him whether the particular part the designer wishes to employ will stand up to the conditions under which they will work in the receiver.

Sometimes a new design of circuit or a new mechanical drive for the tuning condenser will have to be made up by the component designer because no standard part meets the receiver designer's needs. The new component must then be thoroughly tested after several have been made up for reasonable life, foolproof handling, ability to withstand transit conditions between factory and dealers.

To ensure reliability every component must pass a life test which subjects it to strains and stresses similar to those it will have to endure during the estimated life of the receiver. For example, volume controls must be capable of being rotated hundreds of times before they show signs of wear. A normal volume control may only be adjusted three or four times a day by the owner of the wireless receiver, and to test it under normal working conditions would take a very long time. The component designer must obtain his answer by accelerating the wear and tear on the volume control by causing it to be rotated several times a minute for a predetermined number of operations.

For example, let us assume that the estimated life of a receiver is five years, and it is thought that the volume control will be used on the average four times a day, then a total of some 7,300 operations of the volume control must be allowed for if it is to have a five years' life. Therefore, the life test equipment will be designed to rotate the volume control backwards and forwards 7,300 times; so that if the control is rotated by the test mechanism 10 times per minute it will only require 730 minutes to carry out the test.

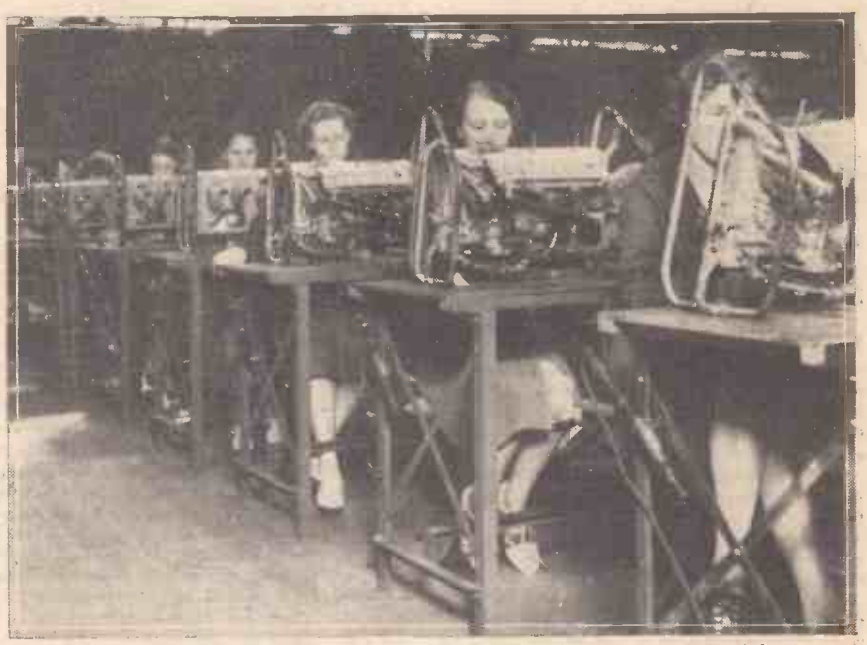
Tuning Drives

Other components which require manipulation by the user of the receiver may be life tested in a similar way. It is very important in the case of tuning drives, which may incorporate cord, to see that in addition to there being no undue wear on the moving mechanical parts, that the cord or wire does not stretch, causing misplacement of the pointer in relation to the wavelength scale.

Items such as pilot lamps, valves and ballast lamps are run at a voltage higher than that normally applied to them, and from these tests their life under normal running conditions can be estimated.

If the instrument under consideration is a radio-gramophone other components will have to be reported on. The chief item will be turntable motors, and these will be life tested by running several motors in a temperature approximating that at which they will operate in the radio-gramophone cabinet. The motor is always in a warm position, as it not only develops heat itself, but will have to tolerate the heat from the

(Continued on next page.)



A view of the production desks in a modern radio factory, showing motor-controlled receivers nearly ready to leave their "cradles" for assembly in their cabinets.

MODERN FACTORY PRODUCTION METHODS

(*Continued from previous page.*)

radio chassis (valves, transformers, etc.) which concentrates around the motor.

Considerations of Temperature

Another consideration which component designers must always keep in mind is heat. The temperature inside a receiver rises from the moment of switching on until it reaches its maximum, and it is at this temperature that all components must operate satisfactorily.

In the case of tuning drives incorporating cord, or thin wire, the latter must be so constituted that either it does not expand or increase in length with the rise in temperature, or that the effect is counteracted by features in the design of the drive.

Components such as chokes, transformers, loudspeaker field coils, etc., must be tested not only for length of life, and the effect of temperature rise, but also for the effect of atmospherical conditions. For this test the components under consideration are connected so that they are electrically operating under accelerated life test conditions with the additional factor that they are located in a humidity chamber. This is a large cupboard often with a glass front for observation which enables the designer to surround the component being examined with any condition of air. Generally, of course, a wet- or moisture-laden atmoshpere is employed which is the worst possible condition under which transformers and similar components can be operated. Upon this test will depend whether impregnation of the coil windings is sufficient to protect them from adverse atmospherical conditions.

The point which must be considered in all factory tests is that the test must not be stringent. This may sound rather contradictory, but what is meant is that designers must keep the price or cost of the components down to an economical figure. For example, if the windings of a transformer will have only 200 v. between them under working conditions it is a waste of money and material (which is often more important than money these days) to incorporate layers of insulating material between windings capable of constantly withstanding a much higher voltage. Component designers must see to it that quality and quantity is reduced to the very minimum, but he must then ensure that his test equipment is capable of rejecting every component that fails to pass the test applied to them.

Components Approval Meeting

A meeting of all designers will be held when the various component designers have had an opportunity of reviewing the components required by the designer and have supplied him with samples in the case of new items. At this meeting there will be representatives of the factory, production staff and process layout engineers, the component designers and the service department. Then it is that the experience of the various experts will be aired concerning any possibility of faults that may develop in any of the components.

The service department plays a very valuable part at this stage. Their analysis of faults which they should have passed to all factory authorities during the life of earlier receivers should ensure that no unsuitable component or weakness in design is repeated in the new instrument. It sometimes happens, however, that due to staff changes among the designers a particular designs engineer has not studied a certain problem with the regard to its past behaviour as shown by service figures, and has perpetuated a trouble which had previously been reported and corrected.

It is at these meetings, which frequently take place during the evolution of the new chassis, that these points are investigated and modifications put in hand where necessary. Further points which are brought up for discussion at the last of these preliminary meetings, together with the first stages of laying out the job for mass production, will be dealt with in the next article.

NEWS AND NOTES

Increased Power for American S.W. Stations

IT is reported that two more American short-wave stations have applied for permission from the U.S. Federal Authorities to have their power increased to 50 kW. They are the National Broadcasting Company's 25 kW. stations WRCA and WNBI at Bound Brook, New Jersey. Application has also been made to reconstruct the aerial of WRCA, which is beamed continuously on Latin America. The two stations are at present simultaneously operating a continuous sixteen-hour service. Station WNBI's transmission on 17.78 mc/s is beamed on Europe from 1 p.m.-6 p.m. G.M.T.

New Use for Loudspeakers

AT a Fighter Command Station in Scotland, the public address loudspeaker system is being put to a novel purpose. Usually this system, with loudspeakers all over the camp and a microphone at some central vantage point, is used for transmitting orders—anything from sending a section of fighters into action to summoning an aircraftman to report to the medical officer.

At this Scottish station, however, it occurred to some smart brain that for much of its time the loudspeaker is unnecessarily idle. So why not, in the B.B.C. manner, bring entertainment and personalities to the microphone? Thus it is announced that at a certain hour, a brief talk will be given, and all who can are requested to be within earshot of one or other of the loudspeakers. A five-minute talk is then delivered by anyone who has something worth while to say.

Short concerts are also held—a selection of gramophone records for a quarter of an hour if somebody can produce some good new ones. Or, again in the B.B.C. style, a couple of experts provide a duologue discussion on some matter affecting the R.A.F.

When there is big news in the papers, or in the B.B.C. bulletins, this also is broadcast. The latest score of German raiders is regularly announced—with unexpurgated comments.

B.I.R.E. Examinations

WE are informed by the British Institution of Radio Engineers that sufficient applications have been received to justify the holding of examinations for associate membership, and the radio servicing certificates at London, Birmingham, Manchester, and Bristol, during the present month.

First F.M. Studio

THE new station W2XOR, which commenced operating from Madison Avenue, New York, at the beginning of August, is claimed to be the first studio built expressly for frequency-modulation transmissions. The studio, which was originally used by the 50-kW parent station WOR, has been equipped with Western Electric audio apparatus to give a flat frequency response from 30 to 15,000 cycles with a total harmonic distortion of less than 0.5 per cent. The 1-kW transmitter radiates on a frequency of 43.4 mc/s.

Licence Figures

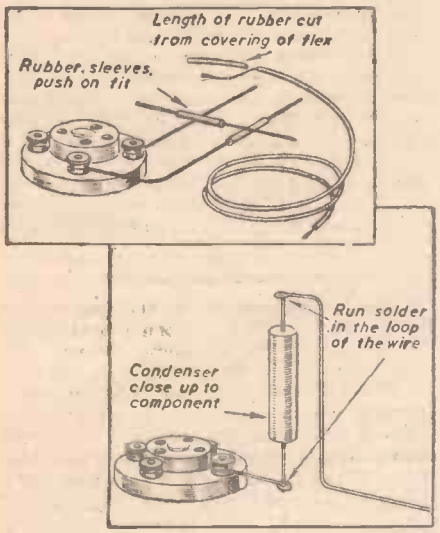
THE figures recently given by the Assistant P.M.G. show that there was an increase of 21,000 receiving licences during the period from September 1st, 1939, to May 31st, 1940, and it is interesting to compare this figure with that of 135,000 recorded during the eight months preceding the war. The approximate number of licences in force on May 31st was 9,065,000.

A corner of the B.B.C. Monitoring Room as a listening post.

Practical Hints

Two Useful Hints

NO doubt many readers, when in the middle of wiring or rewiring a set, have wished to insulate wires at one or more points when using the popular bare tinned-copper leads. The necessary length of systoflex is not at hand, but an excellent substitute can be used in the form of the rubber covering on rubber-covered flex. It has been my practice for a long time to save all the ends when baring this flex, and using them as sleeving. They are both neat and extremely safe, being a tight fit on 18-gauge tinned-copper wire, as shown



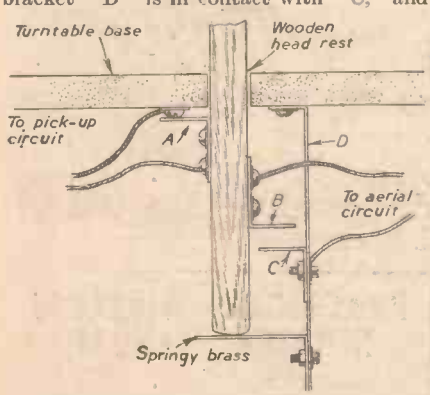
Improvised sleeving; and mounting condensers vertically.

in the illustration. A second useful tip, when space is a prime consideration, is to connect tubular condensers and resistances vertically. The illustration shows clearly how this is done.—W. H. MASON (Dukinfield, Cheshire).

Automatic Pick-up Switch

THE accompanying diagram shows a device which automatically switches in a pick-up as soon as the arm is lifted off its rest. The principle of working is as follows:

When the arm is on the head rest, the weight of the arm will push the rest downwards as far as possible, i.e., until the bracket "B" is in contact with "C," and



A device for automatically switching in a pick-up as soon as the arm is lifted off the rest.

THAT DODGE OF YOURS!

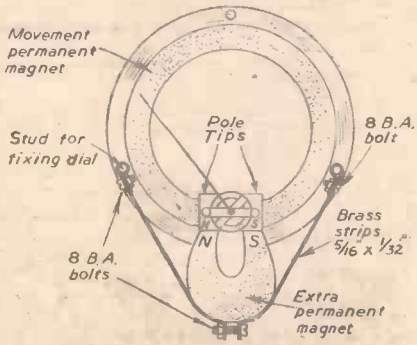
Every Reader of "PRACTICAL WIRELESS" must have originated some little dodge which would interest other readers. Why not pass it on to us? We pay £1-10-0 for the best hint submitted, and for every other item published on this page we will pay half-a-guinea. Turn that idea of yours to account by sending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

SPECIAL NOTICE

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

therefore the grid circuit is joined to that of the aerial circuit.

On the other hand, if the arm is in use, the force of the springy brass strip will push the head rest up until the bracket "A" comes into contact with the bolt, screwed into the underneath part of the base, and then the pick-up is included in the grid circuit.—A. BURGESS (Trealaw).



Improving a moving-coil speaker.

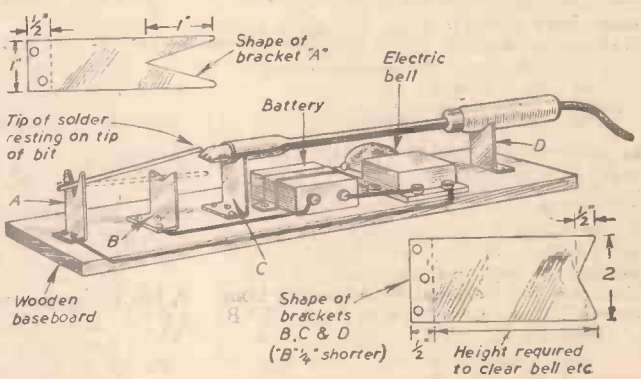
Increasing the Sensitiveness of a Moving-coil Movement

TO complete a new piece of apparatus I required a moving-coil instrument having a low milliampere deflection (in the order of 0-6). I purchased a second-hand moving-coil movement through an advt. in your paper, but as the current taken for full scale deflection was about 0-14 milliamperes, this was too high for the apparatus under construction; the problem then was how to make the instrument read in the order of 0-6 milliamperes. One way of doing this is to increase the flux density in the coil gap, i.e., to increase the magnetic field strength. I therefore fixed a small but powerful horse-shoe magnet (made of the latest magnet alloy steel) to the magnet system of the moving-coil instrument. I was then able to decrease the current for full scale deflection to 0-6 milliamperes.

The magnet, which I purchased locally for one shilling, was fixed as shown in the sketch. It will be noticed that the increase in the size of the instrument is small. The instrument was then fixed in a case, and finally connected to the apparatus.—H. WRIGHT (Rawmarsh).

Automatic Switch for an Electric Soldering Iron

AS I often switch on my electric soldering iron and then forget all about it, I hit on the following idea, which, incidentally, saves testing the iron every now and then to see if it is hot enough. A small stick of solder rests on the tip of the iron so that, when the iron is hot enough, the solder in



Details of the automatic switch for an electric soldering iron.

contact with it melts and allows the end of the stick to drop on to a bracket, B, and thus the circuit from A to B is completed by the stick of solder and the bell rings. Other details will be clear from the diagrams. I have purposely not given all the measurements as these vary for individual requirements.—J. F. H. ASPINWALL (Wirrall).

Testing L.F. Amplifiers

Forms of Distortion: Measuring Stage Gain and Other Important Amplifier Hints

By W. J. DELANEY

THE L.F. stages of a receiver are those in which most forms of distortion originate, and it is particularly important when designing apparatus solely for amplification (such as public address units) to see that the output is free from any form of distortion if the results are to be worth while. Unfortunately the ear is a very "elastic" unit, and it is safe to say that no two people hear alike. Furthermore, individual preferences differ, and thus what might sound high-pitched to one listener would be quite satisfactory to another. There are forms of distortion, however, which no listener can tolerate, and generally these give rise to reproduction which is commonly described as "scratchy," "woofy" or "harsh." These may all be traced to definite faults and may be cured quite easily. Unfortunately, it is not possible to generalise and say, for instance, that harsh reproduction may be overcome by fitting a certain type of valve, or that scratchy results may be improved by the use of a certain type of component. There are, however, certain faults which may be introduced in a receiver, and which may be overcome by proper design or proper use, and it is these which the real experimenter is interested in, as he will be assumed to be using an amplifier which is properly designed.

Fig. 1.—Measuring amplifier gain, and set-up of equipment for taking response curve of amplifier.

Measuring Output

The most important point from a test angle, so far as the keen experimenter is concerned, is the question of performance. If an amplifier is giving its correct amplification, and is properly operated, it may generally be assumed that it is working correctly. Certain forms of distortion may, however, still be present. By feeding a given voltage into an amplifier, and measuring the output, the overall gain may be ascertained, and knowing the valves in use, and the approximate amplification which should be given, this will give a clue as to general performance. The same arrangement will also permit certain forms of distortion to be traced, and therefore an A.C. voltmeter and some form of signal generator are needed for such tests. The signal generator should be of a type which may be adjusted throughout the normal frequency range, and then, if a voltmeter is connected across its output and the signal level is then set so that the output of the amplifier is slightly below its maximum rated value, it will be possible to adjust the generator from one end of the frequency scale to the other, and plot the output at all frequencies, from which a curve may finally be drawn to show the frequency response of the amplifier. It is to be noted that for this test it is desirable to keep the output from the amplifier below its normal maximum in order to avoid distortion which might be introduced by overloading.

The final curve of a good amplifier should be somewhat as shown in Fig. 2. It will be impossible to obtain a perfectly straight line from one end to the other, various slight dips being obtained at different points and a falling off at the ends. The general effect should, however, be a more or less even response throughout, the better the amplifier the nearer the approach to a straight line. If there are any large variations from the straight, then the amplifier should be carefully examined for the cause. Generally it will be found that an increase above the normal is due to some resonance in an anode circuit (wrong values of by-pass condenser or absence of condensers) and a dip in the grid circuit. These must not, however, be regarded as definite causes. There are so many incidental items which can introduce distortion of various forms that a carefully carried out stage-by-stage test is really the only satisfactory way of locating such troubles. When a stage is found in which the effect is introduced, modifications of all components should be made until the curve is straightened out.

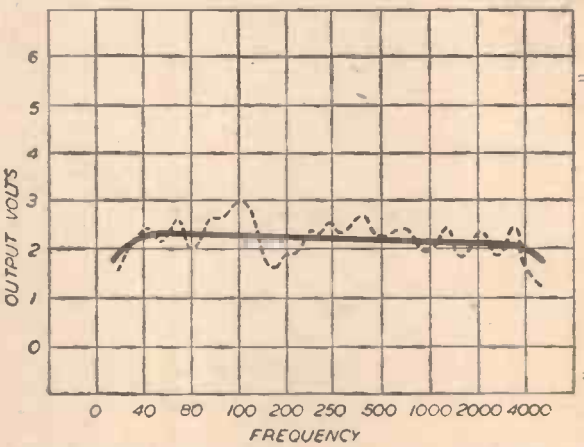


Fig. 2.—Response curve. The real curve will be as shown by the broken line, but this is generally levelled off and represented as shown by the heavy line.

Noise

Many modern amplifiers suffer from noise backgrounds, and it is essential to remember that all valves give rise to some noise, but with modern valves this should not be excessive. Faulty resistances and condensers, as well as badly-made connections, will also give rise to this trouble, and therefore a test is desirable to ascertain exactly what noise level is introduced in the amplifier. For this purpose a non-inductive and reliable resistance must be joined across the input terminals, the value being equivalent to that which is normally used on the input side, i.e., microphone or pick-up resistance. The output meter should be of a type capable of measuring very low values, and should thus preferably be a valve-voltmeter. Obviously, as there is no input voltage, merely a load across the input, the output should also be a zero value, but, as already mentioned, slight valve noises are unavoidable, but the voltage indication on the output meter should be very low. It may then be expressed as a percentage of the rated output of the amplifier, or converted to a decibel value as already mentioned in previous articles in these pages.

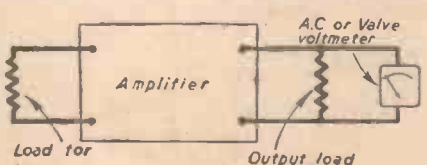


Fig. 3.—Set-up of equipment for measuring the noise level of an amplifier.

Other Troubles

There are various other incidental troubles which may be experienced, but which are not in the main troublesome. Harmonic distortion, for instance, would not be objectionable to some listeners, this depending in general upon the type of distortion. With some loudspeakers and in certain rooms it may be unnoticeable, or offset by the acoustics of the room. The push-pull amplifier is generally regarded as being most free from this trouble, and thus certain constructors adopt this form of amplification in order to ensure that they will have a minimum of distortion introduced in this way. Then, with proper attention to the above points, and with the amplifier set up by means of the instruments mentioned, the only remaining factor is the loudspeaker, and obviously if all previous tests indicate that the amplifier is working properly, and results are unsatisfactory, only the loudspeaker or the method of mounting or using it can be at fault. This should not be a difficult matter to overcome.

Meter Types and Tests

A Description of Modern Service Test Instruments and Their Application

THE average beginner often makes the mistake of assuming that ordinary radio receivers do not need test equipment, and accordingly obtains a simple type of meter with which he expects to carry out experiments at a later date. He finds, however, that many of his tests prove abortive, merely because the meter he is using is unsuitable. In most cases a simple dual-reading meter, that is, one which gives a reading up to 6 or 12 volts on one range and up to 120 volts on the other, is satisfactory for testing the condition of normal batteries. It may not always be suitable for testing mains units—this depending upon the resistance of the meter. It is also possible that such an instrument could be used to measure current by connecting it in series, but again the accuracy will depend upon the type of meter. There are to-day various meters of this type which are more elaborate than the old form of "watch" meter, and are designed to cover several ranges.

The Universal AvoMinor has 22 ranges and allows A.C. and D.C. to be measured.

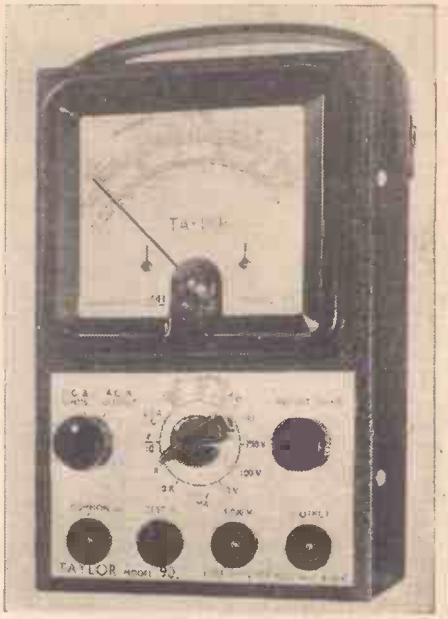
Current Consumption

The full-scale deflection of a meter is the maximum reading, or the position taken up when the pointer travels to that part of the scale remote from its position at rest. For accurate tests of mains units, and certain other purposes, the current required for full-scale deflection should not be greater than 1 mA. This is equivalent to a resistance, when used for measuring voltage, of 1,000 ohms per volt, and will suffice for all normal requirements. For more elaborate tests, and for certain types of combined instruments, it may be desirable to have a maximum current of only .1 mA, and accordingly the reading will be more accurate. It will be appreciated that when measuring some circuits the current flowing may be only a fraction of a milliamp, and if the meter requires more than that, or put in another way, if the resistance of the meter is lower than that of the circuit being measured, a false reading will be obtained, due to the increased current flow. A good meter is, therefore, essential for all-round reliable tests, and it is possible to make up a combined test meter with only a single milliammeter of the lower-reading type as a basis. The fact that many firms now supply a ready-assembled test unit, consisting of such a meter, and the associated parts, has resulted in an increased use of test meters, and a consequent improvement in the performance of many receivers. Good instances of this type of combined meter are the Avometer and the AvoMinor; two models of the latter are illustrated on this page. The AvoMinor is a Junior type of multi-meter, giving current, voltage, and resistance ranges. This particular instrument has a resistance of 330 ohms per volt, and the various ranges are selected by means of plug-in test leads. As an example of an instrument at the other end of the scale we may mention the Taylor meter, a 32-range universal instrument (that is, for measuring A.C. and D.C. supplies) and in which the various ranges are selected by means of a rotary switch.

A.C. or D.C.

The standard current meter is, of course, only suitable for measuring D.C. supplies, and when A.C. supplies have to be dealt with a small rectifier of the metal type is joined in series with it. These rectifiers are included in the universal type of instruments, the operation of the range-selecting switch generally bringing the rectifier automatically into circuit. For testing a normal receiver the meter is set to the D.C. range (if of the universal type), and where various current ranges are provided it is set to cover approximately the current taken by one of the valves, and the meter is then connected in series with the anode load component. It will then indicate the anode current of the valve, and from the valvemaker's curves it will be possible then to ascertain whether or not the valve is working properly. If the current is far from what it should be the H.T., L.T. and G.B. (if used in that stage) should be checked. If these are all in order then the valve will be known to be in need of replacement. If the meter is of the A.C. type it may be used to measure the output of a receiver or amplifier, and for this purpose some of the modern all-purpose instruments have the scale calibrated in watts, and also sometimes in decibels. The 46-range universal Avometer, for instance, provides on its scale decibel readings from −10db. to +15 db., with a reference level of 50 mW. The wattage scale ranges from 0 to 4 watts (the lowest indication being 1 milliwatt), taken with a load of 4,000 ohms. This instrument also provides direct-current readings in 10 ranges from 1 mA to 10 amps., D.C. voltage readings in 12 ranges from 50 mV to 1,000 volts, alternating current in 8 ranges from 5 mA to 10 amps., and A.C. voltages in 8 ranges from 5 to 1,000 volts. These are the scale readings for the various ranges, all of which naturally commence at zero. That is to say, the first range in direct-current readings is from 0 to 1 mA and so on. There are two further ranges on this particular instrument. Resistance values are calculated, also from Ohm's Law, when it is known what current and voltage are in circuit, and accordingly it is possible to fit a battery inside the instrument, and then calibrate the scale to give direct resistance readings with the internal battery. In the Avometer just mentioned the resistance values are obtained with two internal batteries, one of 1.5 volts, and one of 9 volts. With these, direct readings are obtainable from 0 to 100,000 ohms. Then, by means of an external voltage supply, it is possible to obtain readings on three further ranges up to 40 megohms. The remaining scale calibration is for capacity-testing purposes, and gives a direct indication from 0 to 20 mfd. For this purpose an external A.C. supply between 65 and 250 volts at 50 cycles has to be connected in series with the condenser and meter, and then direct-capacity readings (within commercial limits) may be taken.

The AvoMinor, a younger brother of the famous Avometer. It provides 13 ranges and embodies a 2½ inch moving coil combination.



Taylor model 90 32-range testmeter. A very fine instrument, ideal for service engineers.

Useful Text Books

The full use of test instruments would take considerable space to detail, but there are many useful books available for the experimenter. In our own range there is the PRACTICAL WIRELESS Service Manual, which not only describes the use of test instruments, but also describes their construction. The makers of the Avo range of instruments also publish a book on Servicing—"Radio Servicing Simplified"—which deals with the matter, and makes specific reference to the Avo instruments. This particular book has now reached its seventh edition, a fact which speaks well for its contents and value to those interested in servicing and general application of associated meters. Many new pages have been added and, in its present form, it represents a work which should be in the possession of all of those connected, in a private or trade capacity, with the investigation and elimination of the varied forms of trouble encountered with radio equipment in general.

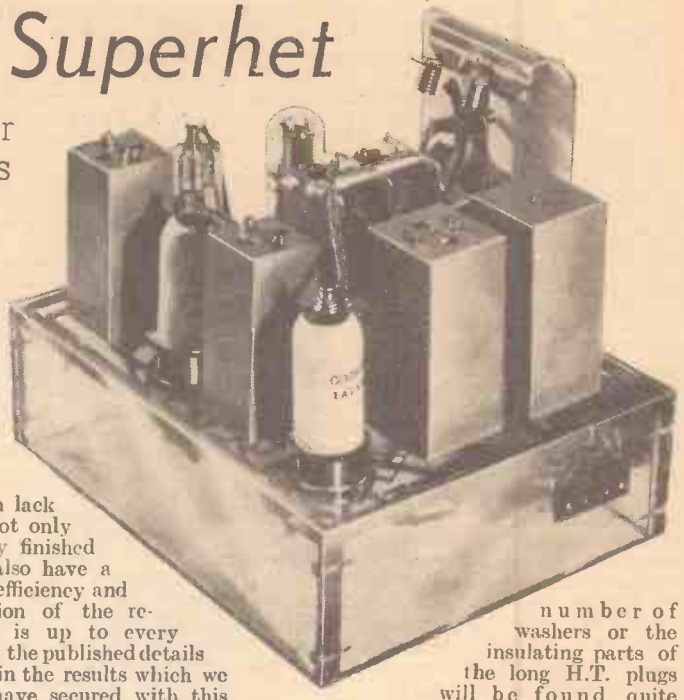
All-dry 4-valve Superhet

Final Constructional Details, Together with Wiring Plans are Given in This Article

IT is hoped that the preliminary details of this up-to-date receiver given in the October issue will have been sufficient to whet the appetite of those constructors who have been waiting for a very efficient, compact superhet receiver built around the latest low-consumption or all-dry battery valves.

Those who have already examined the theoretical circuit (reproduced below) will see that the circuit adopted is a perfectly standard four-valve superhet covering the medium and long waves, the whole operating from one dry battery which provides the required L.T. and H.T. supplies. This item alone is a great inducement to those who have experienced trouble with accumulator charging, and a run-down cell just when they wish to listen to some special news item, or a particular part of the entertainment programme. No battery is necessary for the grid bias, as this is obtained by the usual automatic G.B. method, therefore, one can describe, in the true sense, the receiver as being a single battery installation.

Before going on with the constructional details, it would appear that it is essential to make one small item clear. We made reference in our last issue to Messrs. Bulgin supplying suitable strips of metal for the coil mounting. We explained that they would quite naturally make a nominal charge for the strip of metal, and that it was only necessary to use such methods if a wooden chassis was used for the set construction. If a metal chassis is used, preferably 18 gauge, there will, of course, be no need for the additional metal strips, as the special fixing clips fitted to the Bulgin square-can products are designed for such gauge metal.



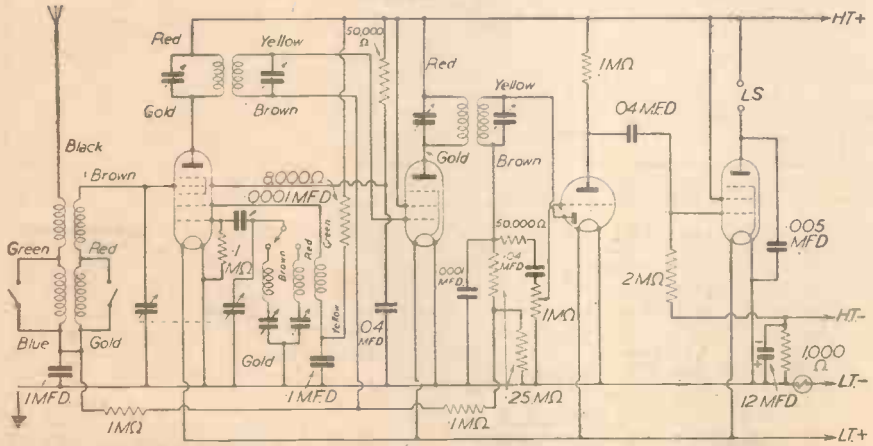
Three-quarter rear view of the receiver. Note the compact arrangement of the components.

Preliminary Details

A careful examination of the plan of the receiver will reveal all the essential measurements for accurate location of the various components, and the drilling of all fixing holes. Particular care should be taken to see that the various parts are lined up according to the plan, otherwise the neat symmetrical and almost commercial finish will be lost. Such lack of attention will not only result in an untidy finished product, but will also have a direct effect on the efficiency and satisfactory operation of the receiver; therefore it is up to every constructor to follow the published details if he wishes to obtain the results which we and other testers have secured with this receiver.

One point which might not be too clear from the plan is that the two-gang variable condenser is mounted approximately 1in. above the top of the chassis. This has been found necessary to enable the particular type of slow-motion drive which has been specified to be fixed in position. To obtain the desired support for the condenser, small pieces of tubing and bolts can be used, or if the tubing is not available, a suitable number of washers or the insulating parts of the long H.T. plugs will be found quite satisfactory.

It will be noted that the aerial and earth and loudspeaker socket strips have been fitted to the sides of the chassis, the former on the left, and the latter on the right when viewing the chassis from the front. These positions were adopted to simplify wiring and avoid long straggling leads, but it will also be found that when the receiver is fitted into a cabinet the locations of the strips will lend themselves to easy connections to their respective leads.



Theoretical circuit of the receiver, with colour-coded references for the coils.

Construction

Before commencing any drilling, it is advisable to accurately mark out the points where holes have to be drilled, thus ensuring the accurate locations of the various parts. For example, if the centre lines for the valveholders are drawn it is quite an easy matter, by using a valveholder, to register their fixing holes, and the same applies to the I.F. transformers, coils, and slow-motion drive fixing bracket. Once the small holes have been drilled the inch and $\frac{3}{16}$in. holes can be drilled for the valveholders, and the smaller ones on the front of the chassis for the wavechange switch and volume control. When all drilling has been completed, the valveholders, coils, I.F. transformers, strips, wavechange switch, and volume control can be mounted, but it is not advisable to fix the two-gang tuning condenser and dial

LIST OF COMPONENTS

One Bulgin coil, type 72.

One Bulgin coil, type 70.

Two Bulgin I.F. transformers, type 73.

One 2-gang tuning condenser, bar-type J.B., .0005 mfd.

One tuning dial J.B. square Airplane type.

One wavechange switch, Bulgin type, S.204.

Four octal valveholders (Clix).

One each A.E. and L.S. socket strips (Clix).

Fixed condensers (Dubilier):
Two .1 mfd., type No. 4603/S; three .04 mfd., type 4601/S; two .0001 mfd. type 4601/S; one .005 mfd., type 4601/S; one 12 mfd., type 3016.

Resistances (Erie), ½-watt type:
Two 1 megohm; two 50,000 ohms; one 100,000 ohms; one 8,000 ohms; two .25 megohms; one 2 megohms; one 1,000 ohms; one potentiometer with 3-point switch, one megohm.

Three top cap connectors, Bulgin, type P.96.

Four Cossor valves, Types 1.A.7.V.G., 1.N.5.V.G., I.H.5.G., I.C.5.G.

One wooden chassis, 10in. by 8in. with 2½in. runners.

One H.T. and L.T. dry battery, type H. 1157 (Exide).

One W.B. speaker.

in position until the major portion of the wiring has been completed.

It will be found easier if the filaments are wired first, and then the connections from the coils to the wavechange switch. At this stage a word might be beneficial about the small rotary switch employed for wavechanging. In diagram form a switch of this type often appears to be very confusing or complicated to many constructors, but if it is examined it will be found that it is nothing more than a 4-point switch, each point or moving arm having three individual contacts with which it can make electrical connection. In the actual circuit only three points of the switch are used, and only two contacts of each section, therefore no difficulty should be experienced in following the wiring plan.

I.F. Transformers

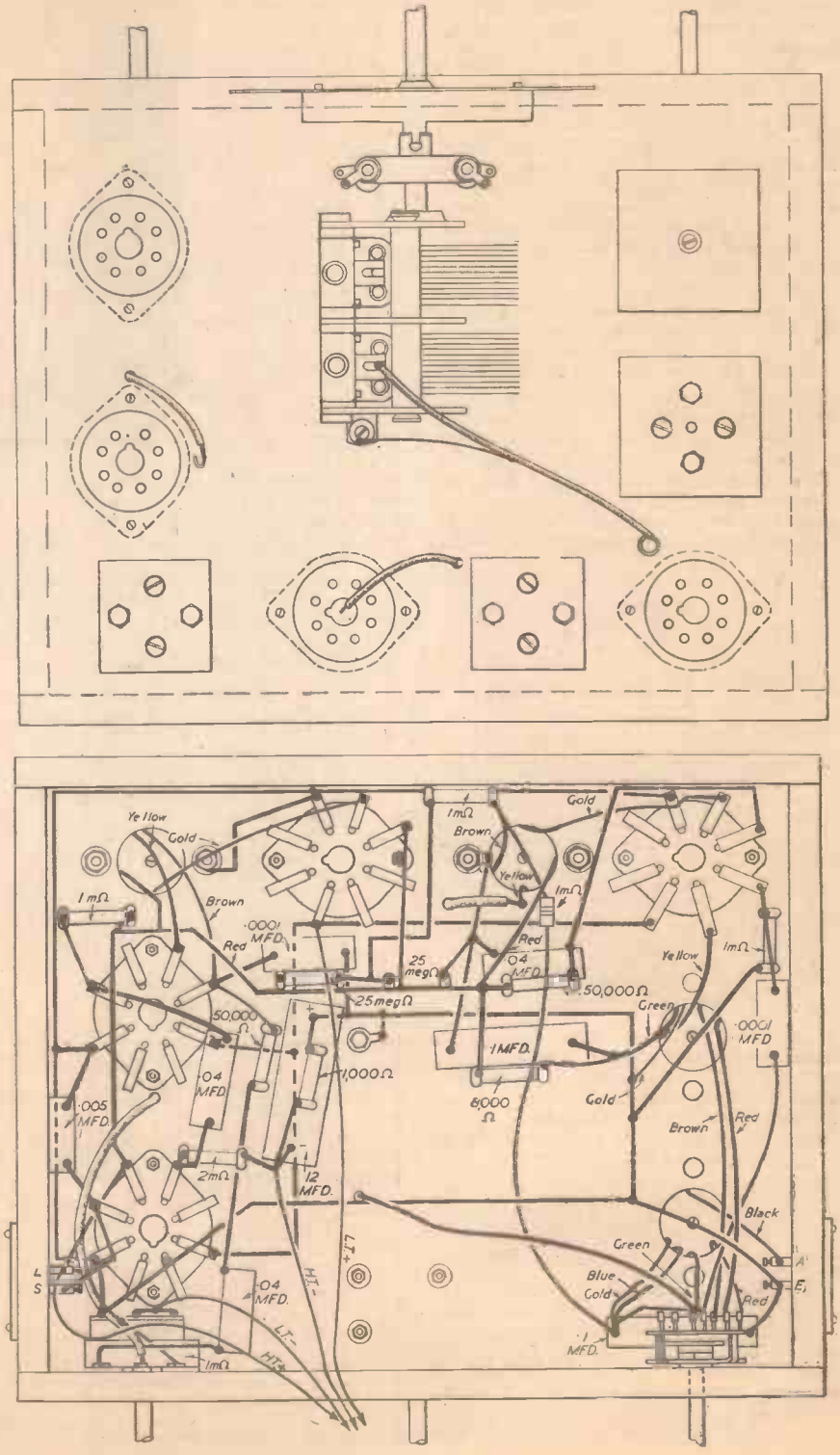
The transformers used are fitted with four coloured leads each of sufficient length to make contact with their respective connections, thus eliminating the necessity of insulating sleeving. The colours are clearly indicated on the wiring plan, but it will, of course, be necessary to take the usual care to see that the leads are not confused or changed over as regards connections. A word of warning is necessary concerning the two trimming adjustments fitted to the top of each I.F. transformer. When testing a set of this type many constructors adopt the rather unsatisfactory method of varying these adjustments if results are not immediately obtained.

This procedure is not to be encouraged as the components are sent out by the manufacturer adjusted to their specified frequency, and if such adjustment is upset, it can be quite difficult to obtain an accurate setting again without the use of an external oscillator. When the set is working, it is permissible to make very delicate adjustments to the I.F. transformers to get the maximum response, but it is an item which should be treated with great respect and reserve.

Resistances and Condensers

Whether it is due to the fact that these components are small and insignificant that so many constructors appear to treat them with scant consideration, or whether it is due to the idea that their location and associated wiring is of no importance, we cannot say, but from actual experience we do know that many good sets can be ruined by slovenly placing and wiring of such parts. Therefore, with the set in question, we would advise all constructors to endeavour to locate each condenser and resistance in the positions shown on the plan, and adjust the wiring accordingly. Short wiring means rigid support for these parts, while on the other hand, instability and inconsistent results can often be traced to resistances and condensers which are free to vibrate, and almost sway in a receiver.

WIRING DIAGRAM OF ALL-DRY 4-VALVE SUPERHET



Prize Problems

PROBLEM No. 413

LANE decided to build a four-valve superhet receiver of the battery-operated type. He made a fine job of the assembly work, and as the I.F. transformers he used were purchased secondhand, he lined them up to their correct frequency by means of an external oscillator, which also proved that the L.F. side of the circuit was O.K. On connecting the receiver for an aerial test, he was very disappointed to find that results were most unsatisfactory, that selectivity was non-existent and that all his labours appeared to have been wasted. On making further tests, currents and voltages were within reasonable limits, and all valves were beyond suspicion. Where had Lane slipped up? Three books will be awarded for the first three correct solutions opened. Entries must be addressed to The Editor, PRACTICAL WIRELESS, George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Envelopes must be marked Problem No. 413 in the top left-hand corner and must be posted to reach this office not later than the first post on Monday, October 14th, 1940.

Solution to Problem No. 412

Major made three main mistakes. He should not have arranged the switching to bring the P.U. directly in the anode circuit, as it would thus have to carry the anode current of the output valve, and, bearing in mind the P.U. winding, this procedure might cause a burn out or damage to the movement. He should have used a choke filter coupling or, better still (the second mistake) a proper matching transformer to allow the P.U. to match up with the specified load of the output valve. Thirdly, it was not wise to use a new steel needle.

The following three readers successfully solved Problem No. 411 and books have accordingly been forwarded to them:

H. Tilbury, "High View," 26, Coningsby Road, High Wycombe.

A. E. Yorston, 35, Cecil Road, Chadwell Heath, Romford, Essex.

Hy. Hayes, 5, Springfield Avenue, Golbourne, Nr. Warrington.

ROUND THE WORLD OF WIRELESS

Bombing to Radio

THE crew of one of our bombers over Ludwigshaven dropped their bombs to the accompaniment of the National Anthem. The pilot said : " Just as we were making our run I switched on the radio set and evidently got the Empire programme. 'God Save the King' rang through the machine. It was about halfway through when we picked it up, and it ended exactly as we released our bombs. They made an excellent effect."

South African Broadcasting

ONE of the outstanding features of the recently issued report of the South African Broadcasting Corporation is the successful inauguration of the diversity receiving station which is now being used continuously for the relay of outstanding transmissions from oversea. The cost of the equipment for this station is given in the report as £3,328. An increase in the Union of more than 36,000 licence holders during 1939 is reported.

U.S.A. and International Radio

BROADCASTING authorities in the United States have decided to spend 2,000,000 dollars for new and more powerful equipment to increase their scope in international radio. The step will be taken because U.S.-originated programmes have proved so popular in South America. International short-wave programmes may be sponsored, but with limitations on commercial announcements. The types of programmes most popular in South America are news, educational talks, fashion notes and Hollywood gossip.

Broadcast Expansion in India

OWING to the increased demand for wireless in that country, the Government of India intend to take early steps to institute the manufacture of cheap radio sets. With this object in view the question of the manufacture of sets has been referred to the Industrial Research Board.

It is felt that medium-wave sets could be produced in India. They would considerably meet the ever-growing demand.

Indian Listeners

AN important milestone in the history of Indian broadcasting has been reached. The number of licensed listeners recently passed the six-figure mark, the actual total being 1,000,388. The 26,690 licences issued during the preceding year is a record.

Radio's Part in War

THE radio industry in Australia are very concerned with the use of radio in all the Australian forces and the need for their being equipped with the most modern radio apparatus—and plenty of it, says the *Radio and Electrical Retailer* (*Australia*). Not just a sufficiency, but an over-abundance is required, because it is just as vital in war as petrol, 'planes, tanks and munitions.

Without adequate communication, no army or air force or navy can function successfully.

Don't Dump Used Batteries

THE problem of disposing of all H.T. and G.B. batteries is now solved. No longer is it necessary to litter up the shelves and odd corners of the den with dead cells; the Salvage Dept. of the Ministry of Supply want them, and want them urgently. This also applies to old torch and pocket lamp batteries, so it is now up to every reader of PRACTICAL WIRELESS to get busy, and turn out all the old and useless batteries which, for some unknown reason, we all seem to store rather than dump.

A moment's thought will reveal that these batteries contain very useful products; in point of fact; weight for weight 10 per cent. is zinc, 3¾ per cent. carbon rods, 10 per cent. pitch, 50 per cent. a mixture of graphite, manganese ore, beconite, etc., 10 per cent. cardboard, 3¼ per cent. pulverised carbon, and approximately 1 per cent. of brass and copper.

Radio students receiving training on transmitting apparatus at the College of Wireless and Telegraphy, Manchester.

KDKA Pioneer Honoured

IT is reported that Dr. Frank Conrad, assistant chief engineer of the Westinghouse Electric and Manufacturing Co., of America, received the medal of merit of the American Institute of the City of New York, for his pioneering work in short-wave radio communication and for developing the first broadcasting system. Dr. Conrad was responsible for the inauguration of America's first broadcasting station, KDKA.

Nuisance Value!

WE understand that Lancashire County Council have adopted a new by-law imposing a penalty of £5 on persons creating a nuisance by wireless or gramophone in private houses. The areas covered include parts of the Fylde.

Ever-Ready Spitfire

IT is interesting to note that the directors and staff of the Ever-Ready Co. (Great Britain), Ltd., have subscribed to purchase a Spitfire, and a cheque has been forwarded to the proper authorities.

News But Not Music

AN Indian frontier mullah has given an interpretation of the Islamic law to the effect that a radio receiver can be used for the reception of news but not for music. It would appear that this ruling was brought about by a rival fakir who did not own a receiver, and who condemned the use of radio as being opposed to Islamic law.

S.A. Radio Demands Up

THE desire to keep in touch with all the latest war developments and news has given a great boost to the sale of radio receivers in S. Africa. It is estimated that at least one-half of the white population now listens-in and it is fairly certain that this figure will continue to show a steady rise.

Remote Control

THE Westinghouse Electric and Firestone Tyres of U.S.A. have developed a system whereby landing lights for seaplane bases can be switched on by radio from a control point approximately six miles away. The lights, fitted to rubber buoys, are provided with a small battery-operated receiver and a " whip " aerial.

LATE DELIVERY OF " PRACTICAL WIRELESS "

A Message from the Editor

We are doing all we possibly can to ensure that "Practical Wireless" reaches you regularly every month, but occasionally there may be a delay owing to the dislocation of transport caused by air raids.

If, therefore, "Practical Wireless" should arrive after the normal day of sale, please help your newsagent by accepting your copy as usual. Under the Government's Paper Control Order he is unable to return unsold copies, and if you refuse to accept he will have to pay for it himself.

Your newsagent is working under difficult conditions these days, and your kind co-operation in this matter will be greatly appreciated by him—and by ourselves.

Cutting Out Resonance

How Loudspeaker Cabinets can be Improved in Order to Obtain More Faithful Reproduction of the Low Notes

IN an endeavour to obtain good reproduction of the lower notes, many listeners have either purchased a loudspeaker which has a bass resonance, or have fitted a good loudspeaker into a cabinet which resonates to some low frequency, and thus gives that boomy effect which is so distasteful to a music lover. What is resonance? In the case of a

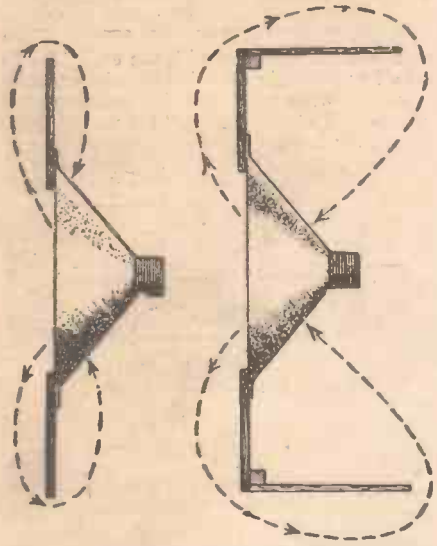


Fig. 1.—Showing the path taken by the surrounding air when movement of the cone takes place.

badly-designed loudspeaker it is a tendency to over-accentuate certain low notes. This may arise from a cone which is too loosely suspended; from a cone which is made from unsuitable material; or from a speaker in which the design of the transformer and speech coil has been so arranged that emphasis is given to a particular frequency. In certain speakers, designed about two years ago, this artifice was often incorporated in order to give the impression that the speaker was good in the bass. When heard standing on a counter, or without a good baffle, it certainly gave that impression, but when mounted in a cabinet, the undue prominence immediately spoilt not only musical items but also speech. The wrong design of the amplifier can also give rise to resonance, and especially in the choice of the coupling condenser in a parallel-fed L.F. transformer circuit is the resonance effect noticed. A good moving-coil speaker should have a straight-line response, that is, it should not reproduce any frequency at a different strength from any other. A good speaker fulfils this condition, but in order to hear the low notes in the musical scale it is necessary to exercise certain precautions.

How the Low Note is Produced

When the signals are fed to the speaker, they cause the cone to move backwards and forwards, and this produces movements of the air and so gives rise to the sounds which we hear. The movement at the extremely low pedal notes of an organ, for instance, is so steady that it may actually be seen if the cone is closely examined. Owing to this slow movement, if we stand an M.C. speaker on the table we should find that the note would be practically lost, owing to the fact that the displacement of the air in one direction is cancelled out by the movement of the air from the opposite side of the cone. This is illustrated in Fig. 1, where the cone has moved forward and should, by so doing, have compressed the air and so caused a forward motion to the air in the direction indicated by the arrows. This movement causes a rarefaction of the air at the rear of the cone, and, therefore, it is easier for the air to rush round to the "space" so formed than it is to compress itself in a forward motion. Consequently, the sound is almost cancelled out. To avoid this we use a baffle, or in other words we interpose something in a line with the edge of the cone to prevent this movement of the air from one side to the other. In order to obtain good response of the various notes it is necessary to make the path of the air from one side to the other a function of the actual wavelength of the sound, and then the cancelling-out will not take place. The actual length of the air path which we must provide for certain frequencies in the lower musical scale is shown by the following table.

Frequency.	Length of air path.
30 cycles per sec.	9ft.
45 „ „ „	6ft. 9in.
60 „ „ „	4ft. 6in.
75 „ „ „	3ft. 6ins.
100 „ „ „	2ft. 9ins.

These distances are from the front surface to the back surface of the cone, and, therefore, the distance along the surface of the baffle is approximately half of the above distances.

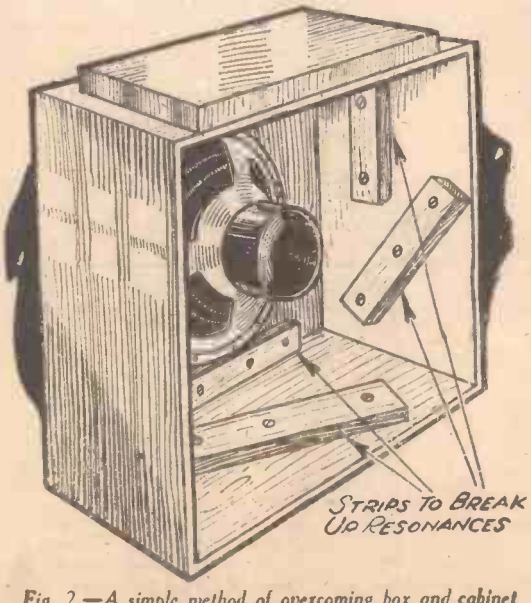


Fig. 2.—A simple method of overcoming box and cabinet resonances. The number and length of strips will depend on cabinet construction.

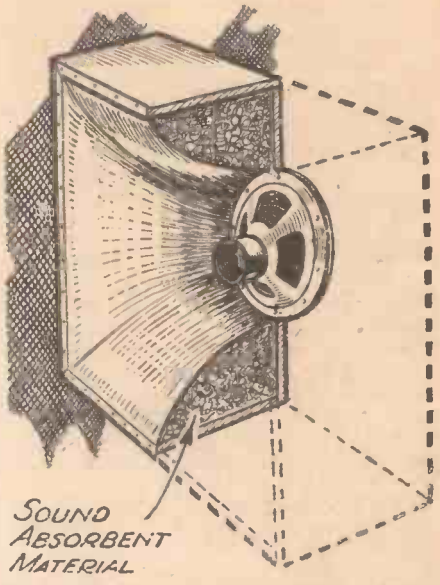


Fig. 3.—One of the best arrangements, provided care is taken with the actual packing and shaping of the absorbent material.

The Ideal Baffle

The ideal baffle consists of a perfectly flat board, and this type may be seen at the Science Museum at South Kensington, where the ideal broadcast receiver is demonstrated. In the home, unfortunately, such a baffle would be out of place, and we are forced to cut it up and bend it to form a cabinet. The first thing to bear in mind, therefore, is the actual length. The above dimensions should not be reduced, but the sides of the cabinet must always be smaller than the front. That is the first point in avoiding resonances. Keep the sides as narrow as possible, and thus approach the flat baffle. If a small table cabinet is to be used, do not close the back. If dust must be excluded, use thin gauze or drill or cut some kind of very large holes in the back and cover these with gauze. It is also important that the cabinet should be stood well away from the walls, so that no box effect is created. The actual material should be of sufficient thickness to prevent vibration at very low frequencies, but if thick wood cannot be worked, or an old cabinet is in use where this resonance occurs, strips of very thick wood may be screwed across the sides and front at odd points, and at varying angles, to break up the resonance (Fig. 2). Alternatively, the box may be lined with some sound-absorbent material packed in a canvas lining, or thick felt (carpet underlay) may be glued on the inner surfaces of the box (Fig. 3).

Gramophone Cabinets

All of the above schemes may be adopted in the case of radio-gramophone cabinets, although in this case we have a much larger area at our disposal, but this is often offset by the

(Continued on next page.)

CUTTING OUT RESONANCE

(Continued from previous page.)

fact that the apparatus is generally much more powerful. The usual method of dividing the cabinet into two parts, and packing the receiver equipment into one and the speaker in another is not ideal. One well-known commercial receiver manufacturer has already departed from this method of design and has considerably improved reproduction as a result. A scheme which I have incorporated in my own radio-gramophone for some time now has, however, been found ideal from the point of view of improving the lower ranges, and is shown in Fig. 4. The receiver is supported on a small shelf, only as wide as the receiver chassis, and this is screwed to the front of the cabinet. Thus it performs two functions, it breaks up the tendency of the front to resonate, and it avoids the division of the cabinet into two parts. The speaker is similarly disposed at the bottom of the cabinet, but to take the weight, strips of quartering are fitted across the inside of the cabinet and it rests on these. Finally, there is no bottom to the cabinet, and it is fitted with distance pieces to prevent it from being pushed up close to the wall. A cabinet improved on these lines will be found to offer better reproduction than the average type of cabinet, and the schemes given above are well worth trying. W. J. D.

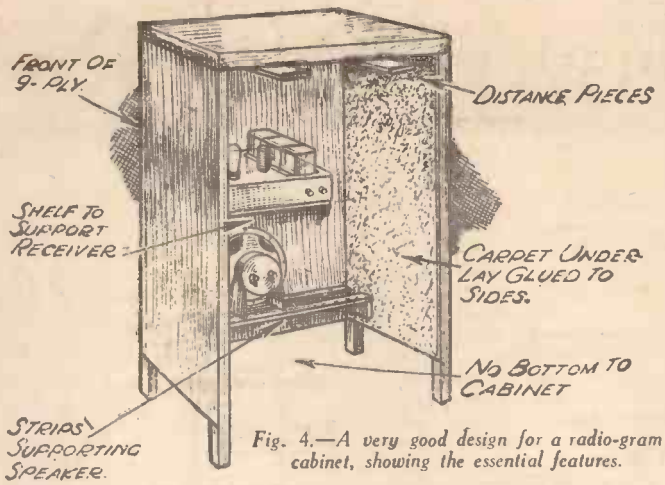


Fig. 4.—A very good design for a radio-gram cabinet, showing the essential features.

A NOVEL SENSITIVITY DEVICE

A System of Reaction Particularly Suited to "Stand-by" Receivers

WE are all familiar with the simple one-valve circuit shown in Fig. 1. It is not, however, suited to modern conditions, even as a "stand-by" set. Generally it is modified to appear as in Fig. 2. The purpose of the modification shown in the dotted area A is to allow reaction, and thus raise the sensitivity of the set. The condenser C is included to make reaction smoother, which is essential, and it may be either entirely separate, or one "side" of a differential condenser.

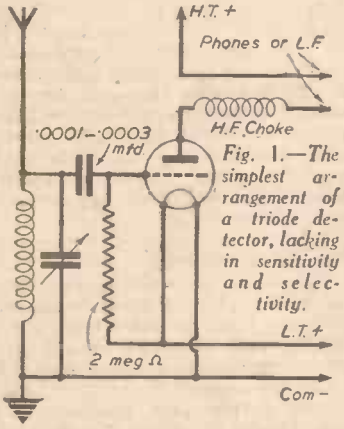


Fig. 1.—The simplest arrangement of a triode detector, lacking in sensitivity and selectivity.

The modification shown in the dotted area B of Fig. 2 is an aerial series condenser. Its purpose is, briefly, to reduce aerial damping, and allow the valve to oscillate more readily.

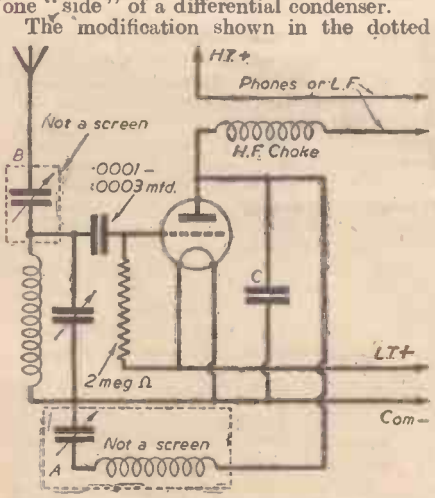


Fig. 2.—A more familiar and likewise more efficient one-valve circuit.

Having briefly run over the simple sets likely to be used as "stand-by" sets, or in the case where a receiver is being installed for a new listener, when a very simple set is usually required, we will now go on to Fig. 3. As shown it is a modification of the original Reinartz. Now to consider its action.

Operation

When the moving vanes, Z, of C_1 mesh with the fixed vanes, Y, the same reaction effect is got as in Fig. 2, but as Z intermesh with Y they separate from the fixed vanes, X, thus reducing the aerial coupling capacity. When Z intermesh with X the reverse takes place.

It may seem that in practice this would give an almost constant level of volume, but it does not really. In any case the purpose of C_1 is not to control volume but to increase (or decrease) the "reaching out" power of the set. The bypass condenser, C_2, should preferably be of the pre-set type, as this allows the smoothness of reaction to be adjusted. A value of .0003 mfd. max. will generally be suitable. The value of C_1 will depend on the coil used, but should be slightly larger than recommended for use with the coil. This is to allow a certain capacity to exist between Z and X even when reaction is being used to the full at the "high" (in wavelength) end of the band.

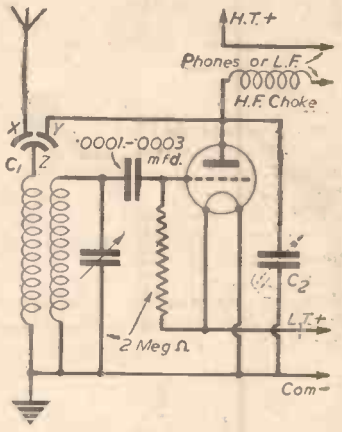


Fig. 3.—Showing the final development of the circuit to embody the features discussed by the writer.

The system has not been tried on short waves but, theoretically, there is no reason why it should not give the same good performance as it does on medium waves. The various "stand-by" sets described in this journal on September 23rd, 30th, October 7th, 14th, December 2nd, and 23rd, 1939, can easily be converted to this system, the only extra components, in most cases, being the pre-set condenser, which may occasionally be omitted.

LATEST PATENT NEWS

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Latest Patent Application.

13251.—Fletcher, H. L.—Wireless receiving apparatus. August 20th.

Specifications Published.

524752.—Naamlooze Vennootschap Philips' Gloeilampenfabrieken. — Tuning mechanisms of radio-receivers.

524776.—Kolster-Brandes, Ltd., and Smyth, C. N.—Television receivers of the superheterodyne type.

524733.—Naamlooze Vennootschap Philips' Gloeilampenfabrieken. — Radio-receivers.

525135.—Crowley, D. J.—Combined articles of furniture and radio-receiving set.

525084.—Nehrke, C.—Apparatus for tuning radio-receivers or like apparatus.

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at the uniform price of 1s. each.

War-time Experiments

"The Experimenters" Make a Number of Suggestions for Interesting Experimental and Constructional Work Suitable for Present Conditions

THE whole field of radio experimental work has undergone a change during the past year, and many have even come to the conclusion that there is nothing further that can be done until the war is over. Of course, that is a mistake, although it must be admitted that amateur short-wave work is dormant. There is also the difficulty of obtaining components in some cases, and so the best use must be made of the parts which are already on hand.

Medium and Short Waves Only

One direction in which experiments may be aimed is in designing a simple type of receiver, compact in form, which will give reliable reception of the B.B.C. programmes on medium and short waves. Long waves are not required at present, and this fact helps to simplify home-made coil design, and also tends towards increased efficiency. A very satisfactory tuner for the 19-50 and 200-600-metre bands (approximately) can be made as shown in Fig. 1. Use is made of a 2in. diameter paxolin or shellacked cardboard tube, the upper end of which carries the tuning and reaction windings for short waves, and the lower end the medium-wave windings. This coil is suitable for use with either a Det.-L.F. or an H.F.-Det. type of receiver and the connections are shown in Fig. 2.

It should be noted, in making the tuner, that all windings are in the same direction and that, for convenience in buying the wire, the same gauge is employed throughout. This is shown as 26-gauge enamelled, but 24- or 28-gauge could be used if this were more convenient. It could be argued that wire as fine as this is not ideal for a S.W. coil, but in practice the loss of efficiency is negligible in the type of "emergency" receiver that we have in mind.

If an H.F.-Det. type of set were to be built a coil of the type shown could be used between the H.F. and Det. valves, whilst an even simpler arrangement could be used in the aerial circuit. Thus, the short-wave windings could be omitted and the M.W. reaction winding used for aerial coupling. On short waves, a good S.W. choke could be switched into the aerial circuit in place of the tuner. The chief advantage of this is that the only tuning condenser required would be a single one of .0005-mfd. capacity.

'Phone Reception

In many cases it will be considered preferable to use headphones only for reception, especially if the set is to be used in a shelter, where children may be asleep.

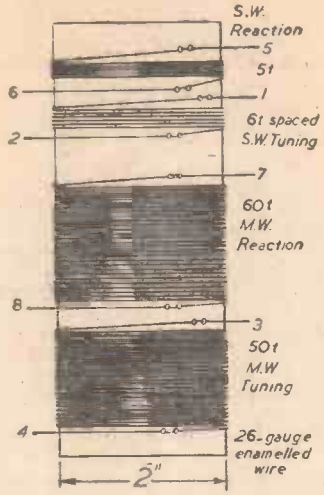


Fig. 1.—Details of a suitable short and medium-wave coil shown approximately to scale, assuming the use of 26-gauge enamelled wire. The length of the former should be about 5in., or 6in. if 24-gauge wire is used.

The two-valve H.F. circuit is then most suitable, because the detector will give an ample output for 'phone operation, and the H.F. stage will give the necessary amplification to ensure that any of the B.B.C. transmissions can be received in all conditions.

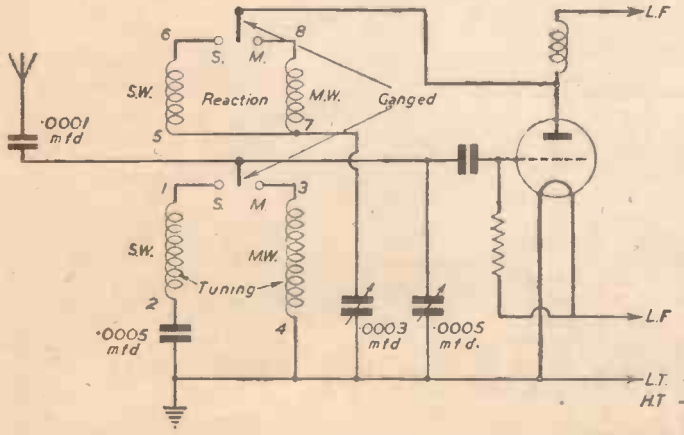


Fig. 2. — Connections which are suitable for a coil of the type shown in Fig. 1. The terminal numbers are indicated to agree with those shown on the ends of the coil windings.

As an alternative to the tuning condenser it will often be considered better to use three pre-set condensers for the three M.W. transmissions, and a .00016-mfd. variable condenser for tuning the short-wave coil. This method is especially convenient in the case of a Det.-L.F. receiver, since a three-point rotary switch is sufficient to select the required M.W. programme. When there is an H.F. stage, two such switches—ganged together—will be required.

"All-Dry" Valves

Many battery-set users will find it worth while to replace the 2-volt valves at present fitted by the newer valves of the "all-dry" type, which have a filament rated at 1.4 volts. Most of these valves are of the octal-base type, the connections for which are indicated in Fig. 3; it should be noted that the pin positions are those seen from the underside of the valve holders. It should also be remembered that different connections are used in some cases and that Mullard 1.4-volt valves have side-contact bases.

When using this type of valve it is possible to use a single battery of the combined H.T.-L.T. type, but where sufficient space is available it is our opinion that it is worth while to use a larger 1.5-volt cell of the kind generally described as bell cells. These are cylindrical and about 8in. high. By following this arrangement the possible difficulty in certain localities of obtaining a special H.T.-L.T. battery is avoided, and the single cell will have an extremely long life. The price is about two shillings, and therefore running costs are reduced to a minimum.

Valve Replacement

In general, two-volt valves can be replaced by their 1.4-volt counterparts as far as circuit considerations are concerned, the only important change required being in regard to the valve holders and the valve-holder connections. As triodes are not made in this range, however, an H.F. pentode should be fitted in place of the triode probably in use as a detector. By this means the general efficiency of the set will often be improved.

Reception in the Shelter

The question of obtaining radio reception in the air-raid shelter is receiving a good deal of attention nowadays, and the matter has previously been referred to in these pages. If the shelter is quite dry it may be satisfactory to instal a permanent receiver in it, especially if a car-radio is available—and also the battery power to

(Continued on next page)

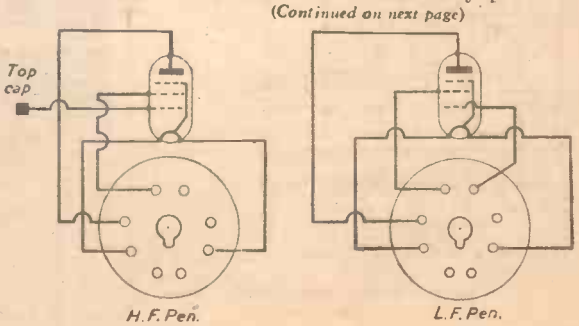


Fig. 3.—Valve-holder connections for 1.4-volt valves with International Octal base—Cossor, Osram, Tungsram.

WAR-TIME EXPERIMENTING

(Continued from previous page)

operate it! The battery may be left in the car if the leads from it are not more than about 30ft., and consist of cab-tyre cable.

Limitation of space is an important factor, but a small set can often be fitted to a bracket attached to the wall in a corner. With a steel shelter this can be done by drilling and bolting metal angle brackets and screwing these to the set. Care should be taken, however, that pitch, tar or a bituminous preparation is spread liberally around the holes to ensure that water leakage cannot occur.

With brick-built shelters the mortar can be drilled and plugged. The same method can be adopted with a concrete shelter, although in that case drilling will be more difficult, due to the hard nature of the concrete.

Mains Connections

Should it be decided to instal a mains operated receiver—and this is not recommended, and is strongly deprecated if there is any possibility of dampness—the mains lead used should be lead-sheathed cable, the sheath of which should be thoroughly earthed to a nearby water pipe or to an earth spike driven into the ground. A three-point connecting socket should also be used, the third socket being earthed to the metal sheathing. Additionally, a lead should be taken to the earth terminal or chassis of the set from the third pin on the plug. It is strongly urged that a mains switch should not be fitted in the shelter; instead, the set should be controlled by its built-in switch, and by a mains switch *fitted inside the house.*

In many respects it is better to leave the receiver inside the house and to run extension 'phone leads to a 'phone jack or two-pin socket in the shelter. Additionally, a simple type of volume control, in the form of a 100,000-ohm variable resistor, may be connected across the two points of the socket. It is often convenient to place two or more 'phone sockets in parallel, a single volume control being used for all, or a separate one for each.

ITEMS OF INTEREST

Permanent Detector Efficiency

IN those permanent or semi-permanent detectors in which two dissimilar crystals are held together by a light spring, there is a particular disposition of the crystals which makes for increased efficiency. One of the crystals is attached to a plunger, which is pulled back when adjusting the detector, and then the two crystals are allowed to come into contact.

If the point of the crystal which is attached to the plunger is central, it is obvious that the arc in which it travels when the plunger is turned is very small; in fact, it may touch the other crystal always at about the same place, leaving the main portion of the crystal "unexplored." Whereas if it were at one side it would sweep all over the stationary crystal as it was turned round, owing to the increased arc of its travel.

The remedy is obvious if on inspection the highest point of the moving crystal proves to be nearly central. The crystal is usually held in its cup by a kind of solder. By melting this solder and rearranging the crystal so that a point projects at one side of the centre this state of affairs will be rectified. It is sometimes possible to split the crystal with a razor blade so that a sharp point is obtained.

War Talks

Do they think that the British are morons
When they vapour in front of the mike,
And put on that "Know-it-all" manner,
Which the rest of us greatly dislike?
Do they think that their hooey and slogans
Are the very best ways to win?
Will their ossified brains never tumble
That the British can "take it" and grin?
Will they never forget their Old School tie
And "We can't hit a 'plane when it's down"?
Will they still argue ethics of warfare
Whilst the Nazis are razing the town?
Do they hope to tame tigers with tea-cakes,
Or cobras by stroking their tail?
Don't they know that mad dogs are a danger
And "cure them by kindness" must fail?
The Nazis are sub-human perverts,
And to win we must treat them as such;
They started their Blitzkreig of horrors,
To stop 'em—give them twice as much.
A dose of their own foul prescription
They would probably never survive,
Let's start and keep on with this dosing
Till there isn't a Nazi alive.
Soothing syrup's not wanted by Britons;
What they ask for is action, not dope.
We're in total war—make it total.
We want deeds and not talks or soft soap.

"TORCH."

German Radio in the Field

ACCORDING to an American contemporary, information has leaked out that not the least part in the success of the German offensive, and the concurrent failure of Norway, Holland, Belgium and, finally, France, lies in the superb communications system which was able to establish and maintain communications with moving tanks and troops at as great distances as 250 miles from home stations. Nothing available in the U.S.A. can touch that at present. Development work along lines towards obtaining long-range mobile type of equipment will probably be done jointly by the Government and the great body of American amateurs.

Still Room in the R.A.F.

EVERY week that passes enables the Royal Air Force to absorb and employ more of the available talent and energy of the younger generation—both men and women.

Wireless mechanics are still wanted. Applicants should have a sound knowledge of the theory and practice of wireless sets and practical experience of the radio trade. Tradesmen rather than instrument makers are required. New opportunities for men anxious to undertake air crew duties have resulted in a speeding up of enrolment. There is still room for pilots, wireless operator-air gunners and observers. Accepted candidates are now usually called up for training without undue delay.

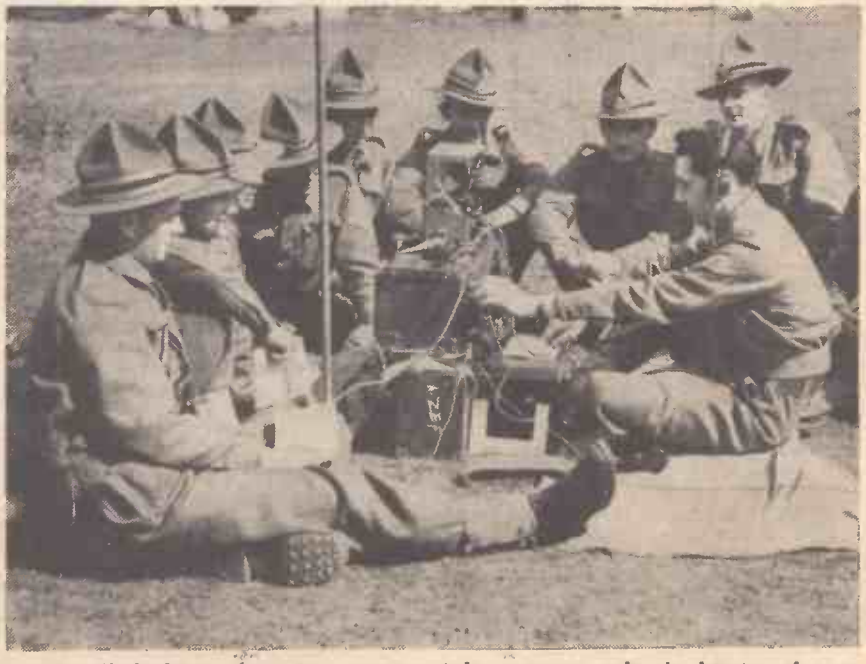
Intelligent women between the ages of 18 and 43 will find an opening as radio operators in the W.A.A.F. Free training is provided for this interesting work.

Men applicants should apply to the nearest Combined Recruiting Centre and women to the nearest W.A.A.F. Area Headquarters or to Victory House, Kingsway, London.

Australian (Melbourne) Transmission

Call signs	*Wavelengths*
Before 5.15 p.m. VLR3	Before 5.15 p.m. 25.25 metres.
After 5.30 p.m. VLR	After 5.30 p.m. 31.32 metres.

Power: 2 kilowatts
Frequencies:
Before 5.15 p.m. 11,850 kilocycles.
After 5.30 p.m. 9,580 kilocycles.
Location: Lyndhurst, near Melbourne.
The times given are Australian Eastern Standard, which is 10 hours ahead of Greenwich Mean Time. All mail matter should be addressed to: Australian Broadcasting Commission, Short Wave Section, Box 1686, G.P.O., Melbourne, Australia. Cables and Telegrams, "Abcom," Melbourne.



New Zealanders in this country receiving wireless instruction under the direction of a Canadian Corps Instructor.

For the Beginner

Harmonics in Wireless

An Interesting and Vital Subject Approached from a Fresh Angle so that the Beginner can Secure a Thorough Understanding of Harmonics

WHEN we strike a note on the piano, the sound produced is not a single tone, but consists of a fundamental or primary tone and several secondary tones. The fundamental note is naturally the most predominant, while the secondary ones or harmonics are of less intensity. These harmonics, as their name suggests, are notes which harmonise with the fundamental. This is because the speed of frequency of the vibrations which constitute them is always an exact multiple of the frequency of the fundamental. Thus, the second harmonic is a note which vibrates at twice the speed of the fundamental; the third harmonic, one with a frequency three times that of the fundamental; while the fifth has a frequency five times as great, and so on. We do not ordinarily refer to the first harmonic, as that is the fundamental note itself.

Harmonics and Tone

It is largely the presence to a greater or less extent of various harmonics which gives individual character to the notes of a musical instrument and enables it to be distinguished from any other instrument. Thus it is possible to differentiate between a note on the piano and the same note produced on a harp. You will readily understand, therefore, that for perfect reproduction of speech or music by radio and gramophone it is essental to preserve the original notes complete with their attendant harmonics. It is the mutilation of the harmonics which so often mars reproduction and produces characterless sounds from the speaker.

To give a simple instance of how some of the harmonics may be lacking from a receiver which through ultra-selective circuits or some other cause, produces a cut-off of audio-frequencies above, say, 5,000 cycles. Assuming the set to be an excellent reproducer in every other respect, it might be thought that all notes below 5,000 cycles would be faithfully reproduced, and that it would only be the high notes above this frequency which would be distorted. This is not so, however, for many of the lower notes may be rich in harmonics, extending above 5,000 cycles. Thus, for example, a note such as C (1,024 cycles) may be attended by the third, fifth and seventh harmonics, which correspond respectively to 3,072, 5,120 and 7,168 cycles, in this case, owing to the set's lack of response above 5,000 cycles, the fifth and seventh harmonics would be lacking in reproduction with consequent loss of quality.

In wireless, harmonics play an important part, but here we are not only referring to the harmonics of the sounds from the studio, but also to the harmonics of the radio and audio-frequency currents associated with the transmitting and receiving circuits. In order to get a clear conception of these it is, perhaps, just as well to examine the nature of the oscillatory motion of which alternating electric currents are constituted, and which is known as harmonic motion.

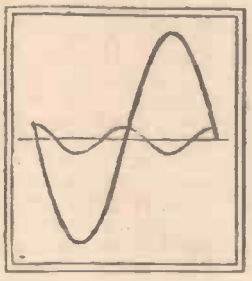


Fig. 3.—Sine curve representing simple harmonic motion together with another curve representing the second harmonic.

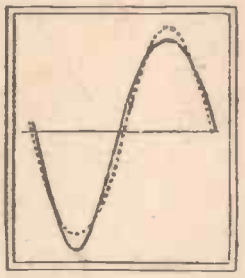


Fig. 4.—The result of combining the two curves, showing how the introduction of second harmonic alters the shape of the pure sine curve.

The Sine Curve

Look at Fig. 1. Imagine the line OP to be rotating at constant speed. From P a horizontal line is drawn to meet the diameter of the circle, AOC at M. As P rotates, M will move up and down AOC. Now, though the point P is moving at a uniform rate round the circle yet the movement of M is not uniform. It moves slowly as it approaches C and A, but quickly as it passes O. Its movement constitutes simple harmonic motion. If it is desired to show this motion diagrammatically, it can be done by plotting a graph. What we do is to first divide the circumference of the circle into, say, 12 equal parts, as in Fig. 2. The points 1, 2, 3, 4, etc. represent various positions of the point P in its rotation round the circumference of the circle. To the right of the circle we draw the graph. We draw a horizontal straight line, XY, to represent the circumference of the circle, and mark it off in divisions in the same way as the circle. These divisions each represent so many degrees, but they can also be used to represent equal intervals of time, since as P is moving at uniform speed round the circle, it always takes the same time to describe the same number of degrees, thus if P takes, say, 12 seconds to travel right round the circle, then it will take 1 second to travel each of the divisions round the circle. In the example given here, therefore, each interval marked along XY represents one second of time. At the points 1, 2, 3, 4, etc., along XY, we draw perpendicular lines each the same height above XY as the corresponding points 1, 2, 3, 4, etc., round the circumference of the circle as above DOB. We now join up the tops of these lines in the manner shown and thus produce an S-shaped curve which first rises and then dips below the centre line.

This curve is, of course, the well-known sine curve which represents, among other things, the oscillations to and fro of an alternating electric current. Similar curves must have been reproduced hundreds of times in these pages. Incidentally, the term sine is merely a trigonometrical expression indicating the relationship between MP and OP which is determined by the angle MOP.

Fig. 1.—Diagram illustrating simple harmonic motion.

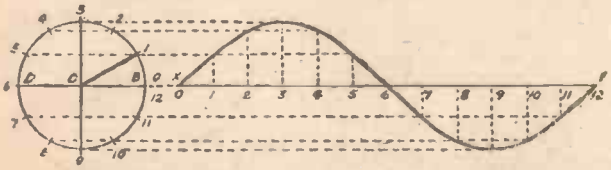


Fig. 2.—How to draw a curve representing harmonic motion. This is called a sine curve and is one of the two most important in wireless.

How Harmonics Alter the Curve

No doubt by this time you are beginning to wonder what all this has to do with harmonics. The answer is that harmonic motion in many different forms is represented by a sine curve such as this. Such motions include the vibrations of the strings of a musical instrument, the swinging of a pendulum, wireless wave motions in the ether, and high-frequency and low-frequency electric currents, etc. Now, whereas simple harmonic motion is represented by a pure sine curve, the presence of attendant harmonics modifies the shape of the curve in a very definite manner. For example, in Fig. 3 is shown the sine curve representing the fundamental of one of the above forms of motion which is accompanied by second harmonic of about 10 per cent. of the strength of the fundamental. The big S curve is the one corresponding to the fundamental, while the smaller one represents the second harmonic. As we should expect, the curve due to the harmonic has twice as many ups and downs

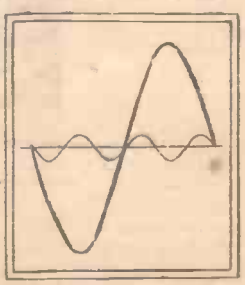


Fig. 5.—Sine curves representing the fundamental and a third harmonic.

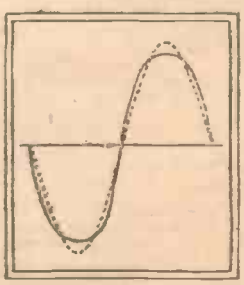


Fig. 6.—The effect of the third harmonic is to flatten the peaks of the fundamental curve.

per second as the other, indicating, of course, that its frequency is twice that of the fundamental. The effect of combining these two curves, in the relative phases shown, is illustrated in Fig. 4.

The resultant curve is, therefore, a graphical representation of this particular motion comprising fundamental, and 10 per cent. of second harmonic. In order to show clearly how the curve differs from that of the fundamental alone, the latter has been superimposed on the diagram in dotted lines. Perhaps the most striking difference between the two curves is the fact that the compound curve is asymmetrical above the centre line. However, the significance of this will be more apparent when we come to deal with harmonic distortion in valves.

Another very interesting modification of the pure sine curve is that produced by the introduction of the third harmonic. This is shown in Figs. 5 and 6. In Fig. 5 is depicted the two component curves—that of the fundamental and that of the harmonic, while in Fig. 6 is shown the resultant. It will be noticed that in this case the introduction of the harmonic has not produced an asymmetrical curve, but that the curve is very similar to the primary curve, the most obvious difference being that the "humps" have been lowered.

At the beginning of this article it was stated that in order to obtain a faithful and lifelike reproduction of the music in the studio it is essential to preserve the accompanying harmonics as well as the fundamental notes. It was also shown how through the various processes of transmission and reception it was quite possible to lose some of the harmonics with a resultant decrease in quality. Now, these harmonics are, of course, sound harmonics, and are represented in the transmitting apparatus by electrical impulses alternating at sound or audio-frequencies as we call them. They must not be confused with the harmonics produced in radio-frequency circuits with which we shall deal next.

Wavemeter Harmonics

Everyone who has handled a heterodyne wavemeter will be familiar with the production of harmonics by a valve oscillator. A heterodyne wavemeter consists essentially of a valve complete with a grid coil and an anode coil somewhat similar to an ordinary one-valve set employing reaction. The reaction, however, is turned "full on," by closely coupling the two coils, and thus continuous oscillations are set up in the circuit. The grid circuit is tuned with a condenser, calibrated in wavelengths or frequencies. To use the meter the condenser is set to the desired wavelength, and the valve switched on. The meter then works like a miniature transmitting station which radiates continuous waves at the wavelength to which the condenser is set. If an uncalibrated receiver is placed near the meter and the tuning dial of the receiver slowly rotated, at the same time keeping the set in a state of oscillation by use of the reaction control, a whistle or chirp will be heard in the speaker when the receiver is tuned to the same wavelength as the meter. This is due to the oscillations produced by the meter clashing with or *heterodyning* those given out by the receiver. In this way the receiver can be calibrated, since the point on the dial at which the squeal occurs corresponds to the wavelength to which the meter is set.

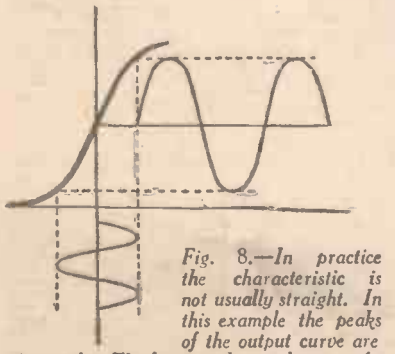


Fig. 8.—In practice the characteristic is not usually straight. In this example the peaks of the output curve are flattened. This means the production of a strong third harmonic.

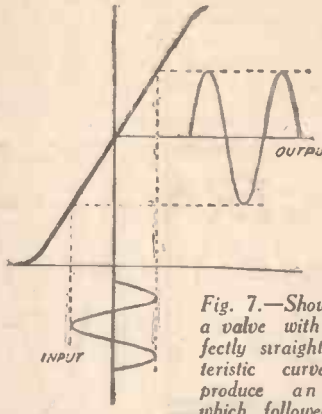


Fig. 7.—Showing how a valve with a perfectly straight characteristic curve would produce an output which followed faithfully the wave-form of the input and would, therefore, contain no harmonics.

This is all quite straightforward, but the trouble starts when it is found that the wavemeter not only radiates waves of the one frequency but also several harmonics. This is usually the case, and it will often be found that an instrument tuned to 1,000 kilocycles (300 metres) will also emit waves at 2,000, 3,000, and 4,000 cycles, and so on. That is to say, it will radiate waves which are the second, third, and fourth harmonics, etc., of the fundamental wave. The harmonics are nothing like so intense as the fundamental wave, but nevertheless confusion is likely to arise if the wavelength range of the receiver under calibration is entirely unknown. In this case it might happen that the fundamental wave emitted by the meter came right outside the wave-range of the receiver, so that one might quite easily mistake the loudest harmonic received for the fundamental, and to calibrate the receiver accordingly.

On the other hand, it may sometimes be very useful to have a wavemeter which emits harmonics, since the harmonics can be used to extend the range of the instrument. For instance, a meter which would not tune below 300 metres could be used for calibrations below this figure by utilising the harmonics. When set to 300 metres the second and third harmonics, if present, would occur at 150 metres and 100 metres respectively.

The production of harmonics by a valve wavemeter or transmitter occurs when the characteristic of the valve is non-linear. If you examine Fig. 7 you will see how a *straight* characteristic would produce an output which is a pure sine curve representing a simple oscillating current without harmonics. However, with a curved characteristic such as that of Fig. 8, in which the extreme limits of the grid swing run on to the upper and lower bends of the curve, the output is not a pure sine curve, but has the peaks flattened. This you will notice is similar to the curve shown in Fig. 6 and indicates that the valve would produce, amongst others, a strong third harmonic. Incidentally, if a valve curve is symmetrical about the mid-point of the grid swing, the positive and negative half-waves of the output will be similar, and therefore, any harmonics produced will be only the odd ones—the third, fifth, or seventh, etc. This is what we should expect from what we have already learned regarding symmetrical and asymmetrical curves.

Now if the grid of the valve be biased, or the anode voltage altered, so that the operating potential of the grid comes nearer to, say, the upper bend of the curve than the lower, as in Fig. 9, then the positive and negative half-waves of the output will be unequal, indicating that even harmonics also will be present in the output.

Distortion in Terms of Harmonics

It is not uncommon when reading about the output stage of a receiver or the output valve in radio journals to find references to the presence of a "5 per cent. of second harmonic distortion," or to learn that "with a pentode valve third harmonic distortion is most in evidence." Such phrases can usually be relied upon to impress the layman, and assure the writer of the respect and admiration which such clear evidence of his technical brilliance merits. However, such high-sounding phrases are not really so formidable as they appear. The presence of distortion in an output valve is conveniently spoken of as harmonic distortion, because it is caused by the characteristic curve not being straight over its whole working length, therefore, the output is not a strict replica of the input. In the case of the input being a pure sine curve the output might be a flat-topped curve as in Fig. 6, or unsymmetrical as in Fig. 4. In other words, it might be said to show the presence of third or second harmonics respectively. Figs. 8 and 9, although primarily intended to show the production of high-frequency harmonics, are equally applicable in this case. Fig. 8 shows how, with a large swing in the input voltages applied to the grid the operation extends beyond the straight part of the curve on to the upper and lower bends, and thus produces a flattening of the peaks of the output current, while Fig. 9 shows how the positive half of the grid swing makes a smaller variation in the output than does the negative half swing, thus giving an unsymmetrical output wave.

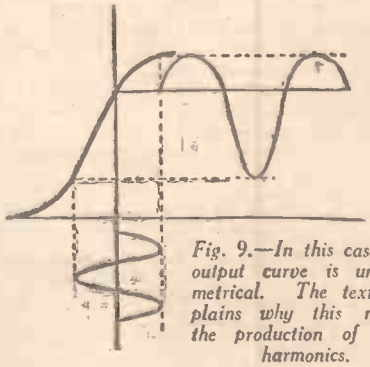


Fig. 9.—In this case the output curve is unsymmetrical. The text explains why this means the production of even harmonics.

When reference is made to "5 per cent. of second harmonic distortion" in the output of a power valve it means that for an input consisting of a pure sine wave the output wave would be distorted similarly to that shown in Fig. 4, and that the amount of distortion would be such that

(Continued on next page)

HARMONICS IN WIRELESS

(Continued from previous page)

the difference between the heights of the two half-waves would be 5 per cent. of the total height of the wave. It is generally taken that 5 per cent. of second harmonic distortion is the maximum amount permissible when this valve is handling its full input. This percentage does not cause a noticeable deterioration in quality, and is the amount allowed when calculating the "undistorted output" of a valve.

A very useful guide to the amount of second harmonic distortion in a valve is the length of what is called the *load-line*. This is a straight line drawn across the usual anode current—anode volts diagram issued by the valve makers. In the middle or thereabouts of the load-line is the operating point, usually marked "O." A comparison of the distances of the two ends of this line from the operating point gives an indication of the distortion present. If they are equal, then there is no second harmonic, but if the difference in their length is, say, 5 per cent. of the total length of the line, then there is 5 per cent. of second harmonic at the maximum input. Third harmonic distortion results in a curtailing of *both* ends of the load-line, and is, therefore, not immediately apparent from an examination of the load-line

It is perhaps hardly necessary to point out, in conclusion, that there must be no confounding the harmonics of the received signal, which form the "character" of the music and which it is desired to preserve, with the harmonics produced by receiving valves due to their non-linear characteristics. These latter, as we have just seen, distort the incoming signals by producing an output which is not a faithful reproduction of the wave-form of the input.

TELEVISION PROGRESS IN JAPAN

ONE is often inclined to overlook the fact that intensive television research work is now being carried out in various parts of the world, therefore, to many it may be a surprise to hear that Japan is paying particular attention to this latest radio development. Many institutes and laboratories, including the technical research laboratory of the Broadcasting Corporation of Japan; the Higher Technical School of Hamamatsu; the Tokyo Radio and Electrical Co., Ltd., and the Electric Laboratory of the Communications Ministry, etc., are all actively engaged in television development and investigation work. As a matter of fact, experimental television broadcasts were made quite recently for the benefit of the general public in Japan, and it would appear that the authorities concerned hope to be able to radiate regular sound and sight programmes in the near future.

One research laboratory, namely, The Technical Research Laboratory of the Broadcasting Corporation of Japan, which is primarily devoted to the study of the theory and application of radio-telephone, actually established an experimental television station in 1937 (J2PG), and in May of last year they succeeded in transmitting photographs to the Tokyo Broadcasting House, some 14 kilometres away from the transmitter. Since that event, intensive study and improvements have been sought, and several television transmissions have been made public to try to popularise the new form of entertainment.

RADIO CLUBS & SOCIETIES

Club Reports should not exceed 200 words in length and should be received First Post on the third Monday in each month for publication in the next issue.

ROMFORD AND DISTRICT AMATEUR RADIO SOCIETY

Headquarters: Red Triangle Club, North Street, Romford.

Assist. Sec.: H. G. Holt, 5, Butts Green Road, Hornchurch, Essex.

AS from September 3rd, evening meetings are suspended for the time being. All members, old and new, are welcomed at 5, Butts Green Road, Hornchurch, Essex, where a room is at their disposal on Sunday mornings.

Also, members can have the use of workbench and tools for small jobs. The assist. secretary will answer any inquiries at the above address.

Open to Discussion

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

A Reader's Den and Equipment

SIR,—As an old reader of PRACTICAL WIRELESS I am sorry that the paper is now published only once a month. I have always been interested in the illustrations of other readers' dens, and I regret I haven't a photograph of mine. I enclose a sketch, however, showing a corner of my den, and the equipment. Incidentally, the R.X. is a Trophy 6 with preselector, and a home-built P.P. amplifier to match. The last named draws its current from the preselector, which has a large mains transformer (identical to the one in the receiver), and feeds the P.A. quite well. However, I did fit a separate smoothing choke and condenser for the P.A. H.T. supply. The arrangement works very satisfactorily. It would be a good idea to publish a set on similar lines—preselector, R.X., P.A., and mains unit. It would make a fine super-set for keen radio amateurs.—HECTOR COLE (Workington).

Spares-box Superhet or Straight 4

SIR,—A "Straight 4" in full howl is not a likeable proposition. When screened and doubly de-coupled it is quieter, but then is no better than a well-designed reacting detector "three."

Make it a "Spares-box Superhet," 465 kc/s, Osc. It will be interesting to see how you arrange for constructors to use their present gear with a minimum of purchasing to be done. In my opinion, when a fellow builds a first-class set fitted with costly ganged items, he finishes as a constructor.—W. H. LAZENBY (Penzance).

French Radio Periodicals Wanted

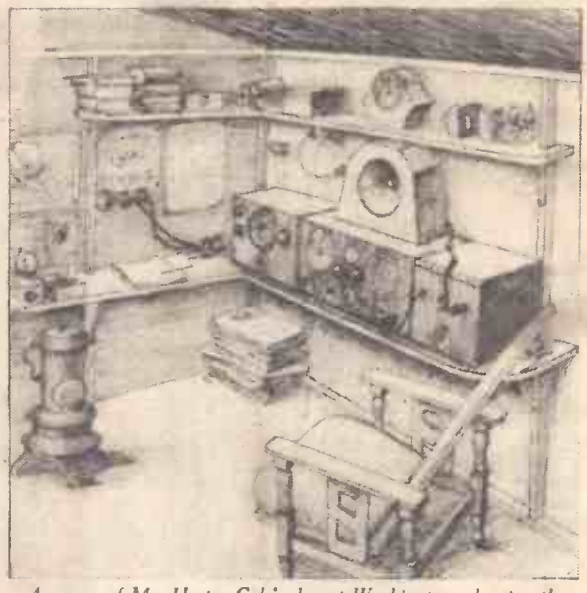
SIR,—As a reader of your excellent paper for many years past, I am now writing to ask you a favour which I trust you will be able to accord me.

I am one of those unfortunate individuals who, after nearly 22 years' residence in France, was compelled to clear out in a great hurry, leaving my home wireless laboratory, and perhaps more important than this latter—a considerable library of radio papers, French, English and American. Wireless has only been a hobby of mine up till now (since 1924) but I have been successful in obtaining war work over here in the industry, and often wish I had some of my books to refer to. I have succeeded in obtaining some recent back numbers of PRACTICAL WIRELESS and certain other English periodicals second-hand, but have been unable to get any French or American books. It occurs to me that amongst your vast circle of readers there must be some who have in the past subscribed to these papers, and might be willing either to sell, or loan them to me. The papers I should particularly like to get hold of are:

L'Amateur Radio
Toute la Radio
Radio Constructeur } French
Radio Plans
Radio News ... ... American

Needless to add, I should take great care of anything loaned me and should be truly grateful.

In conclusion, may I add that as one who can claim some knowledge of France and her people the latter have not betrayed us, but were themselves betrayed by their leaders. I know this has been said and printed before, but thought perhaps my brother radio-fans would like an unbiased opinion of one who has no axe to grind.—E. W. J. BRYDEN (8, Elgin Road, Seven Kings, Essex).



A corner of Mr. Hector Cole's den at Workington, showing the neat lay-out of equipment.

A "Super" One-valver

SIR,—I have been a reader of your fine paper for over two years, and a short-wave listener for about the same period. I noticed in a recent issue an appeal for readers to send in diagrams and details of their "super" one-valvers for the benefit of fellow-readers. In my set the grid-leak (2 meg Ω) is taken to earth as is the L.T.+, not the L.T. —, as this gives greater sensitivity and signal strength. I also use throttle control reaction, which is much more efficient.

I use 4-pin coils (Premier) and a 160 mmf. (Trolitule) tuning condenser. The valves used have been a PM1HL Mullard (till it met with an accident), then a Tungsram P215, and a Mazda P.220 at 60v. H.T. With this set I have received America and most of the Europeans, including Finland, Estonia, Hungary, and Turkey. I have also logged Portugal, Spain, Italy, Russia, South America, Manchukuo and Japan.

I find extension rods are necessary because of hand-capacity, and also high-ratio tuning and reaction controls.

I should like to correspond with any young reader interested in home-constructed short-wave receivers and DX listening.—P. DICKERSON (Church Farm, Fritton, Long Stratton, Norfolk).

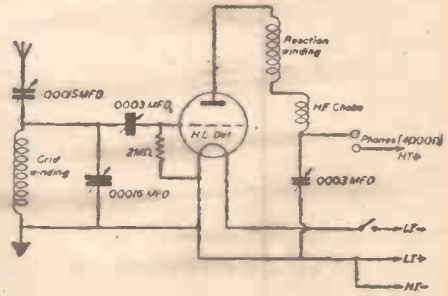
"Spares-box" Superhet Circuits

SIR,—I have often been interested in readers' suggestions for receiver designs, and as greater use of "spares-box" components is likely this winter, I think it would be appropriate if a few circuits were published which would appeal to many readers. Straight circuits are fairly easy to adapt, and modify, and I have successfully constructed many PRACTICAL WIRELESS circuits—including the Kestrel 4—almost entirely from adapted "broadcast" parts.

The superhet is a different proposition, and, taking into account the fact that few constructors would have special frequency-changing valves on hand, and that battery operation is preferable, I suggest the circuits could be on the following lines, the number of valves being limited to four if possible. The frequency changer could be: H.F. Pen. or S.G. in an electron-coupled autodyne arrangement; H.F. Pen. as combined det.-osc. with cathode feed-back for the osc. section; 7-pin H.F. Pen. as det.-osc., utilising the suppressor grid; or S.G. with separate triode osc., with, however, an increase of consumption.

Separate tuning of osc. sections would avoid ganging troubles. The I.F. stage could be H.F. Pen. or S.G., with I.F.T.s home-made or "spares," and anything between 50 kc/s and 465 kc/s—or even modified dual-range coils—with vari-mu volume control. The second detector could be a triode or S.G. with reaction for sensitivity control and C.W. reception, and the output stage a parallel-fed triode or pentode.

The performance of such a receiver would fall short of present-day standards, but it would convert many "straight" enthusiasts.—CECIL MARTIN (Southampton).



Circuit diagram of a "super" one-valver, described by P. Dickerson, of Fritton.

[It is impossible to obtain thoroughly reliable reception from a set of the type mentioned by our correspondent without carrying out a good deal of experimental work.—ED.]

Correspondents Wanted

K. GREENWOOD, 5, South View, Cornholme, Todmorden, Lancs., would like to correspond with another young reader residing in Canada or the U.S.A.

G. Knox, 20, Seymour Road, Broad Green, Liverpool, 4, is at home on most evenings and would welcome any S.W.L.s who care to call.

PUSH-BUTTON TUNING MECHANISM

Details of a Suggested Motor-operated Device

WE are all familiar with the kind of motor-operated automatic tuning mechanism which has been a feature of radio receiver design during the last two years. The motor is adapted to be energised through one or other of a number of parallel paths, each of which includes a press-button-operated switch and contacts of a commutator type selector switch which is mechanically coupled to the motor, and to an adjustable component of the receiver, such as the tuning element or the wave-change switch. The arrangement is such that when a selected press button is operated the motor will move the adjustable component to a desired predetermined position.

In the kind of commutator switch commonly used the rotor comprises two commutator strips separated by insulating segments arranged at diametrically opposite points, and the stator contacts are usually radially spaced round half the circumference of the rotor.

It may sometimes be convenient to space the stator contacts round the whole circumference of the rotor, but a difficulty arises in that if two stator contacts are arranged at diametrically opposite points, it is then not possible to obtain the positions selected by those contacts in succession, since the circuits of both selector contacts are opened simultaneously by the commutator switch.

Stator Contacts

The stator contacts of a commutator switch for use with a wave-changing switch need not be adjustable and their positions are determined by the positions of the stator contacts of the wave-changing switch. Consequently, the difficulty referred to may be overcome by careful attention to design during manufacture.

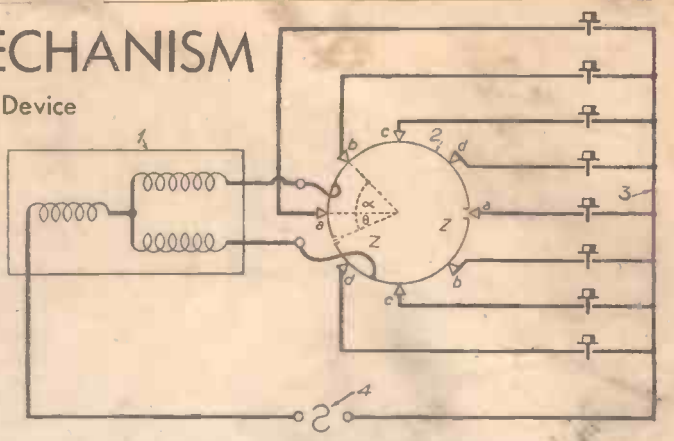
One method of proceeding is to arrange the stator contacts of the wave-change, and commutator switches in pairs of diametrically opposed contacts which are equally spaced round the rotors, and to offset the insulating segments of the commutators.

An automatic wave-changing system of this kind is shown diagrammatically in the accompanying diagram in which 1 is a reversible electric motor. In the illustration 2 is the commutator of the commutator switch, a, b, c and d being the stator contacts, 3 is a bank of press button switches, and 4 a suitable source of electric supply. The pairs of diametrically opposed stator contacts aa, bb, cc, dd are equally spaced round the commutator, and the insulating segments "Z" of the commutator are offset from the diametrically opposite position by an angular distance θ equal to half the angular spacing α of the contacts.

The selector switch shown can select 8 different positions, and is direct-coupled to a wave-change switch (not shown). The wave-change switch must, of course, be provided with stator contacts separated by the angle α. It will be apparent with this arrangement that only one stator contact can bear against an insulating segment at any instant.

The same result may be achieved by arranging the insulating zones of the commutator at diametrically opposite points, and so arranging the stator contacts that no two contacts are diametrically opposed.

An automatic tuning mechanism of the kind described is particularly adapted for controlling so-called turret tuning systems in which the reactance elements of the receiver are mounted on, and radially spaced round, the periphery of a turret or drum which can be rotated to bring a desired set of reactance elements into the circuit of the receiver.



The general arrangement of an automatic wave-changing system employing commutator switching devices.

Replies to Queries

Instability

"I recently made up a 5-valve superhet, and am troubled with some H.F. instability which I find it impossible to overcome. I have decoupled all anodes and screens on H.F. and I.F. stages, paid particular attention to screening and trimming and all the other dodges, but without avail. I wonder if you can suggest anything which I may not have done in this connection."—K. F. (Newcastle-on-Tyne).

THE trouble is one of fairly frequent occurrence, and if you examine modern commercial receivers you will see that various schemes have been introduced in an endeavour to overcome the trouble. It is important to remember that, generally speaking, any form of instability will result in a loss of efficiency and therefore to obtain maximum results the instability should be removed. Although this may be done by reducing working voltages and some other schemes, these only operate by reducing efficiency and, therefore, the instability should be removed by some alternative arrangement. Apart from correct trimming and screening, one of the important items which is often found responsible for instability is H.F. resistance in the tuning circuit, introduced by poor connection between the *moving* vanes of the condenser and the earth line. The condensers are generally provided with an earthing connection, but this is disregarded and the contact between the condenser body and chassis is relied upon. This may cause the trouble, and in your case we think you should try the effect of earthing the moving vanes direct. For this purpose use heavy-gauge flex, or alternatively the screening covering used for screened leads. Strip this off the internal insulated sleeving, press flat and solder thoroughly to the earthing contact on the condenser at one end, and at the other end to the earth line—not the chassis or a holding-down bolt.

Volume Control

"I am experiencing trouble with the volume control on my set, which is a commercial model about five years old. When in the maximum volume position everything is all right, but if the control is set back slightly to reduce volume I find at times there is a crackling noise as a background. This does not appear at all positions of the control, and I wonder if it indicates that I need a replacement. As the firm who made the set is out of business, I am uncertain about such a replacement."—D. R. (Hackney).

THERE are two possible causes for the trouble. In the first case the control may be worn out, dirty, or the moving arm may have weakened, resulting in poor contact at certain positions. In the second case, some other component, such as a valve or resistance, may have changed its characteristics, and at the point where you experience the noises there may be excess current flowing through the control, overloading the element and thus giving rise to the noise. This depends, of course, upon the position occupied by the control, i.e. H.F. gain control. If you can dismantle the control satisfactorily you could test for contact by connecting a good meter in series with a small voltage source and placing this across the control when adjustment of the arm should give smooth indications on the meter. Any jumpiness will indicate poor contact, and the control should then be taken to pieces to see if this is due to dirt or grease on the arm, or a worn-out element. If the control is in order, then attend to the voltage or associated valve and resistances.

Negative Feedback

"Would you please let me know what negative feedback amplifiers are, and if it is possible to add to my present set, circuit attached? I have been out of touch with radio books for some time owing to Army service, but now want to come up to date and modify the set I have left at home for my people's use."—G. R. E. (Cambridge).

BRIEFLY, negative feedback or degenerative amplifiers are those in which a portion of the output voltage is fed back to the input voltage in order to cancel out harmonic distortion. This may be done by including a load resistance in series with the output load or in parallel with it, and tapping off from this additional resistance so that it is fed in series with the input voltage. Owing to the loss incurred by this, the input must be proportionately increased to maintain the same output level. You could add it to your old set, but modern valves are, in general, capable of supplying adequate power without the need for introducing such devices.

Amplifier Design

"I want to build up a small mains-operated amplifier suitable for microphone and pick-up, but have been told that one amplifier is not suitable for both purposes, because of the different characteristics of mike and pick-up. I should be glad of your advice as to a suitable design, for use in a very small hall for general entertainment work."—L. R. E. (Kettering).

IT is true that very often a microphone will need more amplification than a pick-up, or that special tone-control methods may be needed with certain types of pick-up. The usual arrangement is to add a fader input circuit—that is, two volume controls in series, with pick-up across one and mike across the other. This enables fading and mixing to be carried out. For

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 must be enclosed with every query.

ambitious amplifiers, however, an extra stage of amplifications may be included for the mike, connecting the pick-up via a separate valve in parallel with the second stage of the amplifier. This will also permit mixing to be carried out, and at the same time will enable any tone-control schemes to be fitted. We suggest a three-stage amplifier, with the separate valve mentioned, and the output stage to be of the push-pull type. This, if mains operated, should deliver sufficient output for your requirements.

Temporary Aerial

"I have a very small set of the mains-portable type, but the only difficulty is that the volume is not quite enough. I attached an aerial to the input side, and this worked quite well, but I do not want to fit a permanent aerial, and wonder if you can make any suggestions to improve the volume."—N. H. U. (N.3.).

YOU do not state what type of aerial you have fitted to the set, and we are not sure, therefore, whether you have tried to make a receiver without any form of signal pick-up. Some aerial must be used, and generally a length of wire is coiled round the back of the case, or, in order to make the set useful in any district a temporary or throw-out aerial is provided. This consists of about 15 or 20ft. of good flex wrapped round a cardboard strip and stowed away in the back of the set. When the receiver is in use this is laid alongside the receiver, and if this does not provide sufficient pick-up it is uncoiled and laid along the floor, along a picture rail, etc. A good idea is to fit a suction cup at the end of the lead, and this may then be attached to a wall without disfigurement and will give the necessary length and height for the particular local conditions.

REPLIES IN BRIEF

The following replies to queries are given in abbreviated form either because of non-compliance with our rules, or because the point raised is not of general interest.

R. G. B. (Liverpool, 21). The pick-up must not be joined direct. An L.F. choke should be connected across the sockets and the pick-up then connected between the anode socket and earth, via a 2 or 4 mfd. fixed condenser. The arrangement will then work as you require.

G. S. (Sheffield, 6). The indication is not necessarily correct. There may be a faulty component in some other part of the set and a stage-by-stage test is desirable.

R. B. D. (W.2). You cannot adjust correctly by guess-work. A good signal generator should be used and you will be unable to trim if the set is right out of adjustment, unless you use such an instrument.

J. R. S. (Truro). We recommend your first-mentioned nomination, in view of your other qualifications.

S. G. S. (Worcester). At the present time, if the firm in question is unable to supply the Manual we regret that we do not know of any other source.

O. I. D. (Manchester). Silk-covered wire is not essential and the only critical point is the turns per inch. The silk covering will permit more turns as it is thinner, and this must be taken into consideration.

N. B. (Neasden). The screen may be found essential and may be obtained from Messrs. Bulgin. Remember the valve maker's note regarding the grid-leak and condenser position.

H. P. O. (Bristol). The first arrangement is desirable, but we cannot give details under present conditions.

D. O. (Birkenhead). Try the ordinary H.F. stage, using an H.F. pentode of the straight type. This should give the desired increase in range, without altering the rest of the receiver.

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

Practical Wireless BLUEPRINT SERVICE

PRACTICAL WIRELESS	*Date of Issue.*	*No. of Blueprint.*
CRYSTAL SETS		
Blueprints, 6d. each.		
1937 Crystal Receiver	—	PW71
The "Junior" Crystal Set	27.8.38	PW94
STRAIGHT SETS. Battery Operated.		
One-valve: Blueprints, 1s. each.		
All-Wave Unipen (Pentode)	—	PW31A
Beginners' One-valver	19.2.38	PW85
The "Pyramid" One-valver (HF Pen)	27.8.38	PW93
Two-valve: Blueprint, 1s.		
The Signet Two (D & LF)	24.9.38	PW76
Three-valve: Blueprints, 1s. each.		
Selectone Battery Three (D, 2 LF (Trans))	—	PW10
Sixty Shilling Three (D, 2 LF (RC & Trans))	—	PW34A
Leader Three (SG, D, Pow)	—	PW36
Summit Three (HF Pen, D, Pen)	—	PW37
All Pentode Three (HF Pen, D (Pen), Pen)	29.5.37	PW39
Hall-Mark Three (SG, D, Pow)	—	PW41
Hall-Mark Cadet (D, LF, Pen (RC))	16.3.35	PW48
F. J. Camm's Silver Souvenir (HF Pen, D (Pen), Pen) (All-Wave Three)	13.4.35	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)	21.3.36	PW62
The Centaur Three (SG, D, P)	—	PW64
F. J. Camm's Record All-Wave Three (HF Pen, D, Pen)	31.10.36	PW69
The "Colt" All-Wave Three (D, 2 LF (RC & Trans))	18.2.39	PW72
The "Rapide" Straight 3 (D, 2 LF (RC & Trans))	4.12.37	PW82
F. J. Camm's Oracle All-Wave Three (HF, Det., Pen)	28.8.37	PW78
1938 "Triband" All-Wave Three (HF Pen, D, Pen)	22.1.38	PW84
F. J. Camm's "Sprite" Three (HF Pen, D, Tet)	26.3.38	PW87
The "Hurricane" All-Wave Three (SG, D (Pen), Pen)	30.4.38	PW89
F. J. Camm's "Push-Button" Three (HF Pen, D (Pen), Tet)	3.9.38	PW92
Four-valve: Blueprints, 1s. each.		
Sonotone Four (SG, D, LF, P)	1.5.37	PW4
Fury Four (2 SG, D, Pen)	8.5.37	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)	26.9.36	PW67
"Acme" All-Wave 4 (HF, Pen, D (Pen), LF, Cl. B)	2.2.38	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)	—	PW20
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)	5.6.37	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	16.1.37	PW73
Four-valve: Double-sided Blueprint, 1s. 6d.		
Push Button 4, Battery Model / 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)	1.10.38	PW63
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
AMATEUR WIRELESS AND WIRELESS MAGAZINE CRYSTAL SETS.		
Blueprints, 6d. each.		
Four-station Crystal Set	23.7.38	AW427
1934 Crystal Set	—	AW444
150-mile Crystal Set	—	AW450
STRAIGHT SETS. Battery Operated.		
One-valve: Blueprint, 1s.		
B.B.C. Special One-valver	—	AW387
Two-valve: Blueprints, 1s. each.		
Melody Ranger Two (D, Trans)	—	AW388
Full-volume Two (SG det, Pen)	—	AW392
Lucerne Minor (D, Pen)	—	AW426
A Modern Two-valver	—	WM409
Three-valve: Blueprints, 1s. each.		
£5 5s. S.G. 3 (SG, D, Trans)	—	AW412
Lucerne Ranger (SG, D, Trans)	—	AW422
£5 5s. Three: De Luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	—	AW437
Transportable Three (SG, D, Pen)	—	WM271
Simple-Tune Three (SG, D, Pen)	*June* '33	WM327
Economy-Pentode Three (SG, D, Pen)	*Oct.* '33	WM337
"W.M." 1934 Standard Three (SG, D, Pen)	—	WM351
£3 3s. Three (SG, D, Trans)	*Mar.* '34	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

These Blueprints are drawn full size.

Copies of appropriate issues containing descriptions of these sets can in some cases be supplied at the following prices *which are additional to the cost of the Blueprint*. A dash before the Blueprint Number indicates that the issue is out of print.

Practical Wireless (issues dated prior to June 1st, 1940). 4d. Post Paid
" (issues dated June 1st to July 27th, 1940. 5d. Post Paid
(issues dated September, 1940 and after) 7d. Post Paid
Amateur Wireless ... ... 4d. " "
Wireless Magazine ... ... 1/4 " "

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

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

NOTES FROM THE TRADE

Ekco D.C./A.C. Converter

ONE of the latest products which Messrs. E. K. Cole, Ltd., are introducing to the radio market is a particularly useful type of D.C./A.C. converter which we feel sure, in view of the number of inquiries we receive from readers about such units, will be welcomed by a vast number of listeners.

The new converter is designed to enable an A.C. operated receiver or amplifier to be operated on D.C. mains, thus eliminating to a very great extent the limitations previously imposed on those listeners having

A good idea of the neat and robust construction of the new D.C./A.C. converter, by E. K. Cole, Ltd., can be obtained from this illustration of the unit.

D.C. supplies in the choice of suitable apparatus. Similarly, when owners of A.C. receivers are faced with a move from an A.C. to D.C. district, the unit will provide an admirable method of operating their existing set under the new conditions.

The converter is sturdily constructed, yet the measurements have been kept to modest figures (9in. x 7½in. x 6½in.). It delivers an output of 80-100 watts, at 200-250 volts, 50 cycles, and is, therefore, capable of operating most types of receiver, including those incorporating press-button motor-tuning, and other auxiliary mains-operated mechanisms. Extensive tests have proved that the unit is entirely satisfactory, even on extremely noisy mains. The retail price is £5 12s. 6d.

Mr. H. A. Woodyer

WELL known from his previous connections with Dubilier and T.M.C., Mr. H. A. Woodyer has been appointed sales manager of the radio department of Simmonds Accessories, Ltd.

Glasgow Carries On

THE radio trade in Glasgow does not intend that the war should interfere with trade development. Therefore, as in former years, classes for the study of radio technology are being held in the Allen Glens School. The classes have the support of the Scottish Radio Retailers' Association, and the subjects covered prepare radio staff men for the City and Guilds and standard radio examinations.

Philco Car Radio Conversion Unit

PHILCO have now produced a very compact conversion unit for the operation of their car-radio receivers, using a P.M. speaker from A.C. mains. It is most simple to fit, merely a matter of minutes, and is suitable for 6- or 12-volt receivers. The list price is 29s. 6d.

H.T. Battery Prices

THE Association of Radio Battery Manufacturers has announced that they do not anticipate, subject to the operations of war, any increase in consumer prices of batteries. The Association includes the makers of Pertrix, Drydex, Ever-Ready, Oldham and Full-O'-Power batteries, and present prices of popular sizes are as follow:

	s.	d.		s.	d.
Winner 120 volt	7	6	Portable 40 ..	10	6
Radio 120 volt	6	0	Portable 49 ..	18	6
Super 120 volt..	10	6	Portable 56 ..	13	9
Portable 24 ..	15	6	Portable 61 ..	6	9
Portable 30 ..	8	9	Portable 63 ..	7	6
Portable 32 ..	12	9	All-dry 3 ..	10	0

Service Engineers

THE vast number of highly experienced service engineers which have already taken up positions in H.M. Forces has raised a very serious problem for the radio trade in general to solve. It would appear that the matter is of such magnitude that it cannot be solved or dismissed by some half-hearted temporary emergency arrangement as, like many other skilled trades, qualified men cannot be found at a moment's notice or produced from raw material in a week or so. In many districts, the traders are getting together and making a genuine attempt to determine what trained labour is available, and then adopting a system of pooling their requirements or, on the other hand, sharing according to the available work on the benches, the total help at their disposal. There must be a great number of keen and experienced radio amateurs who are above military age, and who are quite capable of stepping into the breach and, if not allowing the trade to cater for their clients requirements as before, at least reducing the load to such an extent as to bring conditions nearer normal. It will, no doubt, be argued that an amateur has not had the opportunity of becoming familiar with all types of commercial products but, provided a man has had sound amateur experience, and is of average intelligence, the facilities now provided by the set manufacturers, in the form of data and test sheets and information, should allow the new recruits to the trade to prove their worth in a very short time.

Radio Trade Reserved Ages

IT is important now to remember that the reserved age for wireless engineers and servicemen has been raised to 35. The following are the main trades and ages:

Occupation	Age of Reservation from	
	General Service	Service in Trade Capacity
Wireless Engineer	18	35
Fault-finder, tester ..	18	30
Wireless Repairer ..	18	35
Wireless Mechanic ..	18	35
Serviceman	18	35
Loudspeaker cone maker ..	30	—

Classified Advertisements

ADVERTISEMENTS are accepted for these columns at the rate of 2d. per word (minimum charge 2/- each paragraph). All advertisements must be prepaid.

EACH paragraph will commence with the first word printed in bold face capitals. Additional words in bold face capitals are charged at 4d. per word.

ALL communications should be addressed to the Advertisement Manager, "Practical Wireless," Tower House, Southampton Street, London, W.C.2.

PUBLIC APPOINTMENTS

VACANCIES IN THE AERONAUTICAL INSPECTION DIRECTORATE. MINISTRY OF AIRCRAFT PRODUCTION.

Vacancies exist for unestablished appointments as Examiners in the General Engineering, W/T Instrument Branches.

QUALIFICATIONS.

All candidates must have good general education, be able to read drawings, understand specifications, use micrometers and other measuring instruments.

(a) Applicants for the General Engineering Branch must have had practical experience in an engineering works. An elementary knowledge of materials testing is desirable.

(b) Applicants for the Instrument Branch must have knowledge of physics and training in light engineering or instrument making. Candidates with knowledge of optical instruments are also required.

(c) Applicants for the W/T Branch must have practical knowledge of W/T and electrical equipment with technical training in radio communication equal to City and Guilds final examination standard.

Accepted candidates will undergo a period of training in inspection as applied to the above subjects, not exceeding three calendar months, and will be paid £3/15/0 weekly during training. Subsistence allowance of £1/5/0 weekly during training is payable to married men normally residing outside the training area. On successful completion of training, candidates will be appointed as Examiners at a salary of £270 per annum (payable monthly in arrear) subject to a deduction of £12 per annum for each year of age below that of 24. Payment for overtime. Examiners must be prepared to serve in any part of the United Kingdom.

Normal age limits, 23 to 60.

Candidates should indicate on their applications for which type of vacancy (i.e., (a), (b), or (c)) they wish to be considered.

Applications must be made on Form 786, copies of which can be obtained on application, by postcard only, to: Ministry of Labour and National Service, Box No. 171, Head Post Office, Small Street, Bristol.

CABINETS

A CABINET for every radio purpose. Surplus cabinets (undrilled) from noted makers. We have hundreds in stock (no catalogues). Send measurements of chassis, etc., and say what kind of cabinet required. Stamp for reply. Inspection invited.
H. L. SMITH AND CO., LTD., 289, Edgware Road, W.2. Tel.: Pad. 5891.

LITERATURE

BRAND New Edition "Amateur Radio Handbook." 330 pages, 4s. 2d., post free.—R. S. G. B. 16, Ashridge Gardens, London, N.13.

LOUDSPEAKER REPAIRS

LOUDSPEAKER repairs, British, American, any make. 24-hour service, moderate prices.—Sinclair Speakers, Pulteney Terrace, Copenhagen Street, London, N.1.

REPAIRS to moving coil speakers. Cones/coils fitted or rewound. Fields altered or wound. Prices quoted, including eliminators. Pick-ups and speaker transformers rewound, 4/6. Trade invited. Guaranteed satisfaction. Prompt service.
L.S. Repair Service, 5, Balham Grove, London, S.W.12. Battersea 1321.

MORSE EQUIPMENT

FULL range of Transmitting Keys, Practice Sets, Oscillators, Recorders and other Radio Telegraph Apparatus, designed and manufactured by T. R. McElroy, World's Champion Telegraphist. Sole distributors: Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089.

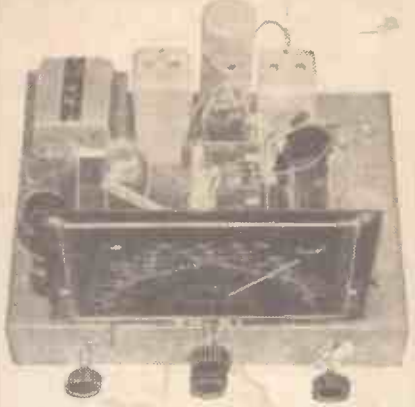
MORSE TRAINING

WIRELESS Code Courses. "Book of Facts" Free.—Candler System Co. (L.O.), 121, Kingsway, London, W.C.2.

ARMSTRONG

SPECIAL OVERSEAS MODEL EXP48

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



This chassis has been developed on the lines of our Model AW38 which has proved an outstanding success since its introduction at 1939 Radiolympia. Overseas requirements, however, have been given primary consideration. Firstly, an additional short-wave band has been incorporated and the chassis now gives an efficient continuous short-wave coverage from 13 to 160 metres. All coils and I.F. transformers have been specially treated to render them impervious to humidity. Switching is of extra robust construction and contacts heavily plated. The mains transformer is interleaved and has a generous iron content to avoid excessive temperature rise and the steel chassis itself is heavily cadmium plated for tropical use. **8 gns.**

EXP48 is equally suitable for Home Market.

Packing and Carriage 4/6 on all models.

With 8" P.P. Speaker.. .. .. £9. 9. 0
With 10" P.P. Speaker £10 3. 0

Please write for Specification.

ARMSTRONG MANFG. Co.
WARLTERS ROAD, HOLLOWAY, LONDON, N.7.
(Adjoining Holloway Arcade)
'Phone: NORth 3213

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The man who enrolls for an I. C. S. Radio Course learns radio thoroughly, completely, practically. When he earns his diploma, he will KNOW radio. We are not content merely to teach the principles of radio, we want to show our students how to apply that training in practical, every-day, radio service work. We train them to be *successful!*

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Dept. 94A, International Buildings, Kingsway, London, W.C.2.

Please explain fully about your Instruction in the subject marked X.

Complete Radio Engineering
Radio Service Engineers
Elementary Radio
Television

If you wish to pass a Radio examination, indicate it below.

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P.M.G. Certificate for Wireless Operators
Provisional Certificate in Radio Telephony and Telegraphy for Aircraft
City and Guilds Telecommunications

Name.....Age....

Address .....

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

NEW RECEIVERS AND AMPLIFIERS

CHALLENGER RADIO CORPORATION.—We still lead with best value money can buy; send 2½d. stamp for illustrated catalogues of finest all-wave receivers, handsome cabinets, speakers and valves, firsts only 6/- each; every article fully guaranteed; buy now before prices again rise.
CHALLENGER RADIO CORPORATION, 31, Craven Terrace, Lancaster Gate, London, W.2.

NEW VALVES

BRITISH VALVES AT LESS THAN ONE-THIRD COST (All Guaranteed). Battery types. 2v. Double Diode Triode, 2/-. Power, 1/6. Super Power, 1/9. Pentodes 4- and 5-pin, 2/6. Class B, 3/6. Mains types, 4v., A.C./H.L. indirectly heated, 2/6. A.C. Screen-grid, 3/6. S.G. High-Gain, 3/6. S.G. Variable-mu, 3/6. A.C.-D.C. types: K.T.30, 3/6; L.13 Detectors, 1/6; U.30 Rectifiers, Octal, 1/6. All made by well-known British manufacturer. Terms: Cash with order to S.S. (P.), Radio Service, 20, Upper Duke Street, Liverpool.

RADIO CHASSIS

ARMSTRONG COMPANY have a limited number of chassis not included in the current catalogue, but carrying the makers' guarantee. Chassis are offered at especially economical prices. Several examples are given below.

ARMSTRONG RF96 All-wave Radiogram chassis with R.F. pre-amplifier, supplied complete with matched moving-coil speaker. £6 10s. 0d.

ARMSTRONG RFPP7 All-wave Radiogram chassis with R.F. pre-amplifier and Push-pull output using PX4 valves capable of handling 6 watts. £7 7s. 0d.

ARMSTRONG 7 stage Radiogram chassis complete with matched speaker, £4 10s. 0d.

ARMSTRONG have several other models. Please write for particulars.

ARMSTRONG COMPANY, WARLTERS ROAD, HOLLOWAY, LONDON, N.7.

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WEBB'S Radio Map of the World enables you to locate any station heard. Size 40" by 30" 2 colour heavy Art Paper, 4/6, post 6d. Limited supply on Linen, 10/6, post 6d. **WEBB'S** Radio Globe—superb 12" full-colour model. Radio prefixes, zones, etc. Heavy oxydised mount. Post Paid. 27/6.—Webb's Radio, 14, Soho Street, London, W.1. 'Phone: Gerrard 2089.

RECEIVERS AND COMPONENTS

VAUXHALL. Rola 8in. P.M. speakers, 14s. 9d.; Rola 10in. P.M. speakers, 18s. 6d.; Rola 1,500 ohm energised speakers, 12s. 6d.: all with transformers. Electrolytic condensers, cardboard case, 8 mfd., 500 v., 2s.; 8+8 mfd., 500 v., 3s. 6d.; 50 mfd., 50 v., 1s. 9d. Volume controls, 2s.; with switch, 3s. Iron-cored tuning coils on base with terminals, switch, 2-gang, 12s. 6d.; 3-gang, 19s. 6d. Bar-type 2-gang condensers, 0.0005 mfd., 6s. 6d. with trimmers. Resistors, 1 watt, 4d. each. Nicket 3-1 L.F. transformers, 5s. 9d. Skeleton H.T. 10 rectifiers, 11s. Gramophone pick-ups, 11s. and 18s. 9d.

VAUXHALL UTILITIES, 163a, Strand, London, W.C.2. Postage extra orders under 3s. Stamp for list.

SOUTHERN Radio's Bargains.
ALL Guaranteed. Postage Extra.

5/- Parcel of useful Components, comprising Condensers, Resistances, Volume Controls, Wire, Circuits, etc. Value 25/-. 5/- per parcel.

15/- Service Man's Component Kit. Electrolytic Condensers, Volume Controls, Resistances, Tubular, Mica, Paper Condensers, Valve Holders, etc. 120 articles contained in strong carrying case, 9" x 7" x 7", 15/- the Kit.

5/- 100 Wire-end Resistances, assorted capacities. ½ and 1 watt, 5/- per 100.

ORMOND Loud-speaker Units, 2/6. Crystal Sets, 5/6; Westectors Type W2, 2/6; Crystal Detectors, 2/-; Crystals, 6d.; "P.O." Microphones on Stand, for use with any receiver, 5/-; Telsen W349 Iron-core Midget D.R. Coils, 5/6; Morse Tapping Keys, 3/-; Buzzers, 1/6.

2/- Tool or Instrument Carrying Cases, ex Government Stock. Wood 9" x 7" x 7", 2/-.

SOUTHERN Radio, 46, Lisle Street, London. W.C. Gerrard 6653.

RECEIVERS AND COMPONENTS

PHILIPS HIGH VOLTAGE CONDENSERS. Infd. at 4,000-volt working, 5/6 each, carriage paid. T.C.C. Electrolytic Condensers, 2,000 Mfd., 12-volt working, 2/6 each, post 4d.

VOLTAGE CHANGER TRANSFORMER, 2,000 watts, 110 to 200/240 volts or vice versa. Price 75/-. Guaranteed 12 months.

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

A SPECIAL LINE—MAINS TRANSFORMER for Dugout lighting off 12-volt car bulbs, input of Transformer is 200/230 volts, output is 12 volts at 3 amps. Price 7/6 each, 6d. post.

NEWTON MOTOR GENERATOR, 220-volt, D.C. input, 16 volts 11 amps output, in perfect condition. 45/-, carriage forward.

MOVING-COIL METER MOVEMENTS, for recalibrating into multi-range meters. Low milliamp deflection. 2½in. dial. Makers: Everett Edgcumbe and other good makers. Price, 6/- each.

EX-G.P.O. UNI-SELECTOR SWITCHES, with relay, 3 rows of 25 contacts in new condition, 15/- each.

HIGH-VOLTAGE TRANSFORMERS, useful for all test work, or television. Input 200/240 volts, output 5,000 and 7,000 volts, 6/6 each, post 1/-.

MAINS TRANSFORMERS, 200/250 volts input, 12 and 24 volts at 4/6 amps. output, suitable for model trains, etc., 15/- each, post 1/-.

MAINS TRANSFORMERS, 200/240 volts input, 50 volts 8 amp. output, useful for small arcs, etc., 15/- each, post 1/6.

ELECTRO DYNAMIC ROTARY CONVERTOR, 110 volts D.C. input, 600 volts 150 m/a 6 volts 5 amps. D.C. output, 45/-. Carriage forward.

B.T.H. LIGHTWEIGHT HEADPHONES, 4,000 ohms., condition as new, but headgear needs repair. Price 3/- per pair. Post free.

VOLTAGE CHANGING TRANSFORMERS (Auto Wound). 100/110 to 200/240 volts or vice versa. Guaranteed 12 months. 250 watts, 25/- ; 500 watts, 32/6 ; 1,000 watts, 50/- ; 1,500 watts, 62/6. Delivery 7 days from date of order.

SMALL ELECTRIC ROTARY CONVERTOR, 110 volts D.C. input. 10 volts at 30 amps. output. Useful for garage charging. 55/-. Carriage forward.

50-VOLT D.C. MOTORS, ¼ h.p., 1,500 r.p.m., 6/6 each. Ditto, 100 volts D.C., 7/6 each.

EPOCH P.M. MOVING-COIL SPEAKERS, 10-in. cone, 10 ohm speech coil, handle 10/12 watts, 32/6 each. Carriage 2/6 .

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

EX-G.P.O. SMALL RELAYS. 1,000 x 1,000 ohms with multi contacts, new, 5/-. Ditto, 7,000 ohms two-leave type, 3/6 each. Useful for remote control, etc.

DYNAMOS, for charging or lighting, etc., all shunt wound and fully guaranteed. 100-volt 10 amp., 4-pole, 1,500 r.p.m., 90/- ; 50/75-volt 15 amp., 1,750 r.p.m., 4-pole, 90/- ; 30-volt 10 amp., ball bearings, 1,500 r.p.m., 4-pole, 70/- ; 25-volt 8 amp., 1,750 r.p.m., 2-pole, ball-bearing, 37/6 ; 50/75-volt 25 amp., 4-pole, 1,500 r.p.m., 110/-.

CROMPTON, self-exciting 50/100 cycle Alternator, 70 volts 500 watts. £3/10/-, carriage forward.

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

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

Terms : Cash with Order or C.O.D. charges extra.

ALL GOODS SENT ON THREE DAYS' APPROVAL AGAINST CASH.

GALPIN'S ELECTRICAL STORES, 75, Lee High Rd., Lewisham, London, S.E.13. Telephone : Lee Green 5240.

BANKRUPT bargains, genuine offer, brand new 1939-40 models maker's sealed cartons, with guarantees at 25 per cent. to 40 per cent. below listed prices ; also portables, midgets ; send 1½d. stamp for lists.—Radio Bargains, Dept. P.W., 261-3, Lichfield Street, Aston, Birmingham.

COULPHONE Radio, New Longton, Preston. Prompt personal service. Brand new goods only. Tungsram valves, Cosmocord Crystal Pickups, Rola speakers, American valves (4s. 6d. to 6s.), guaranteed. Armstrong chassis, B.I. electrolytic condensers, Dubilier resistors. All the new 1941 receivers of Decca, K.B., Ferguson, R.G.D., Pilot, G.E.C. Before you purchase any radio goods send stamp for new list and save money. Special offer of Airmaster (British) 8-valve 4-waveband chassis complete with speaker at £8 8s.

RADIO Clearance, Ltd., Temporary Address: 38, Lamb's Conduit Street, W.C.1.

We advise all our customers that we are now at the above address. All lines previously advertised in this journal in stock.

TRICKLE Chargers for 2 v. accumulator, 8/6. Metal rectifiers for trickle chargers, 3/8. Guaranteed.—Champion, 42, Howitt Road, London, N.W.3.

The Superheterodyne Receiver

By Albert T. Witts, A.M.I.E.E. A reliable comprehensive and up-to-date guide to the superheterodyne receiver, incorporating all recent developments. It is particularly useful for those intending to become radio mechanics in the Services. Fourth Edition. 182 pages. 4/6 net (by post 5/-).

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RECEIVERS AND COMPONENTS

SPARTAN 5-valve Press Button Radio. No manual tuning. 7 stations on press buttons. Walnut cabinet, provision for pick-up and extension speaker, 4 watts output with negative feed back, Multi-stage Superhet with A.V.C., for A.C. mains only, guaranteed reception. Price £4/5/0, carriage paid.

CRYSTAL SETS, Permanent Detector, suitable for A.R.P. shelters, few only, 7/6, post free. Oldhams ex-police used unspillable 2-volt 7 amp. Accumulators, suitable for lamps, portables, etc., 2/-.

B.I. CONDENSERS, 4 mfd., 450 v. working, resin oil filled, 3/-, post free. .25 mfd. 1,000v. working, 2/3 each ; .1 mfd. ditto, 2/3.

MORSE keys, 2/11 each. Microphone 80/1 Transformers, 1/9 each.

BALL-BEARING Bakelite Turntables, 6in. diameter, suitable for all purposes, 2/9 each. Universal Output Transformers for Push-Pull Class B. Pentode, etc., 4/9 each. High-note Morse Buzzers, 4½-6 volts, 2/6 each.

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