THE SHOULDER-STRAP FIVE

Practical Wireless

9D EVERY MONTH

Vol. 23. No. 497 || Editor: F. J. CAMM || DECEMBER, 1947

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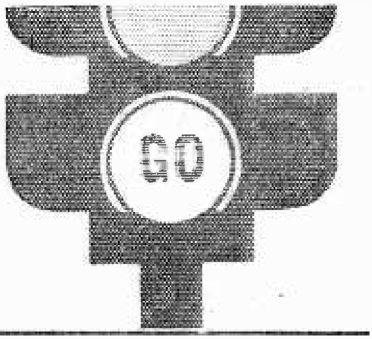

NAVIGATION ON THE ROAD?

When the *Queen Mary* enters a busy port, she and all the other vessels obey the recognized lights and signals on which safe navigation depends.

We, too, obey lights and signals — and rely on them for safety — when we drive or ride or walk on the roads.

We are, in fact, "road navigators." Modern traffic simply could not work without a set of rules which we all accept. Why, then, are there still accidents — far too many?

Partly because we don't all know and understand the rules and principles of Road Navigation. And even if we know them, we forget or ignore them. And partly because some of us don't yet realize that the rules apply to *everyone* — walkers as well as cyclists and drivers. *Any* of us can cause an accident in which we or other people get killed or maimed.

If we all understood the principles of good Road Navigation (based on the Highway Code) and obeyed them *all the time*, traffic would flow faster and more smoothly. We should all get about more easily and, above all, *more safely*. By learning to be skilful Road Navigators, we can help ourselves and everyone else to *get home safe and sound*.

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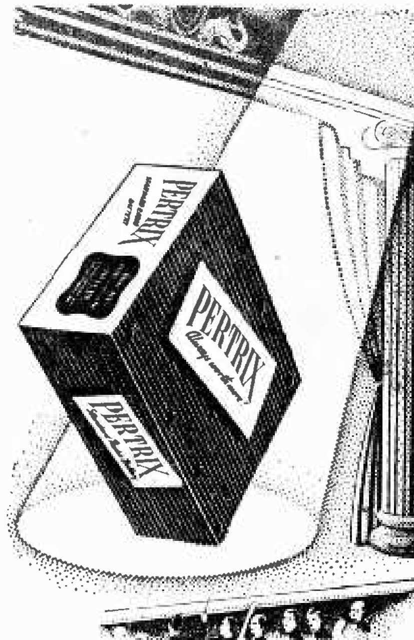

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Practical Wireless

15th YEAR OF ISSUE

EVERY MONTH
VOL. XXIII. No. 497 DECEMBER, 1947.

and PRACTICAL TELEVISION

Editor F. J. CAMM

COMMENTS OF THE MONTH BY THE EDITOR

Radiolympia Summary

THE chairman of the Exhibition Committee of the Radio Industries Council states that the Exhibition has demonstrated the terrific public interest in radio and television to-day. Nearly 450,000 people passed through the turnstiles, and this record for 10 days exceeds all previous records.

No doubt this is accounted for by the fact that there has not been a radio exhibition since 1939, and there was a general desire to see what is new, and to choose receivers to replace those which have done such good service for eight years.

The public, too, was anxious to see how far television had progressed. The interest in this was obvious from the queues which formed inside Olympia to witness a demonstration.

Tens of thousands of people have become interested in radio because of war service and experience in connection with it, and this would account for some of the increased attendance. There has, too, been a marked increase in the interest in music during the past 10 years, accountable to the efforts made by the B.B.C. to make classical music palatable. It is true that to some extent they have negatived those efforts by an excess of dance band music and crooning.

The extension of the Exhibition to include telecommunications equipment, navigational aids, and electronic processes in industry created a further field of interest which would account for some of the increased gate. Of course, a large section of the public likes good entertainment at a cheap price, and a goodly percentage of this section attended merely to witness the various cheap sideshows. They had no interest in the technical developments. They added to the gate and to the profits of the organisers without being of the slightest benefit to the exhibitors.

Some weeks before the show the wisdom of holding it at all in such gloomy times was questioned by prominent members of the trade. From the point of view of the gate it was undoubtedly successful. As most firms are on an export basis we doubt whether the Exhibition contributed very much to the prosperity of the trade, since few firms are able to release much for the home market, and before the show were already fully committed on the export side.

The Government has set an export target of £1,000,000 a month, and we are told that this target is in sight as a result of the Exhibition.

Raw materials, however, provide the key to the position. There is a great shortage, particularly of packing materials. Visitors from 61 foreign countries visited the show, and dealers at home attended in greater numbers than ever before. It is said that from an export point of view the results have been far in excess of expectations.

Most of the advertisers reported an increase in the volume of exports. All of them had to turn away orders for the home market. That being so, the Exhibition should have been a trade exhibition, and one of the generally voiced criticisms was that too many people visited the show for it to be comfortable. However, the organisers have no doubt learned their lesson, and we can hope for an improvement next year.

Revised Prices of Blueprints.

SINCE its inception we have maintained the pre-war prices of our blueprint service. Conditions now, however, force us to make price increases, and we regret that the rise in the cost of production and the shortage of paper have forced this decision upon us. The new prices will be found on page iii of the cover of this issue. We intend to expand our blueprint service, and additions to it will be noted here. We cannot undertake to vary the designs to suit individual requirements.

New Vest Pocket Book

WE wish to draw attention to our new vest pocket book, entitled Newnes' Metric and Decimal Tables, which costs 3s. 6d., or 3s. 9d. by post from the publisher, George Newnes, Ltd., Tower House, Southampton Street, Strand, W.C.2.

This handbook contains a useful collection of metric tables and conversion factors, and it is uniform in style with our other vest pocket books: Radio Engineers' Pocket Book, Mathematical Tables and Formulæ, Screw Thread Tables, Wire and Wire Gauges.

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

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

ROUND THE WORLD OF WIRELESS

Broadcast Receiving Licences

THE following statement shows the approximate numbers of licences issued during the year ended August 31st, 1947.

Region	*Number*
London Postal	2,046,000
Home Counties	1,433,000
Midland	1,552,000
North Eastern	1,670,000
North Western	1,437,000
South Western	934,000
Welsh and Border	620,000
Total England and Wales ..	9,692,000
Scotland	1,038,000
Northern Ireland	160,000
Grand Total	10,890,000

The above total included 23,150 television licences, and prosecutions during August for operating receivers without a licence numbered 448.

Amateur Radio Exhibition

AS mentioned on page 516, this exhibition is being held at the Royal Hotel, Woburn Place, London, W.C.1, from November 19th to 22nd inclusive. Admission will be by catalogue, price 1s. at the door, or 1s. 6d. post free from the R.S.G.B.

Television Studio Building

FEW visitors to Olympia guessed that the handsome, fire- and sound-proof television studio built for the B.B.C. was constructed chiefly of hessian.

Secret is that the hessian has been sprayed with sand and cement by the new Aerocem process. As the film companies found recently, temporary sets, stands, and buildings can be constructed with unprecedented speed by treating a hessian framework with this method.

At Radiolympia the television studio was given a textured finish, and afterwards painted over to achieve a highly decorative, fluted effect.

Eddystone S.W. Equipment

THE Belfast Harbour Board have adopted Eddystone Short Wave Radio Telephonic Equipment, and Messrs. Stratton & Co., Ltd., have recently completed the installation—enabling the Marine superintendent to keep in constant touch with all official craft in the Harbour.

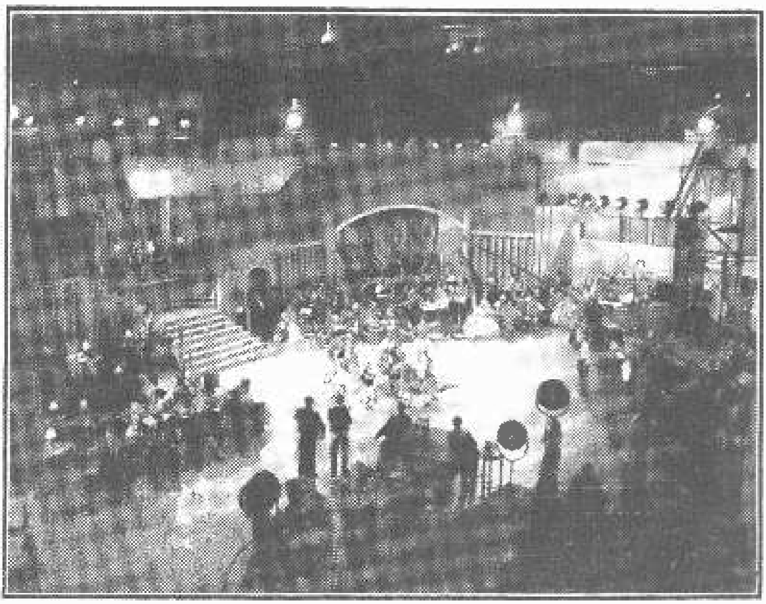
The time- and money-saving efficiency of this unique equipment is becoming widely recognised and inquiries are being received from such diverse undertakings as Taxi Services.

Multicore Success at Radiolympia

THE first few days of Radiolympia, 1947, clearly established that the Multicore idea of having a model factory on their stand to illustrate the use of Ersin Multicore three core solder had considerable appeal to all visitors, whether from overseas, the trade, or the public.

The eight girls from the Bush Radio Works who manufactured every five minutes a coil unit containing 200 parts and involving 70 Multicore soldered joints, drew crowds throughout the hours that they were at the conveyor belt. At the other end of the Multicore Stand, visitors peered over each other's shoulders to see the three girls from A. H. Hunt's capacitor factory make upwards of 1,000 soldered joints per hour.

Her Majesty Queen Mary visited the Multicore Stand and her interest in these factory processes was certainly of considerable gratification to the factory operatives, whose work she inspected.



A scene being shot in the B.B.C. studio erected at Olympia for the Radio Exhibition. The studio walls were made of hessian sprayed with cement.

An Exide Battery Works Overtime

A GLIMPSE into Mr. John Gaul's magnificent 51 h.p. 12 cyl. Phantom III Rolls-Royce: on this dashboard and on a control panel in the rear compartment no fewer than 18 switches are fitted to provide all the usual lighting as well as

The Control Room at Scotland Yard as demonstrated at Radiolympia. The position of any Police radio car may instantly be seen, and they are "plotted" on lines similar to those used for plotting aircraft during the war.

three interior lights, map-reading lights, stepping-in lights, boot and "GB" lights.

Extra electrical refinements which the 12-volt Exide battery is called upon to operate include, *inter alia*, 5-valve radio, car heater, cigar and cigarette lighters, two clocks, not to mention windows, partition and rear-window blind, all of which are raised and lowered electrically.

It is scarcely surprising that this superlative motor car won for Mr. Gaul not only the Monte Carlo Grand Prix, but also the "Prix d'Honneur et Prix de plus grand fini de la Construction Automobile," at the Ostende Concours D'Elegance, earlier this year, nor yet that the prestige of the British motor industry is firmly upheld when such examples of craftsmanship can be sent to compete in foreign exhibitions and rallies.

Postal Orders to H.M. Forces Abroad

THE Postmaster-General announces that postal orders may no longer be sent to personnel of His Majesty's Forces who are outside the Sterling Area (described in the Exchange Control Act, 1947, as the Scheduled Territories).

B.I.R.E. Lectures

THE London Section heard a Paper by J. H. Evans on "Applications of Crystal Rectifiers at Frequencies up to 10,000 Mc/s," at their meeting on October 9th last. Details of future meetings, etc., may be obtained from 9, Bedford Square, London, W.C.1.

Kenya's Radiotelephony Services Restored

CABLE AND WIRELESS, LTD., have re-opened Kenya's pre-war radiotelephone circuits with Canada and South Africa at reduced charges.

The charge for calls between Kenya and Canada (via London) is £3 15s. (compared with the pre-war rate of £6 12s.) for a three-minute call. The three-minute charge on the direct service between Kenya and South Africa is £2 8s., compared with £3 12s. before the war. The report charge is 4s. on each circuit.

The distant terminals are operated by the Canadian Marconi Company in Montreal, and by Cable and Wireless (South Africa), Ltd., in Capetown.

Anti-interference Regulation

AS from January 1st next, the use of unscreened diathermy is prohibited by a law recently passed in Canada. All equipment made in future must be frequency stabilised and must include harmonic suppression circuits or devices.

Walkie-Talkie Equipment

IT is emphasised that the G.P.O. will not issue licences specifically for the use of Walkie-Talkie apparatus of ex-Government origin. This equipment may, of course, be used by those holding the G.P.O. amateur transmitting licence, but care must be taken that they are only used on the recognised wavebands and under the normal conditions of the licence.

A new design in radio receivers. This model, by Champion, has the speaker at the top and gives even sound radiation.

Using War Surplus Gear

Details of Circuits and Sets Which Can be Built by the Experimenter.

By E. N. BRADLEY

THE writer, in contact with many readers of his radio books (published under the pen-name of "Radiotrician") has found one query arising again and again; how can the experimenter and constructor obtain most benefit from war surplus gear? It is hoped that this article will be of assistance to those who have purchased such equipment and who are, perhaps, feeling a little disappointed with their bargains.

A word as to the buying of surplus gear. Whenever possible, buy the gear personally since then it can be inspected and a good article chosen. All too often gear ordered and sent by post arrives in battered and scratched cabinets or cases, and whilst modern valves will stand up to an amazing amount of misusage they cannot be expected to survive a post or rail journey in inadequately packed and protected equipment. Generally speaking, surplus gear is bought for the components and valves, and if these are damaged money is lost.

The equipment at present on sale has almost all been designed and made to perform highly specialised tasks either in communications or radar applications, and so is of little value as it stands. The component and valve value, to the amateur, is considerable, however, and the first task on obtaining surplus gear, unless a receiver has been bought, is to strip the material.

The stripping must be an unhurried and carefully performed operation, especially since the equipment has been built to last and to operate under the most difficult conditions. It will be found that soldered joints, for example, are very well made, component leads or wiring being wrapped two or three times round connecting tags before the solder has been applied, and it will need careful work with a stout pair of tweezers or long-nosed pliers to free a wire-ended resistor or capacitor without damage. Remember, too, to keep heat away from the body of the component, whilst unsoldering, by gripping the lead near the component with the pliers so that heat is led away. Prepare some tins or boxes into which the components can be graded as they are stripped out, and make the first task, once the components have been salvaged, the testing of all electrolytic and fixed capacitors for leakage, testing them, whenever possible, at their rated working voltages. A neon lamp makes a handy tester if better means are not to hand, together with a D.C. source applied to the capacitor in the correct polarity sense.

Discard leaky capacitors ruthlessly: built up into circuits they will only cause harm at some time or other.

Useful Valves

The valves obtained from surplus gear appear to fall chiefly into quite a small number of types. The SP41 is used widely, the service code number being VR65 or VR65A, and since, for some applications, the SP41 like other 4-volt heater valves was given a 6-volt heater, it is only wise to test all the 4-volt types on 4 volts to ascertain that they reach full brilliancy. If not, they will require 6.3 volts on their heater terminals.

Another valve commonly appearing is the little D1 diode, always easily recognised no matter how coded (ARD2 or CV1078 or VR78), whilst the EF50 (VR91 or CV1091) is also conspicuous in its cylindrical (white on red) can. The EF39 was also used in many circuits (VR53 or CV1053).

All these valves have obvious uses, however. It is less obvious to think of a use for valves like the little battery peanut types such as the 1T4 and 1S5 which, complete in aluminium cases together with 465 kc/s dust-core transformers of midget size, have enjoyed wide sales.

A pair of 1T4s, however, make an excellent standby battery receiver which will work off a 36-volt battery made up of four 9-volt grid-bias batteries, with a U2 cell supplying the filament current. The writer uses such a receiver in one of the poorest reception areas in the country with consistently good results. The circuit is shown in Fig. 1 and it will be seen that an oscillating detector is followed by a voltage amplifier to give very good headphone output. A voltage amplifier was used since output valves such as the 3S4 are not easily come by,

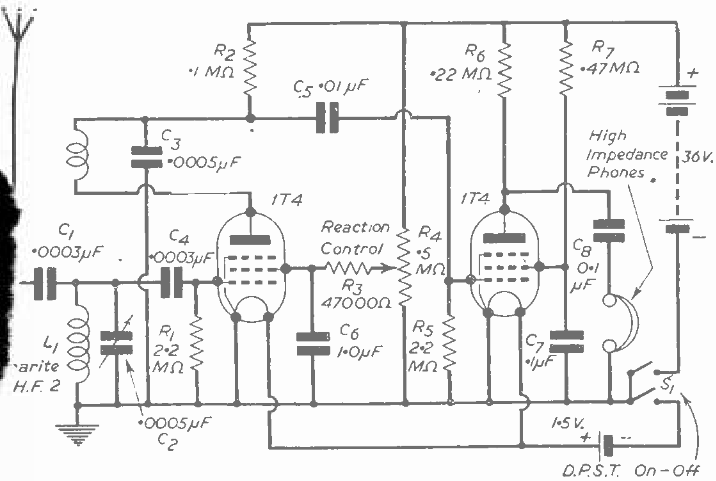


Fig. 1.—A T.R.F. receiver using 1T4 valves.

and at the same time this circuit enables a crystal earpiece to be used if one of these earpieces has been bought amongst surplus gear.

The 1T4 is especially suited to potentiometer control of reaction, giving beautifully smooth working right up to and over the critical point.

A T.R.F. Circuit

The T.R.F. receiver is shown since so many purchasers of the small battery units bought them for the I.F. transformers and have the valves lying idle, but for those with I.F. transformers to spare the circuit of Fig. 2 will be of interest. Here a headphone superhet is shown, using a 1A7G converter, a 1T4 I.F. amplifier and a 1S5 as diode detector and audio amplifier. In both receivers only medium-wave tuning is shown, although the long-wave band can easily be added if desired. The T.R.F. receiver is ready to operate and needs no lining up; the superhet must be adjusted in the usual way, using a signal generator. With the oscillator grid coil shorted to earth via an 0.1 μF capacitor, feed the signal generator into the mixer grid and adjust the I.F. transformers to 465 kc/s for maximum signal. Allow the oscillator to work normally by removing the shorting capacitor, feed the signal generator into the aerial and earth sockets, tune generator and receiver to 250 metres and adjust the trimmer, C5, for maximum signal. Tune the receiver and generator to 500 metres, and adjust the padder, C6, for maximum signal. Return to 250 metres and readjust C5 as necessary; then, returning to 500 metres and repadding as necessary, continue the operation until adjusting the padder has no further effect on the oscillator trimmer. Finally, trim the aerial tuner, C1, for maximum signal on 200 or 250 metres and the receiver is ready to operate. The output from the signal generator should be kept as low as possible so that the a.v.c. of the receiver does not operate.

The Long-lines Circuit

To return to larger and higher-powered valves, another valve quite often found in surplus gear is the RK34, a double triode transmitting valve which will work successfully at its maximum ratings up to 220 Mc/s or about 1.3 metres. This valve will therefore suit the amateur licenced to transmit if a proposal for a 168 to 170 Mc/s amateur band ever comes into force, since a "long-lines" stabilised oscillator is easily built round such a valve to give an output of as much as 12 watts or so. The long-lines circuit, one example of which is shown in Fig. 3, depends for its frequency stability on the mechanical stability of its tuned-grid circuit, this consisting of two tubes of copper, ½in. in diameter, rigidly supported on insulators. These tubes are made quarter wave length long, so that at 170 Mc/s the tube length is only 17.32in. Actually the tubes would be made about 17.5 or 18in. long, final tuning being carried out by the shorting bar which is made movable along the tubes and securely locked in its final correct position.

The anode circuit consists of a small coil wound of copper strip, this coil being tuned by a split-stator condenser. The RK34 is often accompanied by some of these condensers, and the coil, to suit the type usually found, should have two turns of strip 1½in. in diameter, the turns being well

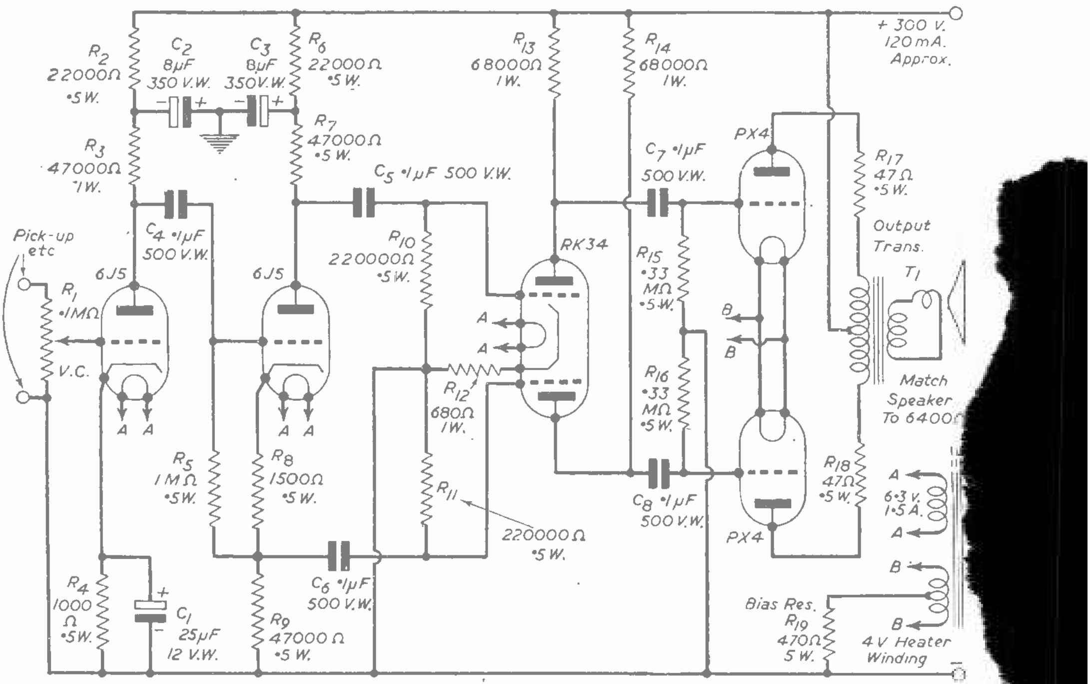


Fig. 4.—An 8-10 watt A.C. amplifier using the RK34.

separated so that the aerial coil, a single turn, can be inserted between them.

The anode circuit is tuned to resonance by watching for a dip in the plate current as indicated by the 0-100 mA. meter, and this tuning must be performed as rapidly as possible since the valve will take a heavy current until the whole circuit is oscillating.

With the tank circuit properly tuned, the aerial coil L1 is coupled into the tank coil L2 until the milliammeter indicates a current of 75 or 80 mA. maximum, L1 of course being connected by suitable feeders to a dipole or beam aerial.

The transformer T in the oscillator's anode line provides for anode modulation of the oscillator and must have a ratio which will match the output impedance of the speech amplifier into the modulating impedance presented by the oscillator. This latter impedance is 3,750 ohms with the oscillator drawing 80 mA. unmodulated, and the speech amplifier should give 5 or 6 watts output. The ratio of T is given by

$$\text{Ratio} = \sqrt{\frac{\text{Modulating impedance}}{\text{Speech amplifier output impedance}}}$$

so that if a 6L6 were to be used as the output valve of the speech amplifier, the required output load of the 6L6 being 2,500 ohms, the ratio of T would then be 1.23 : 1. The component must be

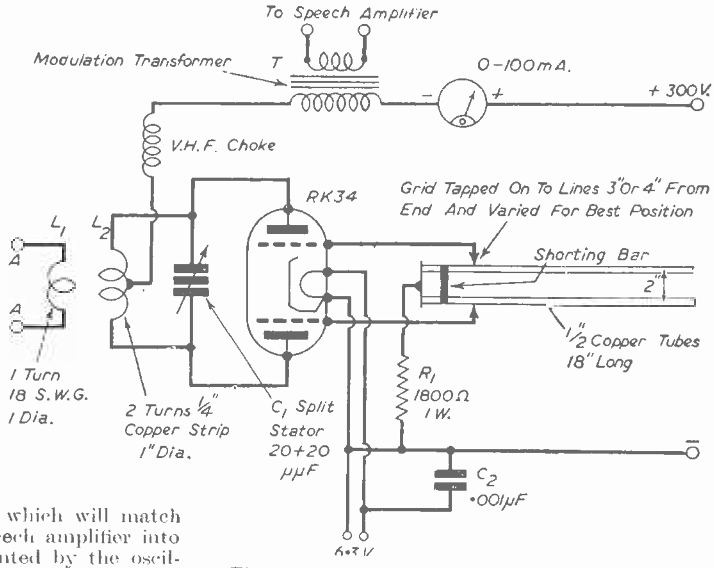


Fig. 3.—The RK34 as a long-lines transmitter.

capable of carrying 100 mA. at least in both windings.

Push-Pull Stages

To the amateur constructor who has no transmitting licence, however, such a circuit must remain of purely academic interest and he still awaits a use for his RK34 double triode. It is the author's intention to test such a valve as a push-pull

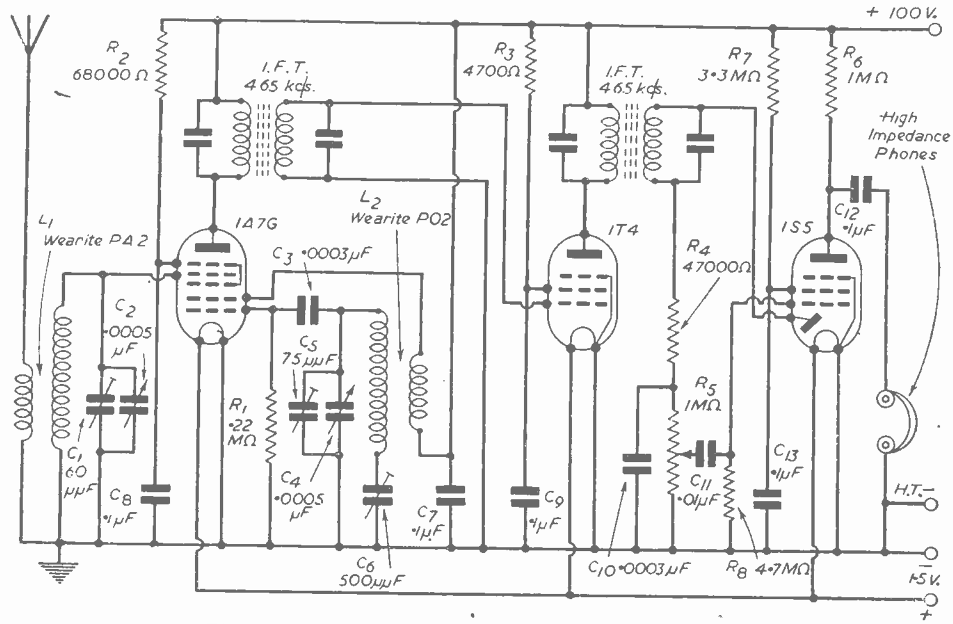


Fig. 2.—A battery superhet circuit with headphone output.

output stage although, since insufficient information is published, it will be a painstaking task to discover the correct ratio needed for the output transformer, the correct feed conditions to the grids and the correct grid bias, etc. It is simpler to use the valve as a driver stage, feeding a pair of output triodes such as PX4s or PX25s, and the fact that the RK34 requires 6.3 volts on its heater whilst the PX4 and PX25 need 4 volts is not a great drawback

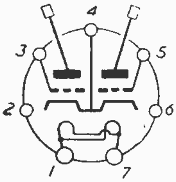


Fig. 5.—Base connections of the RK34 as viewed from below.

now that transformers which supply both these heater voltages are widely available. In any case the output triodes must have a separate centre-tapped heater winding in order that they may be correctly biased.

A basic amplifier circuit using the RK34 in the penultimate stage is shown in Fig. 4, with 6J5 valves as the input and phase-splitter stages since these valves are also easily obtainable, sometimes at reduced prices. This amplifier will be loaded to give full output with about 0.5 volt input, although the gain will be reduced a little if a tone control is fitted. A tone control, if needed, can be selected from the circuits shown in the writer's article published in the December, 1946, issue of PRACTICAL WIRELESS.

The base of the RK34 is of the 7-pin UX type with the connections as shown in Fig. 5. In some cases, however, it will be found that the valve has a British 5-pin base, the anodes again being taken out to a pair of top caps and the two grids connected to the anode and grid pins on the base. In this case the valve is probably a TVO3-10 which has the same ratings as the RK34. The Service code number for the RK34 is VT61 or CV1061 whilst the TVO3-10 is coded VT61A or CV1573.

A Useful Diode

A Mark 1 I.F.F. unit which is sold at prices ranging from 50/- to 80/- contains a pair of TVO3-10s, an EF50, four SP41s and three D1 diodes. The EF50 and SP41 valves will probably be earmarked for use in a receiver or testgear but the D1s need not lie idle.

A spare pair of SP41 R.F. pentodes and a D1 only require a minimum of components and an output valve such as the Pen45 added to them to make an excellent fixed-tuned V.H.F. receiver which is ideal for reception of the Television sound programmes within the service area of the Alexandra Palace station. The circuit is shown in Fig. 6 where two R.F. stages feed into a diode detector, the signal then passing via a volume control to the output stage. Small trimmer capacitors are used to tune the coils—the bandwidth is still very broad and so excellent quality is obtained—and whilst each stage should be contained in its own screening box these can easily be built up from scrap aluminium. Three screening compartments should be used, one for each tuned circuit together with its associated valve. The receiver is trimmed, preferably using a signal generator, from the detector back to the aerial tuned circuit, and then can be left without further adjustment, the only panel control necessary being the volume control.

The coils may be wound on paxolin tube ½in. in diameter, using 18 or 20 s.w.g. enamelled copper wire, L1 consisting of 9 turns and L2 and L3 consisting of 8 turns of wire spaced over 1in. winding length. The aerial, preferably a half-wave dipole, is tapped on to the first turn across earth and a tapping 1½ turns up the coil.

The 0.001 μF coupling capacitors between stages must be of the mica type.

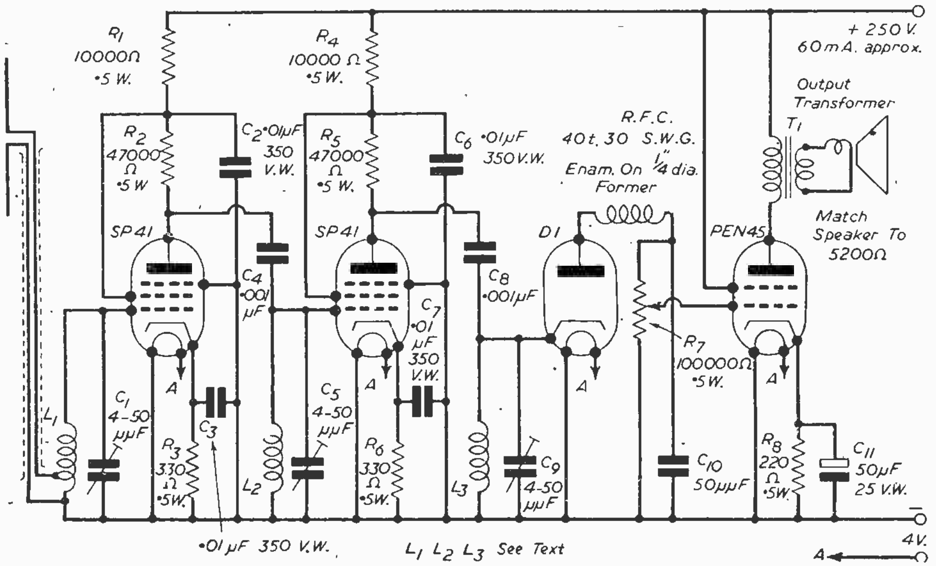


Fig. 6.—A television sound receiver circuit.

The Shoulder-strap Five

An All-wave Miniature Receiver, Using the Ex-Govt. MCR1 as a Foundation, Designed to Give Loudspeaker Results and Using a Shoulder Strap as an Aerial for Local Stations

By R. E. HARTKOPF

FOR many years—ever since the days of the match-box crystal set—it has been the writer's ambition to design and build a really efficient miniature portable receiver. But while tentative plans had often been made they came to nothing, due to the difficulty of finding suitable components, and the high prices, by pre-war standards, of those which were available. However, when the release of the ex-Govt. Miniature Communications Receivers (MCR I) was recently announced, the writer hastily made inquiries and eventually purchased for a little over £6 a receiver complete with headphones, plug-in coils, aerial and battery.

Although the set had been bought with the intention of making drastic alterations, the first evening was not unnaturally spent in trying it out as it stood; and while there is no doubt that it is a beautifully designed little job and the quality of the material and workmanship is beyond reproach the actual results were in some ways rather disappointing. We have come to look upon automatic volume control as a matter of course, and the way the programmes faded—particularly on distant short-wave stations—made them most unpleasant to listen to. Apart from this, the noise level was high and though some of this was obviously due to the poor condition of the battery (also ex-Govt.), which was manufactured way back in 1945, it was felt that the series wiring of the valve filaments had quite a lot to do with the trouble. This series wiring, together with the fact that the H.T. decoupling condenser was a miniature component of only .1 μF capacity, resulted in a certain amount of feed-back and caused a low frequency howl on certain sections of the waveband. Generally speaking, however, the set was full of promise, and the foregoing remarks are made with a view to protecting the experimenter from premature disappointment. After all, the set was not designed to give high-quality broadcast reception, but to receive vital information under adverse circumstances and with any form of power supply which happened to be available. Like most other ex-Govt. equipment, it is a worth-while bargain only for those who are prepared to spend a reasonable amount of time and energy in converting it for peacetime use.

Existing Layout

Before beginning the work of converting the set it must, of course, be removed from its case, and it is very advisable that the existing layout should be studied, together with the sketches, until the reader is quite familiar with all the components. For the sake of simplicity the work of conversion has been divided into two sections. The first deals with the necessary modifications to the

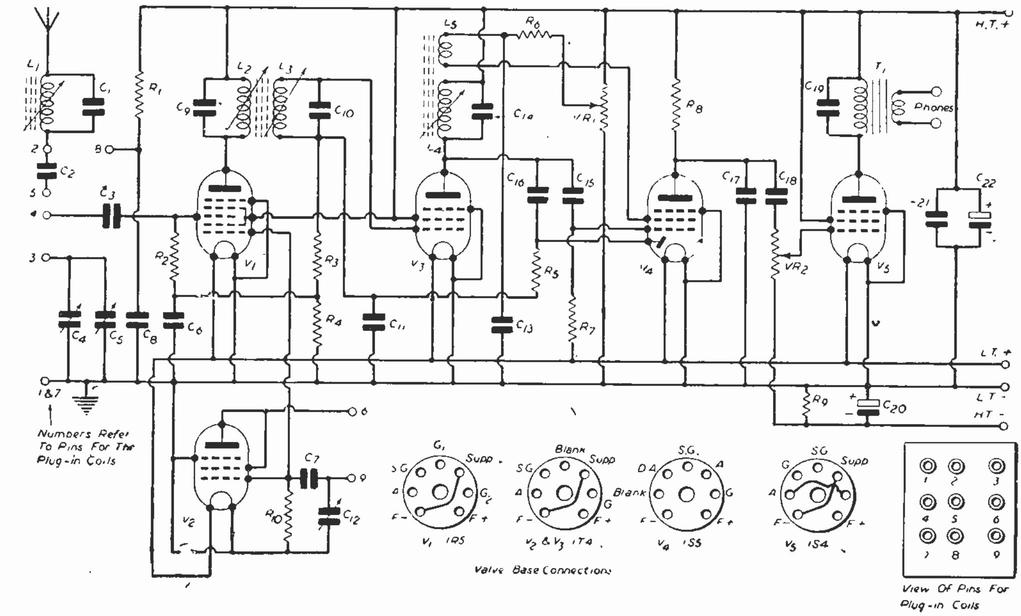


Fig. 1.—The modified theoretical circuit.

existing chassis, namely the alteration of the power supply requirements from 90 to 67½ volts H.T. and 7½ to 1½ volts L.T., the replacement of the 1T4 detector with a 1S5 diode pentode giving A.V.C. (VR2, Fig. 1, is then used as a volume instead of a sensitivity control) and the replacement of the 1T4 output with a 1S4 power output valve for use with a 2½in. miniature speaker. The second section deals with the provision of a suitable case for housing the chassis, batteries and speaker, the making up of the shoulder-strap aerial and some suggested alterations to the plug-in coils.

The actual removal of the set from the case should present little difficulty. Six self-tapping screws at each side and four at each end serve to hold all the casing together. The screws and all other parts should be carefully kept for use later if necessary, and it must be remembered that the two screws on the right-hand side at the plug lead end must have washers, otherwise their points will foul the second I.F. coil can (L4 and L5, Fig. 2).

Modified Circuit

The chassis should then be carefully studied along with Fig. 1, showing the theoretical circuit panel eased up as far as the wiring connections underneath will permit. These leads can then be unsoldered one by one, easing the panel up all the time until it is completely free of the chassis. (In most cases the writer found it more convenient to disconnect the leads at the panel end, leaving them attached to the components on the chassis.) The work should not be done hastily, and it is worth while taking notes of the various leads and connections, as many of them can be used when the panel is connected up again later. For the same reason it is worth taking care that the P.V.C. insulation is not burnt by contact with the hot iron. This P.V.C. covered wire is only single strand and has a tendency to break if handled to any great extent, and where this happened and also where new wiring was required the writer used a seven-strand P.V.C. covered wire, which has roughly the same outside diameter as the original single strand, but is much more flexible. This has recently come on the market in the form of a very light twisted flex, and appears to be readily obtainable. It is best to get lengths of different colours, as the wiring in the set seems in most places to follow a colour coding—red and blue for H.T. runs, green for grid and associated

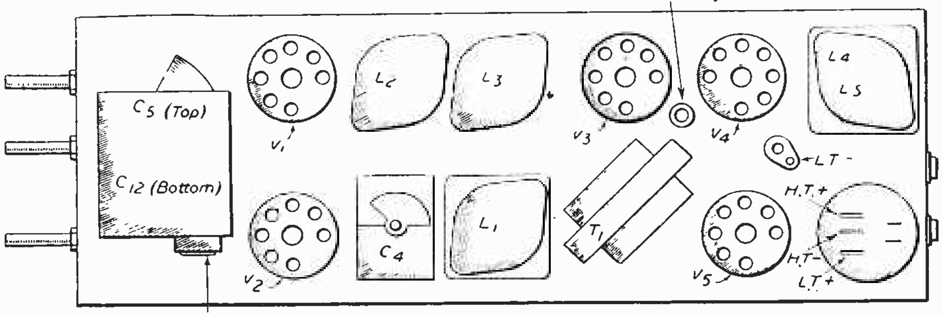


Fig. 2.—Plan view of chassis.

(modified), Fig. 2, the plan view of the chassis, and Fig. 3, giving the plan view of the resistance-condenser panel. It will be noticed that a number of the resistors and condensers in Fig. 3 are shown dotted. These are components which are not required in the modified version, as the reduction of the H.T. voltage and the removal of the series wiring of the valves make the circuit much simpler than before. If these components are carefully removed they form a useful addition to the experimenter's stock.

Having got the "feel" of the job, the actual work of conversion may now be commenced, but here a word of warning is necessary. The set is very compact and the soldering iron used should be as small as possible, to avoid damage to the components. These are rather fragile, and should be handled with care. However, with the aid of a hot iron and a pair of tweezers borrowed from the first-aid kit for places where pliers were too cumbersome, the writer experienced little difficulty.

The first operation in the dismantling of the set is the removal of the paxolin resistance-condenser panel. It will be seen that this is held by three 6BA nuts, and these should be unscrewed and the wiring, and brown for the series wiring to the filaments. Although this is not strictly adhered to, it was found that the use of black for all chassis and L.T.— leads, and pink for the L.T.+ simplified the wiring and helped with the final check.

Rewiring

Another aid in rewiring is to tackle all the valve filament wiring on the chassis and the earth connections on the panel before anything else. Since it is not now necessary to isolate the wiring from the chassis, the L.T.— leads can be soldered to part of the chassis beside each valve if so desired. The writer, however, found it equally convenient to wire V1 and V2 to a nearby tag at the base of the nearest support for the paxolin panel, and to continue a wire from there to V3, and thence to V4 and V5, and through a rivet hole on V5 to the tag on the top of the chassis deck (marked L.T.— in Fig. 2). This earths the chassis in two places and also provides an L.T.— connecting point (the three insulated points on the nearby panel which were originally connected to the plug lead being required for H.T.+, H.T.— and L.T.+ respectively).

Another job which can be done at the same time is the removal of the 350 volt .1 μF isolating condenser which is located in the centre of the underside of the chassis. This can be replaced by the 500 ohm standard ¼ watt resistor R9, and the insulated tag (Fig. 2) is then connected to H.T.—.

The rest of the work on the chassis is mainly concerned with the rewiring of the bases of V4 and V5, and this is quite straightforward. While wiring the base for the 1S4 output valve, the anode should not be connected to the 'phone transformer, but should have about 1ft. of loose wire soldered to it. The same should be done for the anode side of the 'phone transformer (T1) itself. These leads are later connected to an "Off—'Phones—Speaker" switch on the new upper chassis which will contain the batteries and speaker, etc. Meantime, they can be connected together (and bound with insulating tape in case they touch the chassis) for testing the set. The two leads referred to are marked X and Y in Fig. 1.

The Panel

Turning to the panel, the first operation here is the removal of all the unnecessary resistors and condensers which are shown dotted in Fig. 3. After they are removed the panel will be greatly simplified, and if the rewiring is done in a colour coding to match the chassis, it will again make matters easier. The only new component required here is the 50 pF postage-stamp type condenser, C16, which fits very nicely into the space taken by

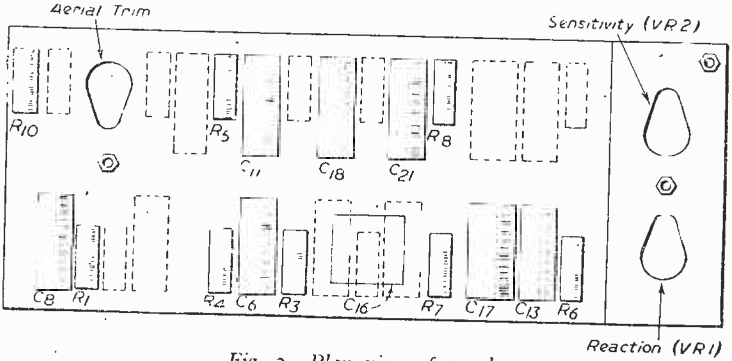


Fig. 3—Plan view of panel.

two of the condensers and one resistor now not required (see Fig. 3). It will be found that one wire end of this condenser will fit through a hole just over the appropriate anode pin of V3, making a short and handy connection.

When both the chassis and panel have been rewired and checked the only thing remaining is

LIST OF COMPONENTS FOR THE SHOULDER-STRAP FIVE

C1—Aerial filter condenser (existing), 30 pF.
C2—Aerial isolating condenser (existing), 50 pF.
C3—V1 grid condenser (existing), 100 pF.
C4—Ae. trimmer (variable) (existing).
C5—Signal tuning condenser (existing), ganged to C12.
C6—V1 bias decoupling (existing), .01 μF (on panel).
C7—V2 oscillator grid (existing), 50 pF.
C8—Oscillator anode decoupling (existing), .05 μF (on panel).
C9—1st I.F. primary trim (existing), 50 pF.
C10—1st I.F. secondary trim (existing), 50 pF.
C11—1st I.F. secondary decoupling (existing), .05 μF (on panel).
C12—Oscillator tuning condenser (existing), ganged to C5.
C13—Reaction H.T. decoupling (existing), .1 μF (on panel).
C14—2nd I.F. trimmer (existing), 60 pF.
C15—V4 grid condenser (existing), 50 pF.
C16—Postage-stamp type, diode feed (new), 50 pF.
C17—H.F. by-pass (existing), .0003 μF (on panel).
C18—V5 grid condenser (existing), .1 μF (on panel).
C19—Tone-control condenser (existing), .005 μF.
C20—Auto-bias by-pass electrolytic (new), 50 μF 12 volt.
C21—H.T. H.F. by-pass (existing), .1 μF (on panel).
C22—H.T. by-pass electrolytic (new), 8 μF 150 volts.
R1—Oscillator anode feed resistor (existing), 17 KΩ (on panel).
R2—V1 signal grid load (existing), 470 KΩ
R3—V1 bias network (existing), 1.2 MΩ (on panel).
R4—V1 bias network (existing), 3 MΩ (on panel).
R5—V1 and V2 A.V.C. feed (existing), 1.2 MΩ (on panel).
R6—2nd I.F. reaction H.T. feed (existing), 100 KΩ (on panel).
R7—V4 detector grid-leak (existing), 3 MΩ (on panel).
R8—V4 anode load (existing), 220 KΩ (on panel).
R9—Auto bias resistor, ¼ watt (new), 500 ohms.
R10—V2 oscillator grid-leak (existing), 100 KΩ (on panel).
VR1—Variable reaction control (existing), 250 KΩ (on panel).
VR2—Variable volume control (existing), 250 KΩ (on panel).
L1—Tuned aerial filter (existing).
L2—1st I.F. primary 1,700 Kc/s (existing).
L3—1st I.F. secondary 1,700 Kc/s (existing).
L4—2nd I.F. tuned 1,700 Kc/s (existing).
L5—2nd I.F. reaction for C.W. and sensitivity (existing).
T1—'Phone transformer (existing).
V1—1R5 frequency-changer (existing).
V2—1T4 oscillator (existing).
V3—1T4 H.F. pentode (existing).
V4—1S5 diode-pentode detector (new), replaces 1T4.
V5—1S4 power output pentode (new), replaces 1T4.
U2 cell for L.T.
Ever-Ready "Battrymax" B101, 67½ volts H.T.

to arrange for the connections between them. Most of these should already be in existence, and any new ones should be made as short as possible compatible with ease of access for connecting. If, as has been suggested, a note has been kept of the sequence in which they were disconnected when the panel was first removed, this should be a handy guide to the rewiring; and when the last connection has been made the panel should be in its original position and the three nuts can be replaced. The loose leads from the 1S4 anode and the transformer should be connected and with the valves in position the four battery connecting points should be checked with an ohmmeter. H.T.+ to H.T.— should give a slight kick and a reading of about ¼ meg. L.T.+ to L.T.— should show continuity through the valve filaments, and L.T.— to H.T.— should read 500 ohms.

Batteries Required

And now, if the four battery leads are brought out and an 8 μF electrolytic temporarily connected across the H.T., and a bias electrolytic (12 volt 50 μF) from L.T.— to H.T.— (Pos. to L.T.—), the set is ready for a test. But, please remember that the batteries now required are 60-70 volts H.T. and, most important of all, only 1½ volts L.T., otherwise all the valves may be burnt out. But having taken these precautions and connected the aerial, earth and 'phones, the set should really begin to show results; and after checking the trimming and/or making any adjustments or alterations which may suggest themselves, the way is clear for the upper chassis containing the speaker, batteries, etc., and the shoulder-strap aerial to be made and wired up to the set.

(To be continued)

Home-made Oscillograph

Details of Construction of a Useful Test Set Built Round the Mullard B100 Unit.

By E. D. WARD

ON looking through innumerable text books, magazines, etc., I failed to find anything detailed about a C.R.O. which I needed, so I decided to branch off on my own and with the old process of elimination hit on the right thing.

I built several time bases, using soft and hard valves, and finally came across Puckles hard valve time base in a book by the same author called "Time Bases." As is often the case with technical books, there were very little values to work on, and no reference as to what valves to use.

The Circuit

As can be seen from the circuit diagram (Fig. 1), this is essentially Puckles time base with one or two slight modifications. The main point I found regarding this time base was the screen voltage on V1—and if a different main H.T. from the one I used is employed the fine frequency control

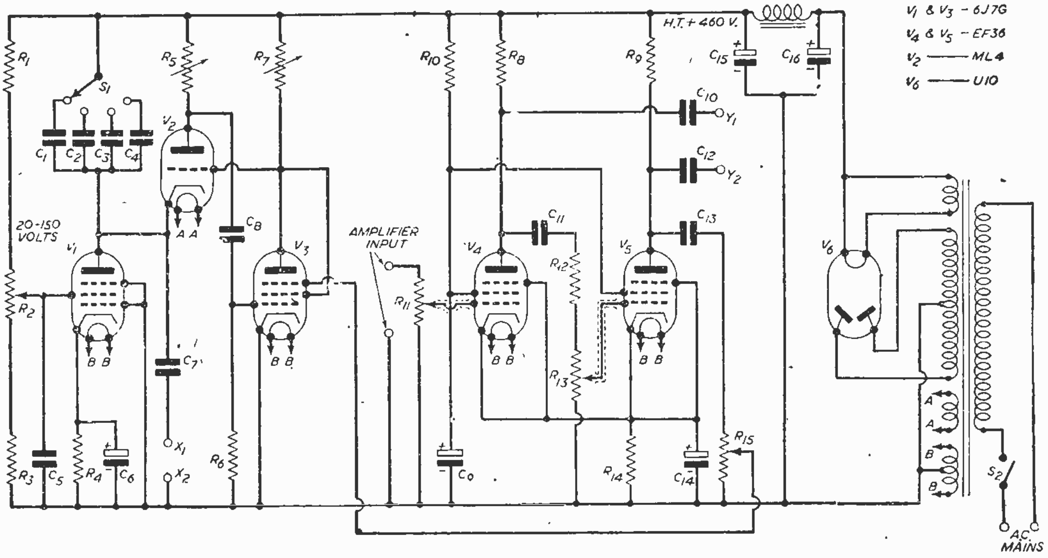


Fig. 1.—The hard valve time base used in the oscillograph described in this article. A full list of components will be found on the next page.

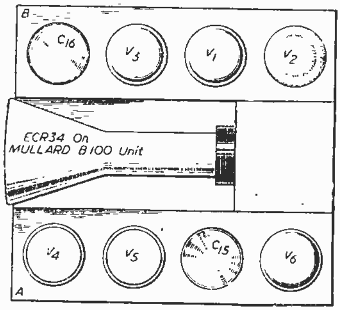


Fig. 2.—This general view is not to scale but shows the arrangement of valves and tube unit.

LIST OF COMPONENTS FOR OSCILLOGRAPH

R1 120,000Ω.	R10 150,000Ω.	C1, C8, C10, C11, C12, C13 .1 μF.	C6, C14 50 μF 50 volt.
R2 250,000Ω (fine freq.).	R11 100,000Ω (Y amplitude).		C9 16 μF.
R3 2,000Ω.	R12 500,000Ω.		C15, C16 32 μF.
R4 1,000Ω.	R13 10,000Ω (pre-set).		
R5 2,000Ω (max.) (trigger).	R14 265Ω.		
R6 1 megohm.	R15 500,000Ω (synch.).	C2 .05 μF.	Mains Transformer, 350-0-350.
R7 250,000Ω (X amplitude).	S1 Single-pole 4-way.	C5 .5 μF.	
R8, R9 50,000Ω.	S2 Ganged on Brilliance Control of B100 unit.	C3 .002 μF.	4 volt 2 amps.
		C4 .00006 μF.	4 volt 2 amps.
		C7 1.00 μF.	6.3 volt C.T.

will not run smooth enough for good results. I found that best results were obtained if the control varied the screen potential from about 40 to 150 volts.

The amplifier is nothing elaborate, just a plain, straightforward two-valve paraphase amplifier.

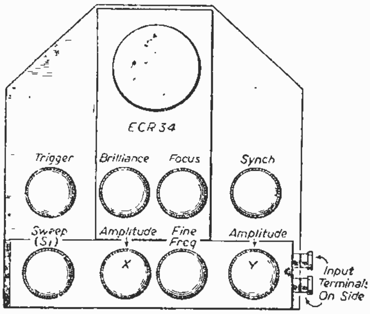


Fig. 3.—Front view of chassis showing controls and Mullard B100 Unit.

The only unconventional part about it is the synchronising voltage control, but this works quite well without any apparent detriment to the amplifier or the "picture."

Constructional Details

When the bottom of the B100 is removed, it will be found that there is ample space under the back upright for the windings of a mains transformer, if this is mounted on the underside of the main chassis, so a hole was cut in the main chassis and the transformer laminations mounted below with the windings protruding through. The mains input leads were connected to the voltage adjustment tag on the back of the B100 unit and switched with the switch on the Brilliance control. The B100 unit was then mounted in the centre of a chassis 10in. wide by 11in. long by 2½in. deep. From here on it is plain straightforward wiring—point-to-point, with no right-angled leads for tidiness.

The main chassis was, of course, cut with the necessary valve base holes as shown in the plan view (Fig. 2).

The trigger and synch. controls were mounted on a piece of sheet tin (with bent back edges) to cover the front of the chassis as shown in the front view (Fig. 3). (This piece of tin was bolted to the main chassis at points A and B.)

The ECR34 protrudes in front of the chassis to about 1in., so a cowl was placed round the hole that was put in the front sheet through which the ECR34 protrudes.

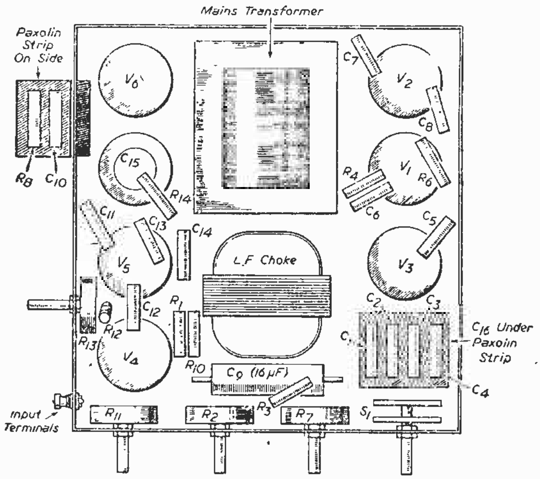


Fig. 4.—Underside view of chassis showing layout of main components.

The whole of the apparatus was then covered with a cowl, with a slit down the back to clear the terminals on the B100 unit.

The control R13 is adjusted so that the signals are equal and opposite at each anode.

ON YOUR WAVELENGTH

By THERMION

What's the Answer?

MR. R. C. BELL, of Ambleside, in a letter dealing with the Purchase Tax on batteries, writes:

"Please tell me why, because I am country bred and cannot have electric light and must use gas instead, I must pay a *listening tax* each time I buy H.T., whilst owners of electric sets can have their listening 'free'?

"Our batteries cost us quite enough without this grim addition. Sir! Do not you think this Purchase Tax an unfair imposition?"

Fun at the Show

THIS is the first opportunity presented to me of recording my second thoughts on Radiolympia. I have no doubt that from the point of view of the sponsors it was a financial success in that it attracted very large crowds indeed. On most days records were broken. Once the visitor had entered the portals, for the first time since 1939, little was done for his comfort. Large crowds were milling around and shuffling along and it was almost impossible to get near to the stands, or to get into the various sideshows.

The B.B.C. Stand artistically was good, but it looked dead. If a theatrical manager booked a theatre which accommodates 1,000 people he does not sell 20,000 tickets for a particular evening, and that was rather the position. The arrangements in that connection were bad, and gave the impression that the Radio Industries Council, which sponsored the Show, were more interested in gate money than they were in seeing that Exhibitors had a chance of demonstrating their wares to buyers, overseas buyers, and to the British public.

As usual, a considerable amount of exhibited stock was stolen. Radiolympia seems to attract, as indeed the retail trade has attracted, the most predatory sections of the public. The general layout of the Exhibition was good, but I noticed a certain disinterestedness on the part of the public. Queueing was the order of the day, and it was practically impossible to obtain refreshments, except after waiting about an hour. The catering at Olympia has always been bad. The organisers go out to attract the largest possible gate, and having got the people there do nothing further for them. I understand that the organisers have sent a circular round to Exhibitors asking them to make suggestions for the next Radiolypmia whilst the present one is fresh in their mind.

I make the suggestion that there should be limitation of entry and that the catering arrangements should be adequate to the number of visitors which Olympia can comfortably accommodate. There should be greater policing to prevent pilfering. After all, Exhibitors cannot be expected to provide their own police. Exhibiting at a Show is an expensive business for the Exhibitor, and he is entitled to some protection in return and should not be regarded as one of the actors in a star production who is paying for the privilege of attracting visitors to the gate whilst the gate money goes into other people's pockets.

From this you will gather that I was disappointed with the Show. It lacked the *joie de vivre* of pre-war Shows. There was an atmosphere of boredom about the visitors which cannot, perhaps, altogether be blamed on the Show.

At our Stand I had many humorous moments. One visitor whose political views were obvious leered up to our Stand, livid of countenance, demanding to see yours truly. He was going to give me a lesson in crooning! He was also very annoyed with the views I have expressed herein on that subject, and which I underline, underscore, and emphasise again.

After he had blown off his steam he strolled away in contrite heart. It was pleasant for me to renew my acquaintance with so many old friends in the trade, and with so many old readers. I do hope that next year the organisers will take heed of my criticisms, which incidentally are supported by many members of the trade. More consideration should be given to the visitors and the Exhibitors. The Exhibition should not be designed merely to attract the largest possible gate.

Curious Correspondents

A RADIO firm recently received the following letter from a lady who had purchased one of their receivers:

"I have one of your radio sets which needs fixing up. As I am expecting a baby and it is one of yours, could you please send someone along to make it go." J'Accuse!

NOW'S OUR CHANCE!

[PRESS ITEM.—Under the latest import ban, it is not possible for English publishers to import American music.]

Now, bards of Britain, here's the chance,
Denied you for so long,
To write us tuneful melodies,
And "native talent" song.
With Tin Pan Alley kept at bay,
A step long overdue,
Here is the chance, you've had to wait
To show what you can do.

Trap drummers you will please delete,
Their antics make us sore,
And adenoidal "parpular sahngs"
Which listeners simply bore.
Don't tamely imitate such tripe,
Or with such efforts fumble,
We're sick of nasty monkey sounds
More fitted for the jungle.

Our native genius can provide
Sweet music for our ears,
Not doggerel loudly howled and moaned,
Provoking angry tears.
Let B.B.C. assist your task
In no uncertain way
And Tin Pan Alley put to rout—
Let British come "to stay"!

"TORCH."

Technical Notes—1

"DYNATRON" Here Discusses Problems of Resonance

A QUERIST has read somewhere that it is not always true that *resonance* obtains in a tuned-circuit when coil reactance = condenser reactance—when $2\pi fL = \frac{1}{2}\pi fC$?

He has read quite correctly, even though the tuned-circuits to which the statement applies would seldom, if ever, be found in receivers—unless extremely badly designed. In certain cases, however, such as heavily-loaded oscillators or transmitters, it is often of importance to know the precise resonant conditions.

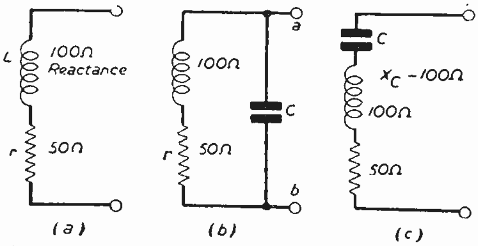


Fig. 1.—To " parallel-*tune* " *the circuit of (a) to resonance, would* —100 *ohms of condenser reactance do, as in (c)?*

As the textbooks tend to be rather vague on the issue, or obscure the practical information in a welter of mathematics, it may be of general interest to discuss conditions from an A.C. point of view: with the aid of vectors, and electrical terminology, not " j " notation! The latter is said to be very useful as a short cut to mathematical results, but I have always held that students should first learn their A.C. circuit principles thoroughly.

A Problem!

Right here, I am going to start elucidating by giving readers a little " problem " to work. I have often found there is no better way of getting important principles remembered.

The " problem " is shown in Fig. 1 (a). The answer is given later, but devote a little thought to the question! A coil is shown, whose inductive reactance is 100 ohms, but it has a resistance, or a " coupled load," of 50 ohms in series. Question: what value of capacitive reactance is required in a condenser C to tune the coil as a *parallel rejector*, Fig. 1 (b)?

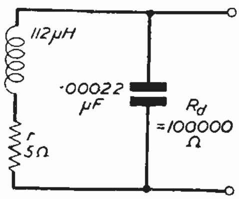


Fig. 3.—Illustrating how to calculate L and C values for a rejector, to give a definite resonant impedance such as 100,000 *ohms.*

The answer is *not* $\frac{1}{2}\pi fC = 2\pi fL = 100$ ohms. This would be quite correct in the case of an acceptor, or series-tuning as in (c), but a rejector (parallel-tuning) embodies numerous complications. Actually, this particular " rejector " would be an extremely inefficient one as, let us say, a tuned-anode combination in a receiver, or as a wavetrap, etc.

The reason is the large value of resistance, and the comparatively low coil reactance. In other words, a very " Low-Q " circuit. Typical values of $2\pi fL$ and r in fairly high-Q circuits would be around 800 to 1,000 ohms reactance, and 3 to 5 ohms H.F. resistance. The aim in designing efficient receiver circuits is to make r as small as possible, by using low-loss wire, etc. But remember, we are considering a rather heavily damped tuning arrangement such as might occur in a transmitter, where r is the equivalent of load *coupled* from a secondary into a primary—our coil being the " primary."

I must assume in what follows that readers interested in this subject—such as students of radio technology—will know something of the main properties of a parallel rejector and elementary vector diagrams.

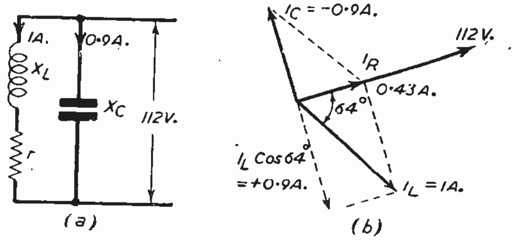


Fig. 2.—Analysis of " *resonance* " *in a Low-Q rejector. Parallel impedance at resonance* = 260 *ohms, resistive. Coil reactance* = 100 *ohms; condenser reactance* = 124 *ohms.*

" Parallel Resonance "

The first thing to be clear about is what precisely *resonance* means in a parallel-tuned circuit.

One difficulty arises because it can denote two or three different things—or conditions which are different. Our article would become somewhat " academic " if we started to discuss them fully—and it would be an insuperable job to do so without pretty involved mathematics. This is where " j " would come in useful, but we will have none of it just now!

(*Continued on page* 503.)

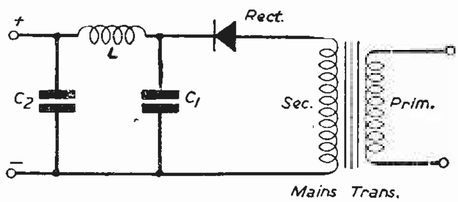


Fig. 4.—Why is C1 not essential when using mercury-vapour rectifiers?

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(*Continued from page 500.*)

Instead, we will simply forget states where the circuit is really *not* resonant. In a parallel combination, true resonance can signify only one thing. The impedance seen looking into the terminals ab, Fig. 1 (b), must be *purely resistive*. If you like, reactances must completely balance out, as in a series circuit. But, unlike the series circuit, that is not quite the same as saying. $2\pi fL = \frac{1}{2}\pi fC$!

That may sound odd! How can reactances "cancel out" if they are *not equal*, and opposite? I will tell you in a minute. To be slightly more technical (or pedantic?), let me add that the "purely resistive" condition is sometimes termed *unity power-factor*.

"Resonance" in rejector circuits means tuning to exactly unity power-factor. When the rejector is connected across an A.C. supply at the resonant frequency, it must take a (small) current *in phase with the voltage*—neither lagging, nor leading. After all, that is merely another way of saying, "no reactance," or "pure resistance."

Of course, the "pure resistance" mentioned is not r, but its *parallel-equivalent*. r is a *series* resistance. But I must assume you have read something about the *dynamic resistance* of a rejector. Consider, for example, how it can act as a wavetrap if put *in series* with an aerial.

Analysing the Circuit

Now, the series impedance of the coil and the 50 ohms resistance is, $Z = \sqrt{X^2 + r^2} = \sqrt{100^2 + 50^2} = 100\sqrt{1^2 + 0.5^2} = 100\sqrt{1.25} = 112$ ohms.

Suppose we connect it across the A.C. supply of the right frequency to give 100 ohms reactance, and 112 volts R.M.S., Fig. 2 (a). Then the R.M.S. current $I = V/Z, = 1$ ampere. Its phase can be found by the rule, $\tan \phi = X/R = 100/50 = 2.0$, and reference to a tangent table will reveal this as an angle of 64 deg., roughly, i.e., the 1.0 ampere *lags* 64 deg. on the supply voltage V, since the part of the circuit considered so far is inductive.

The vector diagram is shown in Fig. 2 (b). To get exactly unity power-factor in relation to the supply, we must shunt a condenser C of such value that it will take a purely reactive current I_C, leading 90 deg. on V, and the vector resultant of I_C and I_L (obtained by completing the parallelogram, as shown) must be a current I_R, *exactly in phase with V*.

This is fairly easy to find graphically, e.g., using 10 cms. = 1A. The required reactance of C will then be, $X_c = V/I_c$, or $C = 10^6/2\pi fX_c$ $\mu F. = 160/fX_c \times 1000$ approximately. But let us proceed with our analysis, using calculation.

The current in the inductive branch is 1A., lagging 64 deg. Therefore, it has a component of 1A. × *cosine* 64° = 1A. × 0.43 = 0.43A. in phase with the voltage. This is I_R in the vector diagram. When exactly resonant, it is the only current taken from the supply, and, because in phase with the voltage, the resonant impedance will be a pure resistance R_d such that $R_d = V/I_R = 112v/0.43 = 260$ ohms approximately. This is the *dynamic resistance* of this low-Q circuit at resonance—nothing like the 100,000 or 200,000 ohms in receiving circuits.

But to find the reactance of the condenser. The 1A. has a "wattless" component of 1A. × *sine* 64° = 1A. × 0.9 = 0.9A. nearly, i.e., this component is lagging exactly 90 deg. behind V—it contributes nothing to the "true watts" in the circuit.

Well, many of the apparent complications of parallel-tuning will vanish if you just remember that the tuning condenser must take a *leading* current, equal and opposite to this purely lagging current. That is what is meant by correcting the power-factor of any inductive circuit to "unity." Hence, our condenser must take $I_C = 0.9$A. at 112 volts, which is a reactance $X_C = 112/0.9 = 124$ ohms, roughly. Thus, at f = 50 cycles per sec., $C = \frac{160}{50 \times 124} \times 1{,}000 = \frac{3200}{124} = 26\mu F$! That sounds pretty large, but at a radio-frequency of 1000 kc/s, 0.0026 μF. will be about the right value.

However, it is interesting to note that the correct reactance for tuning in Fig. 1 is not −100 ohms, but −124 ohms.

Simplified Tuned-circuit Design

Whilst on numerical matters, I will touch upon another question which I have had from time to time.

Suppose we wanted to design, this time, an efficient rejector to give a resonant impedance of, let us say, 100,000 ohms, at a frequency of 1,000 kc/s (300 metres). How does one proceed to estimate the L and C values to use?

There are two conditions to be satisfied: (a) the circuit must tune to 1,000 kc/s, and, (b) it must have a parallel impedance (dynamic resistance) of the order of 100,000 ohms. Because *two* conditions have to be met, we are tied down to only one set of LC values, i.e., provided the H.F. resistance of the coil we are going to use can be obtained fairly closely.

Unless you have some really first-class coils, it will be safe to take the H.F. resistance to be around 4 or 5 ohms, at least—you can get more accurate data from tables or curves. For illustration, let us take 5 ohms.

Our first step is to arrive at the approximate "Q" of our circuit. A very easy rule is that: *Dynamic Resistance*, $Rd = Q^2 x r$, where r is the H.F. resistance of the coil itself. Then, by simple transposition, $Q = \sqrt{Rd/r}$, which in our example $= \sqrt{100{,}000/5} = \sqrt{20{,}000} = 100 x \sqrt{2} = 141.4$, for practical purposes 140 will be near enough.

Next, remembering that Q = Coil Reactance/Resistance = $2\pi fL/r$, we have Coil Reactance = H.F. Resistance × Q = Qr = 140 × 5 = 700 ohms. For resonance, the condenser reactance must also be 700 ohms—we are now dealing with a high-Q circuit.

A frequency of 1,000 kc/s = 10^6c/s, and so $2\pi fL = 2\pi L$, if L is in μH, and similarly, $\frac{1}{2}\pi fC$ becomes $\frac{1}{2}\pi C$ if $C = \mu F$. From the above:

$$2\pi L = 700$$
$$L = 700/2\pi = 112\mu H, \text{ approx.}$$
$$\tfrac{1}{2}\pi C = 700$$
$$C = \frac{1}{2\pi \times 700}$$
$$= \frac{0.16}{700} \text{ nearly } = 0.00022\mu F.$$

This design is shown in Fig. 3. As the average constructor will seldom have means for estimating or measuring inductances correctly, it is probable the figures we have taken do not lead to very useful results practically, but it may be of interest to know how to go about elementary design questions without always relying upon looking up tables, etc.

At any rate, those preparing for examinations may find these principles of value.

Note, too, that it would never be necessary to design any tuned circuit for an impedance of exactly 100,000 ohms. The higher the dynamic resistance the better, as a rule. In R.F. power stages, the dynamic load is much lower, as will be seen from our first example of a low-Q circuit. Here, by the way, you will find that the rule Q^2r will not give very exact results !

About Mercury-vapour Rectifiers

In some previous notes, I referred to the function of the reservoir condenser, C_1, Fig. 4, in an ordinary hard-valve rectifying circuit.

Briefly, without any load on the mains unit, C_1 will be charged to the *peak* of the transformer secondary voltage. When a load is connected, the average output voltage will depend upon the relative rates of charge and discharge. Thus, with a hard-valve rectifier, C_1 is an absolute necessity for maintaining a reasonably large output voltage.

But, if you wanted to make a mains unit with really good voltage-regulation, i.e., one whose output voltage remains reasonably steady at different loads, the best type of rectifier to use is not a hard-valve nor the metal type, but a hot-cathode, mercury-vapour tube.

These have the disadvantage of requiring preliminary filament heating before switching-on the A.C. to the anode, usually by means of some form of thermal-delay device. But, if a reasonably steady output voltage is a first consideration, the disadvantage will not count.

However, C_1 is neither necessary or desirable with these valves. In fact, a reservoir condenser next to the rectifier would take extremely large peaks of current until charged-up to approximately the peak voltage.

The reason why we can dispense with the condenser is the low-impedance valve. The resistance of a mercury-vapour "arc" is very small, and so you will get almost a steady output voltage without resorting to the device of charging and discharging a condenser to maintain a "mean voltage." By comparison, the internal resistance of a vacuum tube or metal rectifier is considerable.

The drop across the rectifier is almost constant at 15 volts, at all loads. Allowing for this, the average D.C. output voltage for a half-wave rectifier will be $1/\pi=0.318$ (0.3 approx.) of the *peak* alternating voltage in the transformer secondary, i.e., 0.45 of the R.M.S. secondary voltage—from which we must subtract 15 volts.

For full-wave, the average is twice the above: $2/\pi$ of the peak secondary volts, or $2\times 0.45 =$ (0.9 R.M.S. volts − 15v.).

The question of the current-loading of a transformer connected to half- and full-wave rectifiers is a little complicated. Without dragging in "form-factors," etc., perhaps the above explanation will suffice to show why good regulation can be obtained without C_1. Admittedly, there is a little more to it than the "peak current" which a reservoir condenser would take, if employed.

For ordinary purposes, the switching complications necessary for soft valves would not be justifiable, since voltage-regulation is not a critical factor. In amplifiers or transmitters using Class "B," however, the regulation of the H.T. supply source becomes a matter of the first importance.

Standard Terms

I notice from a report in one technical periodical that extraordinary efforts are to be made once more to try to standardise symbols and terms.

While the movement has my support, I feel inclined to doubt if "symbols" are really worth all this periodical hullabaloo. As long as we have mathematically-minded technicians, they are likely to use whatever symbols occur to them, and, indeed, it is possible for confusion to arise by too much standardisation. As long as a list of symbols is clearly defined, it is a simple matter to refer to the table to see what a given equation means. Still, there are a few confusing ones, such as "m.c." for megacycles, etc. Possibly, "mfds." *might* be read as "milli-farads," but it is extremely improbable! Really, it is an abbreviation, not a symbol.

More important is precise terminology. That is a source of much confusion. I know there are a few learned pedants who delight in furthering the cause of precise definitions by toying with such trifles as "*capacitance*," etc. They will dock marks from students if they speak of a "condenser," instead of a "*capacitor*," and so forth. One wonders what they would do where a coil is called a coil, not an "*inductor*"!

Though perhaps of some importance, this is not the sort of terminology I have in mind.

What about words such as *modulation* and *demodulation*, *sum-and-difference frequencies* (meaning *sidebands*) and the same term applied to *beat* phenomena, and so on? These are everyday words which students are supposed to understand, but when they learn, on the one hand, that *modulation* is accomplished at a transmitter, and that again "modulation" which at the same time amounts to a sort of "demodulation," occurs in the mixer stage of a superheterodyne, ideas naturally tend to become a bit muddled.

"In-Phase" or Opposite?

Then, there is the term *phase*, with all the ambiguities and conventions associated with vector terminology.

Apropos of what I wrote recently, I find that if I speak of two alternators being in "phase-opposition" when connected in parallel (Fig. 5), many seem to think I am taking undue liberties with terms. Surely, two alternators in parallel are *in-phase*, not in phase-opposition?

Thus, it was pointed out to me the other day that an oscilloscope would show the *terminal* voltages in-phase! Moreover, why talk of "phasing" two alternators, if what is really meant is putting them in phase-opposition? In fact, most textbooks on A.C. engineering refer to bringing the voltages *into phase*.

Why, therefore, must I advocate the "opposite" point of view? I will try to tell you. I am looking at those alternators from an angle of *voltage-balance*. Suppose one machine is generating 200 volts, and the other, which is to be put in parallel, is generating 300 volts. If you closed the switch to put them in parallel what would happen?

(*To be continued.*)

Practical Hints

Transformer Conversion

THERE are many ex-R.A.F rotary transformers obtainable now at low cost which can be put to good use by those who want a high speed and fairly powerful electric motor to run off 230 volt A.C. mains. The type with 12 volt input and 300 volt output is satisfactory and only requires slight changes in the wiring. The diagram of a typical unit before alteration is shown in Fig. 1.

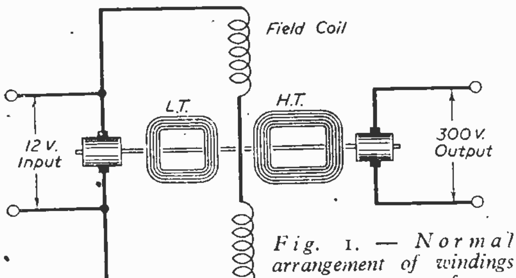


Fig. 1. — Normal arrangement of windings on the rotary transformer.

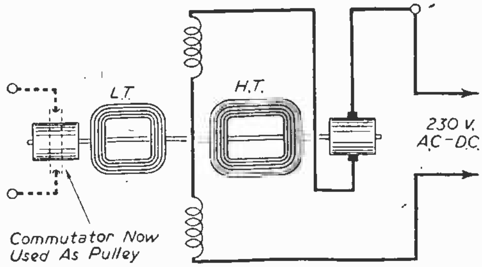


Fig. 2.—The rearrangement suggested by Mr. Wardlaw.

The 12 volt D.C. input energises the field coils shunted across it and also supplies current through the brushes to the armature, causing it to rotate. The other section of the converter, which is on the same shaft and in the same magnetic field, acts as a dynamo and delivers high tension D.C.

To convert for use as a motor connect the field coils in series with the armature and H.T. input. Then the motor will operate on A.C. or D.C. as it is series wound. The alterations are shown in Fig. 2.

By removing the brushes and their holders at the 12 volt end, a free space is left round the commutator which can be used as a pulley for belt-coupling to models, etc.

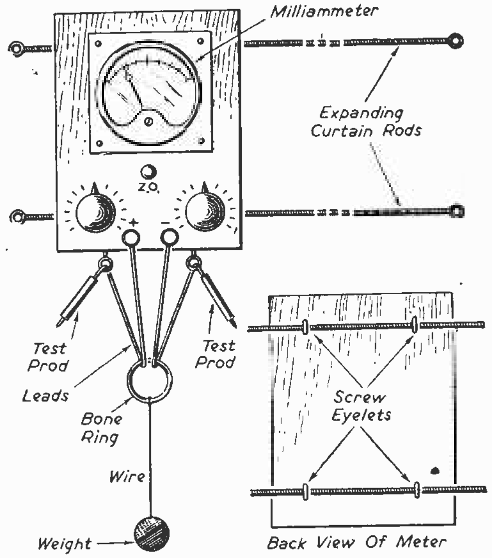
It is important that in the original unit the field coil is connected directly across the L.T. input. Units with a permanent magnet supplying the field are not convertible.—A. C. WARDLAW (Gatley).

Test Bench Meter Mounting

THE accompanying sketch shows a method of mounting a test bench meter in an easily variable horizontal position with leads self-positioning when not in use.

Four eyelets are screwed into the back of the meter so that the instrument can be slid from end to end of the bench on expanding curtain rods which are mounted on the wall at a convenient height above the bench. (In the case of a heavy meter the top support should of be stout gauge galvanised wire for greater steadiness.)

Two further eyelets are screwed into the bottom of the meter so that they will provide a running fit for the test leads and to act as a stop for the test prods when they return to rest. The leads are passed through a bone or other suitable ring which



This idea for a bench test-meter will be found very useful.

is weighted to hang down behind the bench (see sketch). It is essential that the leads should be very securely fixed at one end to the meter and at the other to the test prods.

This meter arrangement renders the instrument readily available (with correct mounting—at eye level) and test leads and prods just put themselves neatly out of the way in a flash.—SGT. G. W. BENNETT (B.O.A.R.).

6/12-volt Rec

Constructional Details of an Amplifier

By R.

THE absence of a "mains" supply need not prevent the home constructor and experimenter from building a gramophone amplifier to give, say, six watts output. A six- or 12-volt car battery will provide an alternative source of power. Then, using mains type valves, ample volume can be obtained for all needs.

A complete theoretical diagram of the amplifier is shown in Fig. 1. The two L.F. valves are triodes. Both are 6J5s, of the octal range. 6J7s, triode connected, as shown in the alternative base connections in Fig. 2, will also serve. Again, 6C5 triodes, with the same base connections as the 6J5s, can be employed. Where new valves are being bought, 6J5s should be most suitable for the circuit discussed.

The tetrode output stage utilises a single 6L6. This valve provides an output of 6.5 watts for an anode voltage of 250 volts. A saving of .45 amp. in the valve heater consumption can be effected by substituting a 6V6 for the 6L6, but the available output will then be limited to 4.5 watts. Also, for optimum efficiency, the value of the bias resistor and the ratio of the output transformer will both need minor adjustment. The value quoted for the output transformer ratio is correct for the valve recommended, when used with a 2-3 ohms loudspeaker.

Negative Feedback

The circuit utilises the conventional resistance-capacity coupling. The anode circuit of the first L.F. stage is decoupled, a 5,000 ohms resistor and 8 μF condenser having been included. The crystal pick-up enables the output stage to be fully loaded, with some reserve, besides providing a very high standard of reproduction. To straighten the response "curve," a tone compensating circuit is incorporated, consisting of a 500,000 ohms resistor and .003 μF condenser at the input terminals of the amplifier. It was not found necessary to include a bias resistor in the cathode circuit of the first L.F. valve.

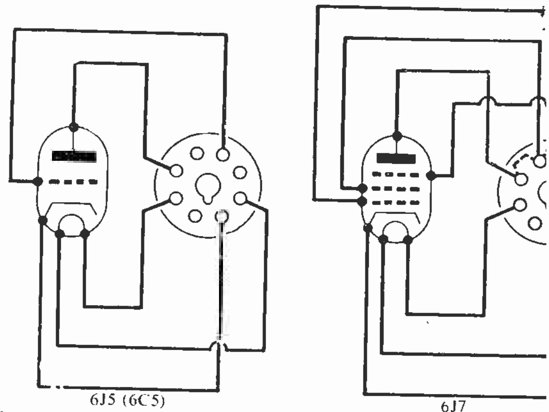


Fig. 2.—Valve base data of recommended

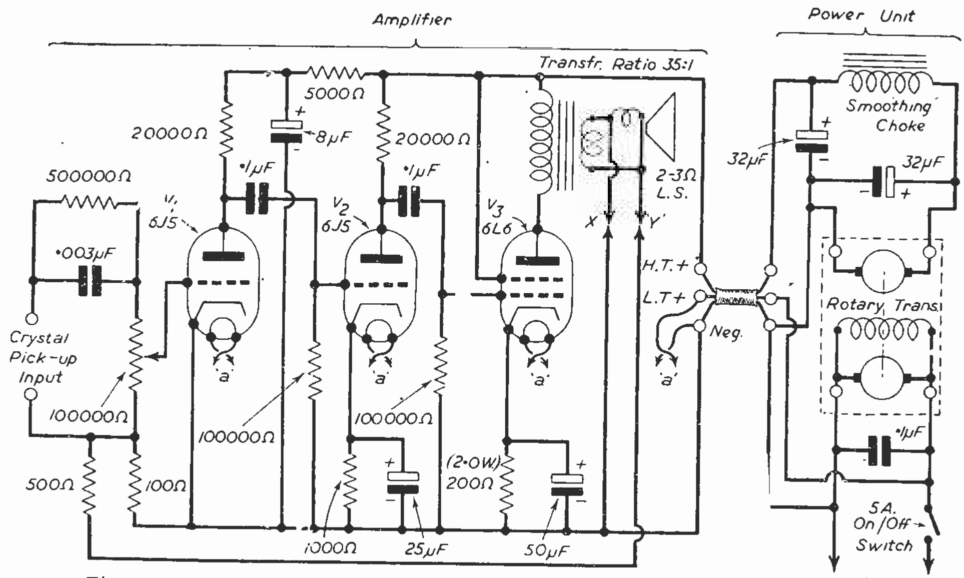


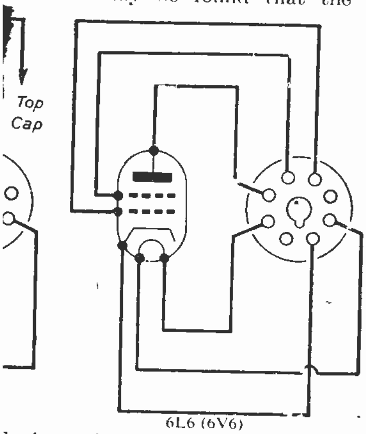
Fig. 1.—Theoretical diagram of complete amplifier, with valve heaters connected for six-volt supply.

ord Amplifier

Operation Through a Rotary Transformer

.UMBARD

Negative feedback over the complete amplifier ensures that all distortion is limited to an absolute minimum. On giving the amplifier an initial trial it may be found that the feedback leads need reversing, indicated by pronounced distortion and instability. Only the feedback leads marked "X" and "Y" must be reversed, and this should cure the trouble.



l alternative valve types.

The negative voltage-feedback is derived from the L.F. potential across the secondary of the output transformer. A proportion of this potential, also appearing across the respective 500 ohms and 100 ohms resistors, is fed back to the grid circuit of V1. Distortion is reduced when the L.F. potential across the 100 ohms resistor opposes the incoming signal voltage from the pick-up.

Six- or 12-volt Supply

All power is supplied from a car type battery, and either a six- or a 12-volt supply can be used. Valve heater connections are straightforward with a six-volt battery, but slight alterations to wiring are necessary if the battery is of the 12 volts type. Fig. 3 gives the essential alteration for 12-volt working, using either a 6L6 or 6V6 in the output stage. A direct six-volt tapping is simpler, but presents an unequal load on the battery.

The rotary transformer H.T. rating is in the region of 250 volts at 60-90 milliamps, depending whether a 6V6 or 6L6 output valve is used. The input voltage rating of the rotary transformer may be six or 12 volts, whichever supply is available. Provided that the H.T. commutator and brush gear is in good condition, smoothing is more than adequate.

If a rotary transformer rated at 12 volts input and 500 volts 60-90 milliamps, output is to hand, this can be used on six volts to provide an approximate output of 250-270 volts. The required change in field coil connections is shown in Fig. 4. It should be emphasised that correct relative polarity of the field-coil leads must be maintained. Using a similar arrangement, an overall input/output efficiency of 60-65 per cent. was realised in practice.

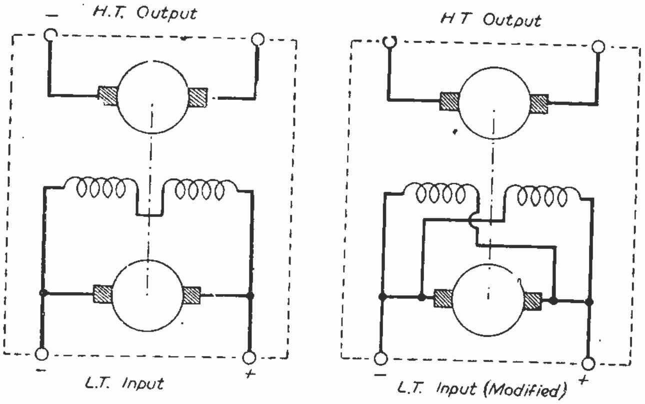


Fig. 4.—Theoretical circuit of: (Left) Rotary transformer unmodified, with both field windings connected in series. (Right) Field windings connected in parallel, for modification to six-volt input of 12-volt/500-volt rotary transformer.

Practical diagrams of layout have not been given. Positioning of components and choice of chassis is left to the constructor. Pick-up leads will probably require screening if more than a few inches long, but they are best kept short, even if screened. This also applies to all grid and anode leads, especially the former; the shorter the better.

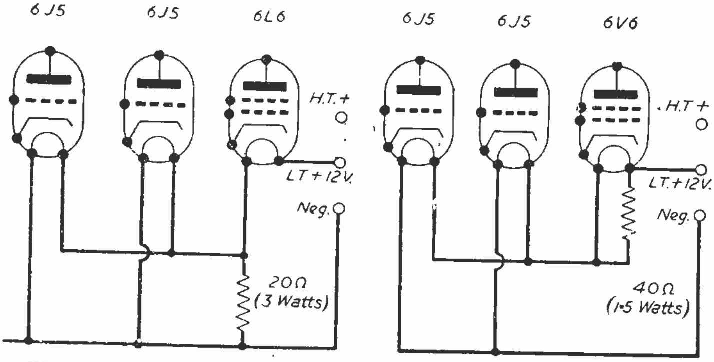


Fig. 3.—Heater wiring for alternative 6V6 output valve, also normal 6L6. Both circuits are modified for 12-volt working.

A Test Bridge

Servicemen and Experimenters Will Find This Tester Ideal for Everyday Use

By L. WALSINGHAM

AS an addition to the test equipment recently described this bridge circuit will no doubt interest many readers.

As will be seen from the circuit diagram, the instrument is built round a simple valve oscillator and is self-contained.

The Circuit

T.1. is an old inter-valve transformer, having two sections to the secondary, these being utilised for the oscillator, the original primary being used as an output coupling. V.1. may be any small battery triode (in practice it is best to try several and select the one giving best results).

The H.T. supply is derived from two or three grid-bias batteries and the L.T. from a large capacity dry-cell. R.6. is a good quality wire-wound pot. of between 10,000 and 50,000 ohms.

For switching I utilised a modified push-button unit. S.1. and S.2. are ganged.

R.1. and R.2. (the "control" network) are carefully selected for equality.

In practice it is best to proceed as follows: Connect the two resistors in circuit and find balance. If after reversing their positions balance occurs in the same place then it may be assumed that their values are reasonably equal.

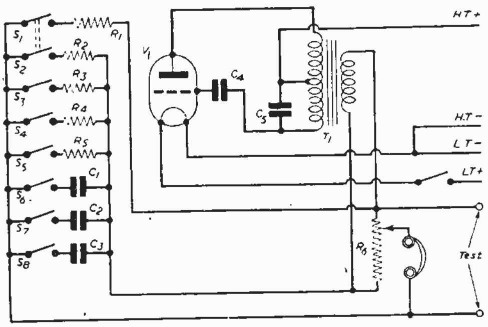


Fig. 1.—Theoretical circuit of the test bridge described above.

The instrument gives three ranges of resistance and three ranges of capacity covering roughly from 10 ohms to 10 megohms and 10 pF to 10 μF.

The dial, which for ease of operation should be as large as possible, may be direct calibrated, or, as in my case, may be marked off in a series of degrees and the various ranges plotted on graphs.

Operation

On depressing the "control" button R.1. and R.2. are thrown across the bridge and the balance point, which has been previously marked, may be checked.

This operation should always be carried out before any measurements are made.

To take a measurement the 'phones should be connected to the terminals provided and the unknown value to the terminals marked "TEST." The appropriate range selected by depressing the corresponding button and R.6. adjusted for balance.

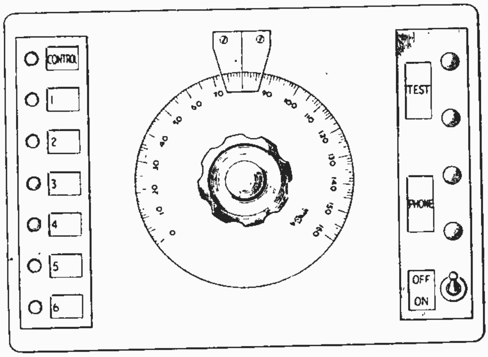


Fig. 2.—Panel layout for the bridge.

In the instrument made the zero was found to be very well defined.

Component values are as follows:

R. 1. 1,000 Ω	C. 1. .0001 μF.
R. 2. 1,000 Ω	C. 2. .01 μF.
R. 3. 100 Ω	C. 3. .1 μF.
R. 4. 10,000 Ω	C. 4. .0001 μF.
R. 5. 1 M Ω	C. 5. .0005 μF.
R. 6. 10,000 to 50,000 Ω	

The whole instrument is housed in a case measuring some 10in. x 8in. x 4in. deep, the case being finished light grey. The escutcheons were cut from sheet ebonite and the dial from stout gauge aluminium.

When finished with carrying handle and rubber feet the instrument presents a quite "professional" appearance.

OUR COVER SUBJECT

One of the main points of interest at Radiolympia was the Ministry of Civil Aviation's stand, made up to represent an airfield control point with a scenic background, depicting the airfield, runways, etc. Actual aircraft control, carried out at London Airpoint, was relayed to the stand, and visitors were able to hear approaching aircraft controlled and landed. In addition, certain well-known personalities spoke to the stand over the air link from aircraft in flight in various parts of the world.

Beginner's Guide to Radar

A Simple Description of the Applications of Radio Control and Direction Finding

THE recent radio control of an aircraft across the Atlantic has brought into light once again the modern radio system known as Radar. For the benefit of those who are not yet fully familiar with the system the following brief details have been drawn up.

The name "Radar," as most readers know, is an abbreviation of the phrase "radio detection and ranging."

Radio Direction Finding

Long before the era of radar there were systems of radio direction finding, of course. They were used between aircraft and ground stations, as well as between ship and shore. In normal direction finding, however, it is necessary that the object whose direction it is required to determine should be provided with a transmitter, the radiation from which can be picked up at good strength on a receiver situated at the point from which the direction, or bearing, is required. Thus, for example, a ship's wireless operator can call up a land-based D.F. station and ask for a bearing. The operator at the station can then take a bearing while the ship's transmitter is sending out a steady signal. After that, it is necessary for the land-based operator to signal the bearing back to the ship. If the captain of an aircraft wishes to know his direction from a fixed transmitter whose position is known, his wireless operator can take a D.F. bearing, using his receiver and loop aerial.

But neither of these methods permits the plotting of the *position* of the craft—only its *direction* from a given point. In order to obtain a position it is necessary to take at least two D.F. bearings on the same transmitter from two widely separated points. It is then possible to ascertain the position with fair accuracy by drawing bearing lines on a map and noting the point of intersection.

Combined Direction and Range

The above "historical" explanation has been given to show how vastly radar differs from normal direction-finding practice. The first point of difference is that both direction and range, or distance (which together provide a position), can be ascertained by means of a single transmitter-receiver. This may be located at a fixed station or it may be carried on a moving object. That is only one application of radar technique, but it is perhaps the most important.

Radio Wave Reflection

Let us see what are the underlying principles of the radar technique. Most, but not all, radar devices depend upon the reflection of radio waves. It has for long been known that these waves are subject to reflection by certain objects, and by the Heaviside, Appleton and other ionised layers in the upper atmosphere. They are also reflected to varying degrees by metallic structures, by the ground, buildings and a thousand and one other objects.

If we direct a radio beam on to a church steeple, a ship, an aircraft or a hill, a certain amount of radio energy is reflected (see Fig. 1). Incidentally, the reflection is likely to be greatest at very high frequencies, and it is relatively small at low frequencies. The reflection or radio echo can be picked up by an aerial and detected by a receiver tuned to the same frequency as the transmitter responsible for producing the energy in the original beam. And if we can measure the time which elapses between the initial radiation and the reception of the echo, we can quickly find the distance between the transmitter-receiver and the reflecting object, because we know the speed of radio waves—approximately 186,000 miles a second.

Distance and Time

The process is comparable to that of sounding a blast on a ship's siren when the ship is some distance from a cliff side; if the time between the blast and the hearing of the echo is measured, the distance of the ship from the cliff can be calculated from the knowledge that sound travels at a speed of 1,100ft. per second. The measurement of time in this case can be made by means of a stop-watch, but the same method is entirely out of the question when radio waves are concerned, because they travel 328 yards in *one-millionth* of a second, or 186 miles in a thousandth of a second.

In order to time radio waves, therefore, we must be able to measure accurately in terms of millionths of a second. That eliminates the more usual timing devices, and introduces the cathode-ray tube as the only known instrument for measuring these almost infinitely-short spaces of time with the required degree of accuracy. But more of the cathode-ray tube later.

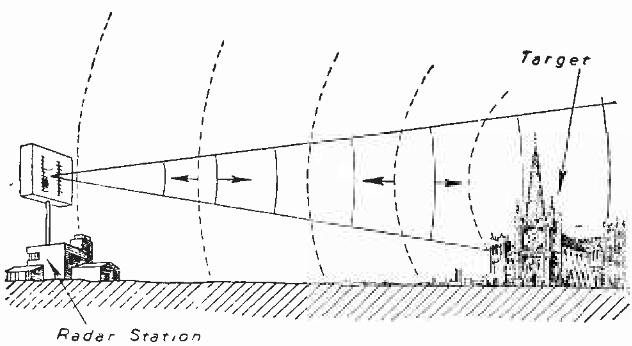


Fig. 1.—How radar pulses are radiated and reflected is shown in this diagram, where the radiated pulses are indicated by full-line arcs and the reflected echoes by broken lines.

Pulse Transmission

Another important point will have emerged from the foregoing simple explanation. It would be useless to emit a continuous signal, just as it would to make a continuous blast on the ship's siren, for the original sound would completely " drown " the echo. With the siren a short, sharp blast is required; so with our radar transmitter. Thus the transmitter is made to send out a series of short pulses of energy. The pulses must be of very short duration, and must be so spaced that the echo of one pulse is returned before the next pulse is emitted.

In practice the pulses have a length of the order of two micro-seconds (two millionths of a second) and are spaced by, say, 2,000 micro-seconds. This means that there would be approximately 500 pulses per second or, to use the customary expression, that the pulse recurrence frequency would be 500 per second. This is illustrated in Fig. 2. It should be mentioned in passing that a variety of pulse lengths and pulse recurrence frequencies are employed in radar work, according to the purpose of the particular equipment.

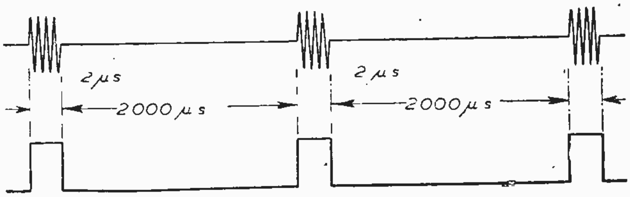


Fig. 2.—The nature of radar pulses. The upper diagram shows the wave-form of the transmitter output, while the lower one represents the rectified output from the receiver. The diagrams are not drawn to scale, and it should be understood that the pulse width and spacing varies considerably with different types of radar equipment. In the case illustrated the pulse recurrence frequency is described as 500 per second—one second divided by 2,000 micro-seconds.

Visual Presentation

Now about the use of a cathode-ray tube, the general details of which are familiar to all readers. By means of a time-base generator a light spot is made to cross a diameter of the tube at such a speed that a line of light is seen on the screen. The electron beam moves backward and forward across the tube, but the illumination is blacked out during the backward trace, or fly-back as it is called. The speed of scan of the light spot can be controlled, and is known. Suppose that the time taken for the light spot to pass from one end of the trace to the other is 1,000 micro-seconds: the distance travelled by a radio wave in that time is 328,000 yards. But as the wave has to travel from the transmitter to the " target " and back again, 1,000 micro-seconds represents a target distance of just half the previous figure, or 164,000 yards.

If it is assumed that the trace is 10ins. long, it can also be seen that a length of 1in. along the trace represents a radio echo distance of 16,400 yards. Knowing this, we could put a scale on the tube face and mark it off accurately in miles, thousands of yards or any other convenient units. In practice, there are generally two scales, each corresponding with a different speed of trace; this is selected by means of a " sweep-range " switch. *(To be continued.)*

New Magnet Material

INCREASED use of small magnets in radio and electrical equipment has called for a suitable magnet material which can be formed into any shape with the minimum, or if possible total elimination, of expensive machining operations.

The Plessey Company of Ilford, who have been investigating these problems in their laboratories, have now introduced a suitable material known as Caslox.

This is a pressed powder permanent magnet material consisting of a mixture of iron cobalt oxides and a small quantity of plastic binder.

Easily Moulded

The chief advantage of this new material is that it can be moulded into any shape and, since this technique eliminates machining operations, the way is opened up for much wider application of small magnets irrespective of their shape. Once the necessary tools are made, as with plastics or similar mouldings, the magnets can be pressed out rapidly in any quantity. The manufacture of small magnets is therefore reduced to the simple operations of moulding and its attendant preparations.

Caslox is particularly suitable for use in small motors and generators. The rotor of a synchronous clock motor is a typical example of a small moulded magnet having a metal insert which can be quickly and easily produced from this material.

The small magnet of a magnetic gramophone pick-up head, telephone and hearing-aid earpieces are further examples. This material has also been successfully applied in the manufacture of children's toys and similar novelties which incorporate light-weight magnets as functional components.

Applications

The potential applications of this new material obviously cover a wide field in the manufacture of radio, measuring instruments, electrical and similar equipment where short magnets of large area are required to work effectively in open magnetic circuits.

The density of the material is 3.2 grams per c.c., it is a reasonably good insulator and has a specific resistance of 0.5 x 10^6 ohms per c.m. cube. It has a very high coercive force and therefore the influence of disturbing magnetic fields is small. When moulded, Caslox is reasonably stable at temperatures up to 70 deg. C., is unaffected by humidity and by atmospheric impurities, while tests have shown that its shelf life is good; the material proving particularly stable over long periods of time.

Principles of Frequency Changing—2

Notes on the Superheterodyne Frequency-changing Stage with the Problem of Aerial and Oscillator Alignment

In all frequency-changing stages the main points of consideration lie in the connections to the various valve types available, the external circuits being practically alike in all cases. We are, of course, not dealing here with early circuit design where special coupling coils were employed with valves of the ordinary R.F. pentode variety. Two further examples of mixer stage were shown in Fig. 4 last month, where a triode-hexode valve is employed and the oscillator coil is double wound, i.e., with separate primary and secondary windings. The coupling between the grid and anode coils is fixed by the designer in such a manner that an even amplitude of oscillation is obtained over the entire tuning range,

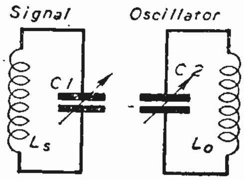


Fig. 5.—Two identical inductances tuned with similar capacities.

assuming that the valve electrode voltages are correctly chosen in accordance with the maker's recommendations. In Fig. 4(b) the oscillator tuning is carried out in the anode circuit of the valve; this does not upset the circuit operations and mixing is achieved exactly as if the grid circuit is tuned, as shown in Fig. 4(a).

Tracking

In order to maintain a constant intermediate-frequency over the whole tuning range, the oscillator and signal frequencies must always be different by a constant amount. This introduces the problem of tracking, since in almost all superheterodyne receivers the aerial and oscillator tuning condensers are ganged together as a single control. Consider first a numerical example where ganging is attempted with two identical condensers (C_1 and C_2 of Fig. 5). Let the signal circuit tune to a maximum frequency of 1,500 kc/s and assume an intermediate frequency of 125 kc/s. Then, for the oscillator to work at a higher frequency than the signal circuit (the usual procedure), the oscillator circuit must tune to a maximum frequency of (1,500+125)=1,625 kc/s. With this arrangement set up by the correct choice of the aerial and oscillator inductances, the tracking will be exactly correct at the upper frequency end of the waveband. Now assume that the tuning capacities range from 45 to 485 $\mu\mu$F in each gang.

By the correct choice of L_s and L_o in Fig. 5, the circuits may be made to tune with the minimum capacity of 45 $\mu\mu$F to 1,500 kc/s and 1,625 kc/s respectively.

Ratio of maximum : minimum frequency of a tuned circuit

$$= \frac{1}{2\pi\sqrt{L.C_{min}}} \text{ to } \frac{1}{2\pi\sqrt{L.C_{max}}}$$

$$= \sqrt{\frac{C_{max}}{C_{min}}} \text{ for one tuned circuit.}$$

Therefore, in the case of the signal circuit, the ratio of maximum to minimum tuning range will be:

$$\sqrt{\frac{485}{45}} = 3.28 : 1$$

Therefore, the signal circuit will tune from 1,500 kc/s to 1,500/3.28=457 kc/s.

In the case of the oscillator, the circuit will tune from 1,625 kc/s to 1,625/3.28=495 kc/s. Thus, if the intermediate frequency is correct at the high-frequency end of the scale (125 kc/s) it decreases to 38 kc/s at the low-frequency end. Hence the circuits are said to go out of track—in this instance, seriously—and the output of the mixer stage will fall off rapidly as the low-frequency end of the scale is approached, the I.F. transformer in the anode circuit being more or less sharply tuned to 125 kc/s. (See Fig. 6.)

The whole problem of tracking is seen to revolve round the fact that in order to achieve absolutely accurate alignment, the oscillator circuit must tune over a smaller maximum to minimum tuning range ratio than the signal circuit. In the above example the oscillator frequency range of 3.28 : 1, which is the same as the signal frequency range, must be compressed to 2.8 : 1; for, in order to secure a frequency difference of 125 kc/s throughout the band, the oscillator must cover the range of 1,625 kc/s to 582 kc/s for the corresponding signal change of 1,500 kc/s to 457 kc/s. This reasoning applies, of course, to other frequency band coverages and other intermediate-frequency values, as a few simple numerical examples can easily show.

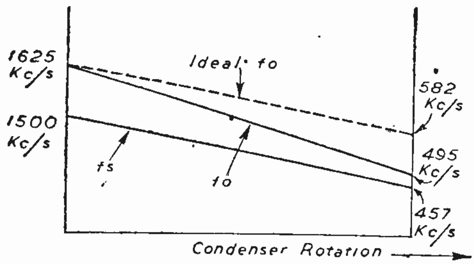


Fig. 6.—Response curves showing "tracking" differences.

There are two chief methods of achieving accurate tracking: (a) by specially shaping the vanes of the oscillator tuning condenser so that the frequency difference between the two tuned circuits is the same at all positions of the gang; and (b) by inserting fixed condensers in parallel with (trimmers), and in series with (padders). the oscillator tuning condenser, the latter of itself being exactly identical with the aerial tuning gang. The first of these methods is an admirable one, but it suffers from the disadvantage that the tracking is correct for only one set of circuit conditions. i.e., if the vane shaping is designed to give correct tracking with medium wave tuning inductances, then it will be useless when the receiver is switched to long or short wavebands. Thus the use of tuning condensers with specially shaped oscillator sections is passing out of fashion, and the padding method, which is applicable to normal identically-sectioned ganged condensers on all wavebands, is completely taking its place.

We have seen already that the ratio between the minimum and maximum frequencies covered by the oscillator circuit on each waveband is less than that of the signal circuit when tracking is accurate throughout the scale; this means that the ratio between the minimum and maximum capacity of the oscillator tuning capacity must be lower than that of the other, or aerial, section.

By connecting a small capacity in parallel with the oscillator gang its minimum capacity is increased, while by connecting a comparatively large capacity in series with it, its maximum capacity is reduced. The addition of both a parallel and a series condenser to the oscillator tuning gang as shown in Fig. 7 (a), therefore, has the effect of reducing the minimum to maximum capacity ratio, and hence the minimum to maximum frequency coverage ratio, of the circuit. The series (or padding condenser) is generally placed at the earthy end of the oscillator tuning coil as shown in Fig. 7 (b), with the parallel (or trimmer condenser) connected directly across the coil.

The trimmer is adjusted to the high-frequency end of the scale and allows tracking to be accurately obtained at this point. The padder is adjusted at the low-frequency end of the scale and permits the circuits to be brought into track at this point. There is usually slight interaction between the two settings, but by careful adjustment accurate alignment can be obtained at the two extremes of the tuning band. The amount by which the tracking falls off over the centre of the scale then depends upon the value of the oscillator tuning

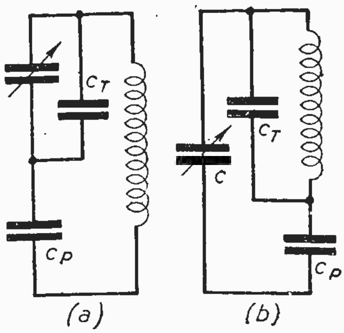


Fig. 7. — How "padders" and "trackers" can be fitted to ensure circuits keeping in step.

inductance. If this is correctly chosen. then it can be shown, by a circuit analysis of Fig. 7, that absolutely accurate tracking can be secured at three points, and at three points only, along the entire frequency scale of the waveband being tuned.

Fig. 8 shows the optimum tracking chart where the difference in the resonant frequency of the aerial circuit and of the oscillator circuit is exactly equal to the intermediate-frequency at three equally spaced points along the dial rotation. The slight deviation between these points is, in practice, negligible, and almost perfect tracking is therefore obtainable throughout the range. Much, however, depends upon the oscillator inductance: if this is too large the central cross-over point of Fig. 8 will be moved towards the upper frequency end of the scale, and the tracking will deteriorate rapidly as shown by the broken line. On the other hand, if

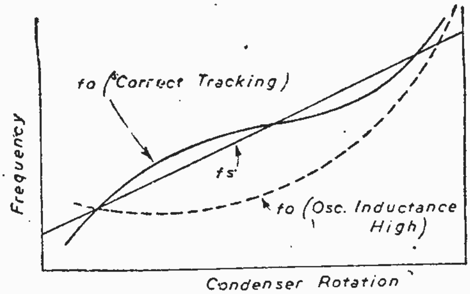


Fig. 8.—Showing how wrong inductance values will lead to "out of step" tuning.

the oscillator inductance is too small the cross-over point is shifted towards the low-frequency end of the scale, and alignment again falls off over the upper frequency end of the waveband.

All-wave Receivers

In all-wave receivers, where at least three wavebands have to be covered, each oscillator coil must be provided with its own series and parallel tracking condensers, and each band must be adjusted separately. The tendency has been of late to use small individual coils for each band in preference to dual-range types, and from the point of view of efficiency the former are much to be preferred. Oscillator coils designed to operate over two or more wave ranges—generally employing as they do a single common feedback winding—are apt to be troublesome to the home constructor in setting up, and difficulties such as obtaining smooth reaction over the entire wavebands may be experienced. Individual coils, on the other hand, are designed for one particular waveband, and the inductances, feedback windings, etc., are accurately wound for the particular job. The values of padding and trimming condensers are usually stated by the manufacturers of the coils, although slight increases or decreases in capacity, especially in the case of padders, is quite permissible when it appears obvious that the recommended value is incorrect.

Trimming is always carried out at the high-frequency end of each waveband (low wavelength), padding at the low-frequency (high wavelength). On short waves, the padding condenser is sometimes omitted altogether or a large fixed capacity is used, trimming only being adjustable at the high-frequency end of the scale.

(To be continued.)

The Series Heater on D.C. Mains

The Causes and Cure of Cathode-heater Shorts.

By L. MILLER

WHILE it is generally agreed that a transformer type power supply is the most convenient and trouble-free method of energising a receiver when A.C. mains are available, the D.C. user must of necessity revert to other means, and he will invariably use his available D.C. supply, suitably smoothed, for H.T. and employ a series heater arrangement for L.T.

The main cause of breakdown in the series-heater sets is heater-to-cathode shorts, due to the large potential difference between cathode and heater of some of the valves.

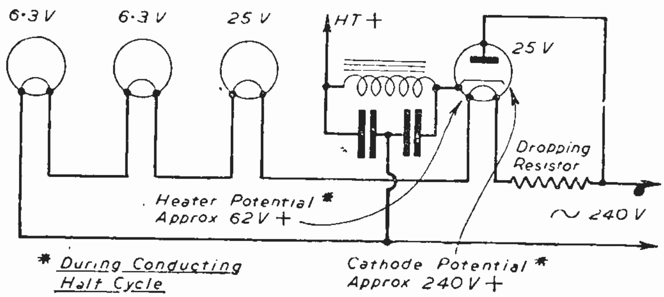


Fig. 1.—*This diagram illustrates a cathode to heater potential difference of* 138 *volts (maximum) in a typical A.C./D.C. Midget.*

Ask any service mechanic! The A.C.-D.C. set is a good source of revenue to him, mainly because of heater-cathode shorts, and resultant damage done to other components.

The Cause of Such Breakdowns

A casual inspection of the heater and cathode potentials of a typical A.C.-D.C. set, as illustrated in Fig. 1, will reveal a difference of potential of some 138 volts between positive end of the heater and the cathode of the rectifying valve, during conducting half-cycles (when using a 25v. rectifier).

A cathode-heater short here would impose an A.C. voltage across the filter condenser, with consequent damage to it. Also, it is very possible that the heater would short-circuit internally, causing a greater heater potential to be applied across the remaining valves. The result might well be one or more heater burn-outs.

Modifying the Circuit

At first thought it may appear that a logical solution to the problem would be to insert the dropper resistor between the rectifier and output valves, as in Fig. 2, so causing the potential of the cathode to be approximately the same as that of the heater.

During the *conducting* half-cycle (i.e., when the polarity of the mains is as shown in Fig. 2), this will be so, but during the *non-conducting* half-cycle, when the cathode will remain at some positive potential due to the previous charging up of the filter condenser, one side of the heater will be at zero potential, and the cathode-heater potential difference will be considerably greater than in the Fig. 1. arrangement.

An Advantage to the D.C. User

This, of course, only applies to A.C. mains, but the D.C. user would benefit by using this arrangement when he wishes to incorporate a rectifier for the purpose of using electrolytic smoothing and filter condensers. It is often advantageous to use electrolytics rather than paper types, because of the far greater capacity for any given size.

Circuit Arrangement with no Rectifier

Even if a rectifier is not employed, the D.C. user will be wise to study the heater-cathode potentials of his amplifying valves, and if necessary

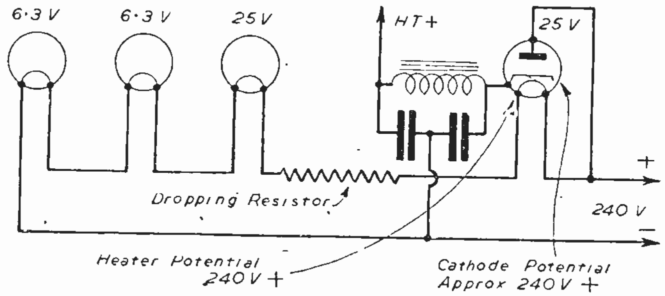


Fig. 2.—*Modification of heater circuit suitable for D.C. operation. Heater and cathode of rectifier are at approximately the same potential.*

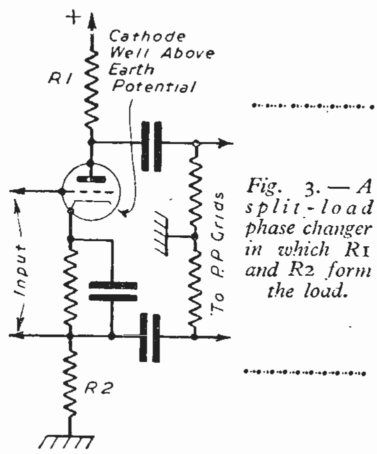


Fig. 3.—*A split-load phase changer in which* R1 *and* R2 *form the load.*

there is no reason why the heater dropping resistor should not be split up into two or more sections if such an arrangement can be usefully employed to obviate large potential differences.

Most present-day valves will easily stand up to a pressure difference of 50 volts or so, but it is quite possible that a minute heater to cathode leak, which would not be detected if it occurred in the output stage, would result in a very noticeable hum if it occurred in one of the penultimate stages. This would apply particularly in the first stage of a high-gain amplifier. The hum would, of course, be caused by the fact that unsmoothed D.C. is being used for the heaters, and would be more pronounced on A.C.

The Phase Changer

Any slight cathode leak would be troublesome in a split-load phase changer as illustrated in Fig. 3. This is one of the most widely used phase changers, and the cathode may be 50 volts or more above earth (or chassis) potential. By wiring the heaters of a push-pull amplifier using this type of phase changer in the manner shown in Fig. 4. the cathode-heater p.d. can be reduced considerably.

Conclusion

It is customary to assume the heater potential to be that of the centre of the heater (i.e., a 6.3 v. valve wired direct to D.C. negative would be 3.15 v. "above" D.C. negative; a 25 v. valve would be 12.5 v. "above" the previous valve, and so on).

The individual constructor should study the circuit arrangements contained herein, and then design the heater arrangement to suit his own specific requirements.

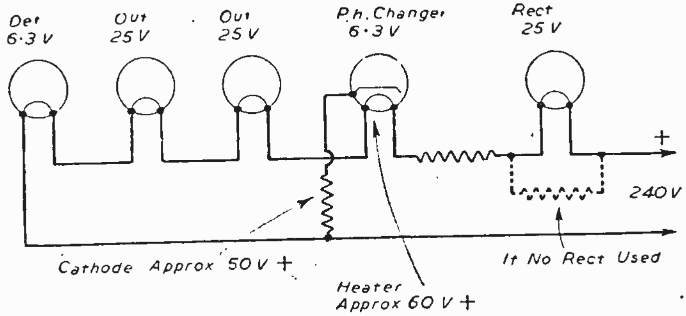


Fig. 4.—The p.d. between cathode and heater of the phase changer is considerably reduced by wiring the valves in this manner. The arrangement is the same if a rectifier is not used, the dropping resistor being increased in value as shown by the dotted lines.

Broadcasting in Poland

THE position of Polish broadcasting is governed by two primary considerations: the extensive losses of the stock of receiving sets suffered by the Polish population during the war and the inadequacy of the native radio industry.

The former factor is particularly regrettable, as the growth of the number of wireless licence-holders showed an excellent momentum before the outbreak of the late war.

Unfortunately most of the 860,000 sets found on Polish territory on the outbreak of the war were seized by the Nazi army and shipped to Germany, where they were lost in the chaos following Germany's defeat. The idea of recovering the confiscated sets or getting an equivalent number of other sets as reparations was, however, quickly abandoned in favour of rebuilding and expanding the radio industry existing on the territory of liberated Poland.

One such plant was founded at Dzierzonow in the newly-acquired Western Territories where the largely destroyed plant of the German concern Hagenuk (which during the war specialised in R/T sets for U-boats) was taken over to serve as a principal centre of Poland's post-war radio industry.

The difficult work of organising the Dzierzonow Radio Works lasted for nearly ten months and was completed in September, 1946. In the initial period of its activities the works undertook, with the aid of a severely reduced technical personnel, the repair of some 2,000 standard pre-war sets and the fitting of another thousand sets with adapted military valves found in the stocks of the former R/T works. The utilisation of war surplus stocks went further and soon the works began turning out an emergency type of radio set built from parts found on the spot. More than 300 of these sets were turned out.

In December, 1946, the works switched over to preparatory work on a commercial radio receiving set. The monthly output of the works is expected to be 2,000 sets in the initial phase of production.

By 1948 four-fifths of the parts used in the production of the set will be of Polish manufacture, importation being restricted to items which cannot be produced in the country owing to lack of raw materials. The maximum productive capacity of the works, expected to be reached by the middle of 1948, will be 3,000 sets a month.

The total 1947 output of radio sets of Polish manufacture is expected to be 30,000 of which half will be produced by the Dzierzonow Works and its associated concerns and half by the State Telecommunication and Radio-technical Works. The 1948 production rate will probably be around 50,000 units. Of the number of difficulties facing the Polish radio industry the most serious ones are encountered in the production of valves, condensers and transformers.

Underneath the Dipole

Television Pick-ups and Reflections. By "THE SCANNER"

DO orchestras make good television material? I think that in most cases we all agree that they don't. We have at various times watched and heard programmes which featured dance bands, swing bands, music hall "dance orchestras," military bands, brass bands and symphony orchestras. On the whole, we have been unmoved. Dance bands, for instance, are not very awe-inspiring to look at, excepting when individual instrumentalists come forward to perform their particular parlour tricks, on which occasions they frequently become so inspiringly awful that one reaches for the "off" switch. It's funny how jazz band musicians trying to be funny can be so unfunny!

I think it was Jack Hylton who started the craze for dance bands on the stage, and who introduced comedy interludes performed by members of his band. These interludes were, however, genuinely funny, and a few of his notable musical clowns have since made names for themselves. Freddy Schweitzer, for instance, a comedy clarinet player, handled his intrument with the droll skill of a Sherkot defending his goal. But that was a good many years ago, before television, and before the inimitable Jack Hylton deserted the stage proper to become an impressario. I fancy that if Jack staged a band show again, with himself conducting, the sight of "Jack's Back" would again electrify audiences, including television audiences.

The Topical Musical Touch

I am not a jazz or jitterbug fan, yet I must confess that on occasion I have found that the musical improvisations of "jam sessions" have an extraordinary fascination. After considering this phenomenon, I have come to the conclusion that this is due to the spontaneity of these affairs, which have the pictorial "topical" appeal that is so successful on television. Turning to more serious music, the topical appeal was exploited very well in the television outside broadcast of the last night of the promenade concerts. In this case the sound and vision of the audience's reaction to Sir Henry Wood's "Fantasia of British Sea Songs" gave it the topical stamp in more senses than one. Their enthusiastic participation in the finale, shouting, singing, stamping and clapping in time with the great orchestra had to be seen to be believed. Close-ups of Basil Cameron, conducting both orchestra and audience, followed by close-up shots of enthusiastic sections of the audience, came over very well. If one could be critical at all, it would be of the lack of close-up shots of individual solo instrumentalists from time to time. It was a great occasion at the Albert Hall, and its greatness was not lost via television.

Image Orthocon Plus Zoom Lens

The use of multiple cameras on outside broadcasts is not without problems, be the locale the Albert Hall, the London Coliseum or a great boxing arena. The position of the television cameras is rigidly fixed and the choice of shots thereby strictly limited. The outside television boys do a great job of work under difficult circumstances. Their task will be considerably eased when the super-sensitive image-orthocon television cameras are introduced, especially if multiple lens turrets or "zoom" lenses are fitted. The image-orthocon camera is, of course, much more sensitive than the present normal Emitron camera. The use of a multiple lens turret will enable a television cameraman to change over from long-shot to close-up, or to mid-shot, by thus changing the focal lengths of lenses. The zoom lens is a single lens which incorporates a variable focal length device, and the resultant effect is frequently seen in films when, for instance, a long-shot of cricket pitch "zooms" to a close-up of an individual batsman. The Gaumont British Newsreel is the proud possessor of one of these expensive instruments, which is most effective if used with discretion, but most annoying if used *ad nauseum*.

The zoom lens itself is quite a large "gadget" for fitting in front of a cinematograph or television camera. It looks like a rather long box Brownie camera with a handle in the side. This handle operates a mechanism which changes the focal length from, say, 2in. to 4½ or 5in. That is to say, it gives a view which is continuously variable from, for instance, a full length group of three people to a close-up of one person in that group. With these three devices, the outside broadcast television cameraman will no longer be restricted by the fixed position of his camera.

Power for Light

Until the super-sensitive television cameras are put into operation, however, a great deal of light is required for lighting adequately these big outside broadcasts. Whether it is the Albert Hall or the Collins's Music Hall, the problem is the same. Large mobile generators are required to provide current for incandescent or arc lights supplementary to the existing permanent lighting. Insufficient light leads to under-exposure, which seems to give a kind of white interference haze or halation on television and to dark results on cine-film. At Collins's Music Hall a number of separate 22½ kW. diesel-electric mobile generators were used, of the type used for supplying power to searchlights during the war. But the use of a large number of small power units is not considered the best way, on account of the multitude of cables and the scattered switchboards. Much preferred is the large mobile generator unit, capable of delivering 200 to 300 kW. in one fell swoop. The largest mobile generator in the country has already been mentioned in these columns. It is the property of the enterprising showman, Billy Smart, whose travelling circus was recently televised. Three separate generators on his huge truck provide a total of 300 kW. And now the Ealing Studios have completed a colossal travelling power plant, comprising a 400 h.p. diesel engine driving a 260 kW. generator, delivering 115 volts D.C. on each side of a three-wire system. This arrangement saves considerable weight of cable, which is an

(*Continued on page 516*)

important factor when the mobile power plant is stationed some distance away from the lamps. I have no doubt that both of these important units will be regularly used as a source of light.

The Power Cuts

Alternative sources of power have been the preoccupation of a good many industrialists, factory managements and others. Three-phase and single-phase A.C. has been the principal demand. But, so far as the B.B.C. television and the films are concerned, D.C. plants have been sought. The unreliability of the grid, the coal shortage, the criticised pronouncements of the former Minister of Fuel and Power, the petrol restrictions and other vexations have, certainly turned electrical history and progress back 25 years within a few months. In the year 1920, for instance, a theatre possessing its own power plant was considered to be well-equipped, but it was then said that in the future electricity could be purchased much more cheaply from outside than it could be made "inside," that the reliability would be greater and efficiency at light loads very much improved. The development of the mercury arc rectifier seemed to prove this prophecy. But the nationalisation of the coal and electrical supply industries, together with incidental limitation of effort, has put the clock right back. All far-sighted power engineers have become insular again, coveting their own power-producing plants entirely independent of the grid and of coal. Great big, old diesel-electric plants, 30 and 40 years old, are being resuscitated. I had the interesting experience of watching one of the old plants being restarted, after being "cold" for years. A large slow-revving four cylinder engine coupled to a 200 kW. generator was prepared for action, and the compressed air for starting the engine was anxiously turned on by the old engineer. Slowly the diesel began to move, and before the great flywheel had turned a couple of times, the engine was firing. Within a minute, the old veteran had settled down to a steady 200 revs. and the voltmeter was reading its 110 volts. The engineer relaxed, grinning broadly. He had retired at the same time as the engine had been put out of commission, when this particular factory had been turned over to the grid; and had a "point of view" about it. He looked at me happily and shouted through the turmoil of the engine, "That's better than yer town mains, guv'nor! It's one of the Old Contemptibles!" Thinking of the "Shinwell," the new unit of no-volts, I couldn't help thinking that he was right! The clock had indeed gone back, and was now striking 13!

Amateur Radio Exhibition

As announced in our last issue, an Amateur Radio Exhibition is to be held in November at the Royal Hotel, Woburn Place, London, W.C.1, under the auspices of the R.S.G.B.

The exhibition will be opened at 2.30 p.m. on Wednesday, November 19th, by Col. Sir Stanley Angwin, K.B.E., D.S.O., T.D. (Chairman of Cable and Wireless, Ltd.), who will be supported by the President and Council of the Society and representatives of a number of Companies who specialise in the manufacture of equipment, components, valves and publications which are of special interest to radio amateurs. The Exhibition will be open during the following hours:—

Wednesday, November 19th, from 2 p.m. to 10 p.m.

Thursday, November 20th, from 11 a.m. to 10 p.m.

Friday, November 21st, from 11 a.m. to 10 p.m.

Saturday, November 22nd, from 11 a.m. to 8 p.m.

Admission will be by catalogue, price 1s. at the door, or 1s. 3d. post free from the Inc. Radio Society of Gt. Britain, New Ruskin House, Little Russell Street, London, W.C.1.

List of Exhibitors

The following is a list of the principal exhibitors and their stand numbers at the time of going to Press:

Exhibitor	*Stand No.*
Antiference, Ltd.	14
Belling & Lee, Ltd.	6
Denco (Clacton), Ltd.	12
Electric & Musical Industries, Ltd.	20
Labgear, Ltd.	17
Measuring Instruments (Pullin), Ltd.	4
Mullard Wireless Service Co., Ltd.	13
Odeon Radio	1
Raymart, Ltd.	9
Radiocraft, Ltd.	7
Southern Radio & Electrical Supplies	15
Stratton & Co., Ltd.	3
Taylor Electrical Instruments, Ltd.	2
Telegraph Construction & Maintenance Co., Ltd.	16
Woden Transformer Co., Ltd.	10

This publication will be represented on the Geo. Newnes Stand, No. 8, where a complete range of our Technical Publications will be on view.

PITMAN
Radio Books

Introducing Radio Receiver Servicing
By E. M. Squire. Gives a useful working knowledge of receivers and servicing equipment. Second Edition. 7/6 net.

Radio Simplified
By John Clarricoats. A simple and well-illustrated introduction to radio for beginners. Second Edition. 4/6 net.

Short Wave Radio
By J. H. Reyner, B.Sc.(Hons.), etc. This is a comprehensive survey of short waves and their application in radio and television. Fourth Edition. 10/6 net.

Radio Upkeep and Repairs
By Alfred T. Witts, A.M.I.E.E. Full of useful hints on the location of faults and their correction. 6th Edition. 7/6 net.

Cathode-Ray Oscillographs
By J. H. Reyner, B.Sc. A.C.G.I., D.I.C., etc. A guide to the numerous practical applications of the cathode ray tube. 8/6 net.

A Dictionary of Electrical Terms
By S. R. Roget, M.A., A.M.Inst.C.E., A.M.I.E.E. Fourth Edition. 12/6 net.

PITMAN
Parker Street, Kingsway, London, W.C.2

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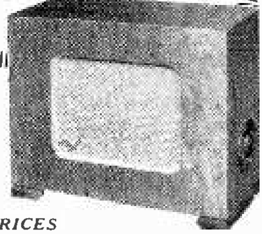

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SENIOR MODEL			
Type SC with Universal Transformer	5	15	6
,, SX minus ,, ,,	5	2	6
JUNIOR MODEL			
Type JC with Universal Transformer	5	0	0
,, JX minus ,, ,,	4	10	6
CADET MODEL			
Type CC with Universal Transformer	4	10	0
,, CX minus ,, ,,	4	0	0
BABY MODEL			
Type BC with Universal Transformer	2	19	6
,, BX minus ,, ,,	2	13	6
MINOR MODEL			
Type MC with Universal Transformer	2	5	6
,, MX minus ,, ,,	1	19	6

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Superhet Kits. Every part required for the construction of a really efficient superhet receiver, with valves, 6K8, 6K7, 6Q7, 43, and rectifier, iron dust cored coils, 5in. P.M. Speaker, drilled chassis, and handsome wood (walnut) cabinet, size 12-7-6¼ins., long and medium wavebands, 200/250 v. A.C./D.C. operation. Circuit supplied. Price, including P.T., **£9 5s.**

Dial and Drives, full vision type, 8-5¼ins., complete with 3 waveband coloured ivorine dial, fully station named, slow motion drive, Pointer, Glass, and attractive bronze escutcheon, **10/6** each. Airplane type, 3¼in. diameter, complete as above, but long and medium wave only, **9/6** each.

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ADMIRALTY INDICATORS.—Complete with C.R. tube, ECR.60 and 7 valves. Suitable for Television and Oscilloscope construction; supplied brand new in maker's carton, **£7/10/0.**

EX-A.M. RECEIVERS.—Type 3,170, complete with the following valves: (10 Type EF50: 1 UU5: 1 VU134: 1 V370: 1 VR137, Smoothing chokes, resistors condensers, etc. Wonderful component value, supplied brand new in maker's carton, **£4/10/0.**

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CRYSTAL MONITORS.—A.M. Type 2, brand new, **10/-.** MCR.1 Miniature Communication Receivers still available complete with power unit, two batteries, 'phones, aerial, etc., **£11/10/0.**

Programme Pointers

MAURICE REEVE Reviews Some More Books on Music and Composers

IN a recent issue I took occasion to make some, I think, deservedly complimentary remarks on Mr. Eric Blom's new "Everyman's Dictionary of Music." Like the great series of classical literary reprints from which it takes its name, though in which it is not included, I pointed out how essential it was for musicians of all kinds and degrees to have ready at hand a "source book" of their subject at once equally portable, manageable, reliable and exhaustive where the definitive and massive Grove was either unobtainable or unpractical. Also I mentioned how Mr. Blom's book so perfectly supplied this need. When travelling, for example, it could easily be added to one's week-end or business compact almost without notice, and much to the entertainment of the voyager.

Now I want to mention, and most highly commend, something to enrich the stay-at-home on his Sunday afternoon of leisure or at such other time when his greatest delight is to both instruct and amuse, educate and entertain, and to generally absorb himself for his profit or pleasure in matters musical. Ever since the first edition greeted our delighted senses in 1938, I suppose the "Oxford Companion to Music" has become at once the musician's ideal source book both for information and entertainment, whilst its editor and founder, Dr. Percy A. Scholes, must be gratefully honoured by thousands of music lovers, professional and amateur, on a scale and with a warmth given to men like Henry J. Wood or Walford Davies.

I have been able to handle for a few days a copy of the seventh edition (Oxford University Press, 42s.), and of this brief inspection I will write a few words.

Useful Contents

The work contains 1,145 pages, and abounds with figures, quotations and diagrams. In addition there are 179 plates and pages of photos including a vivid series of drawings of the master musicians by Batt, of *Radio Times* fame. These 179 pages, comprising as they do the whole story of music in picture and drawing, could form a feature volume in themselves. The pronouncing glossary and appendices bring it fully up to date.

"A Reader's Synopsis" of the work, "showing how, in addition to the use of the volume as a book of reference, the dispersed articles upon various branches of the subject may, if desired, be read as a series of concise comprehensive surveys of the different aspects of the art," gives 19 "aspects" or "headings" for reading—each much sub-divided—as follows: 1. The scientific side. 2. Structure of music—rhythm, scale, form, harmony, etc. 3. Notation. 4. Instruments and performance. 5. Opera. 6. The dance. 7. Chamber music. 8. The orchestra and conducting. 9. Vocal music. 10. Choral music. 11. Church music. 12. Folk music. 13. The history of music. 14. British music. 15. American music. 16. The music of to-day and to-morrow. 17. Social history of music. 18. The profession—its history and present position. 19. Educational aspects. The work is alphabetical, of course, and elaborately cross-referenced.

Dr. Scholes is a monument of erudition. And, what is even more important from our point of view, a stylish, lucid and pleasing writer whom it is a delight to follow through these packed, beautifully printed and numerous pages. "Absolute Pitch," "Acoustics," "Annotated Programmes," "Applause," "Ballet," "Broadcasting of Music," "Colour in Music," "Concerts and Concert Halls," "Criticism in Music," "Education and Music," "God Save the King," 10 columns with numerous figures—"Gramophone," "Hymns and Hymn Tunes," "Improvisation," "Madrigals," "Mechanical Reproduction of Music," "Memory in Music," "Nicknamed Compositions," "Patronage," "Printing of Music," "Publishing," "Ragtime and Jazz," and "Street Music," are samples of the vast canvas—apart from the purely scholastic and biographical subjects—covered by the volume, and enumerated to show its enormous "entertainment" value. These articles range from three or four to 10 or 12 columns, and make delightful reading for the odd moment when mental relaxation is sought.

The views expressed on contemporary personalities and subjects are always interesting, temperate and broad-minded, even though we may sometimes differ from them. But more than half the pleasure derived from a work of this kind is to be had in seeking its opinions on this, that and the other. To get to know what the Oxford Companion has to say about this and that is enormous fun as well as of great education value.

Limited Edition

Unfortunately, conditions are such that the seventh edition having to be brought out in limited numbers, some of us can hope to do little more than put our names down and wait patiently for the eighth. But you will be well rewarded for trying to find a copy, should you be successful in doing so. If you can't get it out of the local public library whenever possible.

"Chopin"

Another book, though of smaller dimensions and more modest price, which is most readable and instructive, is Arthur Hedley's "Chopin," published by J. M. Dent in their Master Musicians Series at 7s. 6d. Unquestionably the most beloved composer for the piano—and his best works have no rival in the literature of the instrument other than the Beethoven Sonatas—the Chopin worship has grown and grown until to-day, a hundred years since his death (1849), the "Chopin recital" is still the greatest attraction in the pianistic half of the concert world. The centenary being little more than a year off, this "life" should prove popular in what is bound to be a spate of Chopin literature.

Mr. Hedley tells the story of the brief life, 39 years, simply and straightforwardly, with some new light on the parting from George Sand—a parting the composer was to feel and mourn the rest of his days.

Trade Notes

Instanta Relays

THE plant, stock and assets of Messrs. Instanta Electric, Ltd., makers of the well-known relays and associated equipment, have been taken over by Magnetic Controls, Ltd., at Instanta Works, 48, Old Church Street, Chelsea, S.W.3. Catalogues and leaflets are in course of preparation describing the various types of relays for A.C./D.C. supplies, and are of particular interest to the amateur transmitter.

R.F. Components

COILS are the nucleus round which every type of receiver is built, and the efficiency of the receiver depends largely upon the coil design. A very interesting range of coils is available from R.F. Components Co., Ltd., of 224, Hornsey Road, London, N.7, and these range from single coils at 8s. 6d. to complete "tuning hearts" at £5 5s. The coils are wound on ½in. diameter paxolin formers, and consist of the usual solenoid and wave-wound windings, according to the wave range required. Riveted soldering tags are provided with the usual single-screw fixing at one end. Long-wave coils and similar high inductance components are available with iron-cores provided with adjusting screws.

The coils are available in sets mounted on flat or angle plates provided with the necessary switch to cover three wavebands, 16-50, 200-550 and 700-2,000 metres, whilst for those who prefer more short-waves a special pack, type "E," may be obtained covering 13-35, 34-100 and 200-550 metres. Amongst the other components are I.F. transformers, I.F. filter coils, and A.C./D.C. filter coils.

The tuning heart consists of a two-gang condenser, set of six permeability tuned coils, two I.F. transformers, and two valveholders, with the necessary associated condensers and resistances, mounted on a neat aluminium chassis and provided with a large rectangular dial. All the inter-circuit wiring is carried out, and colour-coded lugs are provided for connection to a subsequent amplifier. Circuits and diagrams are available from the makers.

"Derwil" Servicing Cradle

MOST service engineers find difficulty in servicing many of the modern types of chassis, and have in many cases to improvise some form of cradle in which the chassis may be held so that access may be gained to any part whilst the chassis remains rigid. The Wilder Instrument Co., Ltd., of 75-81, Tooley Street, London, S.E.1, have produced a cradle of tubular metal, 24in. long, 14in. high and 12in. wide with fixed side runners and a sliding cross member section. It is fitted with adjustable clamps, provided with coil damping springs and will accommodate practically any size chassis with practically instantaneous clamping, and it may then be stood in any position. Finished in grey stoved enamel, the cradle costs £3 15s.

News from the Clubs

SLADE RADIO

Hon. Sec.: C. N. Smart, 110, Woolmore Road, Erdington, Birmingham, 23.

REGULAR meetings of Slade Radio are held on alternate Friday evenings at the Parochial Hall, Broomfield Road, Slade Road, Erdington, Birmingham, at 8 p.m. Forthcoming meetings have been arranged as follows:

November 14th, Mr. H. W. Yeates of the G.P.O. November 28th, Annual General Meeting.

Visitors are always welcome, and details of the Society and its activities may be obtained from the Hon. Secretary, at the above address.

THE WEST BROMWICH AND DISTRICT RADIO SOCIETY

Hon. Sec.: R. G. Cousens (G3BCS), 38, Collins Road, Wednesbury, Staffs.

A SERIES of talks covering the next three months has been arranged covering practically all aspects of amateur radio.

A visit has been arranged to the B.B.C. station Droitwich during November, a special coach being hired for the purpose.

Visitors and prospective members will be made very welcome.

Further details can be supplied, on request, from the secretary, as above.

THE LONDON SHORT WAVE CLUB

Hon. Sec.: R. Lisney, 4, Ongar Road, Fulham, London, S.W.6.

MEETINGS are held every Friday night at 8 o'clock at "The Crown," Battersea Park Road, Battersea, London, and consist of morse classes (when requested), general talks, lectures by members, instructional features by members who bring up equipment, and constructional periods on the club's own radio equipment. At the present a transmitter is under construction, and a start is being made on a receiver and various other items in the near future.

ST. PANCRAS RADIO SOCIETY

Hon. Sec.: H. Brown, 84, Blenheim Gardens, Willesden Green, N.W.2.

AFTER rather a long summer vacation the Society has now settled down to another year's work. Many new members were admitted on the opening night together with most of the old ones and others recently returned from the forces.

Shortly, it is hoped to have a transmitting licence and to go on the air with the rest of the fraternity.

Meetings are now held at L.C.C. Evening Institute, Holmes Road, Kentish Town, N.W.5, on Monday and Thursday evenings, 7 to 9 p.m., and it is hoped to start a third night soon for beginners only.

THE BIRMINGHAM AND DISTRICT SHORT WAVE SOCIETY

Hon. Sec.: N. Shirley, 14, Manor Road, Stechford, Birmingham, 9.

THE Society has now succeeded in obtaining a room at 220, Moseley Road, Birmingham, 12, where meetings will be held on alternate Thursdays, in addition to the monthly meetings being held at the Hope and Anchor Hotel, Edmund Street, Birmingham. The new club room is intended for practical work, and it is hoped to have a club transmitter working there in due course. Several of the club's members have passed the Radio Amateur's examination and it is hoped that they will soon swell the number of active members.

Impressions on the Wax

Review of the Latest Gramophone Records

FEW works could make a finer introduction to the music of Frederick Delius than the "Song of the High Hills." Its general plan is simple, for it traces out the impressions and experiences of a day's climbing. The opening music is orchestral, with a swing of triple measures expressive of the exhilaration of ascent. The high strings give glimpses of the snow line, and as this is approached Delius finds the orchestra no longer adequately fulfilling his purpose: he introduces the chorus. After the icy, glittering violin tones the voices of human singers cannot but sound solid, but this is forgotten once the transition of tone has passed. The orchestral music returns as the descent is begun, but the visionary gleam remains, and the piece does not so much end as merely recede into space. Sir Thomas Beecham, Bart., is the acknowledged master interpreter of Delius, and he it is who conducts the Royal Philharmonic Orchestra in these three delightful records—*H.M.V. DB*6470-2.

Instruments of the Orchestra

There has for some years been a wide demand for a new set of records for Instruments of the Orchestra. The H.M.V. Company have now satisfied this demand and Sir Malcolm Sargent has conceived and directed a set of four twelve-inch records illustrating the instruments. The pieces, selected by Sir Malcolm and specially arranged, where necessary, by him, are played by musicians who are masters of their craft. The records as a whole provide an introduction to the orchestra which will help both the student of any age and the general music lover to understand the contribution of each instrument, and thus to appreciate more fully and clearly the voices of the full orchestra. A booklet, price 6d., to annotate the records has been written by Bernard Shore, author of "The Orchestra Speaks," with a foreword by Sir Malcolm Sargent. The demand for a new set of records has usually been accompanied by a demand for illustrated material. The Bureau of Current Affairs is therefore publishing a set of five wall charts, price 8s. 6d., which are sold with the records—*H.M.V. C*3619-22.

Continuing their arrangements for two pianos of works in the classical repertory, Rawicz and Landauer have selected Chopin and Debussy. The former is represented by the well-known C Sharp Minor Waltz. The Debussy piece is the second of two arabesques written in 1888. The number of the record is *Columbia DB*2338.

There is a degree of achievement in musical performance which leaves even the most experienced listener a little breathless and credulous. In this category must be included Dennis Brain's playing of Strauss's Horn Concerto on *Columbia DX*1397-8. By nature the horn is an untractable instrument, prone to bubble and squawk; in young Dennis Brain's hands it is as supple an instrument as Leon Goossens' oboe. This magnificent performance is conducted by Alceo Galliera, whose Columbia records of Strauss's Don Juan are voted the "best ever" of this work.

Andre Kostelanetz, who further cemented his tremendous British following with a recent personal appearance at the Music Festival at the Harringay Arena, has now recorded two evergreens in "When Day is Done" and "Flamingo" on *Columbia DX*1404.

Peter Yorke and his thirty-seven piece concert orchestra have recorded Tobini's "Hearts and Flowers," and Peter Yorke's own composition "Sapphires and Sables," on *Columbia DB*2340. The latter is, of course, the signature tune of the "Sweet Serenade" broadcasts, and it has been recorded in response to requests from listeners.

With his orchestra augmented to 60, and the composer himself at the piano, Sidney Torch has recorded a remarkable new work—Concerto in Jazz—by Donald Phillips. Scored for a complete symphony orchestra, plus saxophones and additional brass, the work is written in the form of a concerto for piano and orchestra, with the accent on jazz. With Donald Phillips himself at the piano, Concerto in Jazz enjoys an interpretation nearest to the composer's intentions—*Parlophone E*11456.

Variety

Originally formed as an accompanying group for Archie Lewis, the Geraldo Strings are now recording titles on their own account, a factor that will be welcomed by those who favour popular melodies tunefully played. The Strings, actually an integral part of Geraldo's Concert Orchestra, comprise 14 violins, two violas, two 'cellos, harp and bass. The titles they have chosen are "Out of My Dreams" and "On the Banks of Allan Water"—*Parlophone R*3059.

Nelson Eddy's new film "End of the Rainbow" deals with a tale of a nineteenth century trading post and penal colony in northern California. Two of the most important songs have been recorded on *Columbia DX*1406 by Nelson Eddy himself, and they are likely to prove very popular. They are "Nearer and Dearer" and "Tell Me With Your Eyes."

Other vocal recordings are "Always" and "The Moon was Yellow and the Night was Young," sung by Frank Sinatra on *Columbia DB*2339, "I Wish I Didn't Love You So," and "I'll Make Up for Everything," sung by Steve Conway on *Columbia FB*3344, and Rita Williams sings "My Love is Only for You" and "Now Is the Hour," on *Columbia FB*3345.

Harry Davidson and his orchestra continue their series of old-time dances with "The Honeymoon Parade" and "The Glen Mona Waltz," on *Columbia DX*1405. One of the most prolific broadcasters—to date he has been on the air over 2,000 times—he now leads a dance orchestra specialising in old-time numbers, of which these two latest titles are worthy representations.

Two hit tunes of the moment, "Doin' What Comes Naturally" and "Managua Nicaragua," have been recorded by Geraldo and his Orchestra on *Parlophone F*2239.

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).

Correspondents Wanted

SIR,—I would like to correspond with any keen amateur who has obtained an R.A.F. receiver type 1147B. I have recently acquired one of these V.H.F. receivers and I would like to have details on the power required to operate the same. I am sure that some of these receivers must have been converted for 5-10 metre amateur band use.—P. H. SMITH, 16, Waldingfield Road, Sudbury (Suffolk).

Mr. S. A. Knight

SIR,—For the information of readers generally, I would like to point out that I am no longer associated with Midland Radio Coil Products, of Wellingborough, and personal queries should not, therefore, be addressed to me there.—S. A. KNIGHT (Northants).

A Car Radio Idea

SIR,—I have built a four-valve superhet car wireless on the scale of an ordinary household set, so there is nothing miniature about it, and as my car is a two-seater, I have put it in the large luggage boot, merely having the 6in. speaker and switches on the dash. I have found that in practice I want only to receive the 200 kc/s Light Programme and 977 kc/s Home Service.

However, I soon got tired of having to stop the car to tune from one station to the other, so I removed the original coil pack and tuning condensers and substituted two sets of coils and preset condensers switched by four-pole two-way switch contacts on a six-volt relay. As I listen chiefly on 200 kc/s on the road, I wired the relay contacts so that when it is not energised I receive the Light Programme; to change to the Home Service I simply press a single-pole make-and-break switch (on the dash) on two wires to energise the relay.—N. R. BROADBEAR (Teignmouth).

Peculiar Faults

SIR,—We should like to refer to your correspondent Mr. Norman Dean, of Manchester, writing under the heading of "Peculiar Faults." By permitting the early stages of an amplifier to oscillate in a violent manner, the voltage applied to the anode of the 6V6G valve would be of the order of several thousand volts, evidenced in this instance by the flashing-over of the output transformer primary and the breaking down of the internal insulation of the valve. Under these circumstances bulb bombardment, glowing and eventually insulation failure may be expected, varying with the applied anode volts.

Valve type 6V6G is an aligned grid tetrode in which the electrons are focused by the action of the screen and the control grid fields. It was solely due to this action that the trace appeared in the manner described by your correspondent. The green colouring is most probably due to traces of barium within the valve envelope.—A. C. COSSOR, LTD. (Technical Service Department).

Electronic Organ

SIR,—I have been following with some enthusiasm your articles on "Electronic Musical Instruments," but as yet I have not seen what I have really been looking for. I have seriously been considering making an electronic organ utilising rotating discs as used in the Hammond organ. Could any reader give me any information on (a) the design of the open core coils as used in the Hammond for generating the frequencies; (b) the contours of the rotating discs to give a sinusoidal wave form?

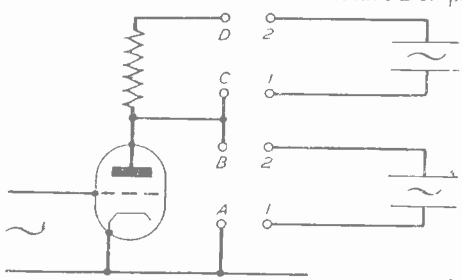
I should be glad to hear from anyone who has experimented with this form of tone generation.—KENNETH S. BAILEY (25, Plumbley Drive, Manchester, 16).

Vectors Again!

SIR,—In reply to Mr. Griffiths in your September issue, I must point out that the vector Ia_2 is not leading the voltage across the inductance; it is leading only on the V_0, the output voltage, which is not the same as the voltage across the inductance.

The voltage across L is similar only in magnitude, and its phase can be found by drawing in the vector marked $Ia\omega L$ in Fig. 1 (March) into Fig. 2 (March), maintaining the same relative angle between Eg and $Ia\omega L$. In other words, the output voltage V_0 and that across L are 180 deg. out of phase.

It has been stated that the phase shift between V_0 and that across the load impedance cannot be shown on an oscilloscope, but this is because the experiment has not been correctly performed. Consider the accompanying illustration. If the terminals 1 and 2 are connected to A and B respectively the output wave will be as shown. If now terminal 1 is switched to D in order to show the voltage across R the picture will not be changed because we have reversed the plates of the oscilloscope. The correct method is to change 1 and 2 to C and D respectively so that terminal 1 is still nearest to the earth line. The picture will then be of the same amplitude but reversed, showing



Mr. Hatch's explanation of phase shift.

that V_0 and V_L are 180 deg. out of phase. The same argument applies if the load is reactive. I think the above should clear all the points raised.—R. S. HATCH (Lancs).

The Value of Checking

SIR,—The value of the oft-repeated advice of checking connections, etc., before dismantling the chassis when undertaking the repair of sets was illustrated when a faulty set came in for repair recently.

The set, a 1-v-1 affair, had lost a few plugs, and its owner was unable to identify the various leads. Upon replacing the appropriate plugs and connecting up, the set only received the Home Service and Light Programme, and that with reaction well advanced. Obviously something was wrong, for a modern H.F. pentode amplifies so well that normally no reaction is required for such powerful stations, even with the shortest of aerials.

Upon checking the H.T. currents it was found that the H.F. pentode was passing no anode current. At first it was thought that the filament was gone or had lost emission, but when inserted in a valve tester it registered the appropriate current. The actual connection at the anode was then examined, and it was discovered that through faulty manufacture the cap (which was a fancy shielded one) was insulated from the wire so that no current could pass. Evidently the set has never been giving three-valve results, as the set had been passed out for sale to the public in this faulty condition.

On making the appropriate connection secure, the set performed up to expectations, receiving a variety of stations at good strength with little or no reaction.

This case particularly exemplifies the importance of checking connections of an external nature, and much time and trouble are often saved by doing so. It is easy to see the wild goose chase which might have resulted if I had not spotted this faulty connection.

Needless to say, the owner was delighted to receive the set back in such good condition, and spent quite a while chasing stations which the set had never previously received. It had been, in effect, a 0-v-1, relying for its pick-up on the wiring, together with, perhaps, a little capacitive coupling from the first tuned circuit. And it might have continued thus but for the mishap in connection with the plugs.—WM. NIMMONS (Belfast).

Ex-Service Equipment

SIR,—I would be very pleased to hear from any reader who has purchased an ex-R.A.F. R.1116-A battery superhet receiver, and who can offer help on the following:

(1) My set appears to suffer with second-channel interference, as there is only one tuned circuit prior to the frequency-changer, and I would like to adapt a regeneration valve in a similar manner to the circuit given on page 275 of the July, 1947, issue of PRACTICAL WIRELESS. This circuit, however, was for mains operation, and details of the battery version would be appreciated, since I understand the regeneration principle is preferable to further R.F. tuned stages.

(2) Details of the fitting of an "S" meter required (1 m/a. moving-coil meter available.)

(3) If anyone has [...] pre-selector, I should [...] this, as I have tried var[...] much success. (Alternati[...]

Information on any of t[...] very much appreciated.—J. [...] Street, Leamington Spa, Warw[...]

SIR,—I have recently obtained [...] Army [...]mitting and receiving set, Mark II, B.19 (three sets in one) with provision for 15 tubes, and dyna-motor operates from 12-volt storage battery, and made by Zenith & Emerson.

Set A has a frequency range of 2-8 Mc/s for telephone and telegraph, includes six-tube superheterodyne receiver, and six-tube MOPA transmitter, with 807 final amplifier.

Set B consists of 235 mc/s transceiver.

Set C, a complete inter-communication system.

I do not know any of the valve types, since the circuit diagrams are not available. If anybody has a similar piece of instrument complete or knows anything about it that could help me to use it, will they please supply me with the information ?—RUFUS ALLEN (4, Pike Street, Lagos, Nigeria, W.C.A)

SIR,—Regarding your request for co-operation of readers re ex-Service gear on page 482, November issue. It would be a great thing for many of us if PRACTICAL WIRELESS would publish a list of ex-Service C.R. tubes with their civilian equivalent numbers. There is available a list of Army valves with equivalents, but not cathode-ray tubes.

The ACR.10 Army tube referred to in your note is identical in size and pin connections with the G.E.C. C.R. tube E-4205-B7 (2¾in. tube), but I cannot find out what the operating potentials of the ACR.10 are. (I have one.) I am informed by the dealer that the maximum anode potential is 450 volts and filament 4 volts, while the maximum anode potential of the E-4205-B7 G.E.C. tube is 1,600 volts. So the ACR.10 must be the old gas-focused type.

I was able, after much difficulty, to get a circuit sheet for an ex-Army set I purchased (Type 1147A) from a dealer who advertises in your paper—Franks, Oxford Street. (The circuit was not advertised.) Type 1147B is identical, but employs E.F.50s instead of acorns, so the efficiency is much greater.—WILLIAM J. LAW (Ealing).

[*Can any reader or manufacturer supply details of C.R.T.s to enable us to prepare a list of equivalents?*—ED.]

Dual Speaker Networks

SIR,—With reference to the letter from myself in October issue, I have received both re-forwarded and also directly through the post many letters asking for various particulars.

In the initial interests I did reply to many, but I have since received many more.

Not a single person had the understanding to enclose a stamp, and as it has become quite an item, I cannot undertake to reply to any more unless a S.A.E. is enclosed.

There will probably be many people who will feel disappointed, but it is hardly fair to ask for information and not to cover the costs.—S. J. HOLT (St. Anne's).

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METERS. All meters are by the best makers and are contained in bakelite cases. Prices are about one-quarter of original cost.

Range	Ext. Diam.	Res.	Fitting.	Type.	Price.
300 v.	3½in.	15K	Flush	M.I. A.C.	7/6
500mA.	3in.	—	Proj.	M.C. D.C.	12/6
40 v.	2in.	8K	Flush	M.C. D.C.	7/6
2½ a.	2in.	—	Flush	Thermo H.F.	7/6
4 a.	2in.	—	Port.	H.W. H.F.	3/6
20 a.	2in.	—	Flush	M.C. D.C.	7/6
40 a.	2in	—	Flush	M.C. D.C.	7/6
25 a.	3½in.	—	Flush	M.C. D.C.	7/6
25 a.	3½in.	—	Proj.	M.C. D.C.	7/6
25 a.	3½in.	—	Flush	M.I. D.C.	7/6

ROTARY TRANSFORMERS. Input 12 v., output 180v., 30 m/a., 4 v. 2-3 a., with 19 volts input, output is 50 per cent. higher. May be used on D.C. mains as L.T. charger. With small conversion could operate as D.C. Motor. Original cost over £5. Employ powerful ring magnet. Price 10/- each.

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To charge 2 v. accumulator at	½ amp.	..	15/-
„ 6 v. „	1 amp.	..	17/6
„ 12 v. „	1 amp.	..	22/6
„ 6 or 12 v. „	4 amp.		

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