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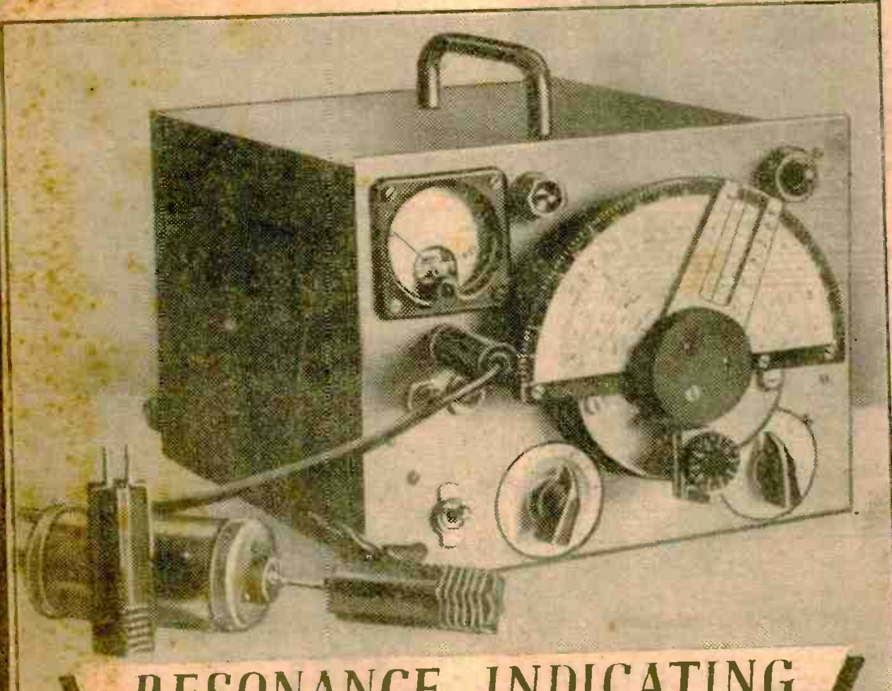
FEBRUARY, 1951

PRACTICAL WIRELESS

EDITOR:
F. J. CAMM



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IN THIS ISSUE

Magnetic Recording
Modifying Type 18 Rx
Electronic Double-beam Switch
Negative Feed-back
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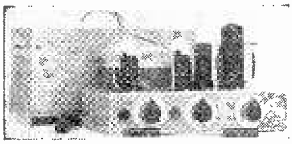

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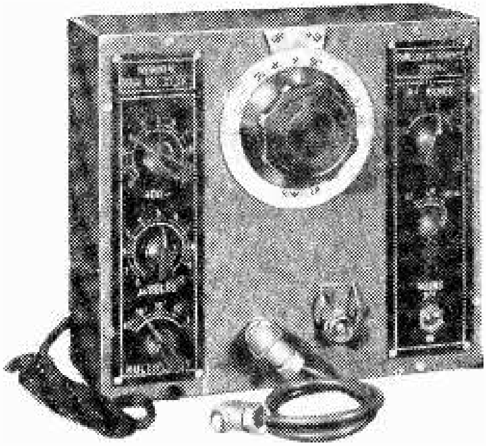

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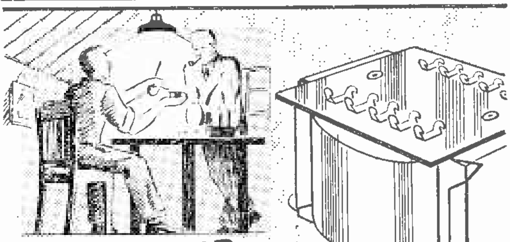

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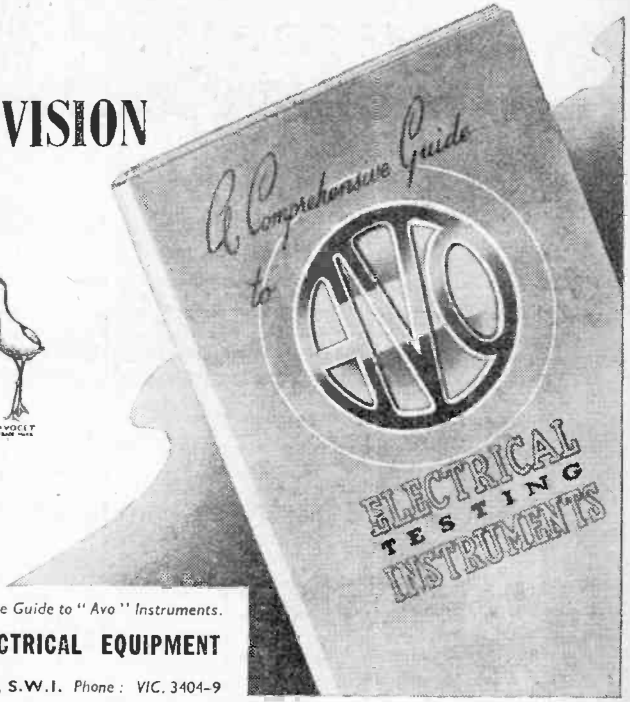

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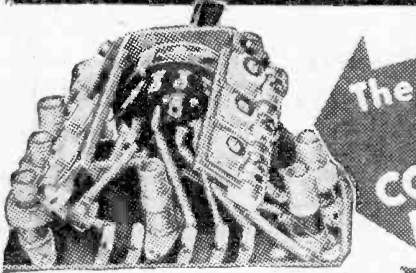

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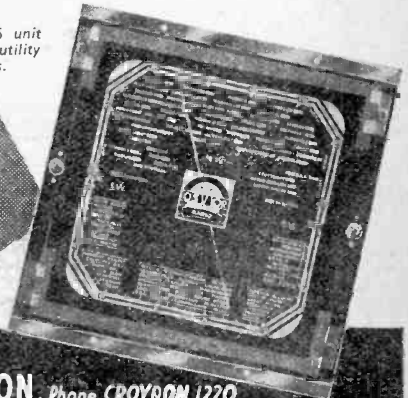

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Practical Wireless
19th YEAR OF ISSUE
EVERY MONTH.
VOL. XXVII. No. 532. FEBRUARY, 1951
Editor F. J. CAMM

COMMENTS OF THE MONTH BY THE EDITOR

The Speed of Light

THE National Physical Laboratory recently announced that it had re-measured the speed of light and found that it was 11 miles out, the actual figure being 186,282 miles per second instead of 186,271, which was hitherto accepted. The new measurement is of immediate practical value in radio and radar, and, of course, it plays an important part in atomic theory and nuclear physics. According to Einstein it is the highest speed at which anything can travel.

In radar the distance to an object is calculated from the time taken by a pulse of radio waves to travel there and back, the speed of the waves being the same as that of light. The new figure will therefore permit more accurate calculations to be made in connection with radar, and it will also be valuable for aerial survey work where the shape of the ground is plotted by means of radar.

Romer first measured light and obtained a speed of 192,000 miles per second, from astronomical observations in 1676, but the first direct experimental measurement was made by Fizeau, in 1849, and in this experiment a beam of light was focused on the rim of a toothed wheel, and after passing through a tooth space it travelled a distance of four miles and was reflected back to the wheel. The wheel was speeded up until the light disappeared, and the time of travel was calculated from the rapidity with which the wheel was turning.

In 1935, Michelson in America conducted an experiment in which a beam of light travelled in a metal tube a mile long. The final value he obtained was 186,271 miles per second, and this figure has been accepted up to the present. Dr. L. Essen, of the National Physical Laboratory, announced in 1947 the new figure, but it was not accepted at that time. He has since confirmed it, and experiments conducted in Sweden and the U.S.A. have resulted in further confirmation.

The method he used is similar to that of Essen, except that the tube was only 7in. long. A radio-wave was transmitted down this metal tube and reflected backwards and forwards between the ends. When the time of travel between the ends equals the time-interval between successive waves, they build up to produce an electrical resonance which can be detected with very high precision.

In this experiment the time of travel is about one ten-thousand-millionth of a second, and it was necessary to measure this frequency with an accuracy of the order of one part in a million.

Gramophone Developments and L.P.R.

DURING the past two years, important developments have taken place in the gramophone industry in the U.S.A. The first was the introduction of long-playing records, playing on a suitably adapted turntable running at 33⅓ r.p.m., as distinguished from the turntable speed of 78 r.p.m. used hitherto, and the later introduction of a 7in. record designed to play at 45 r.p.m. Thus, the record table in the U.S.A. had to deal with the difficult situation of supplying three types of records running at three different speeds. A considerable number of turntables capable of playing at all three speeds has been produced, and it is now possible to buy long-playing records in this country. All the leading manufacturers of records in America are making records to play at three speeds.

A.C.E.

A REMARKABLE electronic development in the form of an Automatic Computing Engine (A.C.E.) is announced by the N.P.L.

Unlike some similar types of machine which are built to deal with one recurring problem only, the A.C.E. can be made to tackle any problem requiring arithmetical calculation. All mathematical calculations in the end resolve themselves into addition, subtraction, multiplication and division, so that there is no limit to what A.C.E. can do.

The A.C.E. works at prodigious speeds made possible by the use of wireless valves and modern electronic techniques. The speed is really too great for stating in ordinary terms. Consider the multiplication:

3,971,428,732 x 8,167,292,438.

A skilled arithmetician would do this sum with paper and pencil in about eight minutes. With a desk calculator it would take about one minute. The A.C.E. will do the sum in about one-five-hundredth of a second.

F. J. C.

ROUND the WORLD of WIRELESS

Broadcast Receiving Licences

THE following statement shows the approximate number of licences issued during the year ended October 31st, 1950:

Region	*Number*
London Postal	2,335,000
Home Counties	1,642,000
Midland	1,732,000
North-eastern	1,893,000
North-western	1,597,000
South-western	1,061,000
Welsh and Border Counties ..	728,000
Total England and Wales ..	10,988,000
Scotland	1,123,000
Northern Ireland	206,000
Grand Total	12,317,000

The above total includes 511,150 television licences.

Motorists are reminded that they should take out a separate broadcast receiving licence for a wireless set fitted in a motor-car.

B.B.C. Studio at Nottingham

ON November 30th a new B.B.C. studio for the East Midlands area was opened by the Lord Mayor of Nottingham.

The new studio is in Bentinck's Building just off the Market Square, Nottingham. It has two microphones, the outputs from which are controlled and amplified in an adjoining control cubicle separated from the studio by a double plate-glass window. From the control cubicle the programme signals will be sent on by special G.P.O. telephone lines to Broadcasting House, Birmingham, where they can be fed into the B.B.C. networks. The technical apparatus for the studio will be operated by engineers from Birmingham.

The size of the studio is approximately 25ft. by 15ft. by 11ft. high, which makes it very suitable for talks and discussion programmes. With its coming into service artists and speakers drawn from the East Midlands will be able to broadcast from Nottingham instead of having to go to Broadcasting House, Birmingham.

Speed of Light

LIGHT travels at 11 miles a second faster than the figure generally accepted by scientists for the past 15 years. This discovery was made from experiments at the National Physical Laboratory which show that the figure should be 186,282 miles per second and not 186,271. (See leader in this issue.)

Interference with London Home Service Transmissions

DURING recent weeks, the B.B.C. Home Service transmissions on 330 metres have been subject to interference, particularly noticeable on the South Coast of England. Some of this interference was due to transmissions from France and Spain, and has now ceased. Interference still exists, however, from a Russian transmission on the same wavelength. Representations have been made to the Russian Government and it is hoped that this remaining interference will also soon cease.

Sweden Likes British Radio Receiver

HIGH-GRADE British communication receivers are finding great favour with Swedish radio engineers. The BRT.400 receiver made by The General Electric Co., Ltd. is used by all the Swedish armed forces and the Swedish Post and Telegraphs Department.

The illustration below shows Mr. Esping, Chief Engineer of the Swedish broadcasting organization using this receiver for monitoring purposes on the occasion of a frequency reshuffle. To quote his

Chief Engineer Esping of the Swedish Broadcasting Company using a G.E.C. BRT400 receiver.

own words, he used the receiver because he found it to be a good one.

B.I.R.E.

THE following meetings of the Institution will be held in January, 1951 :

LONDON SECTION.—Wednesday, January 10th : Commencing at 6.30 p.m. London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1. A Symposium on Hearing Aids. Chairman : J. R. Hughes, M.Brit.I.R.E. "Deafness ; its clinical aspect and the possibilities of its alleviation medically and by deaf aids," E. R. Garnett Passe, F.R.C.S. "A Master Hearing Aid," E. Aspinall, B.Sc. "The Design of Commercial Hearing Aids," J. P. Ashton, B.Sc. (Eng.).

NORTH-EASTERN SECTION. — Wednesday, January 10th : Commencing at 6 p.m. Neville Hall, Westgate Road, Newcastle. "Stages in the Development of a small High-frequency Oscilloscope," H. A. Dell, B.Sc., Ph.D.

SCOTTISH SECTION.—Thursday, January 11th : Commencing at 6.45 p.m. Institution of Engineers and Shipbuilders, Glasgow. "Frequency Modulation and F.M. Measuring Equipment," E. D. Hart, M.A., A.M.Brit.I.R.E., and A. G. Wray, M.A.

SOUTH MIDLANDS SECTION. — Wednesday, January 17th : Commencing at 7 p.m. Exhibition Gallery, Public Library, Rugby. "Ultrasonic Generators for High Powers," B. E. Noltingk, Ph.D.

Turkey Opens New Radio Station

LISTENERS all over the world will now be able to hear Turkish news and culture, for the Radio and Broadcasting Administration of the Turkish Government has opened a new broadcasting station at Elimesgut, near Ankara. A Marconi 100 kW. short-wave transmitter, together with a special aerial system (designed at the Research Laboratories, Great Beddow, and erected at Elimesgut by Marconi engineers) will enable Turkish programmes to be radiated for universal reception.

The special aerial system consists of five lattice steel masts, two of 260ft. and three of 300ft. in height, with aerial arrays, capable of withstanding a wind velocity of 80 miles per hour. Each array comprises two identical curtains spaced a quarter of a wavelength apart and each orientated on a different corner of the world.

Educational Conference

EKCO School Radio Equipment was exhibited at the Annual Conference of Educational Associations held at King's College, Strand, W.C.2, from December 28th, 1950 to January 3rd, 1951.

4-watt and 25-watt equipments were shown with a 25-watt mobile gramophone trolley and a 4-watt portable playing desk. Television was also demonstrated and a range of speakers was on view.

Lecture on Ultrasonics

ON November 15th, 1950, Mr. R. R. Whymark, B.Sc., of the Mullard Electronic Research Laboratories gave a lecture to the Southern Branch of the Institution of Electronics on the subject of ultrasonics.

In this lecture the various methods used to generate ultrasonic waves were considered in detail, and the possible applications of such waves to the commercial field were outlined. Practical demonstrations using the Mullard H.F. generator E.7562 were given, whilst specimen magnetostrictors, moving flange vibrators and an ultrasonic soldering bath were shown as exhibits.

R.E.C.M.F. Exhibition, 1951

THE Eighth Annual Private Exhibition of British Components, Valves and Test Gear for the Radio, Television, Electronic and Telecommunication Industries, will be held in the Great Hall, Grosvenor House, Park Lane, London, W.1, during the period Tuesday, April 10th to Thursday, April 12th, 1951.

Admission will be by invitation only. Further details will be issued in due course by the organisers, the Radio and Electronic Component Manufacturers' Federation, 22, Surrey Street, Strand, London, W.C.2.

A New Year Resolution Worth Keeping

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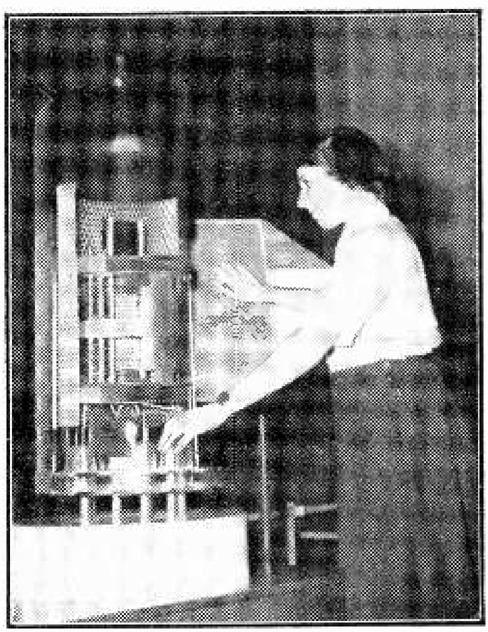


A student from Chorley Wood College for Girls with defective sight examining a giant-scale model of a Mullard valve at the special Exhibition for the Blind referred to in our last issue.

MAGNETIC RECORDING—3

The Subject of This Month's Article is the Tape-handling Mechanism

By F. C. BLAKE

THE basic requirements for a tape recorder mechanism consist of: (a) a capstan drive with pressure roller, (b) a tape take-up mechanism, (c) a feed reel with rewinding facilities (d) record/playback, and erase heads with their associated guides.

The normal practice with commercial mechanisms is to use a small capstan of around ½in. to ¾in. in diameter in conjunction with a flywheel, which is rim driven by a small motor. As, however, I use an ordinary centre-driven electric gramophone motor, running at the normal speed of 78 r.p.m., a capstan with a diameter of 1.98in. is used, which gives a tape speed of 7½in. per second.

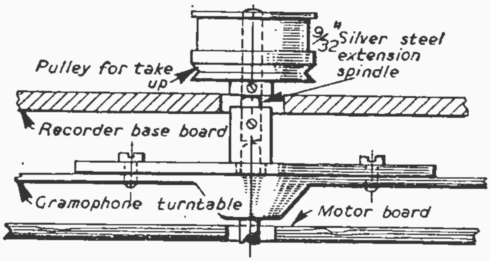


Fig. 1.—Method used to extend spindle of motor in the first recorder.

The recorder mechanism is more or less built around the gramophone motor, which should not only have a fair reserve power, but also should not have too much of an external A.C. field. In this connection a four-pole motor is infinitely better than a two-pole. The motors used successfully in the two methods of construction to be described are both Garrard 202A's. An older type Garrard 202 was used originally, but owing to the arrangement of the fibre wheel and governor, a slight "watery" effect was produced, on the early recordings. The makers kindly offered to modify this motor for me, but I managed to obtain another 202A-type motor from a local radio shop.

As the length of spindle on the motor was too short to accommodate the capstan, a flange plate coupling was made up and screwed to the existing turntable, Fig. 1. Most turntables tend to be out of true slightly in the vertical plane, so that a little judicious packing was necessary to make the extension spindle run true. A plywood panel was mounted on battens over the motor-board to accommodate the heads and reels (Fig. 1 of Sept.-Oct. issue).

The capstan was turned from 2in. brass bar, the vee groove at the lower edge being used as drive pulley for the take-up. The pressure roller, which is made of hard rubber, was pressed on to a brass centre bush. Fig. 2 shows details of a suitable pressure device.

Bootlace Drive

A simple method of friction take-up was used in the first recorder; a leather bootlace belt drive connected to the capstan drives a freely-mounted pulley running on a fixed stub, a disc of cork cut from a table mat rests on top of this pulley, and the take-up reel itself rests on this washer. (See Fig. 3.)

The bootlace drive acts very smoothly without slip, all the slip being provided by the cork disc. The bootlace is joined by a small hook made of 20 S.W.G. piano wire, holes being made in the belt by means of a bodkin.

The tape guides, Fig. 4, were turned from ⅝in brass rod. To simplify things in the first recorder no motor was used for rewinding, though there is no reason why the method to be described later should not be used. Rewinding was carried out by placing a pulley with an engaging spur over the feed spindle—which is also a fixed stud—and slipping on a spring belt between this pulley and a larger pulley, with winding handle attached.

A general plan and layout of this elementary mechanism is shown in Fig. 5, which should help readers to set out the various parts. Excellent results are obtained, and it is eminently suitable for the constructor who has to keep an eye on expense. Apart from the gramophone motor, the cost of materials should not amount to more than ten shillings.

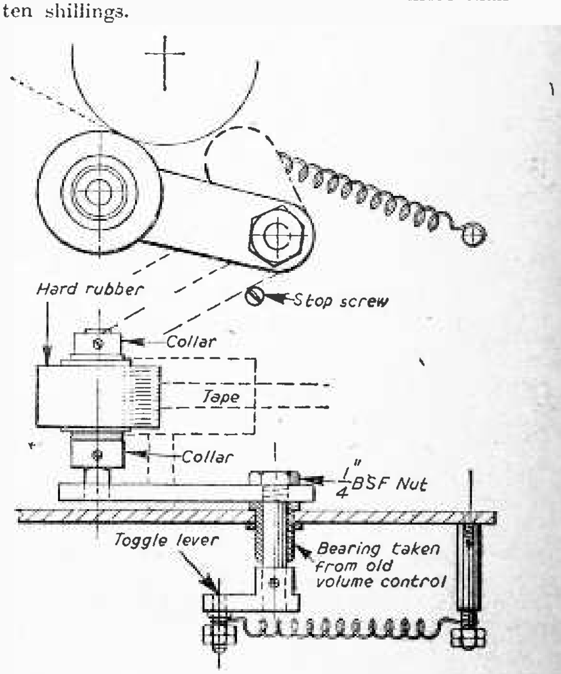


Fig. 2.—The pressure roller with toggle action.

Alternative Design

In the second recorder, which is a more ambitious model, the motor was fitted on a metal sub-panel which was mounted below the top panel by means of mild steel pillars. The method of fitting the extension spindle and heavy brass flywheel is shown in Fig. 6. It will be seen that the extension is not rigidly connected to the motor spindle, and any irregularity in the gramophone motor spindle is not transmitted to the capstan extension with consequent friction, which would cause a variation of capstan speed.

The take-up spindle is much more elaborate than the first method described, Fig. 7, and it makes a much neater job.

The feed spindle, which is similarly mounted to the take-up spindle, has a pulley fixed at a suitable height so that a short spring belt can connect it with the rewind motor, which was a small Hoover induction motor type SP. 201. The rewind motor was secured to the top panel by more pillars.

The reels are held in place by means of knurled nuts. When recording or playback is taking place the take-up reel is locked, and the feed reel is running free on a thin cork disc, which gives just sufficient friction to hold tape steady against the heads. When rewinding, the feed reel knurled nut is tightened and the rewind motor is switched on. A certain amount of adjustment to the clutch tensioning spring was necessary to get the right tension on the tape, without making the load on the motor too great.

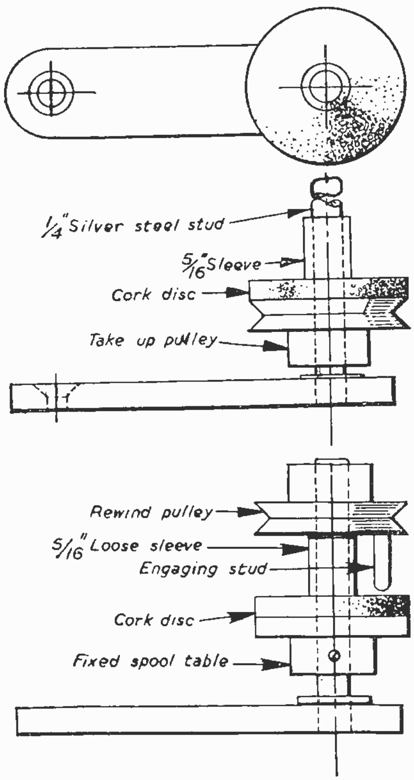


Fig. 3.—The feed-spindle with rewind pulley.

Tape Flutter

It was not found necessary to fit felt pressure pads on the head faces, as is usually done in commercial instruments, but if the constructor finds that tape flutter takes place it should not be very difficult to fit light brass or phosphor-bronze strips covered with a piece of felt to press on the heads, and also to arrange a linking mechanism connected to the pressure roller lever, so that the pressure pads are automatically released for lacing-up purposes.

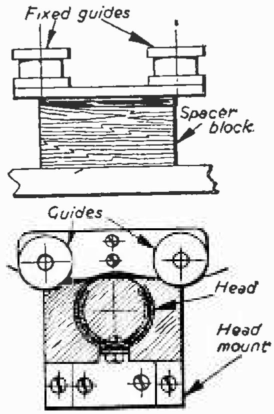


Fig. 4.—The recording head is mounted in a clamp made up from two strips of brass as shown in this plan and elevation.

The two motors are controlled by a three-position Yaxley switch, the centre position being "off." As there is a tendency for sparking to take place at the contacts a switch with a ceramic wafer is to be preferred to the usual Bakelite material, to lessen the possibility of burning and consequent tracking.

It was found necessary to "earth" separately the recorder mechanism to the main amplifier chassis, and to see that the earthy leads of the heads did not come into contact with any metal parts, otherwise an uncontrollable hum was set up.

Care should be taken to see that the reels, guides and heads are all at the same level, and that the reels run evenly without wobble. The guides

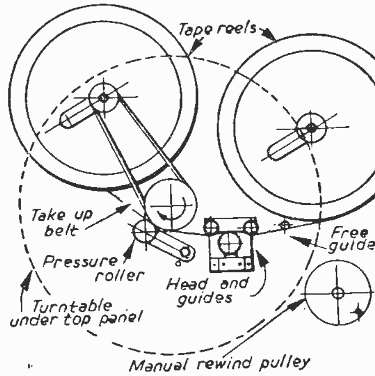


Fig. 5.—Layout of a tape recorder using a gramophone motor.

and capstan surfaces should be polished to prevent wear on the tape, and the rubber pressure roller should occasionally be cleaned with carbon tetrachloride.

Kits

In constructing the recorder mechanism a certain amount of lathe work was necessary, and as there are probably not many readers with this facility I would like to mention a "kit" of recorder parts which is available, and advertised in this periodical, namely the "Qualtape," which is complete in every detail, needing only a few hand tools to assemble. Messrs. Judge Industries, too, can supply component parts for both the electronic and the mechanical sides of the apparatus.

The "Tapedeck"

If you are considering buying a ready-made mechanism there is the Wearite "Tapedeck."

This uses three drive motors, tape take-up being taken care of by one motor which exerts a steady winding torque when recording and replaying. The rewind motor is partially energised during recording and playback, producing a torque in opposition to the direction of tape travel, thus keeping the tape under constant light pressure on the heads. A single four-position control selects either record, windback, wind on, or playback. This control is interlocked with the pressure roller, so that unlacing of the tape before rewind is unnecessary.

Not only are two tape speeds available—7½in. and 3¾in. per sec., but, in addition, two tracks may be recorded, doubling the available recording time. An automatic stop device switches off the mechanism when all the tape has left the feed reel, or in the rare event of tape breakage.

Constructor Sets

For those who wish to make their own equipment, Audigraph, Ltd., of 74, Gt. Hampton Street, Hockley, Birmingham, 18, supply not only a special constructor's envelope but all of the necessary parts. The envelope costs 4s. 3d. post free and contains a theoretical circuit diagram, chassis drilling and layout diagram, component assembly, input circuits, list of components, etc. The amplifier is for use with two heads, one combined record-playback, and one erase (high impedance types). The original model is intended for housing in a steel cabinet, 13¼in. x 9in. x 8in. Three inputs are provided for—radio, gramophone pick-up and microphone.

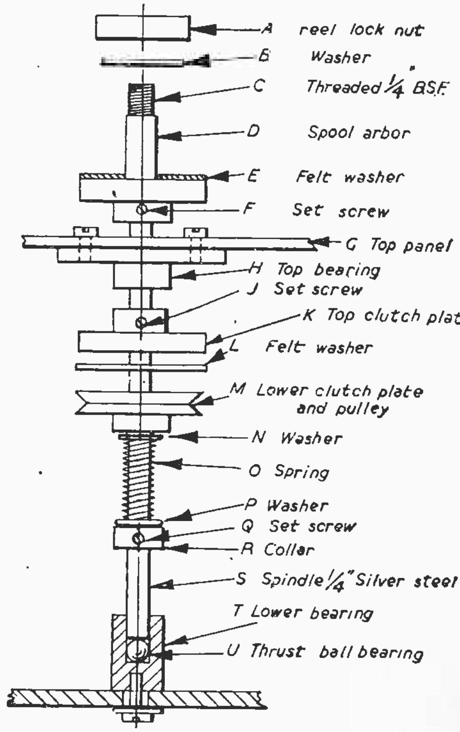


Fig. 7.—Full details of the take-up spindle.

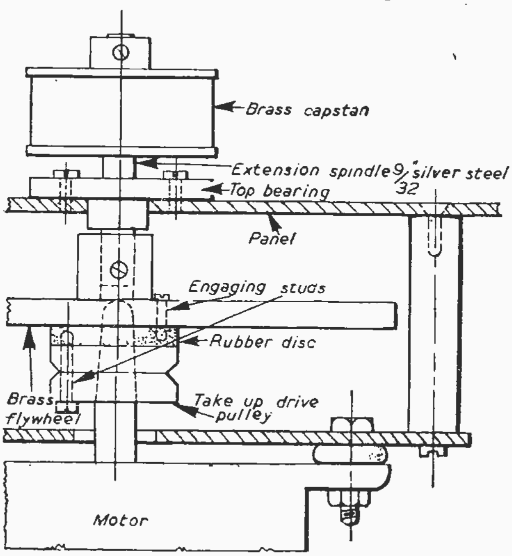


Fig. 6.—Method of fitting extension spindle and flywheel.

A Correction

In the list of components as printed in the Sept.-Oct. issue, V.C.1 was shown as .005 μF. This should, of course, have been .0005 μF and the component actually used by the author was a small bakelite dielectric condenser—of the type usually sold as a "reaction condenser."

Modifying the Type 18 Rx

An Economical Three-waveband Battery Portable Superhet

By D. KEY

THE WS18 receiver (known as the Type 18) is a four-valve battery superhet employing Mazda-octal 2v. valves, and is available from surplus stores at prices near £1. Its normal tuning range is from 6 to 9 Mc/s. The conversion described below provides three-waveband reception and uses the original valves, giving strong signals on headphones. Most readers will, however, require loud-speaker reproduction, and the connections for the extra stage are shown in Fig. 3.

Circuit

Figure 1 shows the circuit of the receiver, and the basic alterations required affect only the first two stages, i.e., up to A B on the diagram.

The modified connections to V1A and V1B are shown in Fig. 2. Fig. 3 shows the circuit and component values for the output stage as already mentioned.

Procedure

Remove the following parts in the order given, retaining those marked with an asterisk (*) for use in the modified receiver:

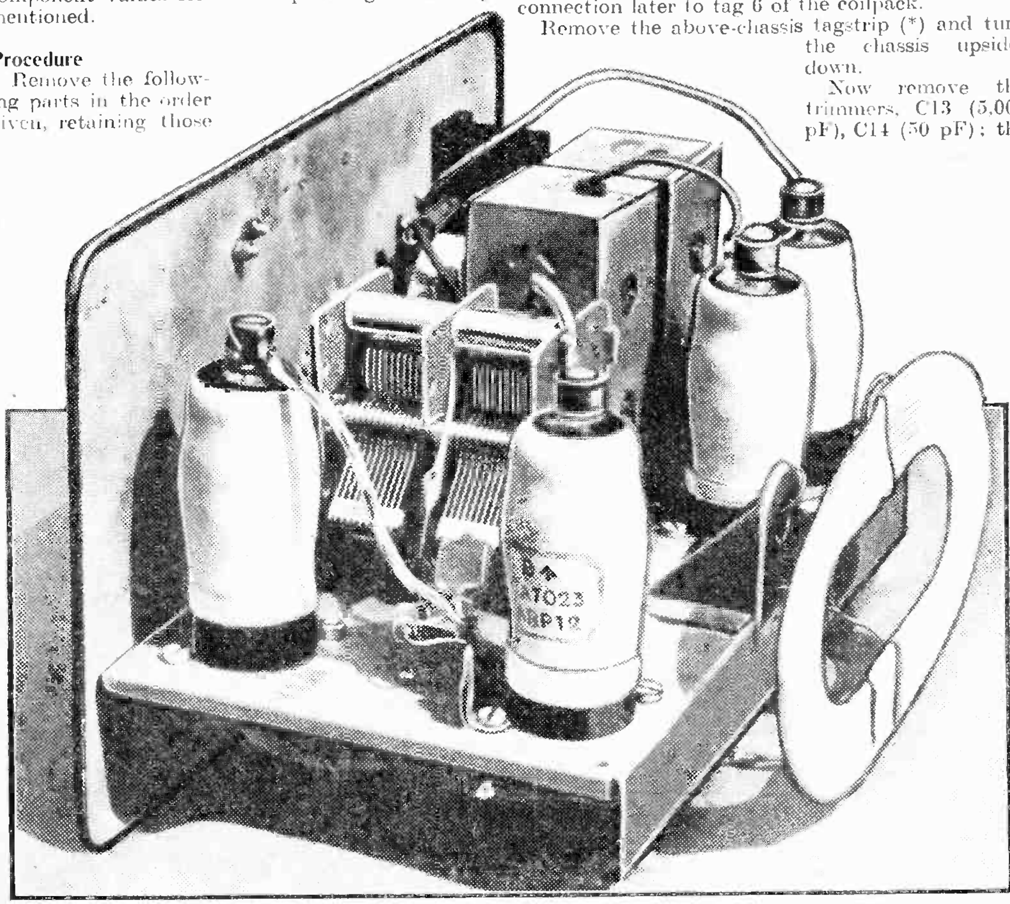
All valves (*), the strut alongside V1A and V1B (*), the tuning dial (*), locking device (*) and slow-motion knob (*), then the above-chassis coil (cutting all leads close to the coil), the adjacent 0.1 μF condenser (C2) (*), the tuning condenser, the screened lead and top-cap connection to V1A, and the clip for the five-way cable, with its screw and nut.

Cut the five-pin plug off the cable and pull it back through the front panel, remove the covering carefully and remove completely the R.F. input lead from the tag strip.

Cut the brown (A.V.C.) lead from the tagstrip and pull it through from under the chassis; cut it so as to leave 1in. still attached to tag 2 of the first I.F. transformer (point B on the diagram) for connection later to tag 6 of the coilpack.

Remove the above-chassis tagstrip (*) and turn the chassis upside-down.

Now remove the trimmers, C13 (5,000 pF), C14 (50 pF); the



A view of the receiver modified, and with frame aerial in position.

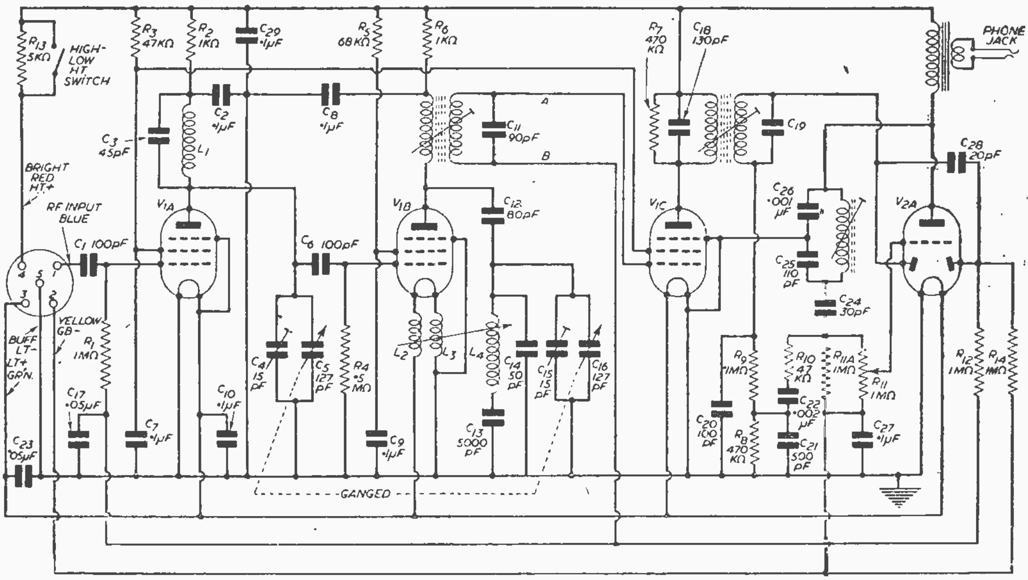


Fig. 1.—Circuit of the WS18 (popularly known as Type 18) receiver before modification.

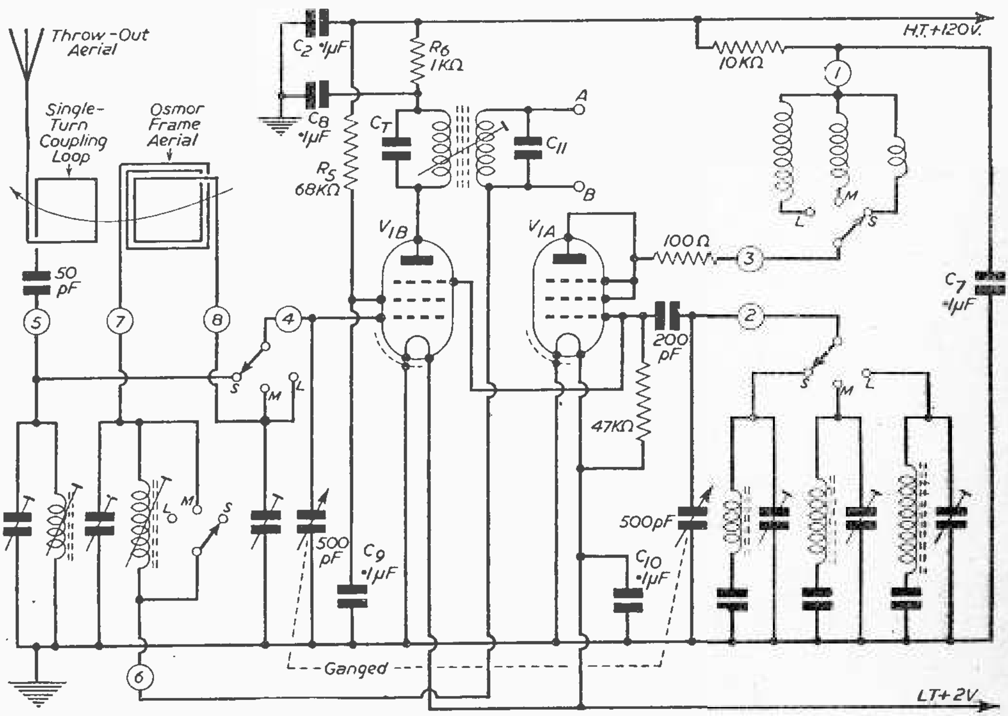


Fig. 2.—Modified circuit of the frequency-changer stage, using the popular Osmor coilpack, Type B.

coil alongside V1B socket; twist off the bosses which held the trimmers; remove the middle screw holding the front panel to the chassis, and remove C7 (*) 0.1 µF.

Remove the clamps holding down the condensers which lie in the zone to be occupied by the coilpack (C8, C9 and C29) and move them, if possible without breaking any connections, to the positions to be shown next month.

Next cut off the surplus length of the eye-bolt holding down the first I.F. transformer and level it off with the nut, also remove the strip bracket in the coilpack zone.

Finally disconnect and remove the 1,000 pF condenser from the anode tag (pin 3) of the double-diode triode (V2A) and also the orange lead from the same tag to the B.F.O. coil. This puts the B.F.O. circuit out of operation and allows more volume to be obtained.

Rewiring

The V1A and V1B valveholders should now be rewired to the circuit shown in Fig. 2, the actual connections to the coilpack tags 2, 3 and 4 being left till the coilpack is fitted. The connections may be seen in the photographs, all fresh wiring being in striped sleeving.

V1A, V1B and V1C are all identical valves, i.e., ARP12 (Mazda VP23) variable-mu R.F. pentodes, with base connections as shown in Fig. 4(a).

Figure 4(b) gives the connections of V2A, which is an AR-8 (Mazda HL 23DD) double-diode triode. Fig. 4(c) shows the connections of the 1S4, DL92, 1P10, etc.

The resistor connected to the strapped electrodes of V1A should be close to tag 5 of the valveholder and is intended to prevent a parasitic mode of oscillation on the short-wave range.

If the short-wave background is very noisy and C.W. signals are heard as musical notes while speech and music are distorted, this indicates parasitic oscillation, and the run of the leads must be examined, if necessary altered, and the value of the stopper may require to be increased above 100 ohms. It should be kept as small as possible, however, in order not to affect the overall performance of the oscillator.

The photograph (page 57) shows the oscillator grid condenser and resistor mounted on the tagstrip above-chassis. The tagstrip is held under one of the screws securing V1B valveholder, and holes must be drilled in the chassis and fitted with grommets to allow leads to be run from the grid resistor to pin 1 of V1A (filament positive), and from the grid of V1A to the suppressor grid (pin 5) of V1B. The lead from the grid condenser to tag 2 of the

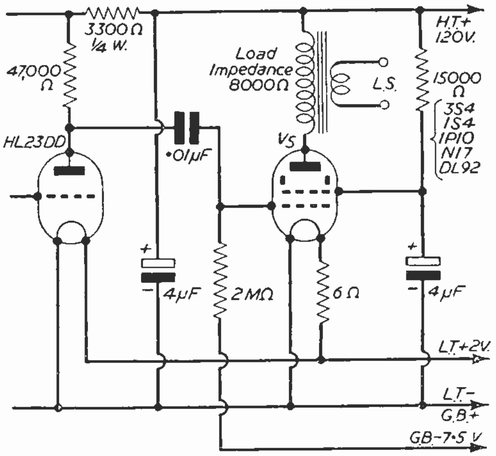


Fig. 3.—Recommended operating conditions for V5, 3S4, 1P10, DL92, etc.

Vf	If	Va	Vs	Vg	Ia	Is	ra	gm	Rk	RL	Wo
1.4	0.1	90	67.5	−7	7.4	1.4	100 KΩ	1.58	—	8000	0.27
Parallel-connected filaments											

LIST OF COMPONENTS
(for the basic conversion)

WS18 receiver with batteries (up to 120 v. H.T., 2 v. L.T., — 1.5 v. grid bias for headphone reception. — 7.5 v. G.B. when the pentode output stage is added).
Osmor type B battery coil-pack with frame aerial.
J. B. standard type E.500 pF 2-gang variable condenser.
Spindle extension adaptor. Resistors : 100 ohms. 10,000 ohms, 47,000 ohms. ¼ watt. Condensers : 50 pF., 80 pF., 200 pF. Silvered mica ± 5 per cent.
One British top-cap grid clip.
Low-impedance headphones.
Extra for Pentode Output Stage :
One valve (Mullard DL92, Mazda 1P10, Marconi N17, Brimar or American 1S4).
B7G valveholder (McMurdo).
Resistors : 6 ohms (2 x 12 ohm, ¼-watt resistors, ± 10 per cent., in parallel), 3,300 ohms, 15,000 ohms, 47,000 ohms, 1 megohm. ¼ watt. Condensers : 0.01 µF midget (e.g., Hunts type W99), 150 V.W. minimum, 2 x 4 µF midget electrolytics (e.g., T.C.C. micropack), 150 V.W. minimum.
Midget output transformer to match the loudspeaker and present 8,000 ohms load to the valve.
Midget loudspeaker (e.g. 2½in. Celestion, Plessey, J. and P., Goodmans).
Midget 1 megohm volume control (e.g. Dubilier).

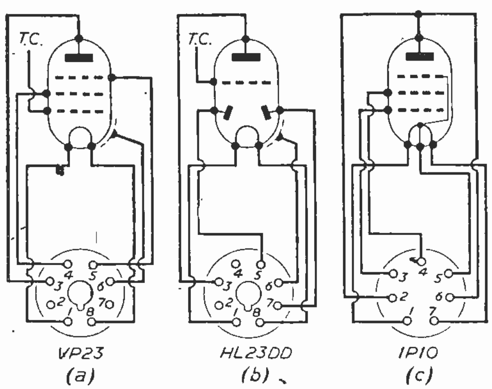


Fig. 4.—Base connections for the three valve types.

coilpack and the tuning condenser is taken through the hole in the chassis by the 2-gang condenser.

The metallising of all valves (pin 6) must be connected to chassis by short, direct connections.

Final connections from the rewired valve sockets must await the fitting of the coilpack.

Choice of Coilpack

The Osmor Type B 3-waveband coilpack was selected for this conversion for the following reasons:

First, it is very compact and can be accommodated below the chassis, which makes it possible to use the existing valves and layout above the chassis.

Second, it is specially designed for use in portable battery superhet receivers with an I.F. of 465 kc/s, and has a very efficient frame aerial and high Q coils giving good signal strength with weak inputs.

Third, all the 3-waveband switching is built into the coilpack and only six connections to the receiver are required (plus two to the frame aerial).

Fourth, the coilpack is pre-aligned, and this greatly reduces the amount of final adjustment required.

Fitting the Coilpack and Tuning Condenser

Carefully drill a hole in the front panel $3\frac{7}{8}$in. from the right-hand edge of the panel and $\frac{3}{4}$in. from its bottom edge.

This hole should be enlarged to $\frac{3}{8}$in. in diameter and should be filed a little at top and bottom to allow slight vertical adjustment of the position of the coilpack.

Cut the 2-gang spindle to a length of $\frac{1}{2}$in. and fit the extension piece to it. The extension piece should have a flat filed on it to match the tuning knob.

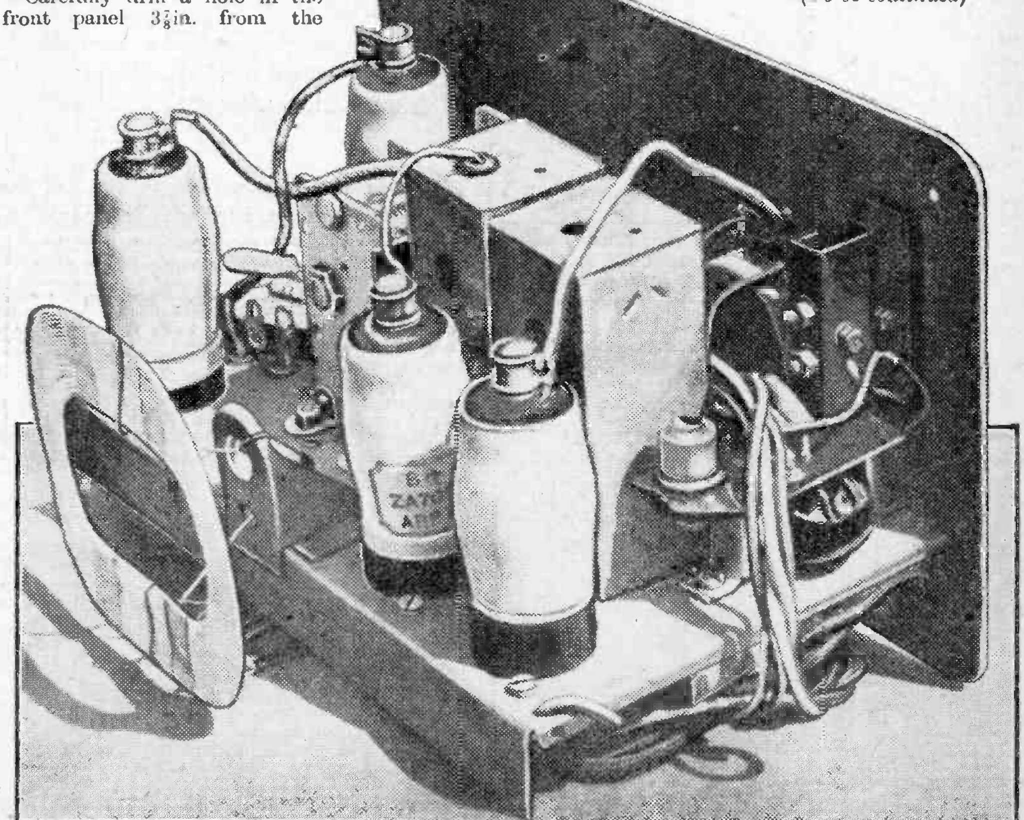
Solder leads to the bottom connections of the tuning condenser and fit it to the chassis, putting the fixing screws through from below to avoid projections under the chassis, with soldering tags under the heads of the rear screws.

Solder an earthing lead to the coilpack tag which is clamped under the screw holding the aluminium front-plate of the coilpack to the Paxolin baseplate. This lead will go to one of the above-mentioned soldering tags when the coilpack is in position.

The coilpack space should now be clear of all projections.

Remove the fixing nut and lockwasher from the coilpack switch spindle, put a $\frac{3}{8}$in.-bore steel washer 1/16in. thick over the spindle as a spacer, and very carefully ease the coilpack into position.

(To be continued)



Another view of the modified receiver.

On your Wavelength

by THERMION

School Research Centre

IN last month's issue I dealt with the Schools' Television Research Centre. I published a full list of its aims, and ended up with the statement that I did not acknowledge that the Centre is necessarily qualified to set itself such a task. I am, of course, aware that some schoolteachers are technically qualified, but a high percentage of them are not, nor do they need to be.

One of my readers, however, thinks that I should be surprised at the technical attainments of some teachers. I should, but not in the manner which my correspondent thinks. Hailing from the county of broad acres, his letter is couched, as one would expect, in bombastic language. He thinks that the schoolteacher is not so much interested in what is inside a television receiver but in what comes out of it, such as its programme value, optical efficiency and dependability.

If this is so I would recommend my reader to read the aims of the Research Centre. It would be impossible to carry out those aims unless the teachers knew the technical features of design, the tracking down of faults, and so on. Without such knowledge it would be a case of the blind leading the blind. But in any case, is the Stratford Green Secondary Boys' School the proper venue for such a centre? Should it not be undertaken by the universities which are staffed by qualified scientists, able to draw proper conclusions from physical data?

I am told that some initial research has been under way during recent months and a start on methodical lines commenced with the autumn term. The sponsors of the Stratford Green Secondary School Centre have circulated the industry, the B.B.C., the National Union of Teachers, the Association of Educational Committees, the B.B.C. Viewer Research Department, and the School Broadcasting Council of the United Kingdom.

The group will largely consist of schoolboys. The technical qualifications of those behind this move are not announced, nor do we know whether the school has the expensively equipped laboratory necessary to carry out the wide aims and objects of the group.

Reciprocating Your Good Wishes . . .

LET me here express my thanks and my gratitude to those many readers at home and overseas who sent me letters and cards of greeting this Christmas. Many of them have been loyal readers from the first issue, and although overseas readers lack the facility to purchase spare parts and to experiment which exists for English readers, they none-the-less continue to evince a lively interest in all that is taking place at home, realising that England is the home of scientific developments, and that what we achieve to-day will be made available to them to-morrow.

It is impossible for me to reply to all of these letters in person, so will those who do not hear from me believe that I greatly appreciate their letters and their good wishes.

1951

WHAT has this year in store? Shall we have the Festival of Britain, or war? How many television stations will be erected by the time the carol singers and the waits are carolling the end of 1951? The B.B.C. has promised to spend more money on television, and so this year must witness the commencement of the decline of sound broadcasts and the star of television in the ascendant. Which is as it should be. The public want television, and having sampled it will not easily go back to sightless broadcasts. Colour television is still a possibility, but of the remote future. It must, however, come. It will not be delayed by lack of scientific endeavour, but through technical and financial difficulties in making the change. Certainly we shall not have colour television in this country for at least five years.

L.P.R.

LONGER-PLAYING gramophone records are being keenly debated in gramophone circles, but those behind the gramophone industry in this country are not yet convinced that the time is ripe for its introduction. One or two firms are supplying records which have been recorded to play back at speeds of 33⅓ r.p.m. and 45 r.p.m. And at least one company is supplying a machine which will play at the three speeds including, of course, 78 r.p.m.

Electrical and Musical Industries, Ltd., who produce records for H.M.V., Columbia, Parlophone, Regal-Zonophone and M.G.M., have announced that they do not propose at the present juncture to make any changes in their equipment. They will continue to study the position to see how it settles down in America: 78 r.p.m., therefore, will be standard in this country for some time to come. If they feel changes to be necessary, they will give six months' notice to the trade.

I have not been too pleased with my own tests of L.P.R. You require an extremely light pick-up or sound head, trailer or fibre needles, and the machine needs to be set with a spirit-level if skating of the pick-up or sound head over the surface of the record is to be avoided. The groove in L.P. records is much shallower than with the standard type. They therefore, in my view, must be less durable. They require a great deal more care in use and storage than the latter.

Perhaps my readers who have experimented with them would like to let me know their views.

Unit Construction

The Modern Trend in Radio and Television Design

By W. J. DELANEY (G2FMY)

IN the early days of radio, as many " old hands " will remember, a favourite form of receiver construction was known as " unit building." In this, each stage of the apparatus was made on a separate box—chassis were not then the fashion. In general there were two input terminals on one side of the panel and two output terminals on the opposite side, and in use the input terminals of one unit were simply joined to the output terminals of the other, and the complete receiver was made up in this way. It is not difficult to see the advantages of this scheme. One could have a simple detector stage with a valve and adjustable reaction in use with headphones, and as one could afford another valve (at well over £1 each) one could add, say, an L.F. stage, then an H.F. stage, and so on.

Apart from this " build as you go " idea, there was one very useful advantage to be gained from the arrangement. Suppose you were using two transformer-coupled L.F. stages, and wished to try out R.C. coupling. All that had to be done was to make up just one stage, take out an existing transformer stage and replace by the new unit. You could compare the results instantly, and if the change was an advantage you left it in position. If not so good, you simply removed it and replaced the old one, and everything was as it was before.

A Disadvantage

If you have a modern type of receiver it is undoubtedly a chassis-built arrangement with only the valves and a few major components on the upper surface, all the essential items being underneath and inaccessible. To try out any new ideas the chassis has to be removed from its cabinet, turned upside down, and quite a bit of work is involved in making even a minor change. It is, of course, in this connection that the home-constructor has the advantage over the commercial manufacturer. The former can build up a circuit to his own ideas and need not necessarily go in for chassis-type work. It is obvious, however, that the advantages of unit construction are appealing to the home constructor and, in fact, certain manufacturers are to-day adopting the idea in a modified form.

There are not so many developments in ordinary radio to-day as there were in the early days. The science has stabilised itself in certain directions, and thus we find that it is possible to build L.F. circuits to obtain the very best response from the existing transmissions, and the limiting factor is the loudspeaker. Thus there exist, either for home-construction or as ready-made units, amplifiers of various output ratings which are complete in themselves, and only need a loudspeaker and pick-up or radio unit added.

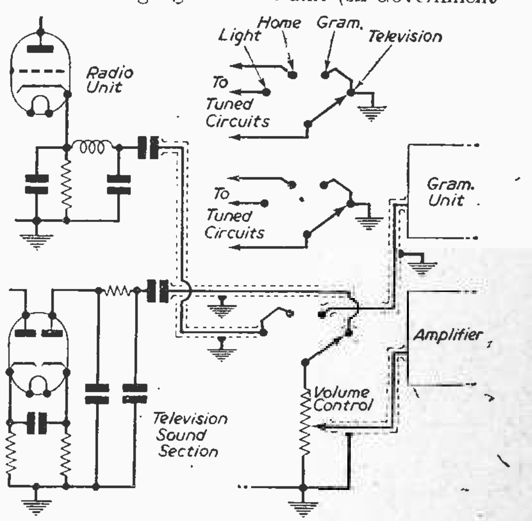
Radio Units

These amplifiers are generally quite compact, and one can be selected to suit the pocket and to deliver the output which is required. To go with it, radio units are also now available or may be made up—again in various types to suit particular conditions. There are superhet units for general reception, short-range high-quality local stations units, and so on. Again, one can select a particular unit for special needs, and some are self-contained with their own power unit, or designed to operate from power supplies in the amplifier unit.

It is only on the gramophone side that most complications exist, and this offers the most interesting field for the home-constructor. A simple pick-up may be switched to the input of the amplifier and will satisfy many. As, however, the recording characteristic of different makes of record vary, and as some records sound better when a certain degree of tone-control is effected, one finds that there is need for a special unit to be included between the pick-up and the amplifier. Generally termed a "pre-amplifier," this may consist merely of top-note and low-note boosts and cuts, or may include one or more valves in conjunction with such controls. The most popular arrangement to-day for such a unit is to make it suitable for use with the surplus power from the amplifier, and to avoid hum, etc., it is mounted on the motor-board. It will thus be seen that there is ample scope to-day for experiment on the lines mentioned in the opening paragraphs, and the amplifier and speaker may be left as standard.

Switching

The main problem with these units is the method of connecting the required part in circuit as required. Thus some form of switching must be introduced, and it is here that most trouble will arise, in view of the risk of hum being picked up. In my own domestic output I use a fixed amplifier with separate power pack, and a small local-station radio unit carries a ganged switch unit (ex-Government



Method adopted by the author for switching, including muting of radio circuits.

on the lines of the Yaxley. The radio unit is pre-set for just the two stations, and separate wafers are used to switch the two sets of coils. A third wafer is arranged to cover two radio positions, gramo. and television. The television receiver has the sound section terminated at the demodulator, and the coupling condenser is mounted on the vision chassis with a screened output lead to two sockets on the radio chassis. The pick-up is fed through a transformer and coupling network to another L.F. coupling condenser, and from here there is a further screened lead to another pair of sockets on the radio unit. The sound volume-control is mounted on the radio unit, and the arm of this is connected through a further screened lead to the input to the amplifier. Thus, in the case of television, for instance, the coupling condenser to input of the amplifier runs to about 3ft. 6in. of screened lead, but by this arrangement of a common volume-control and separate coupling hum is no trouble at all. The combination also leads to a simplification of controls, as there need only be three for the complete radio-gram-television combination—sound volume control on radio, gram and television, with which is combined the on/off switch for the main amplifier and radio unit; brilliancy control for TV with which is combined the on/off switch for the television sections, and a four-position switch giving Light, Home, Gram and Television. It is thus seen that any part of such an assembly can be rebuilt or a new unit made up and substitution made with very little difficulty.

Designing Your Own Receiver—4

Advice and Guidance for the Beginner

By STANLEY BRASIER

IT was stated at the end of last month's article that a careful inspection should be made under the chassis after switching on to ascertain that no harm is taking place. One would think that an ohm-meter test would normally obviate the need for such an inspection. But there is still the possibility of condensers breaking down upon the application of voltage. Especially is this likely where Government surplus condensers are in use, although it is not intended to convey that their use should be abolished. One cannot be too careful, however, for it is not the condenser that matters, but the resultant harm done, usually to the rectifier and sometimes to the transformer. Resistors, too, should be watched for undue temperature rise and if everything is normal in this direction the receiver may be tuned to the best available signal. Trimming of the circuits will now be necessary and it should be stated that this condition will not normally be fulfilled until it is possible to tune "through" the signal on each trimmer. During the process the main tuning control may be "rocked" in order to hold the signal. If one of the trimmers has to be fully open or fully closed for best results, while the other may be tuned through the signal, it is an indication that the circuits are unbalanced to an extent greater than the maximum capacity of the trimmer. This means that extra capacity must be added to one of the circuits. If the tunable trimmer has to be fully *closed* for best results it is this circuit that needs extra capacity and a small condenser of 5-10 pF. should be joined across the trimmer. Then this latter is slightly opened and, in conjunction with adjustment of the main tuning control, a satisfactory overall adjustment should be found.

If the trimmer has to be fully opened it indicates that less capacity is required across this circuit in relation to the other. Since it is not convenient to *reduce* the capacity of the trimmer the difficulty may be overcome by *increasing* the capacity of the other. The first trimmer will then be less *in relation to* the second and again a satisfactory adjustment should be found by compensating with the main tuning control.

With the trimming operations completed it will be possible to judge whether the performance of the receiver is good, bad or indifferent. But usually some adjustment in addition to the above can be made to improve the results.

Checking

For a start check the voltage between point X in Fig. 1 (August issue) and the chassis. This should approximate roughly to the calculated value. If it is rather higher than was anticipated take voltage reading at the anode pin of the 6V6. If it is much above 250 volts the voltage at point X may be reduced by inserting a resistor in series with the smoothing choke as described earlier. The voltage on the screening grid of the 6V6 should be similar to that of the anode. At a later stage, i.e., when the receiver is working efficiently, it will be worth while momentarily shorting out the dropping resistor to this electrode to find out whether results are improved thereby. If so, and the resultant voltage is not too high, this resistor may be dispensed with.

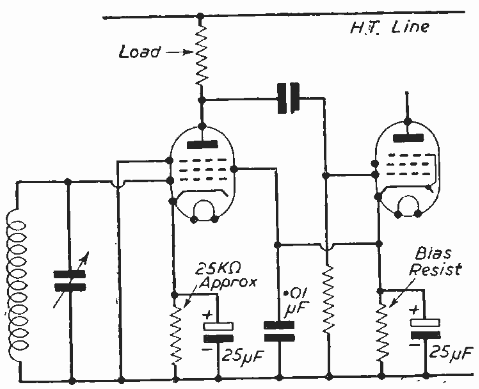


Fig. 3.—Circuit for anode-bend system of detection. Note that the screen voltage may be taken as shown.

Incidentally, during these tests it is assumed that the volume control will be at the position of maximum volume which may, or may not, at this stage, correspond with maximum rotation of the control, and will possibly need adjustment later.

The voltage across the bias resistor of the 6V6 should be near to the stipulated value of 12.5 volts—positive v/meter to cathode pin, negative to chassis—and after checking this, attention may be turned to the detector valve 6J7. This valve is a very critical link in the chain of efficiency and the object should be to obtain as much sensitivity as possible from this stage. A start may be made by reducing the anode resistor to its lowest value consistent with maximum amplification. By this means it ensures the greatest possible high-tension voltage at the anode. It will be noted that the provisional resistance of the anode resistor is given as one megohm and we may now proceed to reduce this in an effort to strike a compromise between effective signal development and greatest H.T. voltage. This is where our mental calculation of resistors in parallel will be useful, because if another resistor of one megohm is joined across the existing one, the result will be 0.5 megohm. Now, by the time the receiver has been switched off, the resistor soldered in place and the set switched on again, it will be extremely difficult to estimate whether an improvement has taken place or not. The change must be rapid so that no time lag exists, and may easily be provided for by soldering one end of the second resistor securely so that the remaining end is very nearly contacting its appropriate point. Therefore, upon switching on the receiver, the resistor may be contacted by means of some insulated rod or pencil, and any improvement instantly detected. In this particular instance it may be noticed that the volume rises momentarily and then falls again. This may indicate that some value between the two is required and a .75 megohm resistor may be soldered in place of the others. (It is assumed that the amateur will have a ready assortment of resistors.) Another useful method of immediate substitution is to solder into place two resistors of suitable value in series and then short out one or the other alternately. A few minutes spent like this will soon determine the correct practical value which, as previously stated, may be rather different from that of the theoretical calculation.

S.G. Voltage

The screening grid voltage of the detector valve is also quite critical as a rule and experiments on the foregoing lines will usually be well repaid. Especially is this true of the anode-bend type of detector (Fig. 3), which may easily be tried, as the alterations are simple. Optimum screen grid volts are usually in the region of 20 or below and it is useful to remember that a suitable supply may sometimes be taken from the positive end of the output valve bias resistor instead of from the H.T. line. The small by-pass condenser should remain in addition to the large one already across the resistor.

Often the mere checking of an electrode voltage will give an indication of correct or incorrect operating conditions. For when a voltmeter is joined to the electrode pin and chassis, it provides, temporarily, a fixed potentiometer feed which may —if the current flowing is low—alter the voltage. This could result in either a rise or fall in volume. If the latter, the voltage may usually be assumed to be correct but if the results are improved thereby, it indicates that a lower voltage is necessary. If a multi-range voltmeter is being used it is interesting to note the effect of switching to different ranges, for it must be remembered that, in effect, the multi-range voltmeter, so connected, forms a variable value lower arm of the fixed potentiometer. The above remarks prove the necessity of using a voltmeter which draws only a small current from the circuit to which it is connected and this subject will be enlarged upon in the section dealing with testing instruments.

The H.F. valve 6K7, may now receive treatment but it will be found that this stage is not so susceptible to critical voltage. Nevertheless, the anode should receive the full 250 volts, if possible, and up to the necessary figure on the screening grid.

It has been stated that the object of inserting resistors in the feed to the various valve electrodes is for the purpose of dropping the applied high-tension voltage.

Decoupling

In certain cases, however, resistors, in conjunction with their associated by-pass condensers, serve to decouple the various valve stages. This process of decoupling is sometimes necessary in order to cure instability within the receiver. If it is omitted from the H.F. stage such treatment may be required in the case of the detector, and a resistor of about 50,000 ohms should be interposed between the high tension line and the anode resistor. Under these circumstances the by-pass condenser now becomes the decoupling condenser and its value should be at least 1.0 μF.

Certain forms of instability may require the addition of an H.F. choke, which should be connected between the anode of the detector valve and the anode resistor.

Volume Control

It is likely that the volume control arrangements may need adjustment. If maximum volume is reached before maximum rotation of the control, the value of the standing bias resistor should be increased. This value may be assessed by turning the control to the position of maximum *volume* and then measuring the resistance between the cathode pin and the slider of the volume control. If initial maximum volume coincides with maximum rotation, the effect of shorting out the standing bias resistor may be tried, or a lower value fitted, to see if any improvement results thereby, for the value of the standing bias resistor is sometimes quite critical. Another problem that may arise is that volume may not be reduced sufficiently when the control is rotated fully anti-clockwise. In such instances the effect of a higher value of volume control may be tried, but in obstinate cases another arrangement may prove successful. Here a fixed potentiometer feeds H.T. to the screening grid of the H.F. valve and the resistance element of the volume control forms part of the lower arm. Thus, a voltage is developed across it which may be picked off by the slider to provide the necessary variable bias.

(To be continued)

Negative Feed-back—3

Cathode-follower Input Impedance is Dealt with Here

By ERIC LOWDON

THE cathode follower is no exception in this respect, and here Vo is also equal to A × Vg. In this case, however, the grid-cathode voltage Vg is not the input volts to the circuit ; Vi is the input voltage and is actually applied in series with Vo and in opposition to it between grid and cathode. This much is obvious from an inspection of the circuit and therefore Vg must be the difference between Vi and Vo. That is to say, Vg = Vi − Vo, or Vi = Vo + Vg, or Vo = Vi − Vg. These voltage relationships are marked numerically on the diagram where it has been assumed that A = 9.0 and thus an input signal of Vi = 1.0 gives Vg = 0.1 and Vo = 0.9 volt.

It is seen then that the overall gain of a cathode follower Vo/Vi—we will call this A_1 to distinguish it from A, the gain of a circuit with respect to Vg, that is Vo/Vg—is always less than unity. In our example A_1 = Vo/Vi = 0.9/1.0 = 0.9 and therefore Vo = A_1 × Vi = 0.9 × 1.0 = 0.9.

Now we can tackle the question of input resistance.

Input Resistance

One way of measuring a resistance as we all know, is to apply a known voltage to it and measure the resultant current : the resistance R is then given by E/I. A circuit for doing this is shown in Fig. 8a where we have a generator GI applying one volt to a resistor and the current in the circuit is 0.5×10^{-6} amp. ; the resistance is therefore $R = E/I = I/0.5 \times 10^{-6} = 2M\Omega$. Now generators are well up in ohms law and GI knows as well as you do that since it is supplying 1.0 volt at 0.5×10^{-6} amp the resistance connected to its terminals must be 2MΩ. In fact, this knowledge of the current and voltage is the only means that a generator has of assessing the resistance in circuit with it ; it doesn't care two hoots about colour coding.

But what will it think about the circuit of Fig. 8b. Unknown to GI we have broken the circuit and inserted another generator G2 in series with it. This second generator, which has an output of 0.9 volts in opposition to GI, has negligible resistance so that the ohmic value of the circuit is unchanged and is still 2MΩ.

GI, however, has its own ideas about this. It knows that it is supplying 1.0 volt to the circuit but it knows also that the current has now decreased to 0.05×10^{-6} amp. and, therefore, argues that the resistance connected to its terminals is $E/I = 1.0/0.05 \times 10^{-6} = 20M\Omega$. We, of course, know that the decrease in current is due to the fact that the two generators are in opposition and therefore only 0.1 volt is now applied across R giving $I = 0.1/2 \times 10^6 = 0.05 \times 10^{-6}$ amp. This argument cuts no ice with GI. The current and voltage conditions are such that so far as it is concerned the resistance is 20MΩ and nothing will make it believe otherwise.

How does all this tie up with the cathode follower circuit of Fig. 7a ? Well, let us see. Here we have an input signal Vi of 1.0 volt, which will come perhaps from the output of a preceeding stage of amplification and can be represented as the output of a generator GI. The 2MΩ grid leak is connected to one terminal of this generator, and in series with this resistance and the other terminal we have the output voltage Vo (which is also the negative feed-back voltage) ; Vo can therefore be represented as a generator G2 working in opposition to GI. This Equivalent circuit is shown in Fig. 8c and as can be seen it is identical in every way to that in Fig. 8b.

So now we see why the input resistance of a cathode follower appears—to the input generator—to be much greater than the actual ohmic value of the resistance across the generator.

We can, with the aid of this equivalent circuit, evolve a useful little formula. The effective voltage across R1 is the difference between the outputs of the two generators, that is to say, Vi − Vo. But earlier in the article we saw that $Vo = A_1 \times Vi$ where A_1 is the overall gain of the circuit, and therefore the effective voltage is $Vi - (A_1 \times Vi)$ and the apparent resistance equals the input volts Vi divided by the current $Vi - (A_1 \times Vi)/R1$ thus :

$$\text{Apparent resistance} = \frac{Vi \times R1}{Vi - (A_1 \times Vi)} = \frac{R1}{1 - A_1} = \left(\frac{1}{1 - A_1}\right) R1$$

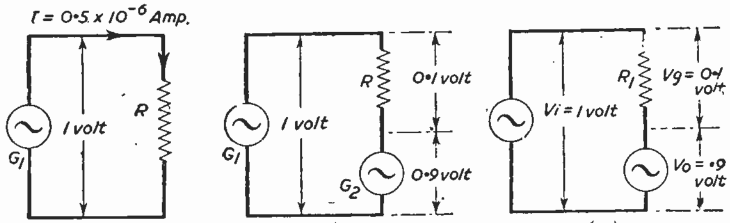
If we take the figures used in our original example where $A_1 = 0.9$ and R1 = 2MΩ we have :

$$\text{Input resistance} = \left(\frac{1}{1 - 0.9}\right) 2 = 20 \text{ megohms.}$$

Input Capacitance

So much, then, for input resistance, now let us see what we can do with input capacitance.

As most modern valves have very low inter-electrode capacities—perhaps two or three pF between grid and cathode—it is possible that some readers are wondering what all the fuss is about.



(a) (b) (c)

Fig. 8—The circuit of Fig. 7 arranged in another way so that its full working characteristics may be understood.

If the amplifier is preceded by a tuned circuit (they may say) then it is only necessary to deduct a little capacity from the circuit to make up for the added grid-cathode capacity. Or if the amplifier has a non-resonant grid circuit, as in A.F. amplifiers, then two or three pF in shunt with it—even 10 pF if we generously allow something for stray wiring capacity—will not be particularly serious except at the very highest frequencies, and (they continue) since the grid-cathode capacity of a valve is not a variable condenser it is bound to be the same whatever type of circuit is used, so why all the fuss about the advantage of the cathode follower in this respect.

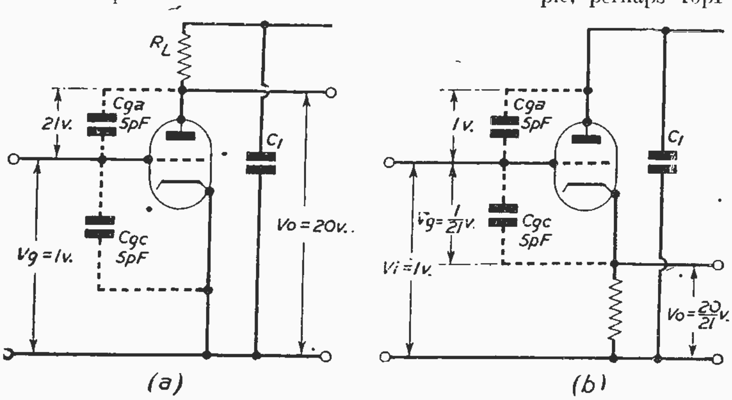


Fig. 9—A non-feed-back amplifier stage showing the stray capacities and their effect.

The fact of the matter is, however, that although the inter-electrode capacities of a valve are listed in valve data books as having definite values, the moment we use the valve in a *working* circuit strange things begin to happen. The two or three pF given for the grid-cathode capacity by the valve manufacturer may become more than 100pF, the actual value depending on the type and gain of the circuit in which the valve is used.

This surprising transformation is due to a phenomenon called the "Miller Effect," a name which will be familiar to most readers. Some readers, however, may not be quite sure of how it works so let us examine it.

In Fig. 9a we have the circuit of a simple non-feed-back amplifier in which the grid-cathode capacity, Cgc from now on, and the grid-anode capacity which we will call Cga, are represented in broken lines; the circuit is assumed to have a gain of 20 and a signal of 1 volt is fed into the grid, and Cgc and Cga are 5pF each which is quite a normal figure for triodes.

Since Cgc is effectively in shunt with the input the application of the signal voltage will cause a capacitive current to flow through this condenser. The value of this current is given by Vi/X where Vi is the input volts and X the reactance of the condenser.

At the same time a capacitive current will flow through Cga via R_L and back to earth through CI and the current through Cga will, of course, be equal to the voltage across it divided by its reactance. In this case, however, the voltage across the condenser is considerably greater than that across Cgc for the 1 volt input appears as 20 volts between anode and earth, that is to say, 20Vi, and therefore the voltage between grid and anode must be Vi+20Vi, that is, 21 volts. The current through Cga is thus 21/X—21 times greater than that through Cgc. This current must come from the input generator and the net effect, so far as the generator is concerned, is as though a condenser 21 times greater in capacity than Cgc has been connected in parallel with Cgc. The effective input capacity then is $5+(21\times5)=110$pF.

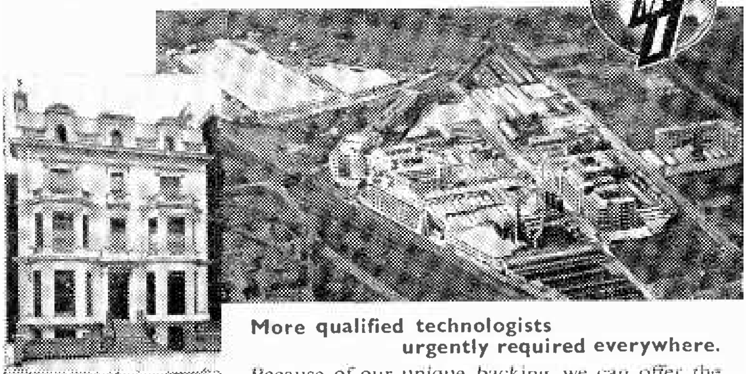
In practical circuits Cga and Cgc might easily be much greater than the figure taken in our example, perhaps 10pF or more each, for the wiring capacity has also to be considered. In addition, the gain of the circuit may be much higher than 20 and since the input capacitance is approximately equal to Cga multiplied by the gain, it will be obvious that in practice an apparent capacitance of hundreds of pF might appear in shunt with the input.

Now take a look at the cathode-follower circuit in Fig. 9b; as we are dealing with capacitive currents only, the grid leak shown in Fig. 7a has been omitted. Here, as in the circuit of Fig. 9a, the gain with respect to the grid-cathode volts is 20; that is to say Vo/Vg=20. Thus, if Vi is 1 volt, then Vg is 1/21 volt and Vo is 20/21 volt. and, as with all cathode followers, the overall gain A_1=Vo/Vi is less than unity, in this case, 0.95 approximately.

As before, there are two capacitive current paths, one through Cgc and the other through Cga, and here also the voltage across Cga is equal to the output volts plus the grid-cathode volts, which in this case is $1/21+20/21=1.0$ volt and is the same as Vi. Thus the current through Cga is Vi/X and as the voltage across Cgc is only 1/21 of Vi, the current through Cgc is only 1/21 of that through Cga. The apparent capacity of Cgc is therefore 1/21 of Cga.

Cga is therefore unchanged and remains 5pF but Cgc is 1/21 of 5pF and the total apparent input capacitance is $5+1/21\times5=5.238$pF as compared with the 110pF obtained with the conventional amplifier.

The cathode follower, then, has a high input resistance and a low input capacitance which, when taken together, add up to a high input impedance, very much higher than can be obtained with conventional amplifiers. This in conjunction with its very low output impedance, which was dealt with in a previous article, is the principal advantage of the circuit.



Electronic Double-beam Switch

A Useful Circuit for Use with a Standard Oscilloscope

By G. F. CRAVEN

ANYONE who is a regular user of a conventional single-beam oscilloscope will have at some time realised what a boon an extra beam would be. Double-beam tubes are expensive and as there is a vast quantity of surplus C.R.T.'s on the market with various sizes of screen, it was decided to design a beam-switching circuit which would provide optimum performance with any tube.

The simple circuit of Fig. 1. will make clear the operation of an electronic switch. Two triodes, V1 and V2 have a common anode load resistor R_L. Both valves are biased to cut-off, therefore there will be zero output at the common anode terminal with a signal on the grids. Further, to simplify the circuit, a mechanically-operated switch is included in each grid circuit. Each switch when closed, will cause its particular grid to become less negative by virtue of the positive potential then applied. The valves will now be brought into their grid-base, allowing them to conduct and produce an output at their anodes. If a continuous signal is applied to each grid and the switches are alternately opened and closed, an output as illustrated in Fig. 2(1) will be produced. Assuming that the switches are opened and closed at a high speed, there will be no visible flicker between the two traces on the C.R.T.

Unfortunately, this system is of little practical use, as the mechanical switching is difficult to operate at the high speed which is required for useful results. It is, however, used in certain Radar equipments.

To produce a true electronic-switch, some form of "gate" circuit is necessary. Fig. 3 shows the basis of such a circuit. The pentode, V1, is normally cut-off due to a negative bias on the suppressor, it, therefore, follows that with a grid signal applied there will be no output at the anode. If a square pulse of sufficient amplitude, positive in polarity, is applied to the suppressor, the valve will conduct and give an output for the duration of the pulse.

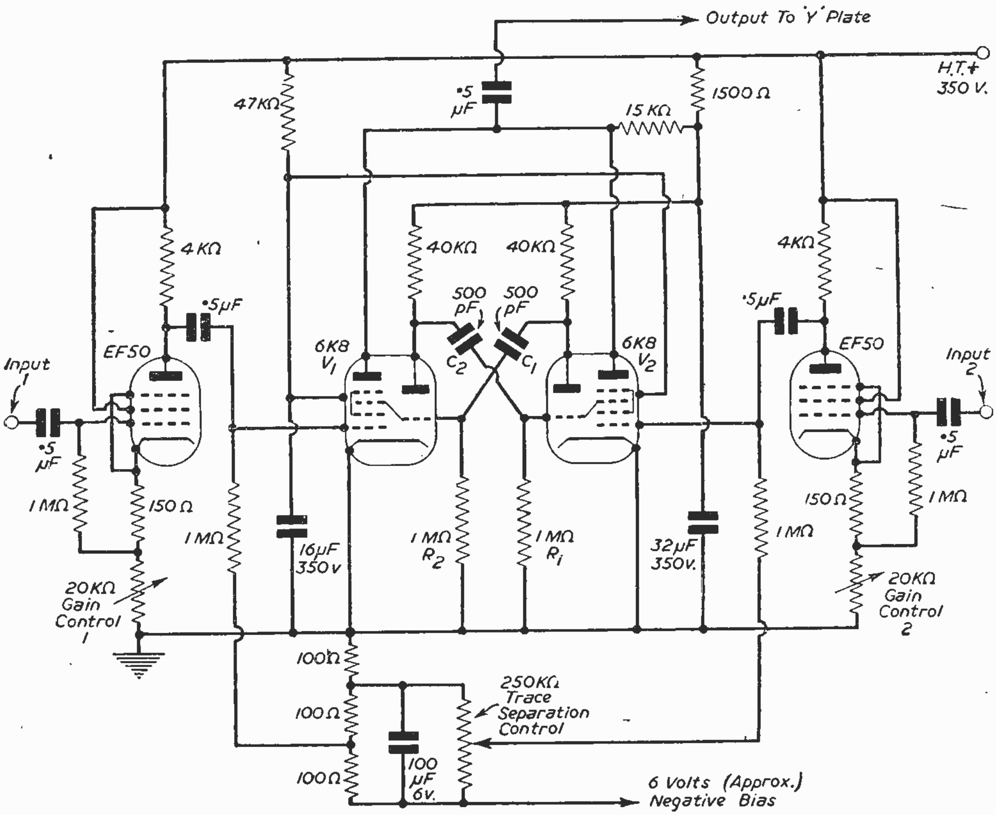


Fig. 4.—Complete circuit of the Electronic Double-beam Switch.

An obvious method of producing a beam-switch now presents itself in the form of two gate-valves each controlled by a multivibrator circuit. Unfortunately, several difficulties are present, but working on the previous idea, an ideal circuit can be built.

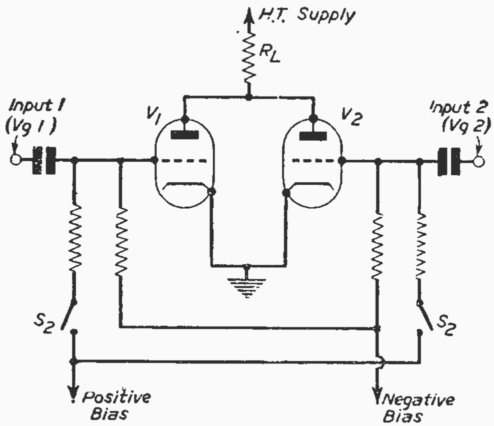


Fig. 1.—*Basic Electronic Switch Circuit.*

The Circuit

Multi-electrode valves are the basis of the successful final circuit. By using triode-hexodes (6K8's), an extremely compact layout is possible. In Fig. 4, V1 and V2 are triode-hexodes with their triode sections coupled as a multivibrator. As the triode grids are also part of the hexode structure, a direct coupling is effected which obviates the use of coupling capacitors. A second feature in favour of triode-hexodes is that the grid used for switching is effectively screened from the other electrodes. Normally, the hexode sections are cut-off, i.e., when the multivibrators are inoperative. The hexode anodes are brought to a common terminal with a 15 kΩ resistor as load. With a signal applied to the grid of each hexode, no output is obtained at the anode terminal. Immediately the multivibrator comes into operation, each "switching" grid will become alternately positive with respect to the other, allowing each hexode to conduct alternately for a period depending upon the operating frequency of the multivibrator.

If no provision is made to separate the traces, the pattern will appear on the C.R.T. as in Fig.2(1a). As most double-beam applications require trace separation, a method of achieving this is included in the circuit. A potential divider (consisting of two 100-ohm resistors), is taken to a negative source of approximately six volts, D.C. The signal grid of one valve is taken via a 1 MΩ resistor to the centre-point of the resistance chain, which provides

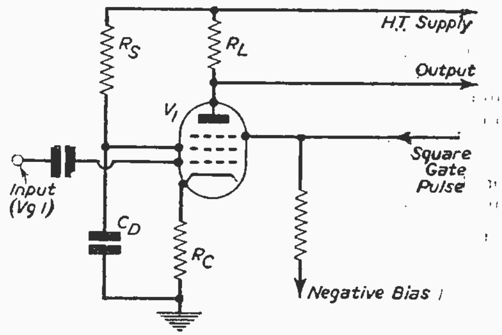


Fig. 3.—*Basic "Gate" Circuit.*

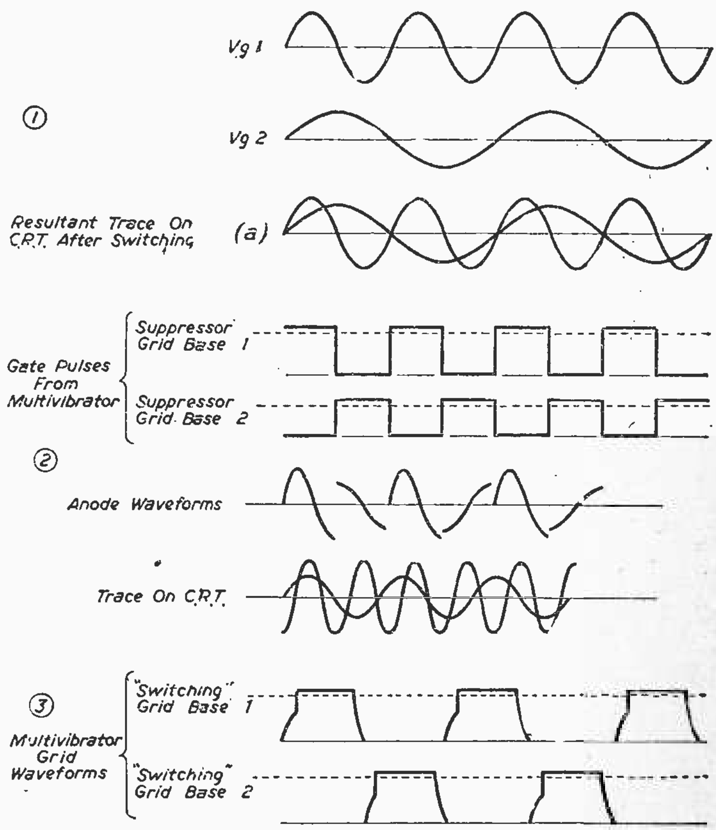


Fig. 2.—*Waveforms associated with electronic switch circuits.* (*Not to scale.*) (1) *Simple circuit.* (2) *Gate circuit.* (3) *Triode-Hexode* (*anode wave-forms as in* (2)).

the fixed negative bias. The signal grid of the second valve is taken via a 1 MΩ resistor to the slider of a 250 kΩ potentiometer coupled across the resistance chain. The mean potentials between the two grids may be varied by adjusting the potentiometer, which in turn will cause the output potentials to differ, thus separating the traces. It is essential that the negative potential used for trace separation is well smoothed and free from ripple. The 100 μF condenser across the resistance chain ensures this and this value should not be reduced if correct operation is to be obtained.

The beam-switch requires an input of 100 m/V or more for efficient operation. An overall gain is produced by the circuit, but as this may not produce a trace of sufficiently great amplitude, further amplification may be necessary. Amplifiers are included in the circuit diagram for completeness. It is necessary to amplify the signals before application to the beam-switch, as an amplifier between the switch and C.R.T. would almost certainly produce distorted traces due to the complexity of the output waveforms.

The amplifiers shown are of simple construction and provide ample gain with a frequency response sufficient for most purposes. Although EF50's are specified, others such as SP61, 6AC7, etc., are equally as good in this equipment.

It is not intended to give a list of the almost unlimited applications of a double-beam oscilloscope as they will present themselves to the user in the course of his work.

Relevant Formula

Operating frequency of a free-running multivibrator circuit:

$$FO\ (kc/s) = \frac{1,000}{R_1 C_1 + R_2 C_2}$$

$$\therefore \quad FO = \frac{1,000}{.0005 \times 10^6 + .0005 \times 10^6}.$$

$$\therefore \quad FO = 1\ kc/s.$$

News from the Clubs

RAVENSBOURNE AMATEUR RADIO CLUB

Hon. Sec.: Mr. J. Wilshaw, 4, Station Road, Bromley, Kent.

THIS newly-formed club meets every Wednesday and Thursday evening at 7 p.m. in Childeric Road school (room F, top floor), New Cross, S.E.14. They have a receiver, constructional, theory and transmitting sections running and are building a CO/PA transmitter and receiver whilst awaiting a licensed call-sign which has been applied for. G2DHV is the chairman and G3ADL is the instructor. Welcome visitors last month were G3DSC and G3KIZ.

ILFORD AND DISTRICT RADIO SOCIETY

Hon. Sec.: C. E. Largen, 44, Trelawney Road, Barkingside, Ilford, Essex.

THE present session of winter lectures, demonstrations, discussions and other meetings, including those devoted to the transmitter, cover such fixtures as:

Mr. A. J. Tyrrell, Mullard, "Industrial Magnets."

Mr. K. Brewer, Osram Lamp Works, "Problems of Valve Life Testing."

The Undersigned, "Developments in Time Keeping and Frequency Measurements at U.H.F."

Mr. J. Clarricoats, R.S.G.B., and many other eminent speakers.

The activities of the society cover all aspects of radio and electronics, with special attention to reception and reproduction as well as transmitting and recording.

This session, additional lectures and fixtures, are being arranged to cater for newcomers and younger members.

The society meets at 8 p.m. on Thursdays at St. Alban's church hall, Albert Road, Ilford, and draws members from a wide radius. Visitors are always heartily welcome, and the membership subscription is unchanged from its pre-war figure!

READING RADIO SOCIETY

Hon. Sec.: L. A. Hensford (G2BHS), 30, Boston Avenue, Reading, Berks.

THE programme at the November meetings of the Reading Radio Society was as follows:

On Thursday 9th, owing to the absence of the expected lecturer, there was a general discussion of members' problems. On Saturday 25th, Captain Benbough gave a talk on "Intercommunication Systems." Simple induction and wired telephone systems were described and demonstrated, while some details of the more complex methods required when amplification in both directions is necessary were given.

The annual Hamfest was held at People's Pantry on Sunday 26th. Despite the fog, there was an attendance of over 100. The technical talk and demonstration were given by Mr. Dolton, a member of the G.P.O. staff, on the subject of Radio Interference. A film show was also provided, for the ladies and children, while the talk was in progress. After tea there was a ventriloquist and conjuring act by Mr. Bennett, following which Mrs. Kemp presented the Nash, Lewis and Hill cups and the Bingham Shield to the winners of these constructional contests which are judged at the Hamfest. The remainder of the evening was then turned over to a general "ragchew," and "fun and games."

EDINBURGH AMATEUR RADIO CLUB

Hon. Sec.: David A. E. Samson, I.E.S. (GM3EQY), 56, Elm Row, Edinburgh, 6.

THE season is progressing with lectures and demonstrations, and at fortnightly intervals the club station GM3HAM is still on the air on alternate Wednesdays on 80 metres C.W. A successful junk sale has been held, and coming events include a Brains Trust, a U.H.F. Lecture and a visit to the local police radio station.

GRAFTON RADIO SOCIETY (G3AFT)

Hon. Sec.: W. H. C. Jennings (G2AHB), Grafton School, Eburne Road, Holloway, London, N.7. (One minute from the "Nag's Head.")

MEETINGS every Monday, Wednesday and Friday, 8 p.m. At the recent fifth annual general meeting the following officials were duly elected:

President, B. Randell, B.Sc. (GW3ALE); vice-presidents, C. T. Bird, A.M.I.(Mech).E., A. E. Mitchell (G8DF), J. A. Reading (G3RX), P. Beresford (BRS8076); chairman, A. W. H. Wennell; vice-chairman, J. H. Clarke (G2AAN); hon. secretary, W. H. C. Jennings (G2AHB); hon. assistant secretary, J. Moran (G3CLV); hon. treasurer, R. T. White (BRS7751); hon. storekeeper, P. Vasey; committee members, P. Beresford and H. Hudson (G3FVL); hon. auditors, D. Outram (BRS17397), J. J. Hollington (G4GA).

Morse classes (beginners to advanced) are held three evenings a week, and members reaching a speed of 10 words a minute may receive instruction and coaching on the air, using the club's transmitter (G3AFT). Practical construction group operates in a large workroom, and expert advice is always to hand. A canteen provides light refreshments at every meeting. New members may be assured of a sincere welcome.

THE BRIGHTON AND DISTRICT RADIO CLUB

Hon. Sec.: L. Hobden, 17, Hartington Road, Brighton.

MEMBERSHIP of this club is around the 80 mark and on the increase. New members will be most welcome. Meetings are held every Tuesday evening at the "Eagle Inn," Gloucester Road, Brighton.

Talks and informal evenings are held on alternate club nights. The club station, G3EVE, is operated on the informal evenings and always looking for QSO's on 80 metres, C.W. and 'phone.

CHESTER AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: R. Windsor, 17, Hough Green, Chester.

THE club TX has been "earthbound" due to a shuffling round of parts and several new items have been added, including a VFO to widen the scope of the x'tal controlled TX.

A welcome was extended to G2AMV—Mr. O'Brien, of Wirrall fame—who gave us a most interesting talk on VFO's, and showed us examples of his equipment of unsurpassed construction.

We were also very pleased to welcome two Americans to the club's activities—one of them W5FTK.

The club meets 7.30 (6.30 for morse classes) in the Tarran Hut in the Y.M.C.A. grounds.

Resonance In
Gen

An All-wave 2-valve Unit, Built from Surplu

By T. H. R

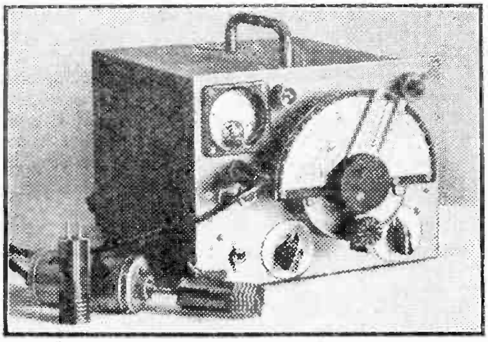


Fig. 1.—The complete unit, with probe and coils.

THIS instrument consists of a two-valve signal generator designed on standard lines, and delivering R.F., modulated R.F., or A.F. Incorporated in the output circuit is a crystal rectifier and milliammeter measuring rectified R.F. in a probe coil. When this probe coil is held near the coil in any external R.F. circuit, and the signal generator frequency swung slowly over the appropriate band, a pronounced kick downwards will occur on the meter at the point of resonance, due to the loading of the external circuit.

It is therefore possible with the aid of this instrument to align complete receivers, adjust I.F. transformers, and modify coils to different frequency bands without even switching on the external apparatus.

The instrument shown was built entirely from spare parts readily available on the surplus market. The total cost should not exceed £4 10s.

Circuit

The circuit is fairly straightforward; two SP41 valves being employed. V1 is the R.F. oscillator, while V2 supplies the A.F.

The SP41 (or SP61 if the mains transformer has a 6.3 volt winding) is a versatile little valve, and readily submits to modulation by its suppressor grid. The output from V2 is therefore fed via a condenser to the suppressor grid of V1. Switch S2 silences the A.F. section.

The R.F. section may be tuned over a wide frequency range by means of several coils and a wave-change switch. For example, with coils PHF4, 5, 6, 7 and 1 tuned by a .0005 μF variable condenser it will be possible to cover a band from about 30 mc/s to 140 kc/s. The R.F. signal produced is rich in harmonics, and by using these the frequency range can be increased. The television frequencies are easily available by this method.

Some difficulty was experienced in getting a full-scale deflection on the meter, and it was eventually achieved by using a fairly large condenser—.1 μF.—between the anode of V1 and

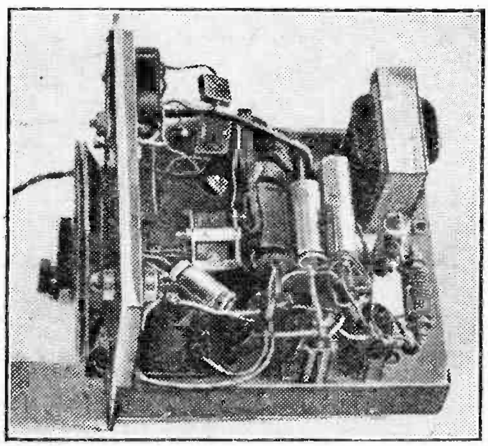


Fig. 3.—Internal view, showing layout.

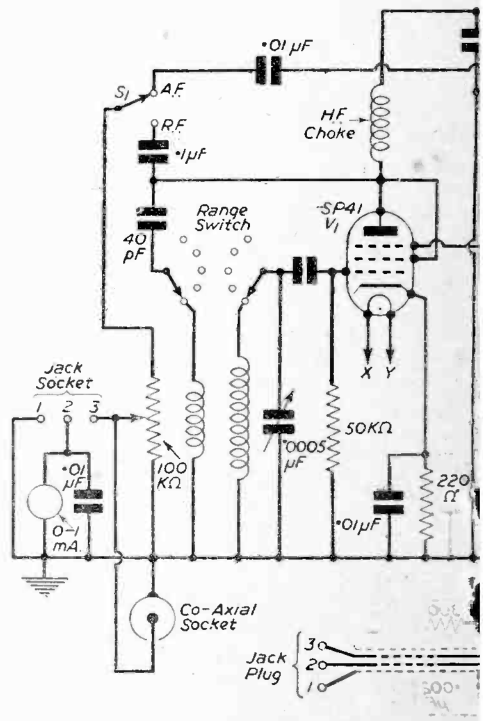


Fig. 5.—Theoretical circuit. The gri

licating Signal rator

Parts, with a R.F. Resonance Meter with Probe

BINSON, B.Sc.

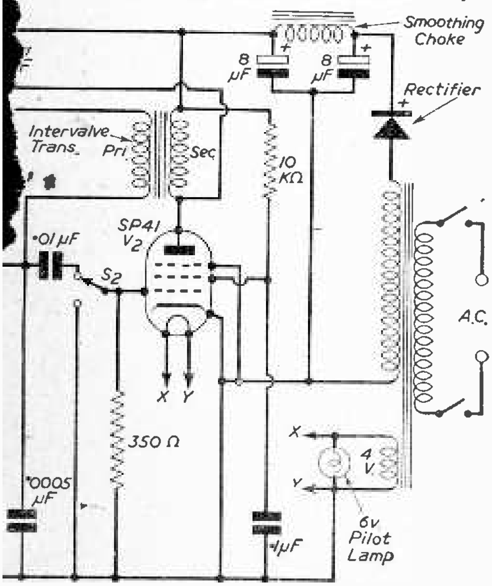
the attenuator potentiometer. Provided the meter reading is satisfactory, this condenser should be kept as small as possible, as if it is unduly large there is a tendency for the frequency of the signal to vary slightly with the setting of the attenuator.

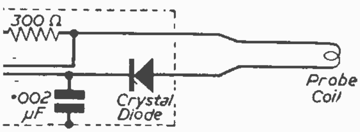
For normal signal generator use, the output is taken to a co-axial socket; switch S1 selecting either A.F. or R.F., the latter either modulated or not according to the position of S2.

When it is desired to use the resonance indicator, the output is taken to the probe unit by means of a three-connection jack plug, the instrument being set for unmodulated R.F.

The A.F. note can be varied by altering the size of the grid leak to V2. 350 ohms is shown, but if this is unsatisfactory, a better value should be found by experiment.

Almost any mains transformer may be used,





condenser has a value of .0002 μF.

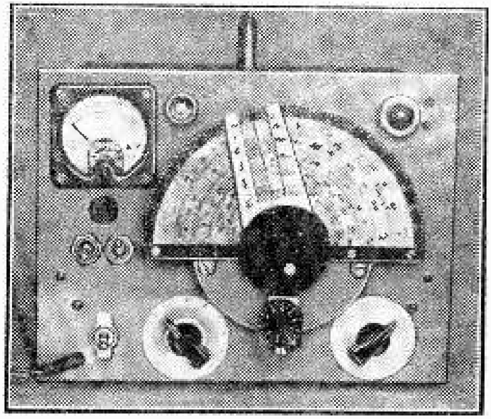


Fig. 2.—The panel layout.

provided it gives an output voltage between 250 volts and 400 volts. Half-wave rectification is shown; but full-wave may be used if desired.

The crystal diode for R.F. rectification is contained in the probe handle, together with a damping circuit.

Construction

It is not proposed to give full constructional details, as the components used will vary in size and type. The whole instrument, however, should be totally enclosed in a metal box. It is advisable to use screened wire from the anode of V1 as far as the output plugs.

In the instrument shown, the coils are mounted in a bank underneath the chassis, thus lessening the risk of interaction with other components. The valves are placed horizontally above the chassis.

The lead to the probe should be of twin screened cable, the probe handle being a small metal screening can. The actual probe coils are wound

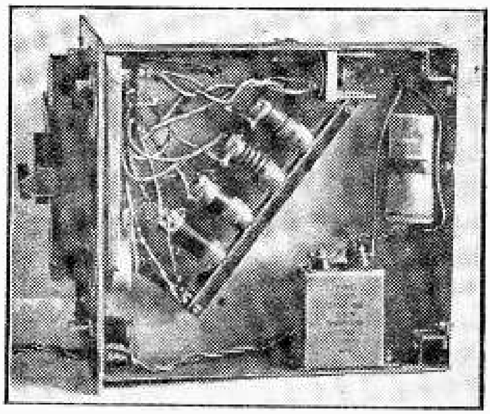


Fig. 4.—Arrangement of the coils beneath chassis.

on two-pin formers, those shown being to the following dimensions :—

Range

30 to 5 Mc/s.	12 turns.
5 Mc/s. to 130 kc/s.	120 turns.

Both these coils are wound on 1in. diam. formers, and 38 S.W.G. insulated wire is used. Neither the diameter nor number of turns is critical, however, and experiment with different types of probe coil, say, for example, a small pile-wound coil, might show improved results.

As a final constructional note, the necessity for a well-made high-ratio slow-motion drive is stressed. It will be found that the meter kicks are very sharp, and can easily be missed if the dial is swung too rapidly.

Upon completion, the instrument should be calibrated against a signal generator or wireless receiver by one of the usual methods described in this magazine from time to time.

Operation

When used as a normal signal generator, the output is taken from the co-axial plug, the probe jack being removed. When using the resonance

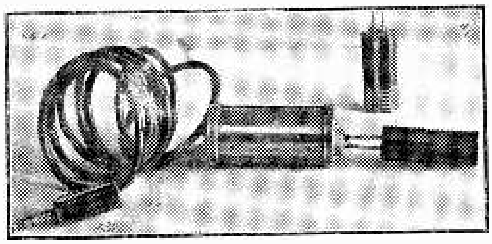


Fig. 6.—The probe with coil in position.

indicator, the jack is inserted and the probe coil placed close to the coil in the external circuit. Upon slowly moving the generator dial over the required range, the characteristic " dip " will show on the meter at the point of resonance.

It will be found that as the dial is swung across each range, the meter reading will vary due to inherent points of resonance in the apparatus; but the dip induced by the external circuit can readily be identified by lifting the probe coil from the specimen, when the meter will kick upwards. If the external circuit has variable tuning it is often quicker to vary this after first tuning the signal generator to a point in the region of the expected frequency. Once the point of resonance is found it can be followed back to any frequency required by moving both dials alternately.

In this manner complete receivers can be aligned: first by adjusting the I.F. transformers, then the aerial and R.F. circuits, and finally the oscillator.

Where commercial sets with very closely screened coils are encountered, the removal of the screens to permit access of the probe coil may be found to alter the tuning slightly; but after basic alignment with the resonance indicator, final adjustment may be made using the signal generator in the normal manner. The author recently modified a long-wave Command receiver to receive the medium waveband. The small screening cans were removed, and the coils still in the set were unwound a length at a time to predetermined frequencies; the gradual approach to the required frequencies being checked by resonance after each shortening. After completion of the operation the cans were replaced and the set was found to be in almost perfect alignment.

The selectivity response of I.F. transformers or band-pass coils can be observed directly on the meter by swinging the generator to each side of the point of maximum dip.

Small inductances and capacitances likely to be met with in R.F. circuits can be measured with the aid of a calibrated .0005 μF. condenser. For capacitances this condenser is connected in parallel with the unknown one together with a suitable inductance coil. The point of resonance is found on the signal generator and the value of the calibrated condenser noted. The unknown condenser is then disconnected and the frequency of the circuit retuned to the original resonance point by the variable condenser, whose value is again noted. The difference between the two readings is the value of the unknown condenser.

To measure a small inductance coil it is connected in parallel with the calibrated condenser. The condenser reading and the resonant frequency are noted and the inductance calculated from the formula :—

$$\lambda = 1.885\sqrt{LC}$$

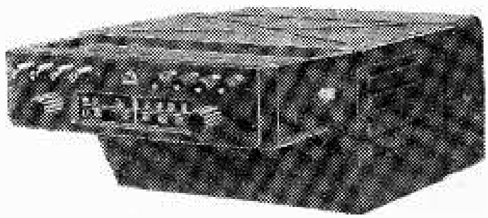
where λ = wavelength in metres.
L = microhenries.
C = picofarads.

Many other uses will be discovered for the indicator: for example, suspected short-circuiting of turns in pile-wound coils can speedily be confirmed. The relative " Q " of different components can be directly compared by measuring the meter dips produced. Aerial resonance can be measured, and so on.

If the frequency of any circuit is required with very great accuracy—in transmitter work, for example, once the resonant point has been established, the signal from the probe coil may be picked up by a nearby receiver tuned to the same frequency. If a crystal-controlled signal generator is available, and its output also injected into the receiver and tuned to the null point, the frequency can then be read from this more accurate instrument.

Car Radio

On page 6 of our January issue we illustrated a car radio receiver and wrongly described it as a new Radiomobile model. The illustration was, in fact, that of the new Ekco Model CR117, full details of which will be given in our next issue. The new Radiomobile receiver is illustrated below.



H.M.V. Automobile Radio, Model 100, marketed by Radio Mobile, Ltd.

Compact Car Radio—2

A Vibrator Power Pack Receiver, for 12-volt Operation

By P. D. BETTERIDGE

Coils

THE inductances L5, 6 and 7 are made by pile winding 24 turns 22G enamelled wire on a $\frac{1}{4}$in. mandrel, removing from the mandrel, taping up with $\frac{1}{4}$in. wide white tape and shellacing. They should be fixed to the chassis by passing a bolt through the middle with a fibre or paxalin washer each end and a short length of sleeving on the bolt.

When completed the set should be "lined up" in the usual manner.

No suitable dial was available so it was decided to manufacture to suit. Fig. 5 shows the details of the pulleys and studs. If a lathe is not available, the builder will have to improvise, and certain mechanical toy parts will be found to suit the circumstances. Fig. 5 also shows the run of the thread and the attachment of the wire cursor. The dial plate is a piece of white celluloid or plastic sheet, $\frac{1}{16}$in. thick, fixed behind the cursor wire on the bolts A and B on Fig. 5. It is calibrated by actually tuning in the important stations and marking them in with indian ink. The celluloid or plastic will have to be roughened all over with very fine glasspaper before it will "take" the ink. When the scale is finished a coat of cellulose lacquer or model aeroplane clear dope will preserve the markings.

The Power Pack

The case for this unit must be made of steel, and tinned steel is very suitable since it is easy to solder the joints and seams. The photograph shows the construction, which should present little difficulty. As mentioned in the receiver text the five pin socket is mounted to suit the plug on the receiver. The practical diagram, Fig. 8, shows the position of the components.

The transformer T4 is made as follows: Stampings with a core of one square inch and a tunnel space of $\frac{5}{8}$in. x 2in. are required. A suitable divided bobbin can be purchased or made from $\frac{1}{16}$in. celluloid or Perspex. Whilst acetone is the solvent to stick celluloid—chloroform is the solvent for sticking Perspex. Bobbins are very easily and strongly constructed from either of these materials.

The H.T. secondary is put on first. It consists of 2,000 turns of 40 s.w.g. enamelled, in each division. It is wound in the same direction in each section, paper interleaved every 400 turns. The end of the first section is joined to the beginning of the other section to form the centre tap.

The primary consists of 70 turns of 20 s.w.g. enamelled in each section, again wound in the same direction. The centre tap being formed as for the H.T. secondary.

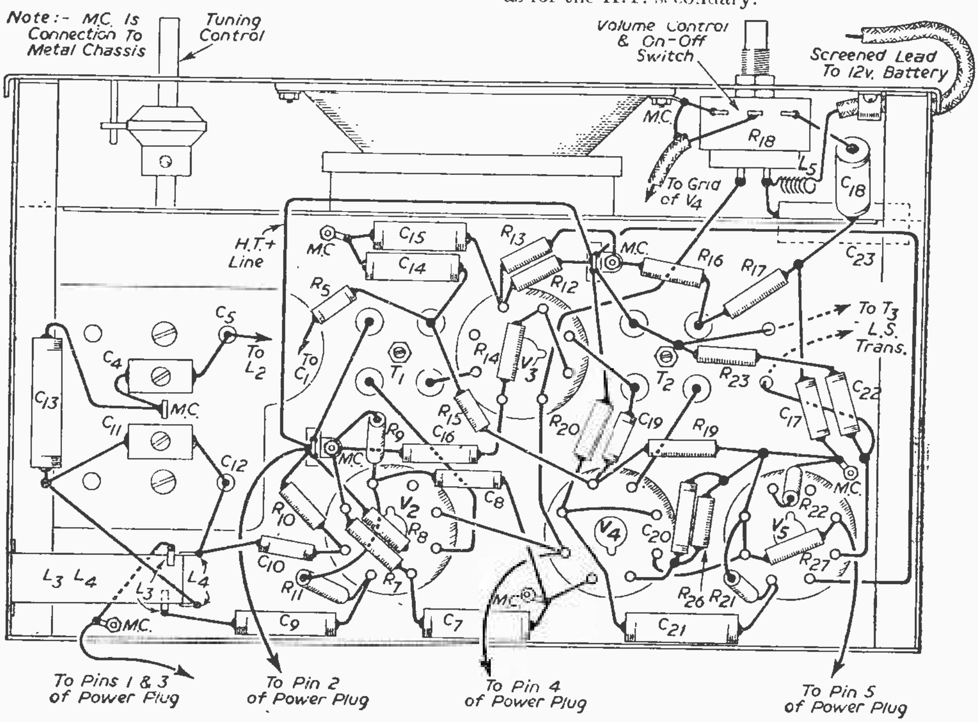


Fig. 8.—Wiring details of the main receiver portion.

Be sure to insulate thoroughly the primary from the secondary windings by using several layers of Empire tape between them.

It will be noticed from the theoretical diagram Fig. 6, that both centre taps are earthed, so that a common tag on the transformer tag board can be used.

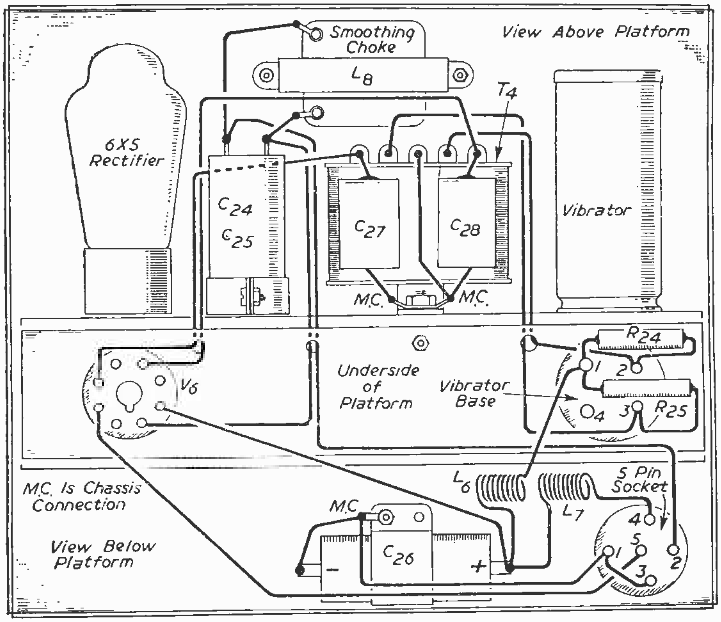


Fig. 9.—Wiring details of the power pack.

L8 is an 8-10 henry 30 mA. choke, any make is suitable, size being the criterion. L6 and 7 are described in the receiver construction

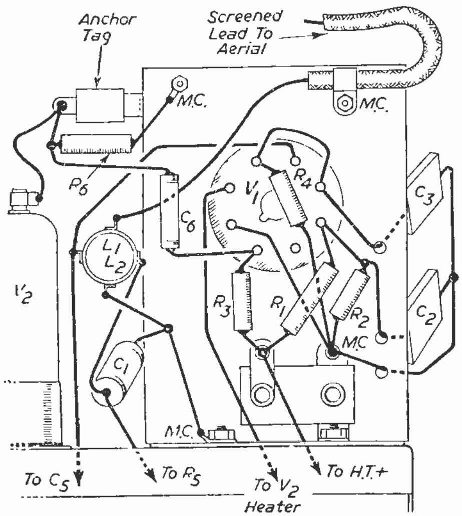


Fig. 10.—Wiring of underside of V1 platform.

Six Volt Circuit

To use the receiver on a six volt battery, the following changes are required.

V1. Change the 12SG7 to 6SG7.
V2. Change the 12K8 to 6K8.
V3. Change the 12SG7 to 6SG7.
V4. Change the 12C8 to 6B8. (or any 6.3 volt double diode triode, and alter the base connections to suit.)

The 6V6 and the 6X5 are connected in parallel instead of in series and the 40 ohm resistor R27 across the 6V6 heater is omitted.

The primary of T4 is changed to 35 turns in each section, and 18 s.w.g. enamelled wire is used.

If the positive of the car battery is earthed the polarity of condensers C23 and C26 must be reversed.

I.F. Transformers

In the list of parts given on page 27 of last month's issue, the Wearite type M400 or 401 I.F. transformers were specified. We are informed by the makers that these types have now been discontinued, although they may be available at some dealers. In their place they recommend that the new type M.800 be used, and these are of similar characteristics and size.

Three-speed Record Changers

RADIOGRAMOPHONE DEVELOPMENT CO., LTD., announce that all their radiogramophones and record players are now fitted with 3-speed record changers. Models are provided with two plug-in pick-up heads, one for use when playing normal 78 r.p.m. records and the other for long-playing 45 and 33⅓ r.p.m. records. Both pick-ups are of the ultra lightweight high-fidelity type with sapphire stylus—specially designed for low record wear.

Auto-changer

For the home market, radiogramophone models 1046 G3 and 850 G3 and record player model RPA5 are equipped for the automatic playing of eight 10in. or 12in. records (not mixed) at 33⅓ or 78 r.p.m.; 7in. 45 or 33⅓ r.p.m. records can be played singly. For export, radiogramophone models 1046 G3 and 1048 G3 and record player model RPA6 incorporate a similar record changer which has the additional feature of facilitating automatic playing of 10 7in. 33⅓ or 45 r.p.m. records.

Radio Gramophone Development Co., Ltd., Bridgnorth, Shropshire.

Audio-frequency Signal Generator–2

A 5-valve Unit for the Experimenter

By D. ALLENDEN,

Suitable Valves

THE first valve of the amplifier is an SP61. Other valves have not been tried in this position but valves having very similar characteristics (EF50, EF54, VR116, 6AC7) should be satisfactory with no change in circuit values. A top-grid connection is desirable, as it makes for shorter wiring. The second valve is a 6F6, but 6V6, 6L6 and 6Y6 have been tried in this position and found satisfactory.

It is essential to use an isolating amplifier stage between the oscillator and the load to prevent variations in the load impedance reacting back on the oscillator. A 6J5 triode is employed as an amplifier, its input being fed from the unby-passed cathode resistor of V2 via a gain control. High- and low-impedance outputs are taken from the anode and cathode of this valve.

A squaring circuit is incorporated which can be switched in at will to enable the transient response of amplifiers to be tested. The squarer consists essentially of two cascaded triodes, which are heavily overdriven by the sine-wave input. The result is that a clipping action takes place and a square-wave output results. The input to the twin triode squarer is fed from V2 anode. Although phase shift, as such, is unimportant, the long time constants are necessary to maintain the square-wave shape at low frequencies.* The output from the squarer is of considerably greater amplitude than the output from V_2 cathode, a resistive attenuator being used to reduce the squared output before it is applied to the output stage. R_{26} in conjunction with the gain control forms a potential divider which operates only when the square-wave output is switched in. The trimmer C_{13} is to preserve the rapid rise and fall of the square wave. A changeover switch, S_2, selects either the square- or sine-wave output as desired. The square wave produced by this means is not quite symmetrical, but there is some advantage in this as it enables the two half-waves to be identified on an oscilloscope. If it is desired to produce a perfectly regular square wave, separate bias resistors may be fitted in place of the single common one shown. These values can then be adjusted until the desired wave is produced. At the higher frequencies the square wave deteriorates somewhat. If space is available, however, an improved squarer can be constructed using two sharp cut-off pentodes operating at low screen voltages. By reducing the screen voltage a short grid base is achieved, so that a larger degree of overdriving becomes possible, and the square shape is preserved at higher frequencies.

Power Supply

A conventional power supply is incorporated. Adequate smoothing is essential owing to the fact that the impedance of the oscillator circuit is low at its critical frequency, and the oscillator has to work within the power-frequency range. Generous capacitor sizes are therefore employed. Electrostatic hum pick-up is minimised by screening the power supply from the rest of the circuit, both above and below the chassis.

The general layout is shown in the photograph given last month. Any other layout may be adopted provided the points already referred to are borne in mind. The size of the completed instrument, which is built into a surplus AN/APA-1 amplifier case, is 12in. × 7½in. × 7in. The main frequency control is a rim-drive unit, but any suitable slow-motion drive may be used.

Adjustments

To adjust the completed oscillator, an oscilloscope is very desirable. Connect the scope input across the cathode of V_2 and set the main controls to the low-frequency (max. cap) end of the intermediate frequency range. Adjust R_2 until a sine-wave oscillation is produced. If R_2 is advanced too far the waveform will deteriorate. Now tune towards the high-frequency end of the band. If oscillation ceases at any point, adjust the trimmers until it recommences. When correct trimmer adjustment is achieved, the amplitude of oscillation should be obtained over the whole band. Now switch to the other ranges and check that the oscillation is satisfactory. If it is not the values of resistors are not sufficiently closely matched and must be adjusted. When correct adjustment is obtained, the amplitude of oscillation over the whole three bands should be substantially uniform.

To adjust the trimmer C_{13} connect the 'scope to the output, switch to square wave, and adjust the trimmer for the best waveshape.

Calibration

Calibration is best carried out by the method of Lissajous figures, using an oscilloscope. The 50 c/s mains is a suitable standard, but an auxiliary oscillator whose frequency can be checked against the mains is useful for calibrating the higher frequencies. No attempt was made to make a single calibration serve for all three ranges, but if sufficient care is taken to ensure that the resistance on each range is an exact multiple of that on the range above, then a single calibration carried out on the low range will serve for all ranges, the figures being multiplied by 10 and 100 respectively on the higher ranges. Holes should be drilled in the case to allow the trimmers to be adjusted with the case in position, since the proximity of the back of the case to the tuning capacitor frame has an appreciable effect on the distribution of stray capacitance.

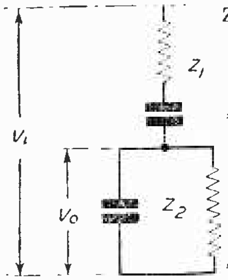
APPENDIX

Analysis of the Feedback System.

The output will be in phase with the input when

* Those familiar with Fourier analysis will realize that this is basically the same process as keeping the phase shift as small as possible.

the power factors of the upper and lower branches are equal. Under these conditions:



$Z_1 = n.Z_2$ where n. is a scalar

$$\therefore \left(R - j/wC\right) = n.\left(\frac{R}{jwC}\right)\left(\frac{1}{R - j/wC}\right)$$

$$\therefore \left(R - j/wC\right)^2 = n\left(\frac{R}{jwC}\right)$$

The R.H.S. of this expression is imaginary, so the real part of the L.H.S. must be zero.

$$\therefore \left(R^2 - \frac{1}{w^2C^2}\right) = 0, \text{ whence } w = \frac{1}{CR} = w_0$$

Equating imaginary parts gives (when $w = w_0$)

$$\frac{-2R}{w_0C} = \frac{-nR}{w_0C} \text{ whence } n = 2 \text{ and } Z_1 = 2Z_2$$

Therefore at w_0 the upper branch has twice the impedance of the lower. Thus the output voltage at A B is $\frac{1}{3}$ of the input and is in phase with it.

The general expression for the output voltage is:

$$V_o = V_i\left(\frac{Z_2}{Z_1 + Z_2}\right) = V_i\left(\frac{1}{1 + Z_1/Z_2}\right)$$

$$\text{But } \left(Z_1/Z_2\right) = \frac{(R - j/wC)(R - j/wC)(jwC)}{R}$$

Appendix. (See bracketed lines "A").

$$= (1 - jw_0/w)(1 + jw/w_0) = 2 + j(w/w_0 - w_0/w)$$

$$\therefore V_0 = V_i/(3 + j(w/w_0 - w_0/w)).$$

This reaches a maximum value of $\frac{1}{3}$ when $w = w_0$

The magnitude of the in phase component of the output voltage is:

$$V_{o_a} = \frac{3V_i}{9 + \left(\frac{w}{w_0} + \frac{w_0}{w}\right)^2} = \frac{V_i}{3 + \frac{1}{3}\left(\frac{w}{w_0} + \frac{w_0}{w}\right)^2}$$

From this expression the feedback curve of Fig. 2 has been plotted.

Transportable All-mains 4

Concluding Details of the Receiver Described Last Month

Adjustments

THE position of one clip on R11 will have to be adjusted according to the mains voltage. If a meter is available for A.C. measurements, adjust the clip until the heater voltage of the 25A6 valve is shown as 25. If a meter is not available, begin with almost all the resistor element in circuit and see how long elapses after switching on before the receiver begins to operate at full normal volume. This should be about 45 seconds. If it is more, switch off, leave to cool, then reduce the resistance value by moving the clip down a trifle.

The clip may be moved after loosening the clamping screw, *but before doing this the mains plug must be withdrawn.* Actually, the setting is not very critical and no adjustment is necessary afterwards unless the receiver is used on a different mains voltage. If frequent use on different voltages is likely, the other clips may be set accordingly and one lead merely changed over.

With A.C. mains there is no polarity to observe, though in some areas it may be found there is less likelihood of mains-borne interference when connections are made in one particular way. With D.C. mains no results will be obtained if the polarity of supply is incorrect, so the leads to the plug should be reversed.

The gang-condenser will have small trimmers built in, and these should be adjusted for maximum volume with the receiver tuned accurately to a weak station. This is particularly necessary for long-distance reception. Adjust C5 for best results.

The purpose of the controls is self-explanatory. When searching for weak stations the reaction control should be advanced so that the set is nearly oscillating. For local reception this control may be left at zero setting and the volume control used to reduce output. The degree of tone control provided is suitable for average needs, but those desiring particularly "mellow reproduction" may increase the value of the condenser from .03 to .05 μF.

If an earth is used this should be joined to the metal chassis with a condenser in series, as shown in Fig. 1. The condenser should not be omitted from either aerial or earth circuit, or mains voltages will be present in aerial and earth wires. Finally, the second tuning coil should not be mounted on top of the chassis or stray coupling with the coil already located there will cause uncontrollable oscillation. *Do not touch any metal part of the receiver when the set is connected to the mains.*

COMPONENT LIST

2-gang .0005 μF. tuning condenser (C1 and C2).
Three .1 μF. paper condensers (C3, C4 and C8).
Two .0002 μF. mica condensers (one for aerial and C6).
.0001 μF. pre-set condenser (C5). 01. μF. mica condenser (C9). 50 μF. 50 v. bias condenser (C10). 8+8 μF. smoothing condenser, 350 v. (C11 and C12). .03 μF. paper tone-control condenser. .0003 μF. reaction condenser (C7).
Resistors: 75,000 ohm (R1). 2 megohm (R3). .5 megohm (R4). 10,000 ohm (R5). 200,000 ohm (R6). .25 megohm (R8). 440 ohm (R9). 100 ohm (R10). 800 ohm .3 amp. dropper (R11). Variable resistors or potentiometers: 100,000 ohm (R2) 50,000 ohm. high frequency choke for H.F. valve coupling.
Small smoothing choke. 4 octal valveholders.
Speaker with transformer (see text).
Valves: Two 6K7, 25A6 and 25Z4G, or equivalents.
Chassis, control knobs, 3-point wavechange switch, mains-type toggle switch, wire and sleeving, etc.

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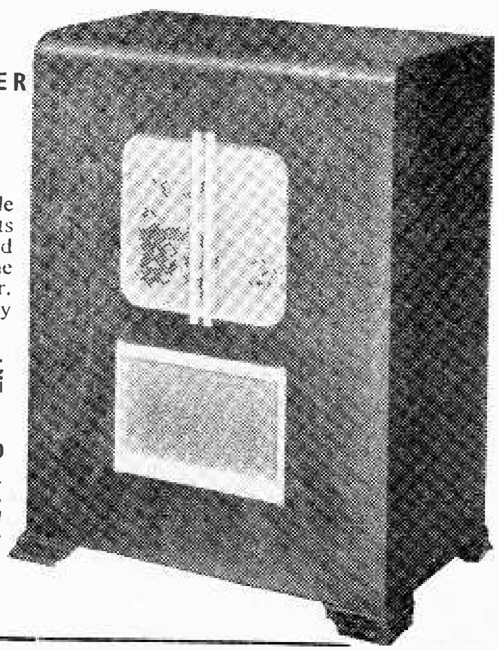

The 12" Concentric Duplex in this handsome console cabinet has aroused great admiration. Even the experts applaud its remarkable performance. Vented and felt-lined to prevent cabinet resonances, it is designed to give the finest possible result from the high fidelity reproducer. Measuring 33" x 24" x 15", the cabinet is finished in highly polished walnut veneer.

SPECIFICATION: Series Gap magnet of Alcomax 3. Flux: LF Gap, 14,000 gauss; HF Gap, 17,000 gauss — on 1½" pole. Power handling capacity, 15 watts. Frequency range, 30-17,000 c.p.s. Fundamental bass resonance, 45 c.p.s.

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A Useful Loudspeaker Control

By K. G. Britton, M.A.

THE high-quality enthusiast will certainly sooner or later try a change-over network on his loudspeaker system. As is well known, this network separates the higher from the lower frequencies and feeds them to a separate loudspeaker. By this means cross-modulation between the upper and lower frequencies is reduced and an annoying wobbling of the upper frequencies, caused by the Doppler effect, is removed. The liveness and intelligibility of the audio signal depend to a very great extent upon the care with which the upper frequencies are distributed over the listening space, and the best results are obtained if the higher frequencies are distributed by a speaker specially designed for the job. A pressure unit loaded with a cellular exponential horn is found to give very good results indeed. There is no doubt that when properly handled the two-speaker system gives a substantial improvement. Unfortunately, a small difficulty arises which can cause much disappointment. We imagine that the amplifier is designed to give a level response curve. We take the signal from this amplifier and divide it into two portions, each of which we feed to a separate loudspeaker. Now if these two speakers have not the same conversion efficiency we shall get more sound for a given signal from one loudspeaker than from the other. This, in effect, puts a step right in the middle of our carefully smoothed response curve. As the change is discontinuous, altering the tone controls will not enable us to put it right. In practice the effect is quite unpleasant, and to get the hoped-for results we shall have to cut the output from the more efficient speaker to restore the balance. The obvious answer is to fit a volume control to the more efficient loudspeaker, but such a rough-and-ready answer will not be good enough if we are really keen on maintaining the best conditions of working. Both the filter of the cross-over network and the output stage of the amplifier are designed to work into one special impedance and the introduction of an ordinary volume control will upset these working conditions. We need to design a volume control which, whilst it does its job, presents constant impedance conditions. Such a device is easy to make and is well worth the slight trouble involved.

In the circuit shown in Fig. 1, R is the impedance of the loudspeaker. The effective value of R_2 and R in parallel is $\frac{R_2 \times R}{R_2 + R}$; call this X.

This, in series with R_1, is therefore $X + R_1$. We can always choose values of the resistances so that this total still comes to the proper value R. The voltage being fed in between A and B is now divided and the fraction appearing across the loudspeaker is $\frac{X}{X+R_1}$; and if we want to know how many decibels the signal has been reduced in the speaker we say: dbs $= 20 \text{ Log } \frac{X}{X+R_1}$

To save calculation the following table will give the values of the voltage ratios for 2db steps.

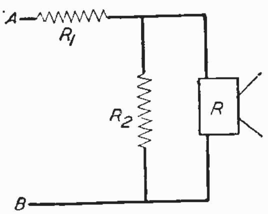

Fig. 1.—Normal output circuit in theoretical form.

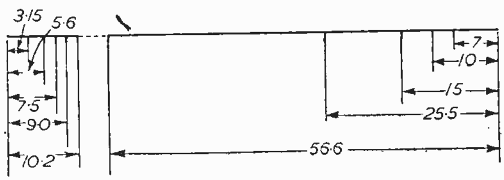

Fig. 2.—Method of making experimental resistors.

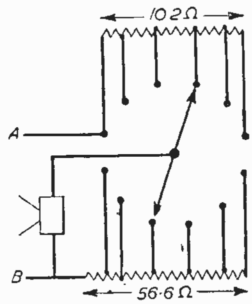

Fig. 3.—Wiring the resistances to a double-pole switch.

dbs reduction	$\frac{\text{Speaker voltage}}{\text{Input voltage}} = a$
0	1
2	.79
4	.63
6	.50
8	.40
10	.32

We can also find the values of R_1 and R_2 from the relationships shown above, and we find these are given by:—

$$R_1 = R(1-a)$$

$$R_2 = \frac{Ra}{1-a}$$

15-ohm Units

As 15 ohms is a very common value for a loudspeaker impedance, the table below is given, which shows the values of resistances required for an

(Concluded on page 82)

STROBOSCOPES

Methods of Designing, Making, and Using Simple Stroboscopes for Checking the Speeds of 78 and 33⅓ r.p.m. Gramophone Turntables— By K. KEMSEY-BOURNE

THE stroboscope is an old and simple device. Like the zipp-fastener, it is obvious enough once somebody has explained it to you. The dictionary will tell you that the word is derived from the Greek "strobos," to turn, and "skopein," to see, so that the whole comes to mean any apparatus for observing rotational or periodic motion by means of a flashing light.

Basic Principle

The principle is simple enough. Imagine a cine camera photographing a rotating spoked wheel. The camera shutter opens, records the position of the spokes at one instant, and then closes. Suppose that the next time the shutter opens the spokes of the wheel have all moved round exactly one place, so that the next photograph taken will look exactly the same as the first although each spoke has actually moved. If we project such a film the wheel will appear perfectly stationary. Now if either the wheel or the camera changes its speed then the synchronism is broken, and on projection of the film the wheel would be shown as moving slowly forward or backward. This effect is often seen in the cinema.

There must clearly be some connection between the number of spokes on the wheel, the rate of turning of the wheel, and the frequency at which the camera takes pictures.

Practical Uses

For the experimenter the stroboscope provides an accurate but extremely cheap means of checking rotational speeds; for example, disc recorders, gramophone turntables, electric motors of all types and speeds, and the capstans of tape recorders. We need a source of flashing light, accurately controlled at a known frequency—this is readily provided by an ordinary incandescent filament bulb (clear glass) connected to the A.C. mains supply—and a ring of symmetrically-spaced black and white marks fixed on the rotating object.

Under the right conditions successive black marks take up the same position at each flash of the lamp, and so the ring of marks, like the spoked wheel we discussed previously, appears stationary. The conditions are given by this equation:

$$R = \frac{120\ M}{N} \quad \text{or, re-arranged,} \quad N = \frac{120\ M}{R}$$

where R is the rotational speed in revolutions per minute

M is the mains frequency in cycles per second

N is the number of black marks rotating.

For gramophone use the stroboscope is constructed for a certain desired speed, and adjustment is made to the speed control, or governor, until the black marks remain stationary. Other stroboscopes, currently used for examining high-speed machinery, involve various means of varying the frequency of the light source itself. A stroboscopic pattern designed to appear stationary when rotated at 100 r.p.m. under given lighting conditions will also appear stationary at 200 or 300 r.p.m. and, in fact, at any multiple speed of 100 r.p.m., although very short-flash lamps are needed to make use of this effect at very high speeds.

A Useful Example

Suppose that we wish to make a stroboscope to check a gramophone turntable to run at 33⅓ r.p.m. for L.P. discs. Then the formula tells us that the number of black marks needed is

$$\frac{120 \times 50}{33\frac{1}{3}} = 180$$

This is very convenient, since the angular spacing between successive black and white bands is exactly 2° (two degrees). The working would be similar for any other desired speed with a known mains frequency.

It is a simple job to mark out the disc required, using thin card and a 5in. protractor (see Fig. 1). There is no point in making a disc smaller than 3in. in diameter, as it is difficult both to mark out and to use. After sketching in pencil, the black spaces are filled in with Indian ink, and the centre hole, which ought to be 0.29in., is cut with a cork-borer. The centre hole must be made as accurately central as possible; otherwise the stroboscope will swing about on the turntable.

The table Fig. 3 summarises the details of disc stroboscopes to check different turntable speeds under lighting run from various mains frequencies. A disc stroboscope should always be used under working conditions; that is, gramophone speed is adjusted with the pick-up actually engaged in playing a record on the turntable.

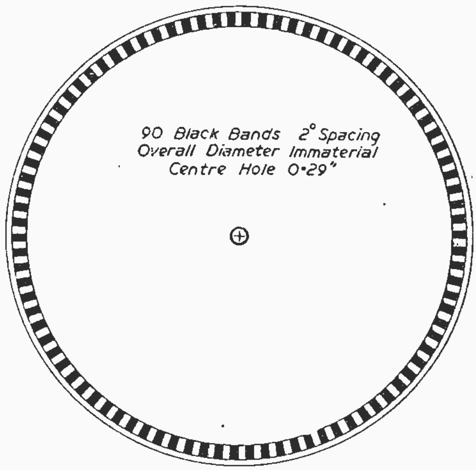

Fig. 1.—Laying out a Stroboscope for a turntable running at 33⅓ r.p.m. under lighting from 50 cycles mains.

Another Method

Sometimes it is preferable to have the stroboscope bands permanently fixed, or perhaps painted, around the edge of the turntable, and this method may be more convenient than the cardboard disc technique from the point of view of construction. A permanent stroboscope is particularly useful on a disc recording machine, as it gives a continuous check on the speed of the table, and any variation is immediately obvious.

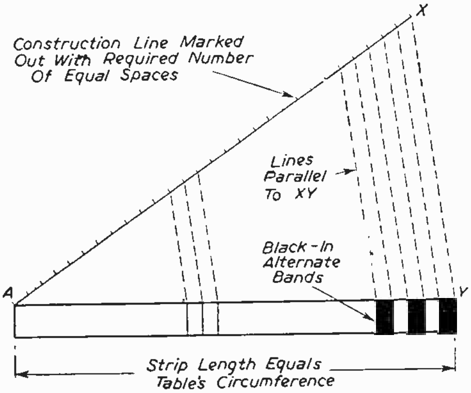

Fig. 2.—Diagram shows method of constructing a stroboscope for the rim of a turntable. The construction line AX is marked out with as many divisions as there will be bands (black plus white). X is the last point marked out. Join X to Y, and draw lines parallel to XY through each mark on AX.

The calculation of the number of black bands needed is, of course, as given above. First we must measure the circumference of the turntable. Then we cut a long, narrow strip of paper to fit round this circumference, and mark out the paper, either by the method illustrated in Fig. 2 (which is good old second-form geometry) or by direct division with a scale. For example, a 13in. diameter turntable to be run at 78 r.p.m. under 50 cycles/second lighting needs 77 black bands and 77 white bands, the circumference of the turntable is 40.8in., and each black or white band is 0.265in. wide.

A rim stroboscope made by painting with ink on drawing paper is good enough to last for a few experiments but is not sufficiently rugged to be permanent. The paper version will be needed in any case to act as a scale for marking the turntable edge before painting bands on to the edge of the table itself.

If you want to fit a rim stroboscope on a play-back turntable with a rounded or bevelled edge, then make a paper version on a strip a little less than a quarter of an inch wide and fasten this to the table edge, using transparent plastic tape.

Illumination

At night ordinary room or workshop lighting, other than phase-compensated dual-tube fluorescent lamps, will serve. In the daytime a low-wattage lamp can be put near the turntable. For permanent work, such as on disc recorders fitted with rim stroboscopes, the small neon glow-lamps often used for pilot lights will be found excellent, since the ignition of these lamps is very sharp with each reversal of the A.C. mains supply. A neon lamp mounted on the motor-board need illuminate only a few bands at a time.

Frequency of mains supply	40	50	60	100
No. of black bands 78 r.p.m.	62	77	92	154
No. of black bands for 33⅓ r.p.m. ..	144	180	216	300

Fig. 3.—Details of stroboscopes for checking gramophone turntable speeds, for both old type and LP recordings. Values for other conditions are calculable by using the formula in the text.

Constant Impedance Attenuator

(*Concluded from page 80*)

attenuator working in 2db steps down to −10dbs.

Attenuation in dbs	R_1 ohms	R_2 ohms
2	3.15	56.6
4	5.6	25.5
6	7.5	15.0
8	9.0	10.0
10	10.2	7.0

These figures may be converted to suit any other impedance by dividing them by 15 and multiplying them by the new impedance.

Finding these various resistances sometimes proves difficult. This is the solution I adopted. Obtain a 750-watt tubular fire element and measure its total resistance cold. Fasten one end of the wire to a nail and carefully unroll the rest of the wire along a corridor. Measure its total length and work out the ohms per inch. At a point representing 10.2 ohms make a tapping and cut the wire. Make a small loop and also one in the end of the rest of the wire. Connect these two loops by a short piece of twine. Measure off 56.6 ohms on the rest of the wire and discard any surplus. Now make tappings along the wire as indicated in Fig. 2, and then carefully wind the wire back on the former.

The tappings are wired to a six-way two-pole wafer switch to make contacts as shown in Fig. 3.

You can easily tell by ear which is the best cut to use, but a more reliable test is to balance the two speakers. It is necessary to feed through the amplifier a note equal to the cross-over frequency of the system and arrange to switch on alternately the bass and the treble speakers. The speaker which is off must in each case be replaced by a resistance of the right value. It is then quite easy to adjust the attenuator so that the same amount of noise is heard in the room whichever speaker is operating.

In conclusion, let it be said that the amount of control introduced is very pleasing and the "bite" without unpleasant "edge" in reproduction is a great help in the endless "Hi-Fi" struggle.

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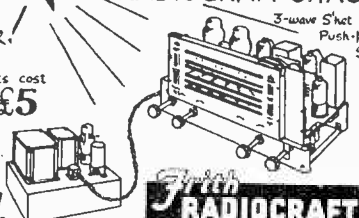

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Programme Pointers

This Month MAURICE REEVE Deals with Some Recent Programmes

ONCE again one hears ugly rumours to the effect that the days of the Third Programme are numbered. I know not how true they are, nor do I know whether smoke is always followed by flame. I would only add my voice to those who fervently hope they are false, and that at least one good thing may be saved from the jaws of the Philistine monster.

The argument that people should not be allowed what others have to pay for simply does not, in this case, hold good. I have to pay for huge chunks of the programmes which do not appeal to me in the smallest degree, chunks of which frequently disturb my Sunday afternoon's rest, and from which I sometimes cannot escape willy-nilly. At least the "Third" is a thing apart and has never obtruded itself where not wanted. Just as many of the finest B.B.C. productions have been on the "Third"—and could not even have been contemplated but for it—so are many of the nation's finest manifestations only patronised by the few. We can name the National and other galleries, symphony concerts and opera, Salisbury Cathedral, the Selworthy bird sanctuary, and even the British Museum itself—these are a few of the many things which the majority of the people help support for the minority to use. Are they to be scrapped for that reason?

I do not attach the same importance to the B.B.C.'s Third Programme as I do to those and similar national treasures, but I do say that most of what is beneficial, improving and uplifting, as well as being of the highest entertainment value, comes through on the "Third." Its abolition would mean the B.B.C.'s final surrender to the demagogues of Hogsnorton and Much-Binding.

Festival Hall

G. L. Martin's talk, on the "Third," on London's new Royal Festival Concert Hall was revealing of what we are being let in for by those who simply do not understand the gravamen of the problem. And that Queen's Hall could have been rebuilt for something like a quarter of what the South Bank monster is taking is—well, just one of those things. I was very amused at Mr. Martin's reference to having taken the advice and information "of musicians and members of orchestras"! Also, of the "musicians' quarters." It sounded like a new version of the "officers and soldiers" distinction, which has caused such untold embarrassment to the former.

The Universe

I listened to one of Mr. Fred Hoyle's talks in his series, "The Nature of the Universe." I was interested because I had heard Mr. Hoyle's praises sung on all sides. They are not undeserved. He is an excellent broadcaster who could easily join the Walford Davies-J. H. Middleton class. I know nothing of his subject so will refrain from touching on the matter of the talks.

Unquestionably, the finest and most important production to emanate from the B.B.C's theatrical department since the last issue of this magazine, and for a considerable while before, was that of the late Bernard Shaw's masterpiece, "St. Joan," which was given, first of all, in the World Theatre series on September 18th, and repeated in a divided form on the two following Sundays. I thought it was excellent in every way.

The fact that producer Peter Watts and all concerned were handling one of the finest plays in the language, instead of an "adaptation for broadcasting" or a play "specially written for broadcasting," only adds to their achievement. For, surely, Mr. Shaw was, unwittingly though it may be, easily the finest of all "script writers." The beautifully terse and concise language not only flows along, as in thet heatre, but "comes over" to perfection: every great moment of the immortal story so packed with drama and charged with destiny, the absorbing religious, moral and political discussions, and the Shavian cracks and jokes—all might have been specially written for broadcasting, so perfectly timed, balanced and generally presented are they. And, whilst with Shakespeare and all the finest "scripts" the absence of the characters and of the scenery is in no way a drawback, it would be a fiasco on television.

At first I didn't think I was going to like Miss Joan Hart in the name part. She didn't quite seem to hit it off on the Domremy farm amongst the chickens and the soldiers. There didn't seem to be quite the perfect combination of the guilelessness

PROFESSOR BOFFIN

"Of course, one expects some teething troubles."

and unsophistication inseparable from a rustic fifteenth-century girl of seventeen or eighteen and the portentous destiny already within her, and which had even then, of course, begun to work. And I can never quite get used to the Lancashire dialect, though I admit it is far preferable to what would be a wholly imaginative broken English-cum-French peasant patois. But Miss Hart did the great climax and the scenes leading up to it full justice.

Space alone precludes adequate descriptions, on their merits, of Wyndham Goldie (Earl of Warwick), the Dauphin—John Wyse; de la Tremvuille—Felix Felton; Dunois—Michael Hordern; de Stogumber—Richard Williams, and many others.

Young Mrs. Barrington

I am in disagreement with those critics who doubted the wisdom of putting on a play like "Young Mrs. Barrington" (Saturday Night Theatre) five years after the war, and, as they suggested, unnecessarily reviving unhappy memories of the marital disputes and difficulties which took place when some husbands—and wives—returned from the war. The problem—very well dealt with in this play and excellently handled in this presentation—of the young man whose experience of or desire for domestic peace and quiet have been completely shattered by the strained, adventurous and hazardous experiences of war is interesting and important. Why avoid it, then? If we are to wait till another war before debating it, then we will all sincerely hope it is never debated again. But this would be a great shame in view of the rubbish which forms the basis of so many plays. Warren Chetham Strode wrote a fine play here, and Elsa Parmer, as the young Mrs. B., and all her colleagues in the cast, very convincing.

Granados

That very fine and deservedly popular pianist, Moiseiwitsch, gave a lovely performance of Schumann's bewitching "Kreisleriana," a horribly-neglected work, and one which nearly always has to stand aside for the more "popular" of the Schumann classics. But I was disappointed in the Granados programme given by the B.B.C. Opera Orchestra under Stanford Robinson, and assisted by Conchita Badia d'Agusta—soprano—and Iris Loveridge—pianist.

This loveliest of Spanish music must be very difficult to handle, and to make a programme of it in this way, as one does with Mozart, Beethoven or Wagner, seemed the very worst. Also, the examples given of the twelve Spanish Dances—piano miniatures—lost all their piquancy and charm in the heavy orchestral versions. The Goyescas is some of the loveliest music ever penned, and it was good to hear the ravishing "La Maja" in its original song form. Miss Loveridge played two numbers with considerable technical fluency, but with unwanted rigidity of rhythm. They are enormously difficult pieces.

"I Was There"

The Sunday morning series "I Was There" is an attractive collection of the less shattering type of event which forms memorable landmarks in our nostalgic memories. Things like Jack Hobbs breaking Grace's record at Taunton, or England beating Wales in the first match ever to be played at Twickenham, revive the most pleasant memories. Retailed by participators, I hope they will long continue.

Reference to Sunday mornings reminds me that at least one item mentions changing its time "in response to numerous requests." Well, what's sauce for the goose will certainly be poison to the gander in this case. If it gains new admirers by changing its time, it may, perforce, lose one very loyal one. I cannot say for certain, yet.

At the time of writing, most of the regular weekly features have returned from their annual visit to the dyer's and cleaner's and are reappearing for a further run—except the unlamented, by me, "Twenty Questions" and "Much-Binding." I have not yet been able to hear the new Ted Kavanagh show, "The Great Gilhooly."

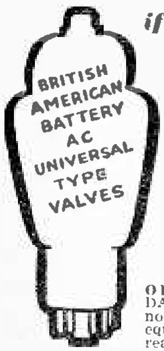
Dreadful !

"In Town To-night" and "Music Hall" are as dreadful as ever. I can see no possible excuse for dishing up some of the stuff that is inflicted on us in these two programmes. I protest against Mr. Bryan Johnston being included as "one of the interesting people who have come by land, sea and air, to be In Town To-night"! As a matter of fact, his duties in connection with this feature, take him *out* of town as often as they keep him *in* it. And, in any case, he doesn't come by land, sea or air to be with us on Saturday evenings, but, if not actually a resident of London, for a wager, comes in to town in a car from Buckinghamshire, Surrey, or somewhere similar. Mr. Johnston is a charming young man and an excellent cricket commentator to boot, but as the B.B.C.'s Mr. Pickwick, having weekly spills on the ice, immersions in the bath, or what you will, I confess I do not like him quite so well.

Workers' Playtime

In a recent "Have a Go," Wilfred Pickles put his well-known question to a lady: "Is there anything you particularly dislike (luv)?" The answer was immediate and emphatic: "I cannot abide 'Workers' Playtime.'" Madam, though unknown to me, allow me to say you are a lady after my own heart.

"The trees and the grass were green" was one of the more profound lines from Frank Gillard's entertaining programme "Just Across the Water."



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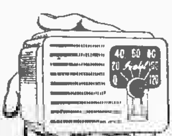

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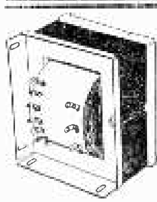

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OPEN TO DISCUSSION

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

"Impedance Meter"

SIR,—With reference to the letter from C. P. Scott-Malden, appearing in the September-October issue, it was not intended that the "Ohms" calibration should be used for capacitance and inductance, and your correspondent's reference to the inaccuracy of the Impedance Meter would only be justified had he not overlooked the paragraph, ". . . inductance or capacity may be established at once from a graph." It was left to the reader to construct this graph.

As a point of interest, reference to a number of manufacturers' catalogues shows that a normal D.C. resistance for a 10 Henry choke lies between 250 and 350 ohms. On this basis, error in measuring a 10 H 350 ohm choke would be only 0.67 per cent.

To obviate continuous use of the graph, selected markings, say,

Range A	.001	.005	.01	.02	.05 μF.	
Range B	.1	.25	.5	1.0	2.0	4.0μF.

could be transferred to the meter scale. Inductance measurements, being less frequent, can be made with the aid of the graph.—T. HATTON, Surrey.

SIR,—May I comment on the letter from C. P. Scott-Malden appearing in the September-October issue of PRACTICAL WIRELESS. With reference to the first point, he does not indicate the extent of the possible error, but, by comparison with a large number of 5 per cent. resistors, the inaccuracy would appear to be well within 5 per cent. everywhere.

When measuring condensers, of course, the total impedance becomes complex, and it is wrong to accept the impedance reading as $\frac{1}{2\pi fC}$ This being so, I was faced with the choice of either calculating points of Z (apparent) v. capacity, and plotting the graph; or making the same calculations and marking the points on the meter scale. It was decided to mark in the values for capacity only, for the two scales, as one seldom needs to measure inductances; this made four scales.

Finally, I must correct your correspondent's ideas on the D.C. resistances of chokes. A good make of 10 H choke may have a D.C. resistance as low as 75 ohms. Certainly, the most inferior component available should not exceed 750 ohms. If it did, the D.C. regulation available would be very poor.—D. VINCENT (S.W.19).

"Programme Pointers"

SIR,—With reference to "Programme Pointers" in the September-October PRACTICAL WIRELESS, may I suggest that if we must have a dramatic critic he should stick to facts?

Mr. Reeve's description of the plot and characters in "A Play for Ronnie" is completely wrong; one can only assume he missed the beginning and end and did not pay much attention to the rest.

I will leave it to Mr. Reeve to cast his memory back and see if he can remember the play a little more clearly.—T. P. LYNOTT (Abingdon).

[In my notice of the play, "A Play for Ronnie," I never so much as hinted at the plot or the story, but confined my remarks solely to one of the characters, a servant, who, being late of the A.T.S.—as it was then styled—clicked her heels and saluted her master or mistress each time they summoned her for their orders.

I remember the story of the play quite well, but do not propose to remind Mr. Lynott of its details.

Like most critics, I presume, I make careful notes of the points in the features I listen to which I intend commenting on in my article. I made no "slip-up" on the present occasion.—M. REEVE.]

SIR,—Having my PRACTICAL WIRELESS at hand for the January issue the letter entitled "Programme Pointers" was very interesting. The correspondent seems to forget that Maurice Reeve isn't the only person who makes mistakes, and, after all, who worries about who wrote the tune of "Music in Miniature"? To my mind, Maurice Reeve's page is very interesting and true. After all, half the radio programmes are not worth listening to. How many men want to hear "Woman's Hour," "Mrs. Dale's Diary" and symphony concerts. Maybe your correspondent has the wireless on all day for company in the home.—F. A. SAVORY (Shillingstone).

Training Service Engineers

SIR,—I received PRACTICAL WIRELESS, January, 1951, to-day, and I note with disgust D. F. C. Smyth (Loughborough) states that builders' labourers wages are £6 per week. I have been working on the building for 16 months since my release from the R.A.F. Present rate of pay for labourers is 2s. 4½d. per hour, flat union rate. All firms under the Master Builders' Federation are working a 44-hour week six weeks before and six weeks after Christmas, which makes my wages £5 4s. 6d., less 4s. 11d. insurance, total cash £4 19s. 7d. During the rest of the year we are able to work 46½ hours, which gives us 5s. 11¼d. more. Less wet weather time.

Another point is that when employed in Hailsham the rate is 2s. 4d. hour.—R. F. HUDSON (Stone Cross).

SIR,—I have read your Editorial in the September-October issue and I can only say that while a higher standard of technical knowledge may be a necessity in the servicing trade, a far greater necessity is for the integrity which you mention, but have no suggestion to offer for a remedy.

To state my point fairly I should start off by saying that I come under the heading of a "dabbler." (I have several years of study behind me and a fair amount of practical experience in constructing and repairing.) I have not yet taken any exam. In other words, I am unqualified—but I have the integrity—which means that if I take on a job and it can be done at a reasonable cost, it gets done and I guarantee it. The significant point of this is that I rarely do any repairs which have not already been "done" by a well-established firm. Sometimes they have done the job several times within a short period and charged liberally each time; it is certainly true that many of the shops can't tackle anything more difficult than a dud valve. A couple of instances will prove the standard of integrity of some local establishments. A 1939 A.C./D.C. superhet. was sent in for repair, reproduction being rather weak and like sandpaper. After several weeks the owner, having called at the shop and been told it wasn't finished on earlier occasions, demanded that the set be returned as soon as possible. They handed it to him immediately (untouched) and charged him £2 for the "job." This man was a farmer and the loudspeaker cover being slack had allowed a couple of pieces of chaff to enter. Needless to say, I charged less for fitting a dustproof speaker than they did for doing nothing.

Another happy set owner had been plagued by the constant recurrence of oscillation and hum; at one establishment after another they fitted fresh smoothing condensers, thereby curing it temporarily; had not one of them time to find out why? I found the voltage was too high, through using the wrong mains tapping on the mains transformer. Does it need technical qualifications and unions to find these faults? Why do so many establishments which have sales departments refuse to repair any set which isn't of the latest design or post-1939? By all means try to persuade customers to invest in a modern set, but this intimidation policy is hardly fair, especially in the circumstances, when we have a national drive for economy. There are many to-day who have a set on the table which doesn't work (and they can't afford to buy a new one) or who, having had rough treatment, fly into the arms of the rediffusion services. (I know, I work for one.)

A radio set only becomes cheaper than a rediffusion speaker rental if it goes for 10 years without more than once being in for repair. Most sets to-day are capable of that standard, but how many of the repairers can make a good job first time? "Get it off the bench" seems to be the watchword; "speed brings returns" is misinterpreted, and the old cobbler's sad lament, "The better my work the less my pay," seems to be believed by the short-sighted, who can't see where the 200,000+ rediffusion listeners on Merseyside alone came from; they aren't all in areas of strong electrical interference.

I hope to qualify before very long but that's beside the point.—BERNARD F. APPLETON (St. Helens).

Strange Fault

SIR,—I have acquired an R1155 ex-R.A.F. communication receiver and have built a power supply for the set to be used off D.C. mains.

This meant connecting all heaters of the valves in series and taking heater L.T. off the mains via a suitably-tapped variable mains dropper. Input to heaters is taken to pin 3 of power plug and the terminal of the last valve heater is connected to pin 8 (the —ve H.T.).

When the set is switched on two valve heaters do not burn (both valves are Osram Marconi DL63). Yet all other valve heaters light up despite the fact that the heaters are connected in series.

When the heaters of the DL63s were tested on a 4-cell torch battery they burned satisfactory and yet they would not light when fitted in the set.

Places of valves were now exchanged and wherever the DL63s were put they did not light, while all other valves worked normally. Finally, the heater connections of the DL63 were cut out, the remaining valve heaters being joined in series. The DL63 heaters were connected to torchlight batteries and the set then worked perfectly.

Could anybody tell me why the DL63 heaters will not burn when placed in their sockets, L.T. being supplied as explained, or what can be done to bring these temperamental valves to reason?

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Impressions on the Wax

Review of the Latest Gramophone Records

WHEN Sir Thomas Beecham was conducting at the Metropolitan Opera House, New York, he described Leonard Warren as one of the finest baritones in the world to-day, an opinion which has since been confirmed by the American public. On one side of *H.M.V. DB*21135 Warren is joined by supporting singers, chorus and orchestra for the "Brindisi Song" from Act I of Verdi's "Otello." This is Iago's famous drinking song, "Then let me Quaff the Noble Wine." On the other side—as a solo—he sings the part of Old Germont in Verdi's "Traviata."

The appearances at Covent Garden of Tito Gobbi, baritone, with the La Scala Company have served much to strengthen his popularity with British listeners. For his latest recording on *H.M.V. DB*1945 he sings two songs from Mozart's opera "Le Nozze di Figaro." They are "Non piu andrai" (Now No More) from Act I, and "Aprite un po' quegli' occhi" (If Men Would Look About Them) from Act 4.

The famous American tenor, Jan Peerce, appears this month with ballads to please a multitude of listeners. Guy d'Hardelot's "Because" coupled with "Bluebird of Happiness," which is a worthy companion piece, on *H.M.V. DA*1953.

The recording of "Les Patineurs" ballet music by the Royal Opera House Orchestra, Covent Garden, on *Columbia DX*8357-8, is the music as danced by the Sadler's Wells Ballet, and under John Hollingsworth's keen direction it becomes an especially delightful invitation to listen. Meyerbeer composed "Les Patineurs" ballet for the performance of his opera "Le Prophete" at the Paris Grand Opera House. It was compulsory at this particular house to introduce a ballet in any opera that was produced there—hence Meyerbeer's music. Constant Lambert, who arranged this suite from the composer's work, has scored for a large orchestra, including four horns, two trumpets and three trombones.

The Welsh are born singers, particularly those enthusiastic citizens of the Welsh town of Morriston who, in their spare time, go to a local chapel to make their recordings. The latest titles by the Morriston Orpheus Choir are a love song in "Myfanwy"—a favourite male voice choir item for many years in Wales—and "Y Delyn Aur" (The Golden Harp), an arrangement by D. Pughe-Evans of a famous Welsh hymn tune—*Columbia DX*1696.

Variety

Admirers of Britain's popular tenor, Josef Locke, will welcome his latest recording on *Columbia DB*2763, which couples an old favourite, "Teddy Bears' Picnic," with Delia Murphy's "If I were a Blackbird."

Those popular partners of the radio series "Ray's a Laugh"—Ted Ray and Kitty Bluett—are heard together again on *Columbia DB*2760, with their version of "Let's put out the Lights and go to Sleep" and "An Ordinary Broom." The first tune is the type of domestic ditty ideally suited to Ted and his "radio wife."

"All my Homeland" is a patriotic song sung by the Radio Revellers on *Columbia DB*2754. In it they are accompanied by an orchestra for the first time on records. The Revellers revert to their familiar vocal-guitar presentation on the coupling "Steamboat Bill."

Other recordings by top-line stars include "Snowy White Snow and Jingle Bells" and "Say Goodnight but not Goodbye," by Dorothy Squires, on *Columbia DB*2605. "Love Like Ours" and "There's no To-morrow," by Monte Rey, on *Columbia DB*2762. "Rudolph, the Red-nosed Reindeer" and "Beloved, be Faithful," by Donald Peers, on *H.M.V. B*9984. "Mona Lisa" and "All My Love," by Allan Jones, on *H.M.V. B*9989, and a selection from Walt Disney's "Cinderella," by Ann Stephens and Company, on *H.M.V. DB*1266.

Dance Music

In deference to a steadily growing demand for non-vocal recordings in dance tempo Geraldo and his Orchestra have made "Once in a While" (Foxtrot) and "I Only have Eyes for You" (Foxtrot), on *Parlophone F*2434. Those who hear these initial performances in Geraldo's "Music for Dancing" series will indeed find that they fulfil in every respect the stringent demands made for ballroom dancing.

One of the hit tunes of the moment, "Goodnight Irene," has been recorded by Billy Thorburn's the Organ, the Danceband and Me combination, on *Parlophone F*2431. The coupling is "The Red We Want is the Red We've Got."

Jack Simpson and his Sextet are in their element with two new titles of lively six-eight songs—"Stick it on the Wall" and "The Whelk Song." on *Parlophone F*2432.

Harry Davidson and his Orchestra continue their "Old Time Dance Series" with a Paul Jones which introduces a number of old favourites, on *Columbia DX*1691, and finally we have Jimmy Leach at the Hammond Organ recording "Drinking Songs Medley" (No. 1), on *Columbia FB*3581, and Felix Mendelssohn and his Hawaiian Serenaders playing a "Scotlanda Medley," on *Columbia DB*2757.

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NEW IDEAS for the New Year. Mr. Bradley's best seller, "Personal Portables," is now in its second edition—new print, new cover, and right up to date. The book gives complete data on building five loudspeaker type midget sets, T.R.F. and superhet, and dozens of letters call it "the best 2/6 worth in radio." At **2/6** (2/8 post paid) it is good value. Our new book, "A Portable Televisor," is remarkable value too, at **3/-** (3/2 post paid). Still the first and only text to tell you how to build a mains-battery TV set which can use either a 3in. or 6in. tube. Sound and vision complete, of course, with all cut-price valves and only the size of a small suitcase. Data for both TV areas, naturally. Both from BRADBOOKS, Sennen, Penzance, Cornwall.

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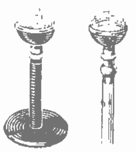

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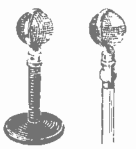

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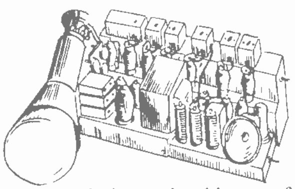

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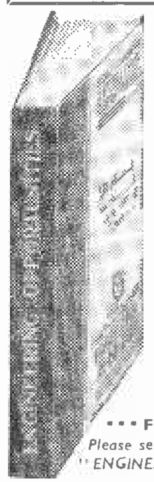

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