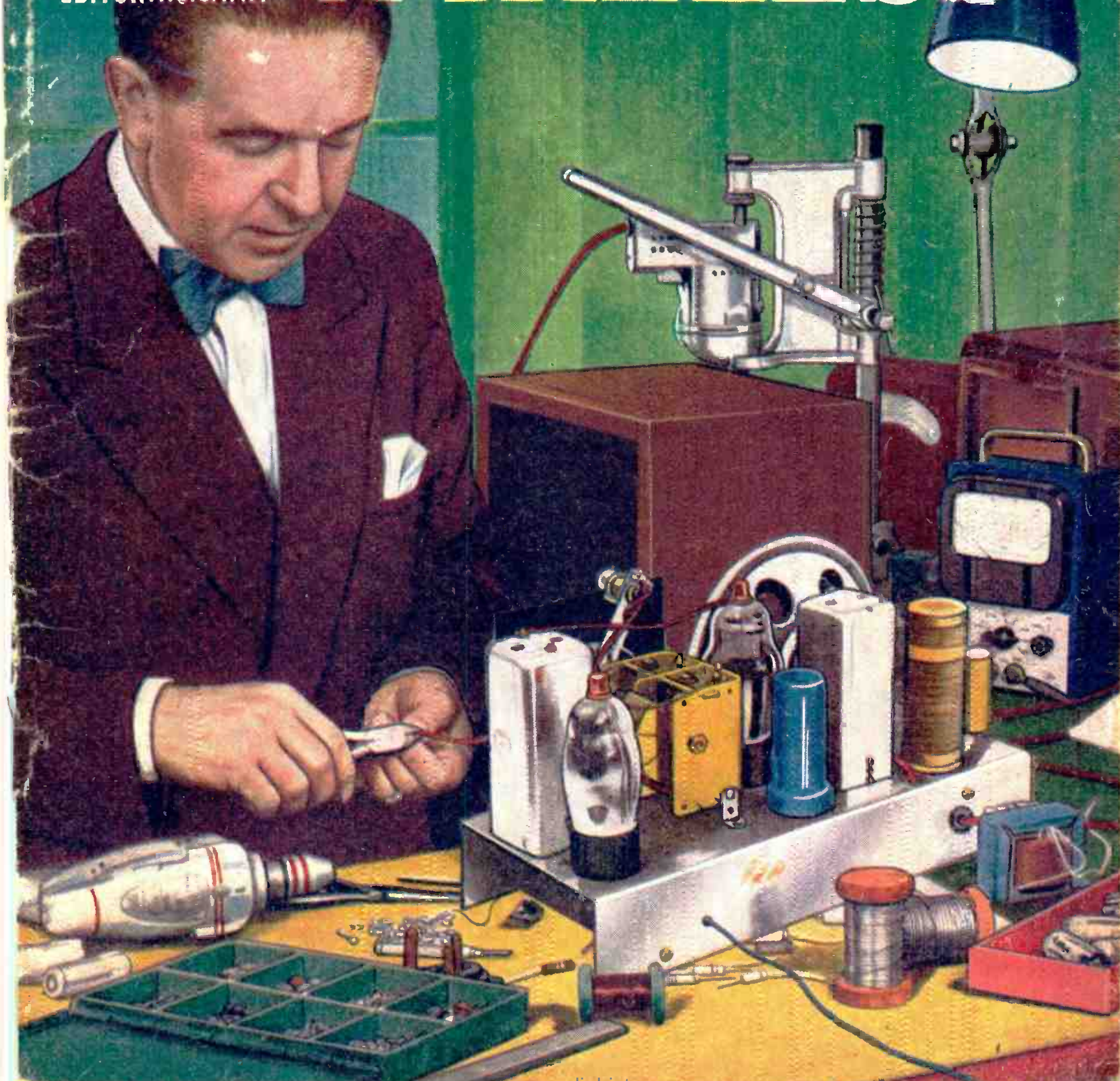
A 3-VALVE A.C./D.C. SUPERHET

PRACTICAL WIRELESS

1/-

FEBRUARY 1956
EDITOR: F. J. CAMM



9 Octave realism

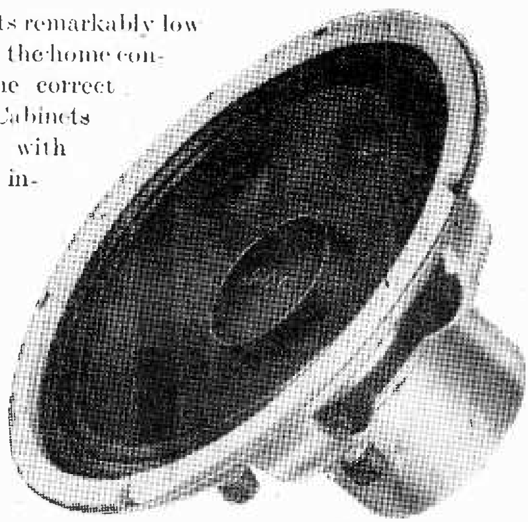
The G.E.C. metal cone loudspeaker gives lifelike reproduction of any type of sound over a range of 9 octaves. This includes the whole musical fundamental range with overtones. This gives the true tonal quality and character that all music lovers demand.

from a single unit

Sound engineers will appreciate the simplification—and the improvement in performance—which has been achieved by combining these qualities in a single unit—*smooth response over a range of 9 octaves, with extremely good low frequency response . . . *negligible inter-modulation . . . *unequalled transient response due to special coil and cone construction.

for only £9.5.0

This is a professional instrument but its remarkably low price makes it particularly valuable to the home constructor. It must be used under the correct conditions to obtain optimum results. Cabinets have been specially designed for use with this speaker. Home constructors are invited to write for details.



G.E.C.

Metal Cone Loudspeaker

THE GENERAL ELECTRIC COMPANY LTD., MAGNET HOUSE, KINGSWAY, W.C.2

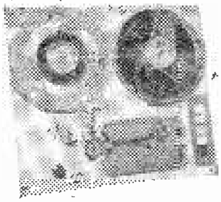
!! HOME CONSTRUCTORS !!

You can assemble the Stern's "Fidelity" Tape Recorder for only £40

!!! IT ONLY NEEDS CONNECTING UP !!!

This 2-speed Twin Track Recorder although supplied at a Genuinely Low Price, provides absolute Fidelity Recordings, and in addition to being completely dependable has a performance at least equal to Recorders marketed at a far higher price. The actual assembly of the Recorder is simple, and only involves a few connections. The Truvox Tape Deck and the Quality Amplifier are supplied tested and ready for use, and all that is required to complete the Recorder is to connect the two together (a connection chart is supplied for this purpose) and secure them by the screws provided into the Attache Case. The items illustrated and described below form the complete equipment.

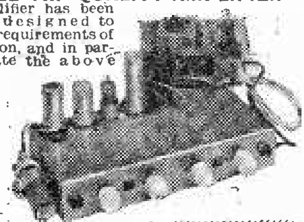
SEND S.A.E. FOR DESCRIPTIVE LEAFLET INCLUDING PRICE DETAILS & H.P. TERMS



TRUVOX TAPE DECK MODEL Mk. III/TR7u

This is Truvox's new "small" design being only 14in. x 13in. The whole instrument is built to close engineering limits resulting in the minimum of "wow" and "flutter" values. It will play the NEW PRE-RECORDED TAPES and takes all standard tapes up to 1,200ft.

MODEL TRF QUALITY AMPLIFIER



This amplifier has been expressly designed to meet the requirements of enthusiasts for fidelity reproduction, and in particular to CORRECTLY operate the above TRUVOX DECK. It is supplied complete with a matched Elliptical 3 ohm P.M. Speaker. It incorporates an efficient Tone Control arrangement and has a Magic Eye Level Indicator (Operative on Record). It can also be used as a general purpose Amplifier for high quality reproduction of gramophone records direct from a Gram Unit.

SCOTSBOY MAGNETIC RECORDING TAPE

Supplied complete with a 1,200ft. reel of Scotsboy Tape. In addition, the Recorder will take all standard makes of tapes.

MODEL MIC33/1 ACOS CRYSTAL MICROPHONE

A highly sensitive Mike which accurately matches the input arrangement of the Amplifier.

It can be supplied complete and ready for use for £43. H.P. Terms available.

PORTABLE ATTACHE CASE

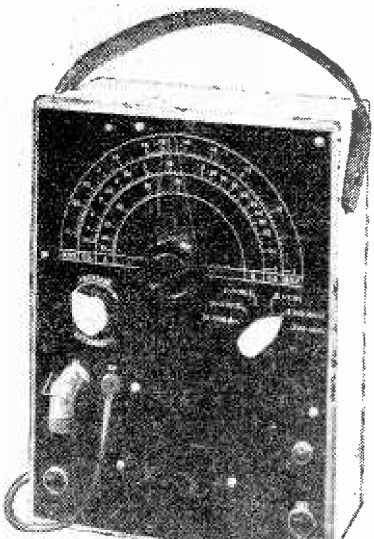
This, as may be judged from the illustration above, is a neat, compact and attractively finished case, being covered with maroon rexine and having an ivory coloured speaker escutcheon. It contains concealed pockets to accommodate the Microphone, Mains Lead and a spare 1,200ft. reel of tape.

STERN RADIO LTD.

109 & 115, FLEET STREET, E.C.4

Tel.: CENTRAL 5812-3-4.

THE "WEYRAD" SIGNAL GENERATOR



AN INSTRUMENT OF HIGH ACCURACY AT LOW COST

- Coverage 100 Kc/s-70 Mc/s (on fundamentals).
- Accuracy better than ±2% on all ranges.
- Large, clearly calibrated scale.
- Modulated or C.W. output.
- 500 c/s A.F. source.
- S.G.M.1—A.C. mains operation. Double wound, varnish-impregnated transformer, tapped 210/225/250 volts.
- S.G.B.1—All dry battery operated.
- All components are by well-known manufacturers ensuring maximum reliability.
- Both types in quantity production.
- Illustrated leaflet available, price 2d.

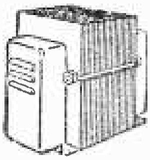
WEYMOUTH RADIO MANUFACTURING CO., LTD.

CRESCENT STREET, WEYMOUTH, DORSET

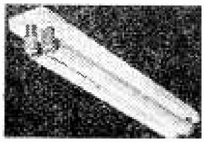
TRANSFORMER SNIP

11/6

Post 2/-

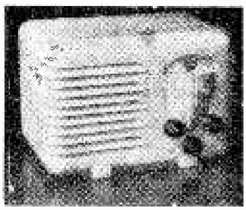


Fully shrouded — standard 200-250 v. primary 260-0-280 at 80 m.a. 6.3 v. at 3 amp., 5 v. at 2 amp.



THE TWIN 20

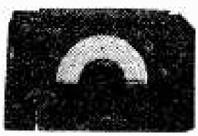
This is a complete fluorescent lighting fitting. It has built-in ballast and starters — stove enamelled white and ready to work. It is an ideal unit for the kitchen, over the work-bench, and in similar location. It uses two 20-watt lamps. Price, complete less tubes, 29/6, or with two tubes, 39/6. Post and insurance 5/-. Extra 20-watt tubes, 7/6 each.



MAINS-MINI

Uses high-efficiency coils—covers long and medium wavebands and fits into the neat white or brown bakelite cabinet—limited quantity only. All the parts, including cabinet, valves, in fact, everything. £4/10/0, plus 3/6 post. Constructional data free with the parts, or available separately 1/6.

R1155 YOURS FOR £3 and 12 monthly payments of 11/6



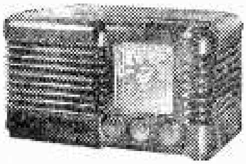
The R1155 is considered to be one of the finest communication receivers available to-day. Its frequency range is 75 kc/s to 18 Mc/s. It is complete with 10 valves and is fitted in a black metal case. Made for the R.A.F. so obviously a robust receiver which will give years of service. Completely overhauled and guaranteed in perfect working order. Price £8/19/6, or H.P. terms if required. Carriage and Transit Case 15/- extra. Mains Power Pack, with built-in speaker, £5/10/-, or in polished cabinet, £6/15/-.

12" TELE-CABINET

Veneered and polished—perfect. New and unused. 15/-, plus 3/6.

1956 T.R.F.

32/6



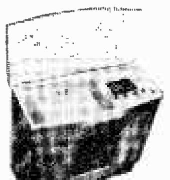
For the benefit of those who already have a loud-speaker and odds and ends, the "1956 T.R.F." is available in basic form. This contains all the essential items, i.e., prepared metal chassis, 3 valves, mains transformer, gang condenser, coil, volume control, valve holders, smoothing condenser, bias condenser, 6 paper and metal condensers, 7 resistors and data. The total list value of all the items is 52/6, but as a Special Offer to publicise the set, we offer all for 32/6, plus 2/6 post and insurance.
Remember, if pleased with results you can add the extra parts to make the "de luxe" set as illustrated.

THIS MONTH'S SNIP

The "ESTRONIC" Band III Converter

To-day's best value in Band III converters suitable for your T.V. or money refunded. Complete ready to operate, 59/6 non mains or 85/- mains, post and insurance 3/6.

CABINETS FOR ALL

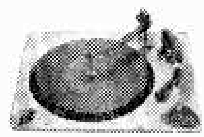


We undoubtedly hold the largest stock of cabinets in the country. All are made of the finest plywood, veneered and polished and all radio and motor boards are left uncut to suit your own equipment. The top one is The Bureau, walnut finished and highly polished, size approximately 30in. high, 32in. wide, and 16in. deep. Price 14 guineas plus 15/- post.

INTERCOM—Home or Office

This is a two-station "master" unit comprising an A.C. mains operated push pull amplifier with built-in P.M. speaker which acts as microphone or loud-speaker, depending on whether switch is set to "talk" or "listen." Needs only another P.M. to act as "slave." Complete in polished cabinet ready to work. Price only £4/19/6, plus 3/6 carriage and insurance.

GRAMOPHONE AUTO-CHANGER



The latest model by very famous manufacturers, 3-speed with crystal turn-over pick-up, brand new and perfect, in original cartons. Price £7/15/0. carriage, ins., etc., 7/6.

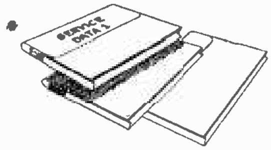
NEW AMERICAN EQUIPMENT

INSERT MICROPHONE
Ref. No. Mic 253-A, a really beautifully made magnetic mike of little over 1in. in diameter. Price 8/6, post free.

LOW-HIGH ADAPTOR
Changes low resistance headphones to high resistance. Ref. No. MC-385-C, standard jack plug fitting. Price 4/6 each.

PUSH PULL OUTPUT TRANSFORMER
Potted Midget type standard matching. Ref. No. 866. Size 1in. x 1in. 2¼in. Price 8/6 post free.

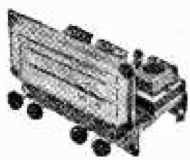
PUSH PULL INPUT TRANSFORMER—
Potted Midget type Ref. No. 4358. Size 1in. x 1in. 1¼in. Price 6/6, post free.



SERVICE DATA

100 service sheets, covering British receivers which have been sold in big quantities and which every service engineer is ultimately bound to meet. The following makers are included: Aerodyne, Alba, Bush, Cossor, Ekco, Ever-Ready, Ferguson, Ferranti, G.E.C., H.M.V., Kolster Brandes, Lissen, McMichael, Marconi, Mullard, Murphy, Philco, Philips, Pye, Ultra. Undoubtedly a mine of information invaluable to all who earn their living from radio servicing. Price £1 for the complete folder.
Our folder No. 2 consists of 100 data sheets covering most of the popular American T.R.F. and superhet receivers "all dry," etc., which have been imported into this country. Names include Sparton, Emerson, Admiral, Crossley, R.C.A., Victor, etc. Each sheet gives circuit diagrams and component values, alignment procedure, etc., etc. Price for the folder of 100 sheets is £1, post free.

THE CLEVELAND ORGANTONE



5 valve superhet covering Long, Medium and Short waves. Miniature valves—low loss coils—permeability—tuned I.F.S.—full A.V.C.—variable negative feedback—gram. position—4 watts output—particularly fine tone. Price £11/10/0. Carriage and insurance, 7/6.

MULTI-METER KIT

Parts suitable for making a multi-meter to measure volts, milliamps and ohms. Kit containing all the essential items including moving-coil meter, resistors, range selector, calibrated scale, etc., etc., is only 15/-, plus 1/- post and packing.

ELECTRONIC PRECISION EQUIPMENT, LTD.

Post orders should be addressed to E.P.E. LTD., Dept. 5, 123 Terminus Road, Eastbourne.

Post enquiries to Eastbourne with stamped envelope, please.

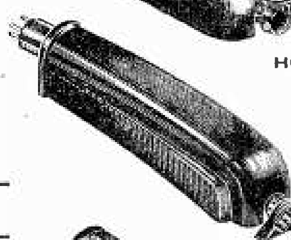
42-46, Windmill Hill, Ruislip, Middx. Phone: RUISLIP 5780. Half day, Wednesday.	152-3, Fleet Street E.C.4. Phone: FLEet 2833 Half day, Saturday.	29, Stroud Green Rd., Finsbury Park, N.4. Phone: ARChway 1049 Half day, Thursday.	249, Kilburn High Road, Kilburn. MAIda Vale 4921.

Bring your equipment up-to-date with ACOS REPLACEMENT PICK-UP HEADS

If you have a	*You need a*
COLLARO RC 532 AC 534 AC 3/534 3 RC 532 Studio Pick-up	HGP 37-1 COLLARO OR HGP 41-1
3 RC 511 3 RC 531 AC 3/511 AC 3/531 3 RC 521	HGP 57-1
GARRARD RC 75M RC 80M RC 90 RC 111 TA Player	HGP 37-1 GARRARD OR HGP 35-1
RC 72 RC 72A RC 75A RC 80 Model M Unit	HGP 63-1 OR HGP 39-1 OR HGP 45-1
EURNE-JONES Pick-up	HGP 55-1
ACOS GP 20 Pick-up Arm GARRARD C TYPE Adaptor GP 19 Heads	HGP 39-1

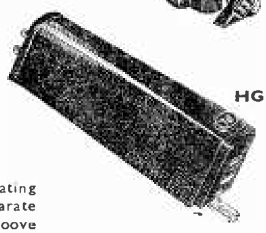
If you already own a fine radiogram or record-player you now have the opportunity of rejuvenating it—of bringing it right up to date for a quite modest sum. The latest types of Acos Hi-g crystal pick-ups are now available in a range of specially designed "plug-in" models to suit most famous makes of record reproducing equipment. These Acos ' Hi-g" pick-ups, you will find, represent a truly phenomenal advance in pick-up design—with regard to both reproduction and tracking characterics (so important with many of the new microgroove recordings). Ask your Dealer!

HGP 37-1 Collaro
A Hi-g pick-up head incorporating the HGP 37-1 turnover cartridge with cantilever sapphire styli. Designed for both standard and microgroove records.
Ask for Data Sneet No. 4800



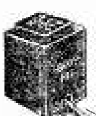
HGP 37-1 Garrard
A Hi-g pick-up head incorporating the HGP 37-1 turnover cartridge with cantilever sapphire styli. Designed for both standard and microgroove records.

HGP 63-1 Garrard
As HGP 37-1 but slightly longer.
Ask for Data Sheet No. 5000 for both heads.

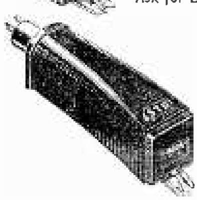


HGP 41-1
Separate Hi-g plug-in type heads for standard and microgroove records incorporating the crystal unit as used in the HGP 39-1 above. Available in cream or walnut.

HGP 57-1
As HGP 41-1 above but shorter. In walnut only.
Ask for Data Sheet No. 5400 for both heads.



HGP 39-1
Hi-g pick-up heads incorporating cantilever sapphire styli. Separate heads for standard and microgroove records.
Ask for Data Sheet No. 4400



HGP 35-1
Separate plug-in type Hi-g heads for standard and microgroove records; fitted with cantilever sapphire styli. The crystal unit is identical to that of the HGP 39-1 above.

HGP 45-1
As HGP 35-1 but slightly longer.
Ask for Data Sheet No. 5600 for both heads.

HGP 55-1
Hi-g pick-up head incorporating cantilever sapphire styli. Separate heads for standard and microgroove records.
Ask for Data Sheet No. 5300.

Price **32/6** (plus 12/6 P.T.) for all types except HGP 39 Models which are **32/-** (Plus 12/4 P.T.)

. . . always well ahead

ACOS devices are protected by patents, patent applications and registered designs in Great Britain and abroad.

COSMOCORD LTD • ENFIELD • MDX. • ENField 4022

PRACTICAL WIRELESS

EVERY MONTH
VOL. XXXIII, No. 592, FEBRUARY, 1956

EDITOR : F. J. CAMM

24th YEAR OF ISSUE

COMMENTS OF THE MONTH BY THE EDITOR

V.H.F. Demonstration

THE servicing of V.H.F./F.M. receivers was demonstrated on a small scale at last year's show, under the auspices of BREMA. These demonstrations are now to be considerably extended in accord with the growth of the BBC V.H.F. service in the provinces. The demonstrations will be much more detailed than those at Earls Court and each will occupy a full day. The first demonstration will be in the North-East area, served by the BBC transmitter at Pontop Pike, and it will appeal to service engineers. Very comprehensive lectures and actual demonstrations of servicing will be given in Newcastle-on-Tyne in mid-February, and admission will be by ticket available from BREMA at 59, Russell Square, London, W.C.1, whose sub-committee are arranging the lectures and demonstrations.

POLICE MESSAGES ON TV

THERE are reports in some of the national newspapers that police messages have been picked up on the sound channel of TV receivers in the London area. Police radio signals operate on a wavelength between 95 and 100 Mc/s, and make use of frequency modulation, and it seems somewhat surprising that such signals should be received on A.M. receivers which are, of course, tuned to a different frequency. It is well known that a Band I superhet TV receiver could pick up the signal if a harmonic of its oscillator was in syntony with the police signal, and produced an intermediate frequency approximating to that of the receiver. No doubt there are other explanations. We should be glad to hear from any reader owning a TV receiver who has received such police signals.

A TECHNICAL PUBLICATIONS ASSOCIATION

INSTRUCTION manuals, whether for radio, TV, motor-cars, sewing machines or any other piece of apparatus, are usually badly written, badly presented, and omit information which would enable the owners to carry out minor repairs themselves. Few instruction manuals on radio and TV receivers, for example, give circuit diagrams and component values. They do not give a list of possible faults and methods of checking them. They are mostly confined to installation and operation, the object being, of course, to force the user into the hands of the dealer. It is generally conceded that service charges are too high, and in some cases the dealer takes advantage of the trade monopoly granted to him by the manufacturer to extract extortionate charges.

There has recently been formed a technical Publications Association, and the object of it is to establish recognised standards of competency for technical writers and illustrators. It is collaborating with the City and Guilds of London Institute and other educational authorities with a view to establishing national examinations and certificates.

The preparing of instruction handbooks and manuals is now a recognised profession and industry, but all too often the job is given to those without technical qualifications. The Association proposes to arrange lectures and organise visits to printers, process engravers and others engaged in book preparation. Whilst the training of those whose job it is to write instruction manuals is an important task, we feel that the Association will fail in its object, for if a man has not a natural gift for writing or illustrating he will not gain it by membership of an association. You cannot train a man to be a writer or technical illustrator. Writing comes from knowledge, not from training, and the grammatical construction of sentences and the orderly and logical arrangement of the text of a manuscript should come from general education, which it is not the object of any association to provide.

The greatest obstacle, however, to the success of the scheme is the attitude of the trade itself, which is to keep service information out of the hands of the general public and to place it in the hands of retailers and service engineers. The trade itself instructs its agents and dealers in servicing matters. Unless the Association can persuade the trade that this is wrong, its efforts will be abortive. Our criticism here applies not only to the radio trade but to all other trades, and particularly the automobile, motor cycle and cycle trades. The new association is non-profit making, and membership is graded according to experience and qualifications, the active grades being Student, Associate, and Full Member. Nevertheless, the Association is a move in the right direction, and in time should provide a pool of writers upon which the trade can draw.—F. J. C.

Round the World of Wireless

By "QUESTOR"

Broadcast Receiving Licences

THE following statement shows the approximate number of Broadcast receiving licences in force at the end of October, 1955, in respect of wireless receiving stations situated within the various postal regions of England, Wales, Scotland and Northern Ireland. The numbers include licences issued to blind persons without payment.

Region	Number
London Postal	1,425,508
Home Counties	1,373,745
Midland	1,102,014
North Eastern	1,448,590
North Western	1,107,140
South Western	898,147
Wales and Border Counties ...	656,873
Total England and Wales ...	7,921,017
Scotland	993,461
North Ireland	215,745
Grand Total	9,130,223

Crystal Controlled Radar for Jan Smuts Airport

THE Jan Smuts Airport, the largest civil airport in the Union of South Africa, is to be equipped with the latest Marconi multi-purpose radar. The contract is valued in the region of £40,000.

Marconi's are to supply their Type S.232 radar, together with four display 'consoles', ancillary equipment and test gear. The equipment is generally similar to that manufactured for use at London Airport.

The Type S.232, which was announced early this year, is claimed to be the only crystal controlled radar of its type in the world. Operating in the 500-610 Mc/s band, it is virtually unaffected by rain and cloud, conditions which can on occasions hamper operations on the centimetric bands.

E.M.I. Suppliers, Ltd. — New Appointments

IT is announced by E.M.I. Suppliers, Ltd., that Mr. Kenneth Moore has now been appointed manager of their Trade Division, in succession to Mr. N. LeGassicke, who has left the company to take up an important appointment in the U.S.A.

Mr. Moore, who was educated at the City of London School, has been an executive in the company for some time past. From 1932 to 1941 he was connected with the electric lamp industry. Since 1945 he has devoted his activities to the promotion of sales in world markets in the electrical and engineering fields, having served as sales director on the board of a large engineering concern, and before taking up his present appointment was the export manager of Electronic Tubes, Ltd., of High Wycombe—an associated company of Electric and Musical Industries, Ltd.

Also newly appointed as assistant manager is Mr. Max H. Moss, who has been a prominent personality in the Trade Division for a number of years. Prior to that he was in the export department of a radio manufacturing company.

B.I.R.E.

THE following meetings will be held during January, 1956:

London Section. *Wednesday, January 25th*, 6.30 *p.m.*, at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1. Symposium on Electronic Methods of Pictorial Reproduction: "Facsimile Communication," by H. F. Woodman and P. H. J. Taylor; "Facsimile Transmission of Weather Charts," by J. A. B. Davidson; "Tone Reproduction with Electronic Stencils," by R. Lant, Ph.D.; "Electronic Engraving," by G. S. Allen.

North-eastern Section. *Wednesday, January 11th*, 6 *p.m.*, at the Institution of Mining and Mechanical Engineers, Neville Hall, Westgate Road, Newcastle-upon-Tyne. "Some Interference Problems Associated with the Television Service," by J. C. Belcher (Graduate).

West Midlands Section. *Wednesday, January 11th*, 7.15 *p.m.*, at Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton. "Computer Control of Machine Tools," by H. Ogden.

Scottish Section (Glasgow). *Thursday, January 12th*, 7 *p.m.*, at the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow. "Peaceful Uses of Atomic Energy," by Dr. K. G. McNeill. (Edinburgh.) *Friday, January 13th*, 7 *p.m.*, at

A bust of Guglielmo Marconi being unveiled in the Hall of Fame of the Engineering Societies Building in New York. On the right are Marchese Giulo Marconi and Mr. McGonigle, President of the Veteran Wireless Operators Association.

the Department of Natural Philosophy, The University, Edinburgh. Details to be circulated by local secretary.

South Wales Section. *Wednesday, January 25th*, 6.30 p.m., at the University College of South Wales and Monmouthshire, Cardiff. "Magnetic Amplifiers," by O. I. Butler, Ph.D..

£1 Million Radar Contracts

ORDERS for airfield control Radar Mk. VI equipment, manufactured by A. C. Cossor, Ltd., now exceed £1 million. Five are operational, including three overseas fittings—the Zurich installation, and two military versions for the Royal Netherlands Air Force—and 12 are still in process of manufacture for customers, including the Ministry of Transport and Civil Aviation and the Ministry of Supply. A number of major airports will be fitted, and already the installation at London Airport with its 14ft. diameter dish-aerial is a distinctive landmark to many thousands who use this airport or pass by it.

The A.C. R. Mk. VI—an S-Band (10 cm.) surveillance radar—pioneered M.T.I. operation and fixed coil displays and is used for short- and medium-range cover of an airfield and its approaches. It can be operated independently of any other radar, or in conjunction with Precision Approach Radar (PAR) to form a complete Ground Control Approach (GCA) system.

Radiotelegraph Circuit with Cambodia

CABLE & WIRELESS, LTD., announce that a direct radiotelegraph circuit for the exchange of international traffic with Cambodia has been opened between Hongkong and the Cambodia Administration's station at Pnompenh.

Coventry's Business Radio

AT the Leofric Hotel, Coventry, on December 6th, the voice of Harry Secombe, the celebrated radio and television comedian, who is appearing at the Coventry Theatre in the "1955 Birthday Show," was the first to be heard over a newly inaugurated communal business radio system which the Cambridge firm of Pye Telecommunications, Ltd., has set up at Meriden, the traditional centre of England, which is six miles outside Coventry.

The business radio station, which is an extension of the well-known police, taxi and ambulance radiotelephone schemes, is designed to enable industrialists who want to control their fleets of vehicles to do so both economically and efficiently over an area extending from Leicester to Wolverhampton.

The first two firms to use the new facilities are the Standard Motor Co. and the Rootes Group. Plans are already well advanced for a further half-dozen users to share the new station, which is capable of accommodating an almost unlimited number of others.

A morning schedule is being operated.

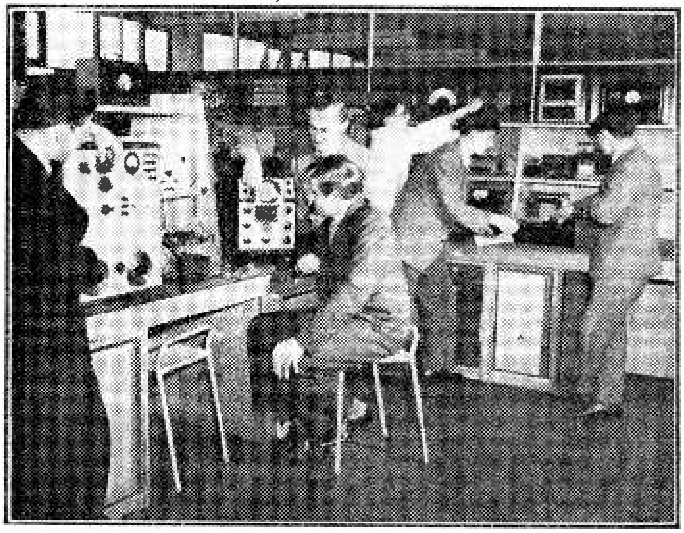
Tariffs are the same as for traffic on the Aden-Mukalla circuit (which opened in 1936) and at present are 2s. 7d. a word ordinary rate from Great Britain and 1s. a word between Aden and Mukalla.

E.M.I. Link with U.S.A. on Automation

LATEST move in the automation field is the newly-concluded agreement between the E.M.I. Group and the influential Cincinnati Milling Machine Co. of U.S.A. This agreement provides for the integration of the study and development of electronic machine-tool control equipment on the part of these two important specialist firms.

The Cincinnati Co. has an unrivalled world-wide reputation for milling and copying machines, while the activities of the E.M.I. Group cover all aspects of electronics, including automation, gunfire control computers, radar and navigation equipment and trainers, telemetry transmitters and guided missiles.

It was recently made known that E.M.I. have installed in a Norwich factory the first example of electronic analogue machine-tool control ever to leave the development laboratory of its designers and go to work on routine production in the factory of an independent user.



The Electronics Laboratory in the new North-west Kent College of Technology at Dartford.

U.K. Trade Correspondent in Newfoundland

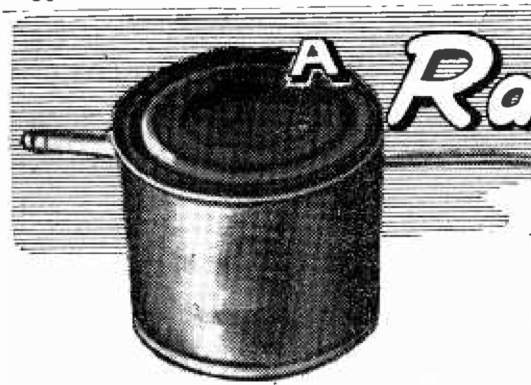
THE Board of Trade has appointed Mr. H. T. Renouf as United Kingdom Trade Correspondent in Newfoundland, to replace Miss W. Caldwell, M.B.E., who has retired.

Mr. Renouf's address is: Newfoundland Board of Trade, Water Street, St. John's, Newfoundland.

New Wireless Circuit in Middle East

A NEW wireless telegraph circuit is now being operated beween Aden and Meifaah, in the Eastern Aden Protectorate. The Aden end is operated by Cable & Wireless (Mid-East), Ltd., and the Meifaah end by signallers of the Hadrami Bedouin Legion.

Our next issue, dated March, 1956, will be on sale on Tuesday, February 7th



A Radio Jack

AN ACCESSORY FOR USE WITH TAPE RECORDERS FOR THE RECORDING OF BROADCAST SIGNALS

By J. B. Hughes, B.Sc. (GW3HMA)

MANY users of tape recorders are interested in recording a favourite radio programme ; there are several ways in which this can be done.

(a) A specially designed tuner, T.R.F. or superhet, can be constructed. This gives excellent results, of course, but is necessarily expensive.

(b) The extension L.S. terminals of the domestic receiver can be connected to the recorder input. This is a very useful method, but uses some needless mains power, and requires a monopoly of the set during recording.

(c) The microphone can be placed near the set speaker. While suitable for " emergency " recordings at very short notice, this method has many drawbacks, not least being the fact that the microphone is live, so that everyone in the room has to remain silent during recording. Also far more distortion is possible due to the introduction of the acoustic link, notoriously the weakest in the chain.

(d) A small crystal receiver can be built around a suitable jack plug, to fit directly into the " MIC " socket of the recorder. The present article is intended to point out the advantages of such a device, and to guide constructors.

The crystal tuner or " radio jack," as it is sometimes called, has the qualities of the familiar crystal set, with two exceptions, both of which enhance its usefulness. First, it has more selectivity, as the high impedance of the input of the recorder, intended for a crystal mike, causes far less damping of the tuned circuit than the usual headphone load. Secondly, since the amplifier is far more sensitive than headphones, a short aerial will often suffice for local station work. Indeed, the results obtained generally prove a pleasant surprise to the constructor.

The first and simplest tuner constructed by the writer has the circuit of Fig. 1. The component values were more or less decided by what was available as, with the exception of the tuned circuit values Lt and Ct, they are not extremely critical. The tuner was fitted into a small tin can, which was afterwards soldered up and painted. The tuning coil Lt was a medium-wave coil taken from a pre-war receiver ; it was already fitted with the aerial coupling coil La, and a movable dust-core by which it could be tuned. For this reason Ct is a fixed S.M. condenser the value of which was found by trial and error. For most M.W. stations it will lie between 100 and 500 pF.

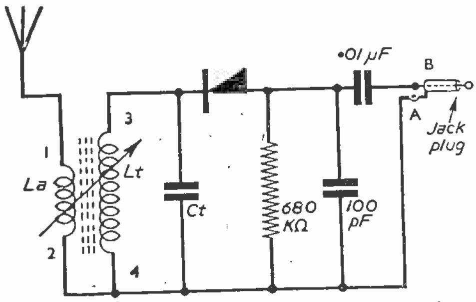


Fig. 1.—Complete circuit diagram dust-cored coil.

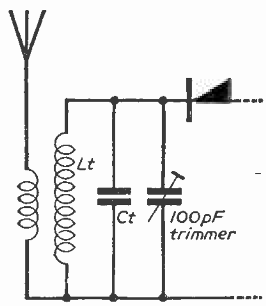


Fig. 2.—Alternative tuning arrangement using trimmer.

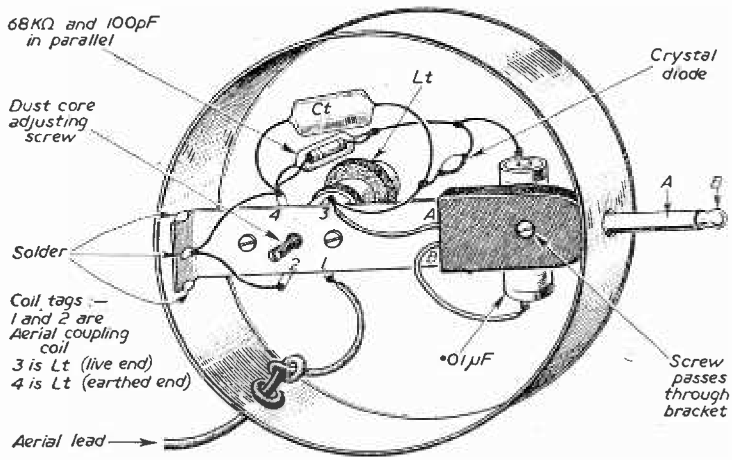


Fig. 4.—Sketch of complete tuner (cover removed). Note that the lead from A should go to point 4 not 3.

In the actual tuner shown, Ct was 220 pF to receive the Welsh Home Service on 341 metres. Lt could, of course, be any medium-wave coil such as the Osmor

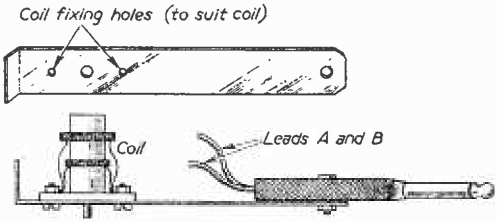
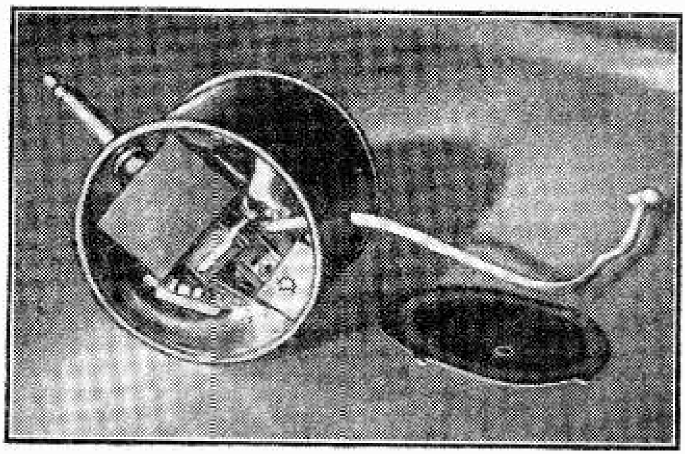


Fig. 3.—Details of mounting bracket.

or Denco types; if no dust core is fitted, final tuning adjustment can be provided by a 100 pF trimmer across Ct. The circuit of Fig. 2 shows the use of such trimmers instead of dust cores for adjustment.

The crystal used was a "surplus" germanium diode and the jack plug a standard G.P.I. type to suit the input of the recorder in use. This could naturally be altered to suit any desired input socket.



A view of the tuner with cover or lid removed.

It was found that a few yards of indoor aerial gave ample gain when the unit was plugged into the MIC socket of the amplifier—an E.A.P. type designed for the well-known Truvox desk.

If a suitable tin can is obtained or constructed the actual assembly of the tuner is fairly straightforward. In this instance a small right-angle bracket was made to support the coil; it was made long enough to enable the centre screw of the jack plug to be passed through a hole in the end of it, as shown (Fig. 3). Before attaching the plug the coil was screwed to the bracket and all the other components wired up around the coil as in Fig. 4. The bracket was then soldered into the can (it could be fixed with screws, but soldering leaves the outside of the can neater), and two ¼in. holes drilled; one in the side of the can to take the plug and the other in the lid in such a position as to enable screwdriver adjustment of the dust core (or trimmer, if fitted) to be made.

The jack plug was then pushed through the hole in the side of the can with leads A and B connected to it, and the centre screw passed through the bracket before tightening. With some shapes of tin it may be found easier to assemble the plug and coil unit before fitting into the can. Finally, a flying lead was connected to the coupling coil and brought out through yet another small grommet hole in the side of the tin (not forgetting to earth the other end of the coil).

The lid was soldered on and a coat of paint gives a pleasing finish, as well as protection: it also helps to "disguise" the homely tin can!

It is essential that the plug should protrude fully out of the can, otherwise it may not make contact when plugged into the socket. If wander plugs are used instead, the live lead should either be screened or kept as short as possible.

Useful modifications that might be made are the addition of a L.W. coil and switch or the provision of variable tuning by replacing Ct by a miniature .0005μF variable condenser.

It is possible that with some recorders, harmonics of the bias oscillator may cause interference by beating with the received station. The best cure is a good aerial system, possibly using a few feet of coaxial cable to bring the signal into the tuner.

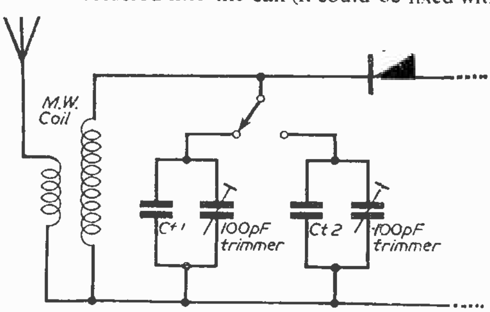


Fig. 6.—Two-station M.W. circuit.

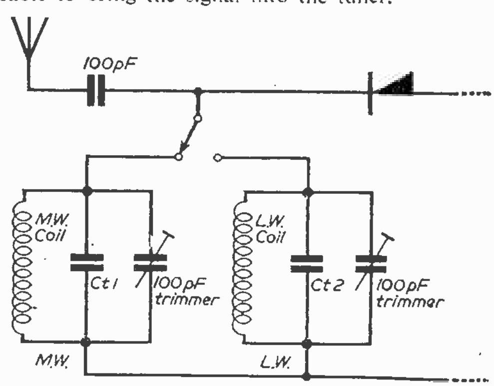


Fig. 5.—Two waveband tuner, Ct 1 and Ct 2 are chosen (between 100 and 500 pFs) to suit the desired stations as closely as possible, final tuning being adjusted with the trimmers.

PRACTICAL AMPLIFIER DESIGN

A NEW SERIES. 1.—TUNED AMPLIFIERS

By R. Hindle

Practical constructional details for various types of tuned amplifier. A series of articles forming a sequel to the theoretical series published some time ago.

THE theoretical considerations governing the design of amplifiers which ended in the April, 1955, issue, aroused considerable interest and many requests have been received for practical designs and layouts of various types of amplifier. It has accordingly been decided to give this information in the form of a continuation of the theoretical series and reference will be made to the theoretical considerations where necessary, although this series will be complete in itself.

A diversion will first be taken, however, to describe a simple unit which does not, at this stage, fit in with the series of chassis already begun but is even more universal in application and illustrates the simplest basic details of R.F. amplification, though it is unusual and interesting, besides eliminating the common pitfall to the beginner in R.F. amplifier design, i.e., instability.

Instability is caused by feedback from anode to grid, either through stray couplings arising from layout and wiring or (even though every possible constructional precaution is taken) through the grid/anode capacitance of the valve itself, and the risk of instability is very much greater if, as is usual, there is a tuned circuit at both grid and anode of the amplifying valve. In actual fact there is no need to have a tuned circuit at both grid and anode of the valve ; it is practicable to tune only the grid if a suitable aperiodic load can be provided for the valve and *vice versa*, the input signal can be applied directly to the grid and the tuned circuit placed in the anode circuit.

The unit first to be described is an R.F. pre-amplifier intended to be interposed between aerial and the aerial terminal of a receiver when receiving on the medium waveband, the intention being to increase the selectivity and sensitivity. Station selection on the medium waveband is a difficult problem these days due to the crowded state of the band so that it seems logical first to apply the knowledge of R.F. amplification to the improvement of this state of affairs. To make matters as simple as possible a single-tuned circuit will be used, as proposed above, so avoiding the problems of ganging and considerably reducing the risk of instability.

Position of Tuned Circuit

If the single-tuned circuit were placed at the grid there would still be, in effect, a tuned circuit at the anode, i.e., the circuit that is actually in the aerial circuit of the main receiver with which the unit is to be used and to avoid this would complicate matters, probably to the extent of requiring an isolating valve such as a cathode follower, a kind of amplifier later to be included in this series. It was decided, therefore, that the one-tuned circuit should be in the anode circuit of the valve. Thus two problems were posed ; firstly, the method of coupling the anode-tuned circuit of the pre-amplifier to the first tuned circuit of the main receiver and, secondly, the method of coupling the aerial to the grid of the pre-amplifier valve.

The advantage of a tuned circuit in the grid circuit is, as was seen theoretically earlier in this series, that the tuned circuit itself offers some amplification of the signal. This amplification has to be sacrificed, of course, in the present design. The input circuit now becomes a matter of aperiodically loading the aerial circuit (aperiodic simply means without tuning—i.e., equally effective at all the frequencies involved) and more or less elaborate ways of doing this have been evolved. It was found, however, that a load giving a very satisfactory voltage signal on medium waves was simply a resistance placed from aerial to earth, the grid of the valve being connected to the top of the resistor, i.e., directly to the aerial.

Modulation Hum

Most receivers are operated in houses wired for mains and there exists throughout the house a magnetic field due to the alternating currents flowing. This applies even where the supply is nominally D.C. because of the ripple in the D.C. supply. An

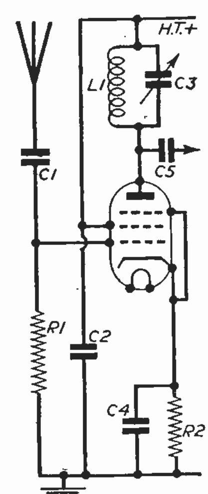


Fig. 1.—Basic R.F. pre-amplifier.

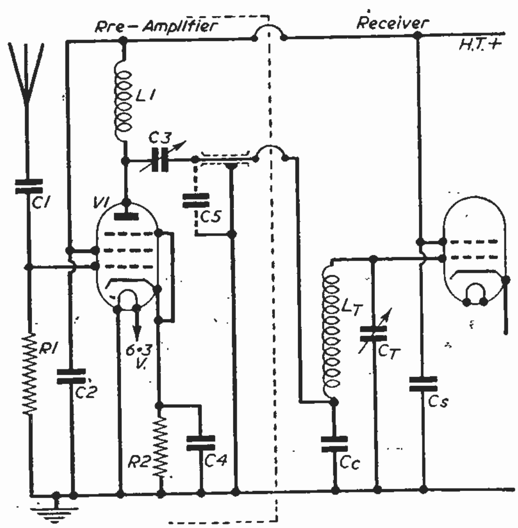


Fig. 2.—Pre-amplifier feeding into bottom-end coupled receiver.

aerial in such a situation has induced in it an A.C. hum potential due to this field and if there is a large impedance in the grid circuit an appreciable hum signal is presented to the grid of the valve to which it is coupled. Here it is cross-modulated on to the wanted signal by virtue of the curvature of the valve characteristic (giving the effect of partial rectification) and no amount of selectivity at a later stage will separate this hum from the wanted signal. The resulting hum is

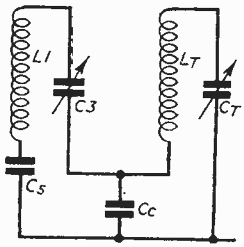


Fig. 3.—Simplified circuit indicating method of coupling.

called modulation hum and is indicated by the fact that it appears only when a station is tuned in but disappears when no station is tuned in or when the aerial is removed.

A resistance, as now proposed, in the grid circuit may well give rise to this modulation hum as its resistance is the same, more or less, to 50 cycles as to the R.F. signal, whereas a coil used in the conventional aerial tuned circuit has a very low impedance to hum frequency, which it virtually shorts out. It is found, however, that by feeding the aerial through a small capacitance which has a reactance at mains frequency very high compared with the resistance used there is no sign of modulation hum. This part of the circuit is represented in Fig. 1, C1 of 50 pF having a reactance of around 60 MΩ at 50 cycles compared with the value of R1 of 47 KΩ, which is the aerial load.

Valve Choice

Because the gain of a tuned circuit has been lost some thought was given to the possibility of increasing gain elsewhere. Firstly, the reduced risk of instability permits the use of a high efficiency valve such as would be very prone to instability with normal constructional methods if a tuned grid and tuned anode were used. A.V.C. was not practicable so a non-variable mu-valve was decided upon and, in fact, a Brimar 6AM6 was used. This is a high-gain valve having a μ of 7.5 mA/V.

Tuned Circuit

A further step taken to increase gain is with regard to the anode tuning circuit. The reader will remember that the effect of a parallel tuned circuit at resonance is that of a resistance of "Q" times the reactance of either the inductance or the capacitance (these two having equal reactance at resonance—that is the definition of resonance in fact). The size of the inductance is fixed by the need to tune

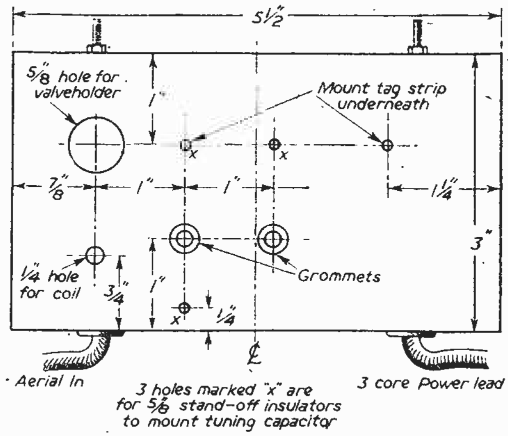


Fig. 5.—Top of chassis drilling data.

it over the normal wave-range by means of a standard 500 pF tuning capacitor but the Q is variable depending on the method of construction of the coil. It will be remembered also that a very high Q is not practicable in normal work because of the risk of instability. Here, however, the risk of instability has already been considerably reduced by the use of an aperiodic grid circuit and a tuned circuit of high Q in the anode is practicable. This will make up for both the loss of gain and the loss of selectivity due to the aperiodic grid circuit. Fortunately, there has recently been made available a new type of coil with phenomenally high Q of the order of 300. This coil, made by Osmor, is wound inside a pot core which completely encloses the winding, the medium-wave version having the list number QA51 and the long-wave version being the QA52; the former is used in the present case.

It was proposed to use this unit with the prototype of the Beginners' Superhet described in PRACTICAL WIRELESS in 1953, and in daily use by the author, so the coupling circuit between receiver and pre-amplifier was developed further. The Beginners' Superhet uses the Osmor coilpack which incorporates bottom-end coupling of the aerial on medium waves and the use of a small coupling capacitance such as intended in Fig. 1 would not be entirely satisfactory. The solution was found to be to use the bottom-end coupling capacitor of the coilpack as a common impedance coupling between the tuned circuits and the eventual circuit is given in Fig. 2. This shows also the appropriate components in the main receiver. LT being the medium-wave

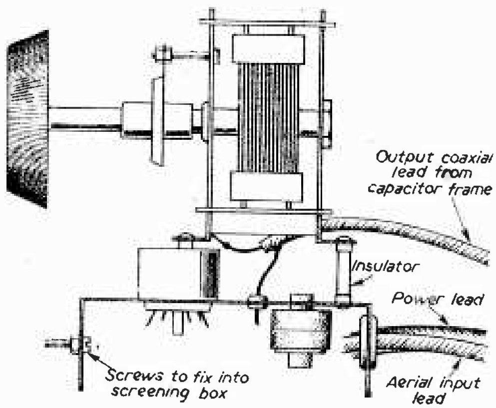


Fig. 4.—Wiring of the pre-amplifier.

tuning coil, Cc the bottom-end coupling capacitor and CT the grid section of the ganged tuning capacitor.

The tuning capacitor of the pre-amplifier is seen to be no longer directly across the tuning coil and the exact form of coupling may look a little obscure from this illustration, so the tuning and coupling circuit has been dissected from the complete diagram and appears in more understandable form in Fig. 3. It will now be seen that the pre-amplifier tuned circuit is still parallel tuned, being completed by Cs (which

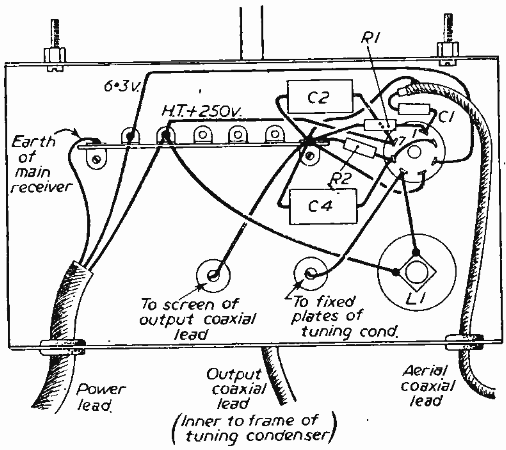


Fig. 6.—Underside of the chassis.

is actually the H.T. smoothing capacitance of the main receiver from which the pre-amplifier is intended to draw its power) and Cc, the coupling capacitor. The actual tuning capacitance is the resultant of C3, Cs and Cc in series, but as the latter two components are much higher than C3 in value the circuit is tuned, to all intents and purposes, by the value very little less than C3. Cc is clearly part also of the receiver tuned circuit and so voltages developed across it by virtue of its position in the pre-amplifier tuned circuit are transferred to the receiver tuned circuit.

If the pre-amplifier is to be used with a circuit using a transformer aerial coupling it may be better to revert to the circuit of Fig. 1. It will be necessary to keep the value of C5 low to prevent double-humping and a value around 10 pF is suggested as a start; one cannot be too dogmatic about size because the exact form of aerial coupling used in the main receiver has a bearing on the matter. The reader could well consider the modification of his receiver to bottom-end coupling to allow the use of the second circuit, construction of which is to be described in detail, if this is not already incorporated. It may, perhaps, be pointed out here that if, when the pre-amplifier is completed, the user wishes to reduce the degree of coupling offered by the circuit of Fig. 2 the method is to *increase* the value of Cc. It is unnecessary to alter the circuit of the main receiver: the extra capacitance is obtained by adding C6 (shown dotted in Fig. 2) so that on disconnecting the pre-amplifier the main receiver reverts to normal. The constructor will find it interesting to try different values at C6, say, starting at 2,000 pF and going up to .1 μF.

The pre-amplifier tuned circuit is seen from Fig. 2 to include Cs, the smoothing capacitor of the coil-pack, but this is very likely an electrolytic component and not necessarily suitable for R.F. work. To make quite sure C2, of .1 μF, is included in the pre-amplifier effectively in parallel with Cs.

The screen grid of the valve is taken to the H.T. line and C4, R2 provide the bias. If a volume control is wanted R1 could be made a potentiometer, but in the prototype no such control was provided and no tendency to overload was noticeable: only if the unit is to be used very near to a transmitter will a pre-amplifier volume control be necessary. Perhaps in this connection the constructor should be reminded that there is no tuned circuit to give a gain between aerial and grid in this design. As a result a much bigger signal can be accepted from the aerial without overloading than is the case with the more conventional circuit.

Gain

It is interesting to consider the gain theoretically possible from a valve used in this way. The equivalent resistance of a tuned circuit (at resonance) using a potentiometer cored coil is of the order of 300 KΩ at the middle of the medium wave range. Gain is given approximately by gm.RL, i.e., with the valve here specified 7½ × 300 or, say, 2,000 times. A valve in a conventional R.F. stage may give an amplification of 100 times (which, however, is increased by the gain in the input tuned circuit).

Construction

The construction of this unit is quite simple and is not likely to provide any pitfalls to the most inexperienced constructor. The prototype was built on an open-ended chassis 5½in. × 3in. × 1in. deep (a piece of aluminium, 5½in. × 5in., is folded at right-angles 1in. from the longer sides to give the cross-section indicated in Fig. 4). The drilling diagram for the top of the chassis is given in Fig. 5, but should be used with a little caution in case the components to be used differ somewhat in their dimensions. Holes are all ⅛in. in diameter except where grommets are indicated or where alternative sizes are given. The three holes marked "x" are for mounting the tuning capacitor and these, in particular, should be checked from the component actually to be used. The aim is to get this component as far back on the chassis as it will go to allow for the epicyclic reduction drive to be fitted to its spindle. Quite small grommets will suffice where these are indicated.

The positions of the holding down bolts for the valveholder are not indicated. It is best to punch the ⅝in. hole in the position marked (a tool such as the Osmor punch will give professional neatness to such work); insert the valveholder, rotate it until the pins are in the relative positions indicated on the wiring diagram, Fig. 6, and then mark the positions for the bolts through the valveholder holes. The specified coil is single-hole fixing. The substitution of an orthodox coil for the one specified will not give the same results, of course, because of the considerably lower Q.

Two holes are punched in the back of the chassis, one at 1in. from each end, as indicated. These are fitted with grommets; one takes the three-core power lead bringing the heater and H.T. supply from the main receiver and the other takes the coaxial cable from the aerial; the output signal is also carried by a coaxial cable but this is taken from the tuning capacitor on top of the chassis.

Two bolts are screwed to the front wall of the chassis, projecting outwards, and are used to fix the chassis to the lid of a screening box in which the unit is fitted. The use of such a box prevents interaction between the pre-amplifier and the main receiver where these are operated close together; whether it is necessary or not will depend on the nature of the receiver and the operating positions; the prototype was actually tested without such a box and there was no tendency to instability. This is again due to the avoidance of a tuned circuit in the grid circuit. The aerial must be brought to the unit through a coaxial cable, however, as shown. This is

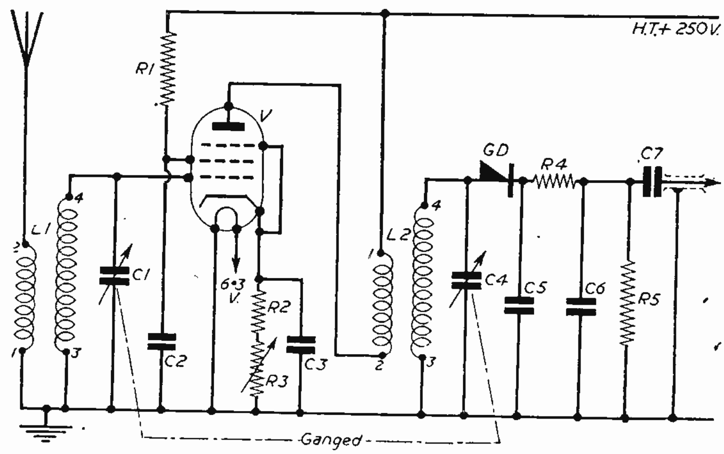


Fig. 7.—A T.R.F. tuner, the complete constructional details of which will be given next month.

actually a very neat way to do this in any case. The aerial and earth can be terminated in a coaxial socket into which the lead from the receiver or pre-amplifier is plugged, so avoiding the two trailing leads so often seen.

The chassis being prepared, the valve-holder, tag-strip and coil (which goes underneath the chassis) can be mounted. Note that the frame of the tuning capacitor must not be earthed as the moving plate connection has to be fed to the main receiver aerial input. Consequently the component is mounted on three ceramic stand-off insulators supplied by Jackson Bros., the makers of the tuning capacitor. Another point is that in the case of the prototype a valveholder with skirt was used so that, if necessary, a screening can could be fitted over the valve. The can was found to be unnecessary, but the constructor would be wise to incorporate this type of holder so that, if he finds it necessary, he can fit one.

To anchor the fixed part of the reduction drive it was found that a 1in. 6BA bolt fitted in one of the holes already provided in the end-plate of the tuning capacitor was correctly placed. Care has to be taken that no damage is done to the capacitor and that the head of the bolt is small enough to clear the vanes as they are rotated. Any kind of knob will do for the drive, of course, but the original was fitted with a 3in. graduated knob to make tuning easier and permit calibration.

Wiring

First, connect the heater, pin 4 going to the earth tag and pin 3 to the 6.3-volt tag, running close to the chassis all the way. Tinned copper wire, 22 gauge, in sleeving is the most convenient wiring material. Then wire in C2 and C4, making the leads at the valveholder end as short as possible. The remaining leads can follow in any order and the only point to note is that the aerial coaxial lead is taken right up to the valveholder. It is anchored by soldering the outer screen, after trimming back ½in. to allow connection to the inner, to the earth solder tag. C1 is then connected directly between the inner and pin 1 of the valveholder. The three-core cable is finally brought through its grommet and soldered to the tags, ensuring their accuracy by noting the colour of the leads; blue is used for earth, green for 6.3 volts and red for H.T. positive. Finally, the chassis is turned upright and the output coaxial fitted, going to the soldering point connected to frame and moving plates. The screen of this coaxial lead is connected, via a lead through the grommet, to the earth solder tag beneath the chassis.

Using the Pre-amplifier

The three-core power lead is connected to the appropriate points on the main receiver. It is convenient to fit a socket on the receiver to facilitate this connection. The output lead inner is connected to the aerial input of the receiver and the aerial and earth goes to the coaxial lead from the pre-amplifier. Now, when the receiver is switched on the pre-amplifier will also operate. It is a little tricky to tune because the pre-amplifier tuning has to be kept in step with the main receiver tuning but the operator soon becomes accustomed to this. After all, in earlier years, receivers almost invariably had two such tuning knobs. It should be remembered that the oscillator tuning of the main receiver will exert the main control of tuning and so if the pre-amplifier tuning is kept somewhere near to that of the main receiver, when the station is heard it can easily be brought exactly into tune by means of a final adjustment of the pre-amplifier knob. In practice there is a characteristic noise indicating coincidence of tuning and after little practice this is recognised.

If it is decided to mount the chassis in a screening can the lid of the can is drilled to take the two holding bolts and also to clear the tuning spindle. This must not be allowed to come into contact with the can or the output signal will be shorted out. The rear of the box is drilled to take the three cables.

A T.R.F. Tuner

The second unit to be described to illustrate the principles of tuned amplification is in the form of a more conventional R.F. stage. This is intended for use with the audio chassis already designed and full details will be given next month.

(To be continued)

TRANSMITTING TOPICS

CHOOSING A CIRCUIT

By O. J. Russell, B.Sc. G3BHJ

THE selection of a circuit for a transmitter may or may not follow orthodox methods. It is, of course, possible to operate with ultra-simple gear or with varying degrees of elaboration that lead to the ultra complex rigs bristling with voice-operated switches, automatic keys and fully automatic break-in facilities, plus motorised beams and direction indicators. However, from the viewpoint of the transmitter circuit there is often nothing to choose from the efficiency viewpoint between an ultra-simple rig and a highly complex one. Thus, on top band, where a single valve TX is often used to good purpose, one finds a number of published designs ranging up to the elaborate five-valve R.F. arrangement, plus additional valves for modulator service.

The selection of a particular circuit is, of course, largely a matter of taste, as it is possible to operate at high power with simple gear just as easily as it is possible to operate at low power with elaborate gear! It is interesting to examine the "family tree" of possible transmitter circuits, to select a suitable basis for a transmitter. The reason for additions and modifications may also be of interest in showing how transmitter performance may be improved by elaboration upon a simple basis. Accordingly, the "family tree" of transmitter circuits is shown in Fig. 1.

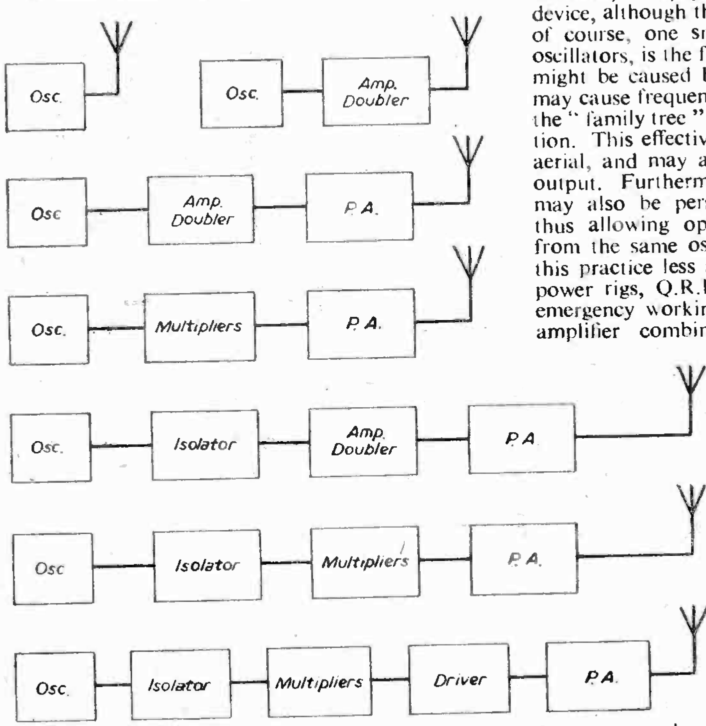


Fig. 1.—Illustrating the "family tree" of progressively more complex circuits in R.F. transmitters.

Simplest Scheme

The simplest possible rig consists naturally enough of an oscillator, or "other R.F. generator" . . . this qualification is necessary because a low-power S.S.S.C. generator is often used for low-power single-sideband working. However, even the simplest S.S.S.C. generator is far from the simplicity of a plain oscillator. While a plain oscillator is sneered at to-day, it is not generally realised that many historic DX "Firsts" were worked on plain oscillators. Moreover, many operators to-day still use plain oscillator rigs, and in some cases a plain oscillator is the only rig at a number of stations!

Despite the simplicity of the plain oscillator rig, however, it is, generally speaking, a "one band" device, although this is not necessarily so. Generally, of course, one snag, at any rate with self-excited oscillators, is the fact that aerial loading changes that might be caused by the aerial swaying in the wind, may cause frequency shift. Accordingly, we move on the "family tree" to the oscillator amplifier combination. This effectively isolates the oscillator from the aerial, and may also give a useful stepup in power output. Furthermore, in a simple rig the amplifier may also be persuaded to double or even triple, thus allowing operation on more than one band from the same oscillator frequency. TVI has made this practice less attractive, nevertheless simple low power rigs, Q.R.P. portables and stand-by rigs for emergency working consist of the simple oscillator-amplifier combination. Moreover, with modern valves it is quite feasible to run high power on the amplifier even when a low-power oscillator is used. For 'phone working we now have a choice of several modulation methods to apply to the amplifier without the snags sometimes met with modulated oscillators. The oscillator amplifier combination is, therefore, a more flexible and satisfactory form of lineup than the plain oscillator.

For multi-band operation it is customary to interpose a frequency multiplying stage between the oscillator and the power amplifier. Here again it should be remembered that an oscillator stage may in itself also serve as an oscillator-multiplier. However, TVI questions have led to a distrust of generating harmonics in profusion at the oscillator, and a separate multiplier stage is now generally favoured. Here again the "multiplier" stage may range from a single doubler stage up to several switched stages coupled by wideband couplers, so that many shades of complexity are possible. It is impossible to detail all the ramifications and modifications resulting from variations on the "multiplier" theme in this article.

There is one technique, however, which deserves a specific mention. That is the growing tendency to use an isolator stage between the oscillator and the rest of the transmitter proper. This is accentuated by the need in multi-band rigs to reduce oscillator instability, especially when multiplying up to the higher frequency bands. An oscillator sounding perfectly stable on the fundamental may often put out a very ragged note when monitored on its higher harmonics, due to the multiplication of oscillator instability by the order of the harmonic. Moreover, tuning of stages driven by the oscillator may cause undesirable reactions upon the frequency of the oscillator. To reduce these reactions, an isolator stage is employed. Generally, an isolator stage is run in Class A thus requiring very little drive, and is often very lightly coupled to the oscillator, so that inter-reaction is small. Often the isolator stage gives little or no gain, as its real purpose is not to give gain, but to isolate the oscillator from the loading effects of the rest of the stages in the rig. One popular method is to drive a cathode follower from the cathode of a Clapp oscillator as shown in Fig. 2.

Modulation, of course, may be applied in many ways to the transmitter circuits shown in the "family tree." Generally as indicated modulation is applied to the final stage of the transmitter. Thus a plain oscillator rig is amplitude-modulated directly, while more complex rigs are modulated at the output stage. However, there are important exceptions to this principle. First, it is common in some circumstances to modulate the driver stage as well as the PA stage. One example of this is in the well-known SCR522 transmitter often used on 2 metres. Here the driver stage is also modulated on the screen while the PA is anode-modulated. This method is often employed to give a more effective phone signal at V.H.F., where the "under-modulation" effect is often reported. However, it is not generally realised that a grounded grid PA must

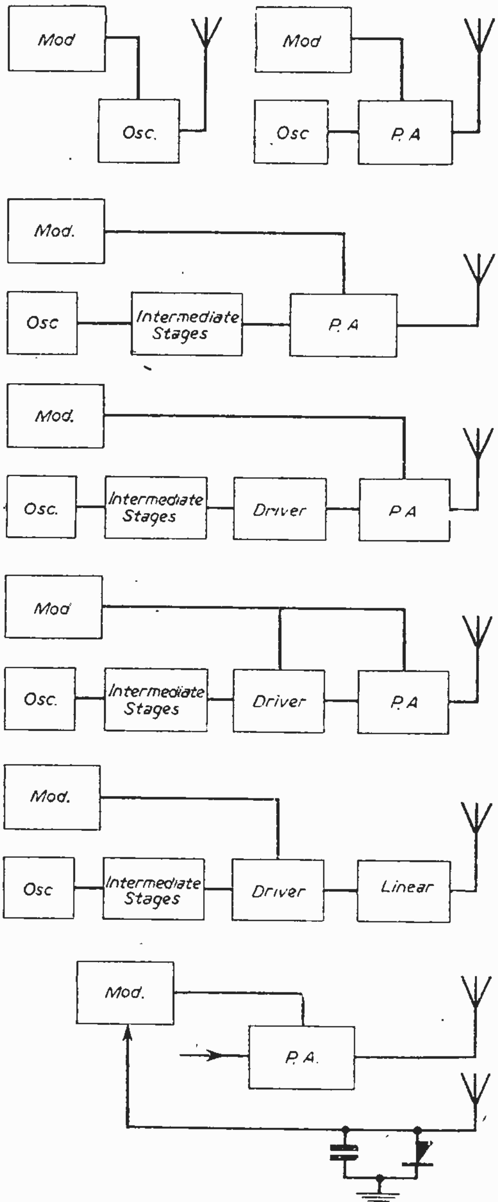


Fig. 3.—A "family tree" of modulation applications. The final system illustrates carrier derived negative feedback to the modulator.

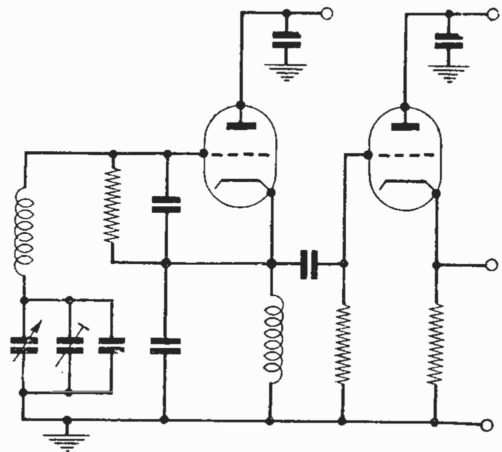


Fig. 2.—The use of "isolators" for reducing loading reactions upon the V.F.O. is an important part of transmitter technique. Illustrated is the popular and effective isolation system of a Clapp oscillator cathode coupled to a cathode follower isolation stage.

be driven by modulated R.F. if 100 per cent. modulation is to be achieved. This is because drive power from the driver appears in the anode circuit with grounded grid operation, and unless the drive R.F. is also modulated, 100 per cent modulation will not be realised. The actual percentage of modulation applied to the driver stage varies with operating conditions, and generally is less than 100 per cent. In any case the driver stage will need much less audio power than the PA for modulation, so that this modification may be useful to V.H.F. men who get those familiar reports of "under-modulation" on the V.H.F. bands.

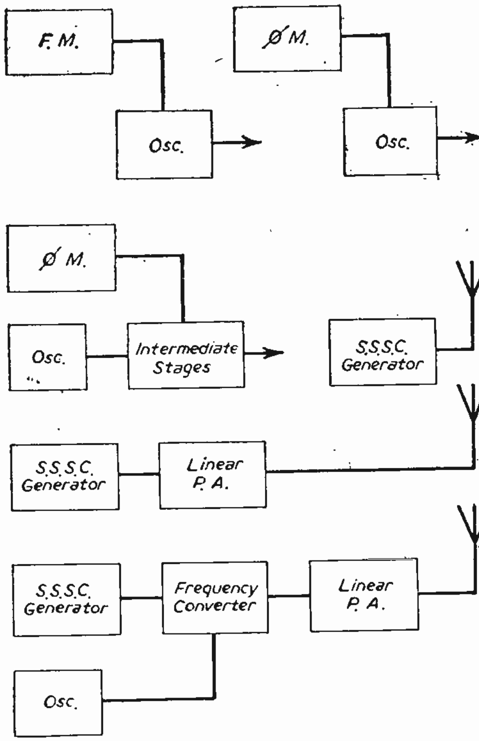


Fig. 4.—Various alternative "line-ups" are also possible in applying the more recherche modulation methods such as frequency modulation (F.M.), phase modulation (P.M.) and single sideband suppressed carrier (S.S.S.C.).

The above consideration leads finally to the modulation circuit in which only the driver stage is modulated. This is, of course, the familiar "Class B Linear" modulation system. When correctly adjusted the Class B linear amplifier accepts a modulated R.F. drive, and produces an amplified replica in its anode circuits. This permits of a small driver stage being modulated with relatively small audio power to produce a high power R.F. modulated output from the Class B linear stage. This is, in fact, an "efficiency" system as far as the PA stage is concerned, and the usual arguments apply to the power handling and dissipation figures of the PA valves. It is not often realised, however, that while ideally a correctly adjusted linear stage accepts a 100 per cent modulated drive and produces (ideally) a 100 per cent modulated output, in practice the adjustments of the Linear Class B stage may affect the modulation percentage of the outgoing signal! Thus, it is feasible to drive a linear amplifier with a signal of less than 100 per cent. modulation, and produce a 100 per cent. modulated output from the amplifier! Also a 100 per cent modulated drive to a linear amplifier may, if incorrectly adjusted, produce an over-modulated output! This is the usual result of what is effectively a grid-modulated efficiency system, that is, the R.F. conditions affect the modulation conditions. However, it is often convenient to be able to produce a 100 per cent. modulated signal from a driver stage that is not fully modulated!

There is a further, and nowadays more familiar use of the Class B linear stage, and that is in single sideband working. Most amateurs are acquainted with the needs of single sideband working, and the use of linear amplifiers to boost the small output of the S.S.S.C. generator to full power. Here the linearity of the amplifier is just as important as for amplifying a modulated wave. While the adjustment of a Class B linear amplifier for correct operation is not a matter for discussion in this survey, it may be of interest to those finishing their CW probationary period. Thus it might well be useful to commence orthodox telephony operation using a Class B linear amplifier. The experience gained would be very worthwhile should single sideband working be contemplated, as conventional A.M. operation could be started at once using a Class B linear amplifier. When the "bugs" had been removed from a single sideband exciter, the change to S.S.S.C. operation could be made. However, it is fair to say that much worthwhile S.S.S.C. working has been effected using only the small output from a S.S.S.C. exciter coupled directly to an aerial.

No mention to date had been made of N.B.F.M. operation. However, to complete the picture of circuits, these should be considered. N.B.F.M. is generally considered mainly from the angle of directly modulating an oscillator by a reactance valve or similar means. However, "phase modulation" methods may be applied to a buffer stage instead of to the oscillator if desired. This has advantages in cases where it is not convenient to tack a reactance modulator on to the oscillator itself.

While not exhaustive, it is hoped that the possibilities of variations on circuits has been presented in a useful manner.

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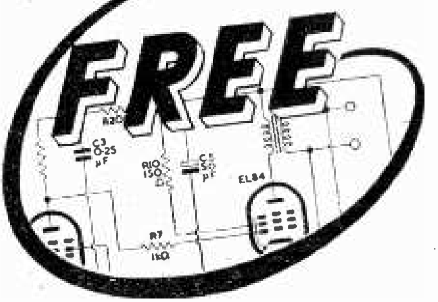

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A.F. and R.F. Generators

PRINCIPLES OF THE DESIGN OF TEST INSTRUMENTS FOR FAULT FINDING, ETC.

By F. G. Rayer

SIGNAL generators are used by almost all service engineers, and can enable stage-by-stage checks to be made with great ease and rapidity. Such instruments may readily be constructed in many forms, and may derive current from batteries, or in some cases from the receiver being tested. Or they may be operated from any mains point if a simple power-pack is incorporated.

Signal generators for amateur purposes may employ extremely straightforward circuits, or may be of a more comprehensive type with provision for band changing, etc. A generator which produces an A.F. output may be used for testing the A.F. stages of a receiver by injecting the oscillation into grid and other circuits working backwards from the loudspeaker. When the generator produces a modulated R.F. signal this can be traced right through the receiver. Apart from fault-finding, it may be used for alignment, trimming, etc., upon any wavelength to which it can be tuned. (And upon higher frequencies, also, by the use of harmonics.)

The simplest kind of circuits, using a buzzer, are shown in Fig. 1, but have only a limited field of usefulness. That shown at A gives an A.F. output which can be used for A.F. circuit testing. The note will depend upon the buzzer, which should be of the small enclosed type with a steady, high note. Only a very small dry cell will be required. At B the buzzer is made to energise a tuned circuit. The latter is adjustable to any desired wavelength by employing a suitable coil and condenser. The main disadvantage of this circuit lies in the broad tuning obtained, exact peaking of the generated signal not being easy, as it is with valve oscillators.

A.F. Oscillators

An extremely simple A.F. valve oscillator is shown in Fig. 2, and is of the type often used for Morse practice. As with the other circuits to be dealt with, the type of valve is not important. Any mains or battery types, other than output valves with large anode currents, may be employed. For 6.3-volt operation, valves such as the 6K7, 6J7, etc., are satisfactory, or the six-pin UX based types 6C6, 6D6, etc., may be used, if to hand. One or two valves of this kind may be operated from dry batteries if required, and oscillation may be achieved with very low anode and screen-grid voltages. A 6-volt dry battery is suitable for heater supply if no accumulator or transformer is available. If a 12-volt or similar supply is available, types such as the 12K7, etc., may be used. The seven-pin English-based valves such as the 9D2 (13 volt .2 amp.) are equally suitable and cheaply obtainable. For maximum battery life when batteries must be used, octal pentodes such as the 1A5G/GT or 1N5G/GT (1.4 volt .05 amp) are satisfactory, or miniature valves such as the B7G, 1S4, 1T4, etc. If to hand, the old type 2-volt 4-pin battery valves are perfectly satisfactory. Various obsolescent valves could also find employment in such circuits. Triodes need not be employed, but pentodes or screen-grid valves can be used. These may have screen-grid and anode wired together for use in triode circuits, or may have a separate screen-grid supply in the usual way. Where the suppressor grid has a separate pin this is wired to cathode or valve filament.

In Fig. 2, oscillation arises because of the coupling of the transformer. With this kind of circuit connections to one winding should be reversed if oscillation does not arise. Some control over the tone obtained may be had by adjusting the H.T. voltage, or by adding condensers in parallel with one or both windings to lower the frequency. The frequency may be increased by including a resistor (about 5,000 to 50,000 ohms) between transformer and valve grid. The output may be injected into any point in the receiver by means of an insulated lead and test-prod.

Fig. 3 illustrates a circuit which does not require a transformer. Separate valves, or a twin triode or other twin valve, may be used. None of the values are in any way critical, but to some extent govern the frequency of oscillation. With average valves and the values shown, the A.F. output frequency may be adjusted from a few cycles per second to the upper limit of audibility. However, an equal range is still obtained when some values are changed, and it is not necessary that both anode resistors and both coupling condensers be of the same value.

R.F. Oscillators

The simplest type of R.F. oscillator produces an unmodulated R.F. output—in effect this resembles the signal radiated by a radio transmitting station *when no programme of any kind is being broadcast.* As a result, no audible indication of tuning will be obtained unless the receiver is a superhet with beat-frequency oscillator (the latter is not present in domestic sets), or a T.R.F. receiver with reaction advanced to the point of oscillation. In such cases the usual whistle will be heard on tuning through the generator signal. Such an R.F. signal will also cause the A.V.C. system of a superhet to function, together with any associated tuning indicator, etc.

A circuit of this kind is shown in Fig. 4, and may, of course, be mains operated or employ a screen-grid

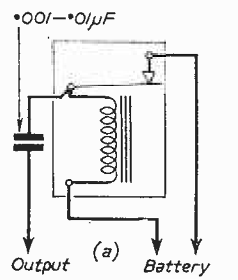


Fig. 1 (a).—Buzzer circuit for A.F.

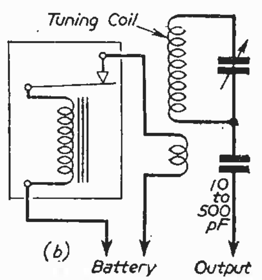


Fig. 1 (b).—Buzzer circuit for R.F.

or pentode valve. One or two points arise, an understanding of which will enable more advanced circuits to be followed readily. To begin with, an R.F. output is only obtained when the valve is oscillating. Feedback must, therefore, be sufficient for this state to arise. If the feedback coil is wired in the wrong phase, oscillation will not arise; insufficient H.T. or L.T. voltages will have a similar result. Secondly, the tuning coil may be of dual-range type (for M.W. and L.W. operation); or four or more "unit" coils may be switched in, so that all-wave operation is obtained. The coil or coils should thus be chosen for the frequencies to be tuned. The condenser may be a .0005 μF type, unless short waves only are to be provided, when a smaller capacity facilitates tuning.

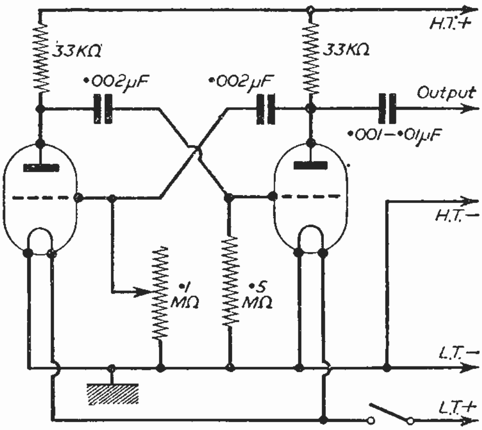


Fig. 3.—A Variable Switch A.F. oscillator.

The R.F. output is taken through a very small condenser. The value is not important but must be kept small, and two insulated wires, looped together, will be satisfactory.

Modulating the Output

When the R.F. signal is modulated the modulation tone is audible with an ordinary superhet receiver, or with a T.R.F. receiver which is not in a state of oscillation. Such modulation is thus usually required, though provision may be made to switch it out, when desired.

Fig. 5 shows a combination of the two circuits given in Figs. 2 and 4. The .0005 μF condenser is required in order that the R.F. oscillator may function, and the value is not in any way important. An A.F. output alone may be taken from the second valve anode, a condenser being included in the test-prod lead, as in Fig. 2. If an unmodulated R.F. signal is required, the second valve may be rendered inoperative by shorting the transformer secondary, or by switching the valve filament or heater off. With mains valves, care should be taken to see that the primary current of the transformer is not exceeded. If there is any danger of this the transformer may be resistor-condenser fed so that no primary current flows.

A further method of obtaining modulation is shown in Fig. 6, and only a single valve is required. Here, oscillation is so violent that grid blocking arises, causing R.F. oscillation to cease. As the grid charge leaks away through the 500K. resistor, oscillation recommences, and this is repeated rapidly, the frequency of blocking being controlled by the setting of the resistor. The result is a modulated R.F. output, tunable to any wavelength provided by the coils, and adjustable in tone, within limits.

For this type of circuit a fairly high degree of back-coupling is required, and the coil or coils may consist of a single winding, centre-tapped for earthing. For battery operation a valve of the output type (e.g., 1S4) is very satisfactory, and will operate with very low H.T. voltages. The R.F. type of valve, having a lower anode current, will require an increased H.T. voltage. Due to the manner of operation the H.T. current is extremely small, and if such

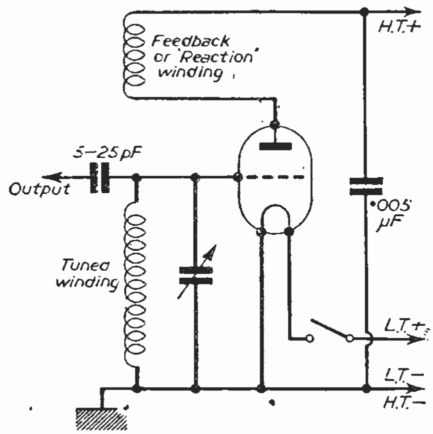


Fig. 4.—An R.F. oscillator (unmodulated).

a reading is discovered this does not indicate a faulty valve or other defect. The circuit has the disadvantage that the A.F. note changes, to some extent, according to the setting of the tuning condenser.

A Comprehensive Circuit

Fig. 7 shows a signal generator of more advanced type, with provision for band-changing and adjustment of R.F. and A.F. output levels. The first valve is an R.F. oscillator similar to those which have been described, and coils can be fitted for any required waveband. In order that the R.F. output may be reduced when dealing with receivers having enough amplification to make this necessary, a potentiometer is fitted in the R.F. circuit. The isolating condenser may be of 15 to 250

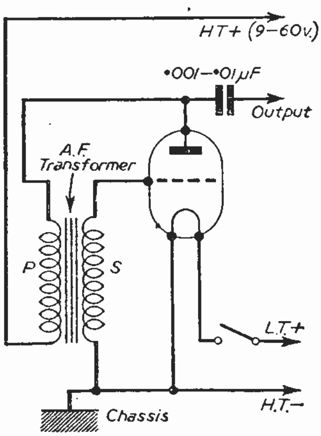


Fig. 2.—A One-valve A.F. oscillator.

pF. In practice the .1 megohm control will not usually give reduction in output to zero, due to capacity, but a good degree of control is obtained.

Modulation is arranged by feeding the A.F. signal to the R.F. oscillator screen grid, but anode modulation could be used. In this case the 50K fixed resistor may be omitted, and the R.F. valve anode connected into the anode circuit of one of the triodes. Again, no component values are critical.

Further, .1 megohm potentiometers allow A.F. output strength and frequency to be adjusted. The A.F. isolating circuit condenser may be of about .001 to .01 μF. Both isolating condensers should be of sound type (preferably mica) with high " voltage working " ratings, especially where mains equipment is employed. Both R.F. and A.F. output leads should

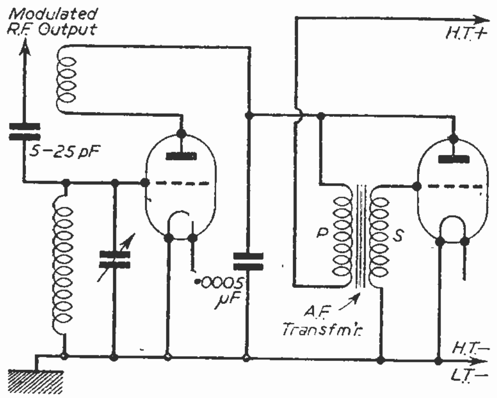


Fig. 5.—Modulation from an A.M. oscillator stage.

be screened, or sockets provided so that a screened test-prod lead can be plugged into either. Separate triodes may, of course, be used instead of the twin triode.

Practical Construction Points

To prevent stray radiation the R.F. type of unit is best enclosed in a stout metal cabinet, which will be bonded to the chassis. Without this precaution, direct radiation from the coils, etc., may be picked up at quite considerable strength by the receiver. With the A.F. type of oscillator, screening is not really required.

If the tuning ranges are to be provided with calibrated scales, rigid construction is absolutely essential, and the dial must be firmly fitted to the condenser spindle. Where the unit is to be employed for frequency checking purposes, a large dial, with reduction drive, will be required. The wavelengths or frequencies obtained at various dial settings may be found, as will be explained.

For some purposes no accurate indication of frequency will be required, and no particular care need be taken in this direction. Receiver and genera-

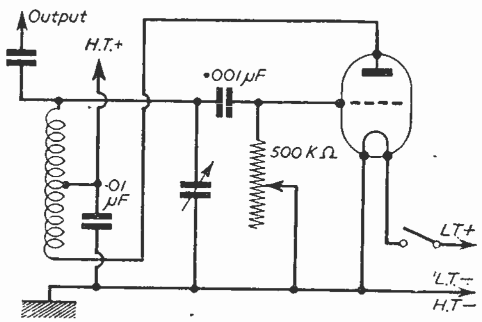


Fig. 6.—Modulation by grid blocking.

tor may be got on the same frequency by tuning until the note is heard, and a very simple scale of approximate frequencies or wavelengths, with large control knob, will then be sufficient for the unit.

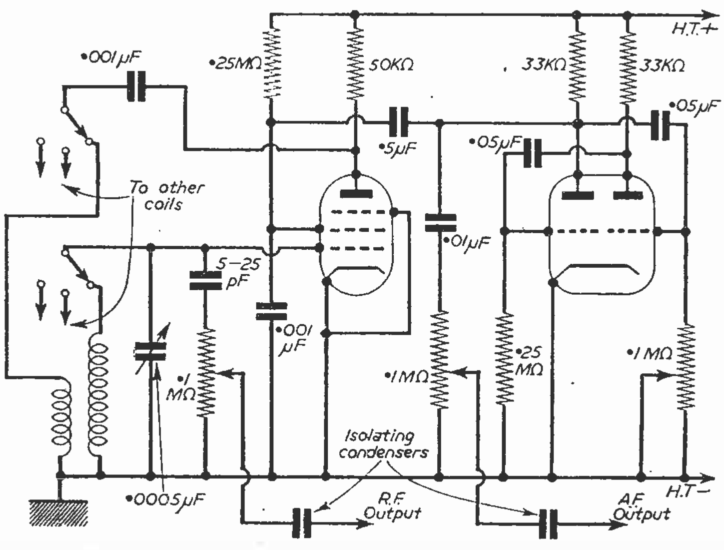


Fig. 7.—A comprehensive circuit for R.F./A.F. Generator.

Usually, results are not very good when operating such a unit from the same batteries as those employed with a battery receiver under test, because oscillations are introduced directly into the receiver through the batteries. This is particularly so with A.F. generators, where the H.T. battery is in poor condition. If such supplies must be used, the unit should be isolated by a circuit such as that shown in Fig. 8a.

For mains operation a suitable circuit is shown at "*b*" in Fig. 8. A.C./D.C. operation is not recommended unless essential, because H.T. will then be common with one mains lead. The transformer secondaries should have a rating suitable for the valve or valves in the generator. Though a metal rectifier is shown a valve can be used. The whole is best built in the same cabinet as the generator. The circuit in Fig. 8b is, of course, only suitable for A.C. mains.

Calibration

Assuming that a calibrated signal generator is not available for reference, a home-built unit of this type can be calibrated by plotting dial readings against the wavelengths of known stations. If the graph is fairly large, and care exercised, a high standard of accuracy may be achieved.

A receiver is also required for this method, and should be of selective type. A T.R.F. receiver fitted with reaction is highly satisfactory—if reaction is advanced to the oscillation point, both transmitter and generator may be tuned in so accurately that heterodyne oscillation in the receiver ceases. With superhets exact indication is less easy to obtain, though good results are possible. The volume of radio reception should be kept low by removing the aerial, or using a very short wire. Signal strength from the generator should also be kept low, so that a more accurate indication of tuning is obtained. A short wire from the generator output socket placed near the receiver aerial lead-in will usually afford sufficient coupling for calibration purposes.

To calibrate, a known station is accurately tuned in on the receiver. The signal generator is then tuned until it is upon the same frequency; the latter will then agree with the transmitter. When a number of points have been plotted, as shown in Fig. 9, the dial readings for other wavelengths (or frequencies) may be read off. Readings at the extreme minimum or maximum positions of the dial should not be employed. With some types of tuning condenser the graph line will be curved.

Finally, harmonics may be used to obtain further plotting points for the same, or other, ranges. For example, if the receiver is tuned to 250 metres the generator signal will be heard when the generator is tuned to 500 metres. The receiver may then be tuned up to 500 metres and left untouched while the generator is tuned to 1,000 metres, when its note will again be heard. Similar results may be obtained with any other wavelengths, the generator always being tuned to the higher wavelength (or lower frequency) when making use of harmonics. To avoid possible confusion due to third, fourth and other harmonics, the generator should always be tuned to progressively higher wavelengths (or lower frequencies) from the fundamental, until its note is heard.

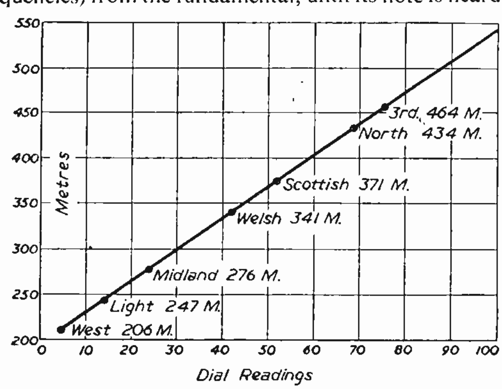


Fig. 9.—How to calibrate the dial from BBC transmitters.

This will then show it is tuned to twice the wavelength, or half the frequency, of the fundamental. In the same way, if the generator were tuned to 250 metres its note would be heard if the receiver can be tuned to

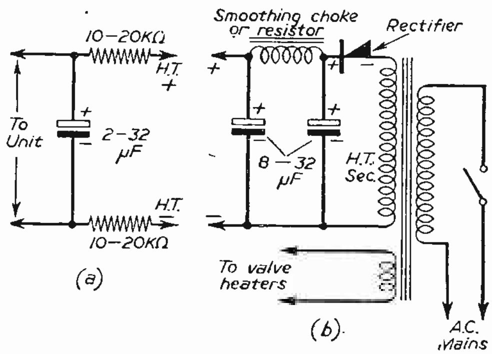


Fig. 8.—Isolating and mains circuits.

125 metres. The latter setting, left untouched, would then form a calibration point for the generator at 125 metres, and so on.

Radio in Mobile Warfare

EFFICIENT communications are of supreme importance throughout all formations in modern warfare, but nowhere is the need for speed and certainty of signals more vital than along a mobile battlefront, where complete co-ordination is essential between artillery, tanks and infantry.

The firms of Mullard and Plessey recently gave demonstrations of the latest British developments in mobile military radio equipment to representatives of Commonwealth, N.A.T.O., and other countries. The demonstrations, which were the culmination of a tour of Western Europe by two Army type vehicles containing the new equipment, took place recently at Chobham, Surrey. The vehicles, which are manned by members of the two firms, are now in Spain, a country not visited on the earlier tour.

It is hoped that, in addition to providing British forces with equipment of the first quality, a contribution to the export trade will result from the sale of this equipment overseas. In addition there are obvious operational advantages to be gained by the use of standard equipment by a number of co-operating armies.

Technical Improvements

The use of V.H.F. radio has made possible really reliable day and night short-range communications. The range of these sets, whilst being more than adequate for the purpose for which they are designed, is short enough to reduce considerably the risk of enemy interception.

In the design of all equipments, special attention has been paid to ease of operation; for instance, the frequency stabilities achieved are such that no "netting" is required, tuning being extremely easy and accurate. Servicing is made easy by unit construction and by designing the equipment for maximum accessibility, while the need for servicing is reduced by due attention to robustness and by sealing against dust and moisture.

On Your Wavelength

BY THERMION

Radio in Schools

I HAVE had a fair amount of correspondence from teachers and others concerning my recent note on radio in schools and particularly my comment that many of the instructors were not properly certificated teachers. The plain fact is that remark is true although it is equally true that having obtained a job as a teacher in handicrafts, the teacher must qualify by taking a recognised examination such as that of the City and Guilds of London. That is the least which should be recognised. There are other institutions that claim to train people, but membership, however, is available to all. There is no entrance examination, and in return for their annual subscription they are entitled to put certain letters after their names. Before joining such institutions you should first find out whether they carry any weight in industry and whether membership, associateship, or fellowship is recognised. Some of the associations are non-resident and claim to fulfil their object by organising conferences and lectures, which in many cases are a waste of time. I am always very cautious when dealing with an individual vain enough to try to impress me by appending after his name letters he has obtained for a guinea or so a year. Such a man is usually trying to hide his lack of knowledge, hoping that the recipient of his document is unaware that such letters carry no weight at all. I received a most bombastic letter from the secretary of a society which deals with handicraft, who objected to my comments about unqualified teachers. He claimed to speak on behalf of handicraft teachers but admitted that the letters which members place after their names are not recognised degrees. Membership is confined to those who have already obtained diplomas of the City and Guilds or who have spent two or three years in a recognised teachers' training college, and therefore membership is recognised as a standard of education because all members are recognised as qualified teachers by the Minister of Education. This is rather an inverted way of putting things. The Minister of Education recognises qualified teachers because of their C. and G. diploma, or their tenure in a recognised teachers' training college, which does not by a mere act of membership set a seal upon their qualification. I am informed that as from 1960 C. and G. qualifications will cease to be recognised for teachers, who must then pass the necessary examinations through a recognised teachers' training college. It is my view that to be qualified as a teacher of handicrafts, the prime requirement is that teachers should pass through an apprenticeship. Practical training demands practical and not academic qualifications. I see no reason why anyone should wish to duplicate the work of the City and Guilds of London Institute which is recognised throughout the world.

When it was my task to sub-edit manuscripts, I made it a rule to delete from an author's name all but recognised degrees. I also gave their manuscript more than an ordinary care in preparing it for press.

How Many Have You Built ?

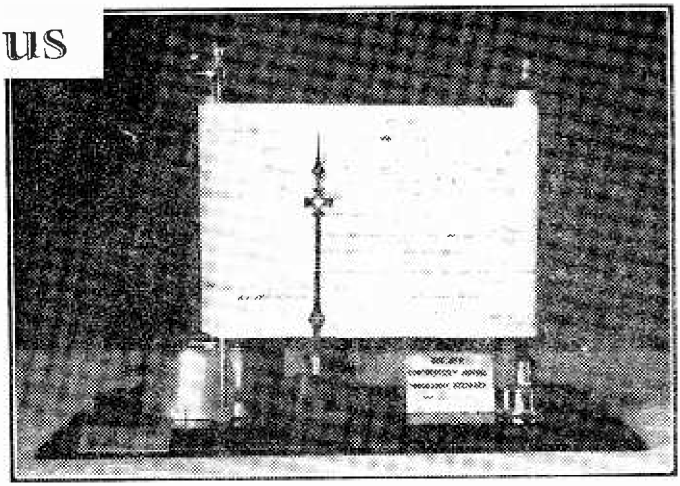
I RECEIVED a letter the other day from a reader who claimed to have built every receiver described in all the technical journals, from 1932 onwards. From his description of the circuitry of those receivers with which I am acquainted, and of his knowledge of the faults and defects of some of those early receivers, it is obvious that he has. I was interested, therefore, to probe the matter a little further, and asked him why he had been so prolific. His answer provided the solution. He was a dealer in the days when dealers encouraged the amateur by stocking components and often by lending their workshop for weekly meetings of the radio club. He felt it necessary to build the receivers as a test so that he could help customers who were in difficulty. That was the sort of dealer in existence in the early days of radio, but how different now. Few dealers will even take the trouble to order a component for a reader and that is why mail order firms continue to do such good business. Constructors should be grateful to them. In fact, most constructors now purchase their material by mail order. I asked this reader which set had given him the most trouble and he named a well-known reflex circuit (not sponsored by this journal). I asked him which had been most popular, and he had no hesitation in naming the F. J. Camm's "Fury Four." This set was widely advertised, and for the first time in the history of radio journalism the whole of the front page of the *Daily Mail* at a time when the *Daily Mail* took advertisements on the front page, was booked to advertise it. Even now the modified version is being built and readers are still operating the original version with modifications, such as tone control and single knob tuning. The original "Fury Four" did not use ganged tuning condensers and employed two H.F. stages. How many other readers can claim to have built so many receivers ?

An Early Book

BROWSING amongst some secondhand books in the Charing Cross Road area the other day, I came across "Practical Wireless Data Book," first published in 1923. I was interested to find out who the author was. It was the editor of this journal. Much of the data in that book is still up-to-date. PRACTICAL WIRELESS in those days, of course, was not born. I wonder whether the germ of PRACTICAL WIRELESS was in his mind in those days ?

A Continuous Programme Indicator

DETAILS OF A NEW COMMERCIAL AUTOMATIC SWITCH



A view of the completed indicator.

THIS instrument is the only machine in existence that shows listeners and viewers exactly what is on at a glance on every programme at every and any minute of the day, and enables one to choose the particular programme they most desire to turn on.

The fact of being able to see all programmes at a glance not only saves listeners and viewers the trouble of looking up each programme separately in the magazine, which in itself is somewhat of a tedious process, but being a slow and cumbersome method, the time taken often results in one missing the particular turn they much desired to hear or see. But with four programmes straight in front of one it is an easy and quick matter to know which programme you like and wish to choose.

How "The Indicator" Works

The driving power is obtained from an electric clock, which is secured horizontally on to the base board of the instrument. From the centre post of the clock (that is the minute hand drive) is secured a vertical post or drum. This drum, which is located on the left-hand corner, winds off a strip, which is approximately 6in. wide, from another drum on the right-hand corner containing the printed programmes for the week. In doing so all the programmes are drawn into sight on the window in front of the set. In the middle of the screen is a fixed pointer across which all the programmes pass with clock-like precision, enabling any programme to be read at a glance, at any minute of the day. When the programme strip passes the vision of the viewer the driving drum rolls it up neatly out of sight.

At the top of the picture is the date and the day of the week; this is printed in bold type to enable it to be read easily and quickly, and is in fact a revolving calendar. Next comes the exact time divided off into five minute spaces, and indeed is a clock. Next comes the Home Service, Light, and Third programmes, then the Television programmes. The strip is divided off so that each programme has its own horizontal space. Underneath the TV strip, or space, there comes another space that gives other interesting and useful information, such as sports events, etc : below this again we have yet other pieces of useful information—" postal information," phases of the moon, state of the tides, lighting-up times, etc. The final space, towards the bottom of the screen, is designed for an advertising medium, and should, as the programme indicator becomes more and more popular, be a most lucrative source of revenue to the manufacturers of the invention. Details of how the new reels are to be distributed each week have been carefully gone into and found highly practicable and easy and straightforward.

The patent specification includes the protection for the use of both types of clock driving mechanism—the electric clocks for listeners and viewers who are on the electric mains, and the spring wind mechanism for users who are not on mains and depend on batteries for working their sets—both of these new machines are now ready for inspection. This device is also intended to be incorporated in an ordinary wireless set, either built in from the start on new sets, and also even for altering old existing sets, enabling them to use this indicator.

The inventor is open to receive propositions from would-be manufacturers for the invention, and they should get in touch with the inventor and patentee: H. W. Bolsover, The Mount, Grosmont, Yorks.

Electronic Painting

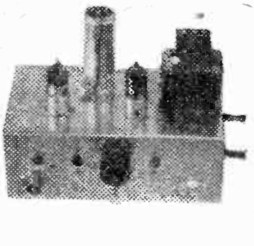
ELECTRONIC painting, in which the paint flies on to the object without use of brush or high-pressure spray, is being developed in Hungary's Red Star Tractor factory.

Parts to be painted are placed on a revolving stand surrounded by a copper-wire grid connected to the negative side of a 100,000 volts direct current supply.

Electrons flow towards the object to be painted—which is an earthed positive pole—creating an electrostatic field around it. Into this space is injected atomised paint from a low-pressure gun. The paint particles pick up the negative charge and fly to their " positive " target like filings attracted to a magnet.

According to the newspaper *Népszava* paint loss drops to 10 per cent. compared with 50 per cent. with normal spraying. Another advantage is that the operator can control the operation from a closed cubicle without fear of damage to his health from the paint.

So far the method has been used only for component parts, but plans are being made to adapt the method to painting whole tractors.



BAND 3 T/V CONVERTER—186 M/cs - 196 M/cs
£2 - 5 - 0 post free.

This Unit comprising drilled chassis. 7in. x 4in. x 2½in., two miniature valves and met. rect., wound coils, res., cond., etc., is a slightly modified version of the circuit shown in *Wireless World*, May, 1954. It has proved itself highly successful—over 3,000 sets have already been sold to buyers all over England. We invite you to visit us and see it in operation for yourselves. Suitable for most types of T/V sets. T.R.F. or Superhet. Blueprint and circuit details will be sent on application by return of post. 1/6. post free. Supply voltages required 200-250 v., 20 mA. H.T. 6.3 v. 1 a. L.T.

Power pack components to fit chassis as illustrated. 30/- extra. Complete set wired, tested and aligned ready for use 20/- extra. Band 1, Band 3 Ae switching can now be added, switch kit, 6/6. Full range of Band 3 aerials in stock. Adaptors from 7/6 per set, Dipoles-indoor 6/6. outdoor with cable 13/6. Band 1-Band 3 Cross-over filter unit, 10/6

Volume Controls

Midget Ediswan type. Long spindles. Guaranteed 1 year. All values. 10,000 ohms for 2 Meg.-ohms.

No Sw.	S.P.Sw.	D.P.Sw.
3/-	4/-	4/9

COAX PLUGS ... 1/2
SOCKETS 1/-
COUPLER 1/3
OUTLET BOXES ... 4/6

80 ohm CABLE COAX

STANDARD ¼in. diam. Polythene insulated. GRADE "A" ONLY.

8d. yd.

SPECIAL. — Semi-air spaced polythene. 80 ohm **Coax** ¼in. diam. Stranded core. Losses cut 50%. **9d. yd.**

TWIN FEEDER, 80 ohms, **6d.** yd. ; 300 ohms, **8d.** yd.
TWIN SCREEN FEEDER, 80 ohms, **1/-** yd.

50 OHM COAX CABLE 8d. per yd. ¼in. dia.

TRIMMERS, Ceramic, 4 pf.—70 pf., **9d.** 100 pf., 150 pf., **1/3** ; 250 pf., **1/6** ; 600 pf., **1/9. PHILIPS** Beehive Type—2 to 8 pf. or 3 to 30 pf., **1/3 each.**

RESISTORS.—Pref. values 10 ohms 10 megohms.

CARBON

20% Type. ½ w., **3d.** ; ½ w., **5d.** ; 1 w., **6d.** ; 2 w., **9d.**
10% Type. ½ w., **9d.** ;
5% Type. ½ w., **1/-**.
1% Hi-Stab. ½ w., **2/-**.

WIRE WOUND

5 w.	25 ohm—	1/3
10 w.	10,000	1/6
15 w.	ohms	2/-
5 w.	15,000—	
	33,000	1/9
10 w.	ohms	2/3

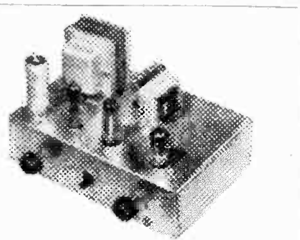
WIRE-WOUND POTS. Pre-Set Min. T.V. Type. Knurled Slotted Knob. All values 25 ohms to 30 K., **3/-** ea. 50 K., **4/-**. Ditto Carbon Track 50 K. to 2 Meg., **3/-**.

3w. LAB COLVERN, Etc. Standard Size Pots, 2¼in. Spindle. High Grade. All Values. 100 ohms to 50 K., **5/6** ; 100 K., **6/6.**

W/W EXT. SPEAKER CONTROL 10 Ω, 3/-.

CONDENSERS.—Mica or S. Mica. All pref. values. 3 pf. to 680 pf., **6d.** ea. Ceramic types, 2.2 pf.-5,000 pf. as available, **9d.** each. **Tubulars**, 450 v., Hunts and T.C.C. .0005, .001, .005, .01, .02, and .1 350 v., **9d.**, .05 .1 500 v. Hunts Moldseal, **1/-**. .25 Hunts, **1/6.** .5 Hunts, **1/9.** .1 1,500 v. T.C.C. (Simplex), **3/6.** .001, 6 kV., T.C.C., **5/6.** .001 12.5 kV. T.C.C., **9/6.**

SILVER MICA CONDENSERS.—10%. 5 pf. to 500 pf., **1/-**. 600 pf. to 3,000 pf., **1/3.** 1% 1.5 pf. to 500 pf., **1/9.** 515 pf. to 5,000 pf., **2/-**.



3 VALVE AMPLIFIER

With variable Tone and Volume controls. 3 Midget B.V.A. valves. 4 watts output. Neg. feedback. Chassis isolated from Mains. A.C. 200/250 v. A quality amplifier at an economical price. **PRICE £3.19.6.** Carr. 2/6. Wired and tested, **15/-** extra. Blueprint, circuit and instr., **1/6** (free with kit).

I.F TRANSFORMERS — 465 kc/s

Brand new ex-manufacturer's midget I.F.T., size 2½" x ⅞" x ⅞", dust core tuning. Litz wound coils, High Q. Bargain offer, 7/6 pair.

ALL WAVE RADIOGRAM CHASSIS
THREE WAVEBANDS FIVE VALVES

S.W. 16 m.—50 m.
M.W. 200 m.—550 m.
L.W. 800 m.—2,000 m.

LATEST MIDGET B.V.A. SERIES.

Brand New and Guaranteed. A.C. 200/250 v. Four positions. Wavechange Switch. Short-Medium Long-Gram. Pick-up connections. High Q iron-dust cored coils. Latest circuit technique, delayed A.V.C. and Negative feedback. Output approx. 4 watts. Chassis size 13½ x 5½ x 2¼in. Glass Dial—10in. x 4½in. horizontal or vertical type available, lit by 2 Pilot Lamps. Four Knobs supplied. Walnut or Ivory to choice, aligned and calibrated ready for use. Chassis isolated from mains. **PRICE £9. 15. 0** Carriage and Insurance. **4/6.** 8in. or 10in. speakers to match available.

BARGAIN VALUE IN RECORD CHANGERS

Recommended for above chassis

B.S.R. MONARCH.—Latest Model 3 sp. Auto-Changer Mixer Unit. Famous Magidisc. 7, 10 and 12in. Record Selector. Modern Cream Styling Dual Xtal Cartridge Stylus for Hi-Fi reproduction. As used by leading manufacturers. Bargain Price.

£8.19.6 Carr. ins. 4/6

NEW BOXED VALVES ALL GUARANTEED

1R5	7/6	6Q7	8/6	ECL80	12/6	MU14	8/6
1S5	7/6	6SN7	9/-	EF41	10/6	PCC84	12/6
1T4	7/6	6V6	7/6	EF50		PCF80	12/6
1S4	7/6	3X4	8/6	Mullard	10/-	PCF82	12/6
3S4	8/-	6X5	8/-	EF50		PL81	12/6
3V4	8/-	EA50	2/-	Equip.	5/6	PL82	10/-
3D6	3/6	EBC41	10/6	EF80	10/6	PL83	12/6
5Z4	8/6	EB91	7/6	EF86	13/6	PY80	11/-
6AM6	8/6	EBC33	8/6	EL41	11/6	PY81	12/6
6AT6	8/6	ECC83	12/6	EL84	12/6	PY82	10/-
6CH6	10/6	ECC84	13/6	EM80	12/6	SP41	5/6
6H6M	3/6	ECF82	13/6	EY51	12/6	SP61	6/6
6K7	6/6	ECH42	10/6	EZ40	10/-	U22	8/6
6K8	9/-					U25	12/6

SPECIAL PRICE PER SET.
1R5, 1T4, 1S5, and 3S4 or 3V4 ... ... 27/6
6K8, 6K7, 6Q7, 6V6, 5Z4 or 6X5 ... ... 35/-

SPEAKER FRET.—Expanded Bronze anodised metal 8in. x 8in., **2/3** ; 12in. x 8in., **3/-** ; 12in. x 12in., **4/3** ; 12in. x 16in., **6/-** ; 24in. x 12in., **8/6.** etc.

QUALITY FLUORESCENT FITTINGS

Ideal for home or workshop. 4ft., 200-250 v., complete with tube, ballast unit, etc., ready for use. Famous manufacturer's surplus offered at approx. half price. Starter switch type, **42/-**. Quick start type, **47/6.** Carr. and ins., 7/6 extra.

ELECTROLYTICS ALL TYPES NEW STOCK

Tubular Wire Ends		Can Types, Clips, 3d. ea.	
25/25 v., 50/12 v.	1/9	8+8/450 v. T.C.C.	4/6
50/50 v., 4/500 v.	2/-	8+16/450 v. Hunts	5/-
100/25 v.	2/-	16+16/275 v. T.C.C.	4/6
8/500 v., Dub.	2/6	16+16/450 v. B.E.C.	5/6
8+8/500 v. Dub.	4/6	16+16/450 v. T.C.C.	6/-
8+16/450 v. Hunts	5/-	16+24/350 v. B.E.C.	5/-
16/450 v. B.E.C.	3/6	32/350 v. B.E.C.	4/-
16/500 v. Dub.	4/-	32+32/450 v. B.E.C.	6/6
16+16/450 v. T.C.C.	5/6	60/350 v. B.E.C.	6/6
32/350 v. B.E.C.	4/-	60+100/350 v.	11/6
32/500 v. Dub.	5/-	60+250/275 v.	12/6
32+32/350 v. B.E.C.	5/6	100+200/275 v. B.E.C.	12/6

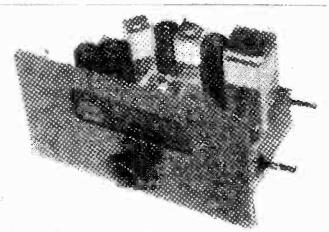
MAINS TRANSFORMERS.—Made in our own Workshops to Top Grade spec. Fully interleaved and impregnated. **RADIO AND AMPLIFIER TYPE.**—250 v., 60 ma. F.W. sec., 5 v. or 6.3 v. 1 a. rect. 6.3 v. 2.5 a. set Htrs., **21/-**, etc. **C.R.T. HTR. ISOLATION TYPE.**—Low leakage with or without 25% sec. boost voltage. Ratio 1 : 1 or 1.25, 2 v.s **10/6** ; 4 v., **10/6** ; 6.3 v., **10/6** ; 13.3 v., **10/6.** Ditto with mains primaries 200/250 v., **12/6.** Special, to order. **SPECIAL TYPES.**—To designers spec. Simplex, **35/-** ; Viewmaster, **35/-** ; Lynx, **30/-** ; P/W Tape Deck, **22/6** ; Soundmaster, **35/-** ; Mullard Amp., **35/-** ; Osram 912, **35/-**. **HEATER TRANSF.**—Prim. 200/250 v. 6.3 v. 1½ a. or 4 v. 2 a., or 12 v. .75, **7/6** ; 6.3 v. 3 a. or 5 v. 3 a., **10/6.**

L.F. CHOKES.—10 H. 65 ma., **5/-** ; 15 H. 100 ma., **10/6** ; 10 H. 120 ma., **10/6** ; 20 H. 150 ma., **15/6** ; Simplex, **10/6** ; Soundmaster, **10/6** ; P/W Q.R. gram., **13/6.** **OUTPUT TRANSF.**—Soundmaster **6/6** ; P/W Quality R/gram., **35/-** ; Osram 912 sectionalised windings, **£3.10.0.** Mfrs. surplus types; standard pentode, **4/6** ; ditto tapped prim., **4/9** ; small pentode, **3/9** ; Midget battery pentode (1S4, 3V4, etc.), **4/6.**

SOLON SOLDERING IRONS (200-220v. or 230-250v.) 25 watt, instrument type, **21/-** ; 65 watt, Pencil Bit Type, **26/8** ; 65 watt, Oval Bit Type, **25/-**. Comprehensive stock of spares available.

CRYSTAL DIODE.—Very sensitive. G.E.C., **2/-**.

RECORDING TAPE.—1200ft. reels, Scotch boy, **30/-** ; competitive paper type, **12/6.**



F.M. TUNER-UNIT (87 mc/s—105 mc/s), **by Jason.** —As tested and approved by Radio Constructor. Complete Kit of parts to build this modern highly successful unit, drilled chassis and J.B. dial, coils and cans, 4 B.V.A. miniature valves and all components, etc., for only **£6.10.0**, post free. **SUPERIOR TYPE GLASS DIAL.**—Calibrated in Mc/s and edge lit by 2 pilot lamps, **12/6** extra. Illustrated handbook with full details, 2/-, post free

TRS RADIO COMPONENT SPECIALISTS (Est. 1946)

70 BRIGSTOCK ROAD, THORNTON HEATH, SURREY (THO 2188)

50 yards Thornton Heath Station. Buses 130A, 133, 159, 166 & 190

Listed above are only a few items from our very large stock. Send 3d. stamp today for Complete Bargain list.

Hours : 9 a.m — 6 p.m. 1 p.m. Wed. OPEN ALL DAY SAT.

Terms C.W.O. or C.O.D. Kindly make cheques, P.O.s, etc., payable to T.R.S. Post/Packing up to ½ lb. 6d., 1lb. 1/-, 3lb. 1/6, 5lb. 2/-, 10lb. 2/6.

3-D Stereophonic Sound Is Here !

ANOTHER SOUND BARRIER OVERCOME BY TSL

GOLD PLATED DIAPHRAGM. With a gold sputtered polythene diaphragm for purity of tone these electrostatic loudspeakers, recently introduced into this country by TSL, are designed to reproduce the very high frequencies in the sound spectrum and to operate between 7 and 20 Kc/s where the ordinary dynamic loudspeaker sounds flat and lifeless when reproducing certain symphonic passages. To obtain life-like high quality reproduction and reception just add one or more high fidelity TSL electrostatic speakers to your receiver, radiogram, television or AM/FM receiver.

THREE MODELS AVAILABLE. To meet differing conditions and types of amplifiers, TSL market three models of their electrostatic "tweeters."

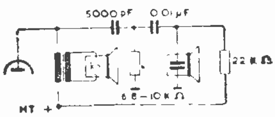
Type LSH 75. For single-ended output and small push-pull amplifiers.

Type LSH 518. A high output wide-angled model for medium power amplifiers.

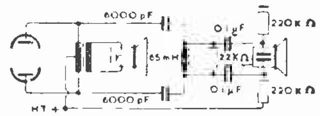
Type LSH 100. A high power diffused model for all classes of amplifier.

INSTALLATION.—TSL electrostatic loudspeakers must be operated from a high impedance source, i.e., from the primary of the existing output transformer. They are not suitable for connection at speech coil impedance.

FITTING A TSL ELECTROSTATIC SPEAKER to any ordinary receiver is simple—it merely entails the addition of resistors and capacitors. To fit an LSH 75 the best method is to suspend the unit centrally in front of the cone of the existing speaker. When two or more electrostatic units are to be added they should be mounted as near to the dynamic loudspeaker as possible. Leads from the equipment to the electrostatic "tweeters" should be kept to the minimum length.

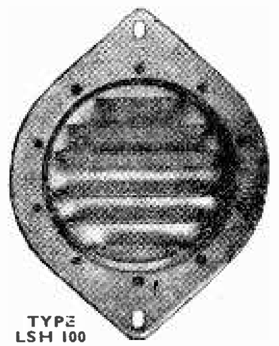


Circuit suitable for single-ended output.



Symmetrical Network for Push-pull.

CIRCUITS.—The circuits illustrated are but two of the many ways in which electrostatic units may be added to existing receivers and amplifiers. Circuit values are the same for each model. Resistor and capacitor, or choke and capacitor values, have been chosen to provide necessary filter constants to prevent frequencies of the middle and lower registers reaching the electrostatic units.



TYPE LSH 100

Type LSH 75, 12 6
Type LSH 518, 17/6
Type LSH 100, 21/-
(Purchase Tax free.)

Full instructional data supplied with each model. The frequency response of each model is identical and is as follows:—

3 kc/s	response	= +0dB
8 kc/s	,,	= +13dB
10 kc/s	,,	= +15dB
12 kc/s	,,	= +18dB
14 kc/s	,,	= +18dB
16 kc/s	,,	= +18dB
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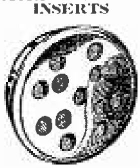

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A BEDSIDE TIME SWITCH

SWITCH-CONTROLLED RADIO AND READING LAMP OR OTHER ELECTRICAL EQUIPMENT

By K. V. R. Bowerman

SEVERAL manufacturers have produced radio sets which incorporate electric alarm clocks, the idea being that the clock, instead of ringing a bell or sounding a buzzer, switches on the radio and perhaps a bedside lamp as well. The sleeper is thus gently awakened by music to a room lit by the soft warm glow of the bedside lamp.

Unfortunately we cannot all afford to buy such a radio set. But if there is already an ordinary bedside radio and an ordinary clockwork alarm clock in the possession of the reader the same facilities can be provided at very little extra cost.

Modifying the Clock

Fig. 1 shows one of the more popular types of alarm clock, but the principle is the same no matter what type of clock is in use. Unscrew the winders and remove the screws which hold the back casing of the clock. Remove the casing. Bend the alarm striker so that, although free to oscillate, it cannot strike the bell or the side of the casing. Replace the casing, the securing screws and the winders. Give the "alarm" winder a few turns and set off the alarm. Note the direction of rotation of the winder. Solder a piece of the stiff wire or rod to the winder. The length of rod must be such that, at some point during the rotation of the winder, the end of it will touch the surface on which the clock rests.

If necessary, make a "set" in the rod so that it clears the mainspring winder, hand-setting knobs, etc., throughout its full extent of travel. At the free end of the rod slide on a piece of rubber sleeving (bicycle valve sleeving will do). Now secure the clock to the lid of the cigar box—at the front edge and at one end, as shown. With the type of clock illustrated it is necessary only to drill two holes in the base to take two small wood screws. Methods for other shapes of clock will no doubt suggest themselves to the reader.

Fixing the Main Contacts

From insulating wafers and a pair of relay contacts make up a contact assembly, as shown. Secure this to the lid of the cigar box (with two 6 B.A. bolts, nuts and washers) in such a position that the rod on the alarm winder closes the contacts when it reaches the end of its travel. It will now be seen that if the rod is turned as far as it will go in the "wind" direction it will travel back when the "alarm" goes off and will close the contacts.

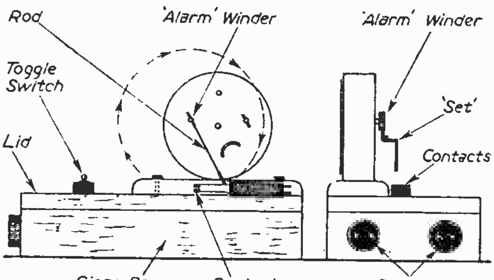


Fig. 1.—Views of the switch and contact mechanism.

Fixing the Relay, the Switch, and the Plugs

Open the lid of the cigar box with the clock and contacts attached and allow it to rest on a book or some other convenient support. Place the relay on the floor of the box close to one end, with the moving contacts uppermost. (See Fig. 2.)

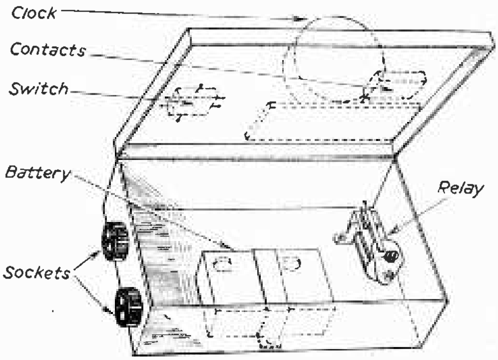


Fig. 2.—How the apparatus is housed in a cigar box.

Now cut a strip of thin tin or thin aluminium about 3in. long by ½in. wide, and drill a hole at either end of it. Pass the strip of metal over the coil of the relay and screw down the ends of the metal strip so that the relay is held lightly but firmly in position. This somewhat unorthodox method of fixing is not recommended for relays required for delicate work, but is quite satisfactory for this purpose. Drill two pairs of holes at the opposite end of the box to allow the passage of flex to the two 2-pin sockets which will be fixed there later. Drill a hole in the lid beneath the tags of the main contacts so that flex can be run through to the contacts. Drill another ⅜in. diameter hole at some convenient position on the lid to take the toggle-switch. Secure the toggle switch in position. Cut another strip of the metal large enough to make a bracket to hold the battery. Finally drill a hole at one end of the box for the mains lead.

Wiring

Plastic-covered flex is suggested for all wiring. Single leads can be made from flex which has been untwisted. If you are electrically minded the schematic diagram (Fig. 4) should enable you to wire up the unit without difficulty. If not, the point-to-point wiring diagram (Fig. 3) will help you. Note that for the clock contacts, relay contacts and switch contacts, wires will have to be soldered to solder tags. The other connections are as for ordinary electrical fittings (i.e., grub screws). The following sequence is suggested :

1. Solder two leads to the relay *coil* tags. Take one lead to one of the contacts on the box lid and the other to one side of the battery.

2. Looking at the switch from the back (see Fig. 3), join tag one to the vacant contact on the top of the box. Join tag three to the vacant terminal on the battery.

3. Take a lead from one of the moving contacts of the relay and measure off enough to reach tag four on the switch. Strip the insulation for about a ¼in. at this point but *do not cut the wire*. Solder the bared section of the lead to tag four, then run the lead to the holes for one of the two-pin sockets. Again bare the wire without cutting it and twist the bared portion into a point. Push this through one of the holes and secure it to one of the points of one of the two-pin sockets. Take the loose end of the lead and push it through one of the holes for the other two-pin socket. Cut it to length and secure it to one of the points of the second two-pin socket.

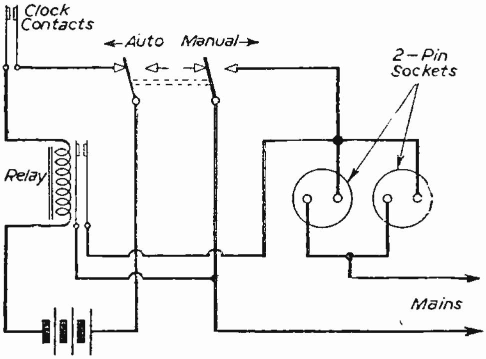


Fig. 4.—Wiring diagram of the mains switching.

4. Now take two yards of flex and unwind about 12in. of it. Take one 12in. length, bare the middle and solder it to tag six of the switch. Measure off enough of the other 12in. length to reach one of the vacant points of the two-pin sockets. Bare the end and secure it. This leaves one point of the two sockets vacant. Solder the end of this lead to the vacant relay tag. Measure off enough of the same lead, bare a ¼in. and twist the bare section as before. Secure this to the vacant point of the socket.

This completes the internal wiring. Secure the sockets to the side of the box with wood screws.

Connect one of the plugs from the two sockets to the two-yard flex lead from the cigar box. Connect your bedside lamp to the other plug.

Testing

Turn the rod in the " wind " direction as far as it will go. Set off the alarm and let the rod run back to close the contacts on the lid. The relay contacts should also close. If not, operate the toggle switch and try again. If the relay contacts close, and operation of the toggle switch causes them to open again, all is well with that part of the circuit. Close the lid and reset the rod. Now plug in the radio and bedside lamp to the two-pin sockets and switch the toggle switch to the " relay off " (Manual) position. Switch the radio on. Plug in the two-yard lead from the cigar box to your wall socket. The lamp should light and the radio should start to warm up. Operate the toggle switch (Auto). Both radio and lamp should cease working. Now set off the " alarm." As the brass rod comes round and closes the contacts on the lid the light should come on and the radio start warming up.

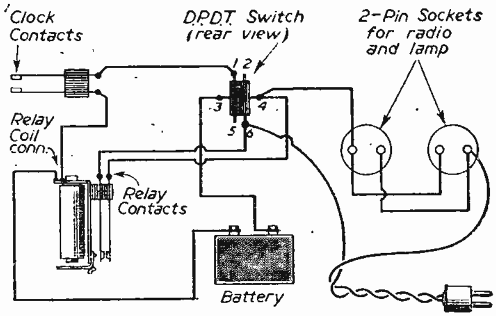


Fig. 3.—Complete wiring diagram of the installation.

Operation

Mark the switch " Manual " and " Auto " as indicated above.

Before retiring set, switch to Manual and wind the alarm clock mainspring. Set the alarm dial to the time you wish to be wakened and turn the brass rod in the " wind " direction as far as it will go. Switch on the bedside lamp and radio. Adjust the volume to the required level. When you are ready to go to sleep switch to Auto. This will turn off the radio and the light. At the time set on the alarm dial the radio and lamp will be switched on automatically. As soon as you are properly awake switch over to Manual, as this will disconnect the battery and enable you to work radio and bedside lamp independently in the normal way.

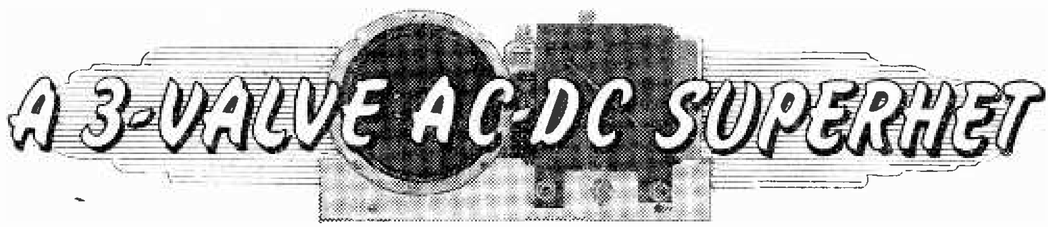
In this way the battery will last at least as long as that on any front door bell circuit.

The use of a relay in this circuit isolates the mains voltage from the clock contacts and it is, therefore, perfectly safe, provided the box is kept closed. If there are children about it is best to screw it.

Readers will, no doubt, be able to adapt this idea to suit their own needs. For instance, a more elaborate and craftsman-finished support for the clock might be devised and the clock contacts themselves could be partly concealed to make a really neat job.

LIST OF PARTS

1 P.O. type relay with one pair of heavy duty contacts.
1 4½ volt battery.
1 double-pole double-throw toggle switch.
2 2-pin plugs and sockets.
3 yds. of plastic flex.
Small length of stout rod in any solderable metal (4 B.A. screwed rod is suitable).
Piece of sleeving (valve rubber).
Relay contact assembly with insulating wafers.
Cigar box or other convenient container.



A "REFLEXED" RECEIVER USING THE MINIMUM OF COMPONENTS AND VALVES

By W. Sheppard, G2FUF

MOST constructors, when faced with the task of constructing a superhet, are deterred by three factors. These are : (a) Multiplicity of circuits ; (b) Complexity of circuits, and (c) Need for expensive instruments for lining up the I.F.s. The writer is no exception to the general class of constructors and had repeatedly sought the solution among published designs. But all failed to qualify in one respect or another.

So the writer decided to design and construct the simplest and best superhet possible in the light of general requirements. These were, that the receiver should be : As small and compact as possible without using expensive midget components. A.C./D.C. type. Capable of giving high-quality output. Be readily transportable.

Rather regretfully, the writer has to admit that he has not entirely been able to eliminate the need for expensive lining-up instruments, but a signal generator can be dispensed with if I.F. transformers of the recommended manufacturer are used. If others are used the lining-up procedure is given.

Since the writer is not a keen short-wave broadcast listener, and since the inclusion of a short-wave band would make the circuit unnecessarily complex, it was decided that the receiver would incorporate only long and medium wavebands. Within this specification surprisingly high-quality output has been achieved.

Circuit and Components

As can be seen, the circuit is the superhet stripped down to the minimum. There is little remarkable about it, with the exception of the 6B8. This valve is in a reflex circuit which has the advantage, not only of amplifying the I.F., but also of increasing the audio signal to obtain greater amplification without using an extra audio valve. The three valves used were chosen because of their ready availability from W.D. sources and consequent cheapness.

The I.F. transformers are Wearite 465 kc/s Series 500 and were chosen because of the superlative results that the writer has obtained with them in the past. Their connections are always plainly marked. However each constructor has his own pet preference where I.F.s are concerned.

The output valve is biased by a 150Ω 1 watt resistor and by-passed by a 25μF 25 v. tubular electrolytic capacitor. In the interest of quality, considerable experimenting was carried out to find the best bias combination and finally the writer decided on the combination shown. The midget output transformer should be the best the constructor has, or can afford, for the writer has found that more trouble originates in this component than is generally realised. The correct match in this case is 70 : 1 feeding into a 3Ω. 5in. Rola speaker. A tone controlling capacitor is connected across primary of output transformer.

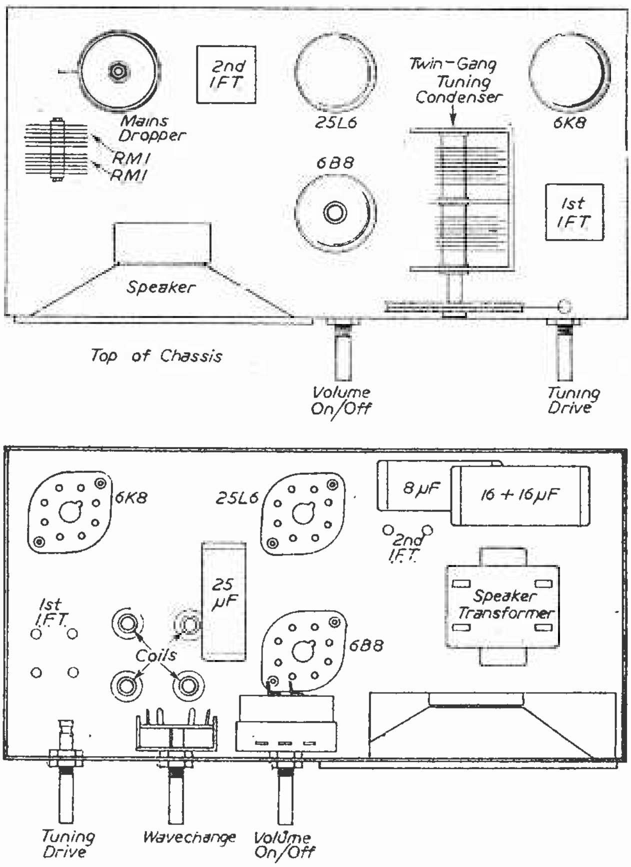
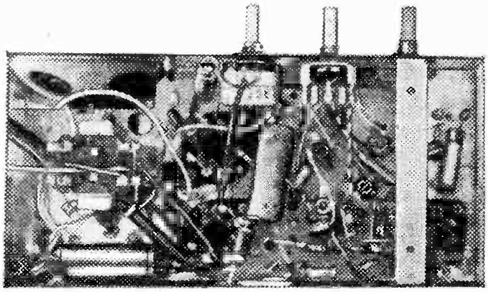


Fig. 1.—Above and below chassis wiring details.

The power supply calls for a little comment, particularly with regard to the selenium rectifiers. Two of these units (RM1's) are connected in series and before mounting them, the constructor should, in the interest of safety and expense, make quite sure that no little pieces of wire or solder are trapped between the vanes. It takes very little time to examine them carefully under a strong light. It is recommended by the makers that the RM1 rectifiers be mounted with the fins in a vertical plane. This is to allow the heat generated readily to escape.



Underside view of the chassis.

Details of their mounting are given in Fig. 4.

The mains dropping resistor is a 640Ω standard type. The writer's method of finding the correct resistance is to incorporate an "AVO" meter in the series heater chain and regulate the resistance until the correct current is flowing. In the case of the present receiver this resistance was found to be 643Ω. (See Fig. 5 for details of dropper connection.)

Although the mains dropper is mounted near the selenium rectifiers no trouble caused by heat should be noticed. Most of the heat from the dropping resistor will rise, and adequate provision is made, both for this component and that of the output valve, by the inclusion of a metal plate mounted on the back cover of the set. The plate is fitted so that it is about ½in. below the top of the cabinet when the back is in place.

The size of the plate should be such as to extend beyond the space occupied by the output valve and mains dropper. The heat is collected by the plate and deflected out of the holes in the back cover. This arrangement avoids the polish on the top of the cabinet being blistered by the heat developed from the components in question. (See Fig. 6 for details of plate mounting.)

Construction

A good idea of the layout will be gained from the photographs, but to facilitate the construction the valve holders should be bolted in position; then the coils should be mounted on the underside of the chassis. After this has been done the two-gang tuning condenser should be fitted, preferably on grommets to avoid any microphony. Next, the I.F. transformers and mains dropper followed by the output transformer. Finally, mount the rectifiers and all the other components.

Some constructors drill holes for volume controls,

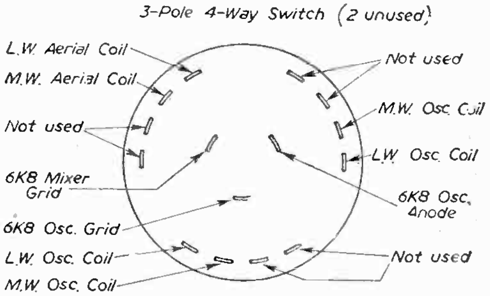


Fig. 3.—Details of the wavechange switch wiring.

LIST OF COMPONENTS

Resistors

- One 1 K 10 watt.
- One 5 K 3 watt.
- One 150 Ω 1 watt.
- Two 27 K 1 watt
- One 12 K ¼-watt.
- One 1 M Ω ¼-watt.
- One 27 K ¼-watt.
- One 470 K ¼-watt.
- One 100 K ¼watt.
- One 47 K ¼-watt.
- One 270 Ω ¼-watt.
- One 1 M Ω Volume Control with switch.

Capacitors

- Tuning Condenser. 2 gang 500 µµF.
- 16+16 µF, 500 µµF, 350 v. working.
- 8 µF, 500 µµF, 350 v. working.
- One 25 µF 25 v.
- Two 0.1 µF 350 v. working.
- Two .02 µF.
- One .0025 µF.
- Two .001 µF.
- Two 100 µµF.
- Three 500 µµF.
- One 150 µµF.
- One .002 µF.
- Four 50 µµF Trimmers.

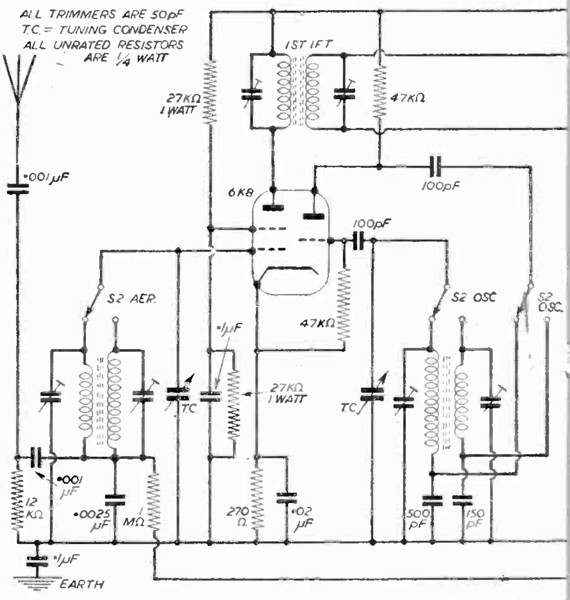


Fig. 2.—Theoretical ci

etc., after most of the wiring has been done, but the writer has had very little luck when doing this since swarf from the drill always manages to short circuit important components.

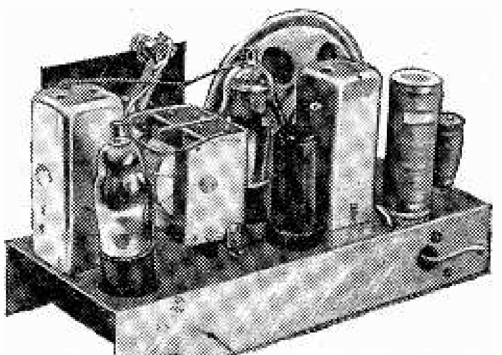
The loudspeaker should be mounted only after everything else has been done in order to avoid damage to the cone, and also to keep metallic particles from getting in the gap.

Wiring

Wire the heater chain first. It is advisable in the interest of low hum level to keep the wiring flat on the chassis and wherever possible into the angles and corners. The heater chain also includes the wiring of the mains dropper. This should be followed by the wiring of the rectifier and smoothing capacitors.

From here on, to avoid the possibility of missed connections it is recommended that the constructor should work backwards from the anode of the 25L6 output valve.

Wiring between the coils and wavechange switch should be kept short and direct, otherwise instability may be caused by interaction in the leads. Chassis connections of each stage should be taken to one point on the chassis.



Three-quarter rear view of the receiver.

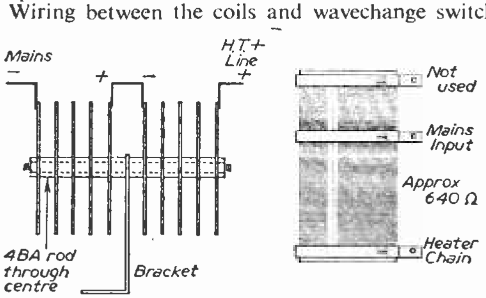
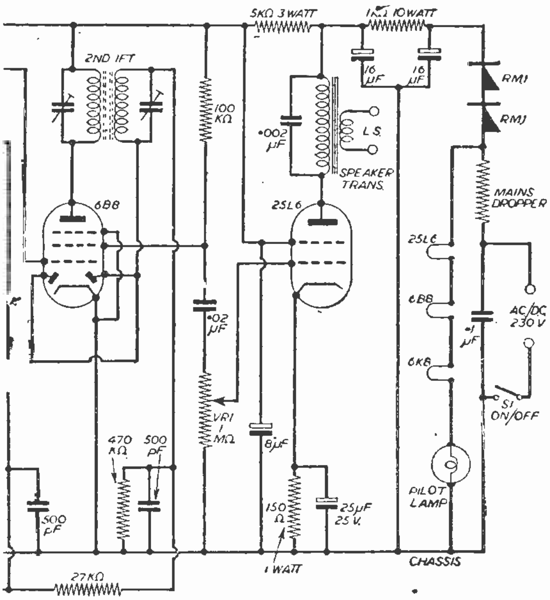


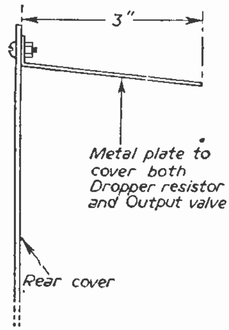
Fig. 4 (left) and 5 (right).—Mounting details of the rectifier and ballast resistor or voltage dropper.



rcuit of the receiver.

Wiring associated with the I.F. circuit should be kept short and the grid and anode leads of the I.F. amplifier must be kept apart, also in the interests of stability.

Fig. 6.—How to make the protective device to avoid the heat from the ballast resistor spoiling the cabinet.



Lining-Up

It will generally be found with the Wearite I.F. transformers that they are pre-tuned at the factory

LIST OF COMPONENTS

- One Set of L.W./M.W. Coils (Weymouth or Olympic).
- Two I.F. Transformers Wearite Series 500, 465 Kc/s.
- One 5in. Rola Speaker.
- Two R.M.I. Metal Rectifiers.
- One Midget Output Transformer, 25L6 to 3Ω (70 : 1).
- One Mains Dropper 640 Ω.
- One 3-pole 2-way Yaxley Switch.
- One Pilot Lamp and Holder.
- One Drive Spindle and Drum.
- One Tuning Scale.
- Three Knobs.
- Three Octal Valveholders.
- 6K8 Frequency Changer.
- 6B8 Reflex I.F. Amplifier.
- 25L6 Output.

and, consequently, only a very small adjustment is needed to compensate for the circuit changes in wiring capacity. This small adjustment is a simple matter and can be done without a single generator.

It is only necessary to tune a signal on Medium waves and adjust the I.F. trimmers for maximum output Should another type of I.F. transformer be used, a signal generator is practically essential. Procedure is as follows: The leads from the signal generator should be connected between chassis and top cap of 6K8 valve. The generator should be set to 465 kc/s. and once again trimmers or cores—depending on type of I.F.—adjusted for maximum output. This should be done on Medium wave with the tuning condenser at *minimum* capacity to avoid possibility of oscillator being tuned to I.F. frequency and so giving a false alignment.

Adjust on Medium waves first. It will be found that the oscillator trimmer affects the low wavelength end of the band and the iron-dust core will tune the high end. Calibration is best done on stations of known wavelength i.e. Light programme 1214 kc/s and Third programme on 647 kc/s. If in some parts of the country the Light programme is not well received, Luxembourg on 208 metres (approx. 1429 kc/s.) will be found a good substitute.

When the receiver has been calibrated to scale (normal long/medium scale) the aerial trimmers and core should be set for maximum output on same wavelengths as used for the oscillator.

The Long waveband is calibrated in a similar manner. Useful stations on this band are: Luxembourg on 1289 metres (approx. 232.6 kc/s.) and Radio Paris (approx. 164 kc/s.).

Housing the Set

When completed the set should be housed in a suitable cabinet, because the chassis is "live" to one side of the mains. For the same reason the greatest care should be taken to ensure that nothing metallic which is in contact with the chassis may be touched by the operator or any unsuspecting member of the household—children, etc. The back of the cabinet should be closed by some material such as cardboard, hardboard, etc., and all control knobs should have the grub screws of such a length that they are well below the surface, and the hole should be filled in with wax. Further information on the mounting of this type of receiver will be found on pages 113 and 114.

News from the Clubs

LOTHIANS RADIO SOCIETY

Hon. Sec.: John Good (GM3EWL), 24, Mansionhouse Road, Edinburgh. 9.

MEETINGS are held at 25, Charlotte Square, at 7.30 p.m. on alternate Thursdays.

January 12th.—Hints on Mobile Operation, a recorded lecture by C. H. L. Edwards, G8TL, from the R.S.G.B. tape library.

January 26th.—Band III Convertors, by F. Tuck, GM3BBW.

All new members made welcome. Instruction for R.A.E. and Morse classes now being held.

SOUTH MANCHESTER RADIO CLUB (G3FVA)

Hon. Sec.: M. Barnsley (G3HZM), 17, Score Street, Bradford, Manchester, 11.

THE future programme of lectures will be as follows:

January 13th.—"Hints on Soldering." G. Kenyon (G3HMF). "How to Solder Aluminium." P. Lougher.

January 27th.—"Transistors." P. Cone.

February 10th.—"Radar and its Applications." P. Cone.

We are also arranging a Hot Pot Supper to take place on Friday the 17th February, 1956, at the Wellington Hotel, Manchester. The cost will be 5s. 6d. Any person wishing to join us will be welcome and they should write to the Sec. to make the necessary reservation.

The Radio Amateurs Examination Course is now well under way. The meetings of this course take place on Mondays at 8 p.m. in the Headquarters at Ladybarn House, 17, Mauldeth Road, Manchester, 20. Quite a number of readers have joined the course and also become members of the Club.

THE HULL AND DISTRICT RADIO SOCIETY (G3AMW)

Hon. Sec.: M. P. Squance (G3HTB), 118, Wolfreton Lane, Willerby, Hull, E. Yorks.

THIS society moves to a new QTH 'The Royal Oak (Tony's)' from Jan. 10th.

Meetings are held every second and last Tuesday in the month the next few meetings being as follows:

Tuesday, Jan. 10th.—Open meeting and introduction to new QTH.

Tuesday, Jan 31st.—Annual General Meeting.

Tuesday, Feb. 14th.—Discussion Club Tx and Field Day 1956.

Tuesday, Feb. 28th.—Radar by R. Mayman, G2ABR.

CLIFTON AMATEUR RADIO SOCIETY

Hon. Sec.: C. H. Bullivant (G3DIC), 25, St. Fillans Rd., Catford, S.E.6.

THE two main programmes during November were a quiz on the 4th and a junk sale on the 18th.

Programme for January:

20th.—Constructional Evening and Ragchew.

13th.—To be arranged.

27th.—"Radio Astronomy" by S. Coursey, G3JJC.

Meetings are held every Friday at 7.30 p.m. at the clubrooms, 225, New Cross Rd., London, S.E.14, where visitors and new members will receive a warm welcome. Details of membership can be obtained from the Hon. Secretary.

ROMFORD AND DISTRICT AMATEUR RADIO SOCIETY G4KF-P

Hon. Sec.: N. Miller, 55, Kingston Road, Romford.

THE Society's winter programme includes film shows, lecturettes by members, construction evenings and the monthly "junk sales." The Club "net" meets every Saturday evening on 28 Mc/s, the participating stations being G3EBF, G3FKJ, G2FWJ, G2BVN and G3AUG.

The Society meets every Tuesday evening at 8.15 p.m. at RAFA House, 18, Carlton Road, Romford, and all visitors and new members will be warmly welcomed.

COVENTRY AMATEUR RADIO SOCIETY

THE forthcoming programme, at 9, Queen Road, at 7.30 p.m., is as follows:

Jan. 7th.—Children's Christmas Party.
Jan. 16th.—Station Descriptions.
Jan. 30th.—Two-metre Demonstrations.
Feb. 11/12th.—Affiliated Societies Contest.
Feb. 13th.—Aerials and Switches—G5GR.
Feb. 27th.—Junk Sale.
April 7th.—Annual Dinner (Barras House Hotel).

SPEN VALLEY AND DISTRICT RADIO AND TELEVISION SOCIETY

Hon. Sec.: N. Pride, 100, Raikes Lane, Birstall, Leeds.

JANUARY meetings:

January 11th—Film Show.

January 25th—2 metre Transmitters, by W. A. Thompson (G2FCL).

February 8th—2 metre Receivers, by W. A. Thompson.

The Annual Dinner has been arranged for January 21st at Dewsbury. Guest speaker will be Mr. B. Marsden of Associated Broadcasting Co., and late of Radio Luxembourg. Entertainment will be provided by a member of the International Magic Circle and Miss Glennis' Young Ladies. Free draws for equipment.

The annual trip will be on May 13th to visit a R.N. W/T station. Further details from Hon. Sec.

TORBAY AMATEUR RADIO SOCIETY

Hon. Sec.: L. H. Webber (G3GDW), 43, Lime Tree Walk, Newton Abbot.

REPORT of meeting held on Saturday, November 19th, 1955, at the Y.M.C.A., Torquay, at 7.30 p.m.

"The November meeting was held under the chairmanship of Frank Wadman, G2GK, and we were also pleased to see our president, Walter Sydenham, G5SY, who brought along some test gear to illustrate the recorded talk by Louis Varney, G5RV.

We were also pleased to see how well the recorded talk was attended—no fewer than 15 members turning up.

The chairman also mentioned that we were pleased to see Bern Symonds, BRS 19991, after his long spell of hospital.

The next recorded talk is to be "Inter-planetary Travel," by G2WS, and it is hoped that this also will be well attended."

Constructing A.C./D.C. Equipment

CONSIDERATIONS IN THE DESIGN OF "UNIVERSAL" SETS

By E. G. Bulley

WITH the ever-increasing use of A.C./D.C. circuits, either in television, radio or similar equipment, it is advisable that certain safety precautions are taken. The use of such circuits has, no doubt, reduced the cost of equipment in so far that no mains transformer is used. This cost factor naturally influences the amateur, experimenter or constructor; this article is, therefore, written in the hope that it will assist the newcomer to this field.

A.C./D.C. circuits employ valves that are designed with fairly high heater voltages, but although valves used in the same circuit may have different heater voltages their heater currents must be constant throughout. This can be clarified by assuming four valves in an A.C./D.C. circuit, the heater voltages being 50, 50, 6.3 and 6.3 volts, giving a grand total of 112.6 volts, the heaters being series connected. Each one of these valves must have the identical heater current, for example, 0.3 amps. One can, therefore, appreciate that to operate these heaters from the 250 volt A.C. mains supply (see Fig. 1), a suitable dropping resistance such as a line cord, barretter, etc., must be connected in series with the heater chain. Furthermore, whatever type of dropping device is used, it is essential that it must have the same current rating as that of the heaters. It is essential to bear in mind that as these heaters are in series, the permissible variation in mains voltage is much less than when valves are used in parallel.

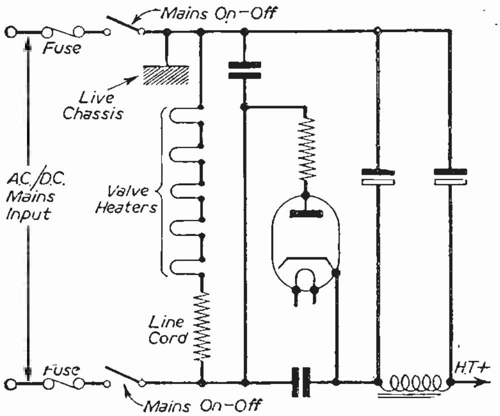


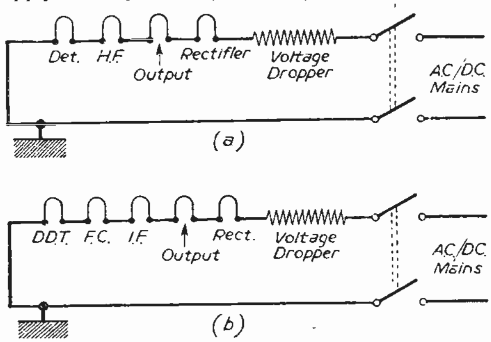
Fig. 1.—Basic circuit indicating heaters in series.

Precautions must, therefore, be taken to ensure that the value of current is correct at the average line voltage. This will assist the valves to withstand any mains fluctuation. It is advisable, however, to connect the various heaters in circuit in a definite arrangement. This applies mainly to radio reception. The reason for this is that it does avoid unnecessary mains hum being induced into certain valves such as detectors and frequency changers. The arrangement for series-connected valves can be appreciated by referring once again to Fig. 1. Many constructors may wish to include dial lamps in their particular circuit. This likewise must be of the same current rating as that of the valves, bearing in mind that such lamps are connected in series with the heater chain.

The Chassis and Earth

The chassis being in direct connection with the mains makes the construction of such equipment a danger to the inexperienced, and it is, therefore, essential that suitable safety precautions are taken. These precautions should not, however, deter the newcomer from using such circuits, but only assist him in safeguarding himself and any possible user.

Now, as the chassis is connected to one side of the mains, it is essential that one must not make any external earth connection to it, the reason being that it would be a direct short-circuit across the mains supply. It may well be, however, that if from a radio reception point of view an external earth is essential, then such an earth must only be made via a suitable condenser to chassis. Furthermore, it is also necessary to isolate the aerial in a similar way, that is, by a suitably rated condenser. Failure to do so in this case will cause the aerial to become "alive," dependent, of course, on which way round the mains plug is



Figs. 2(a) and 2(b).—Typical heater arrangement for a superhet type receiver.

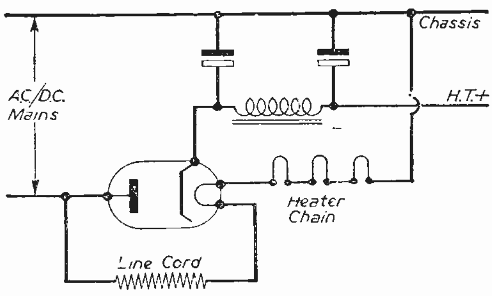


Fig. 3.—Basic half-wave rectifier circuit.

inserted in its socket. Reference to Fig. 4 will clarify this point.

An unearthed chassis is naturally dangerous from the point of view of electric shock. One must bear in

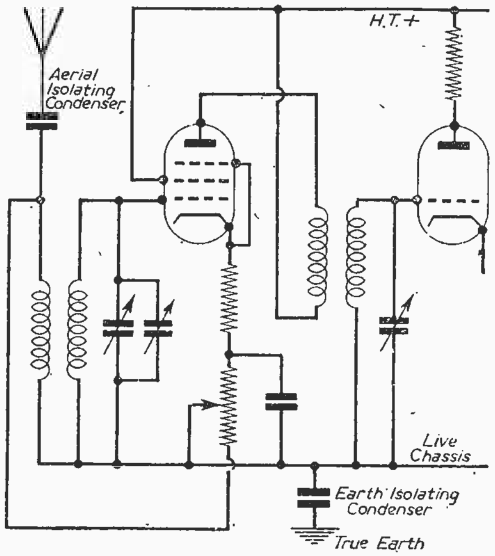


Fig. 4.—Isolation of aerial and earth.

mind that metal frames of volume controls, tuning condensers, etc., must have suitable insulated knobs attached to their spindles, either the push-on type, the outers of which lack any metal, or the type that have grub-screws which are set well below the surface. In the latter case, however, it is advisable to seal off the sunken screws with sealing wax.

Furthermore, it is also essential that on no account should exposed screws, speaker frets (metal), etc., be left unprotected ; it is far better to avoid entirely any external metal fixings and use a speaker fret of non-conductive material.

Many constructors prefer to include suitable R.F. chokes in the mains leads to prevent R.F. currents from entering the circuit. Biasing in such circuits is conventional and requires no further comment.

A.C./D.C. circuits utilise the half-wave rectifier

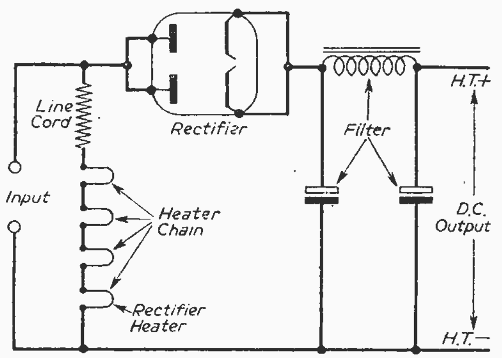


Fig. 6.—Half-wave rectifier circuit with full-wave rectifier valve.

power supply, but in many cases the voltage doubler circuit is used. These are shown in Figs. 3, 6 and 7. The latter method, however, enables twice the output voltage to be provided against that of a similar valve used as a half-wave rectifier on A.C. mains.

Power Supplies

Whilst we are dealing with the question of power supplies there is one that is becoming extremely popular with the amateur. It is, however, only suitable on A.C. supplies, but utilises the live chassis principle and likewise the same precautions must be taken. This supply does away with the voltage-dropping resistor and utilises only a filament transformer for lighting the heaters in the circuit, the A.C. mains being

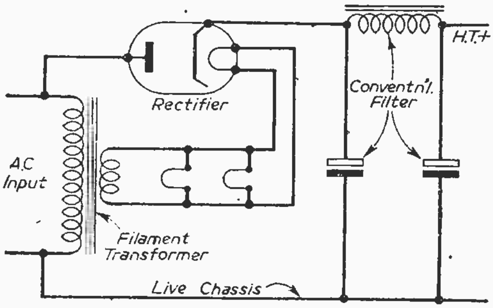


Fig. 5.—Using valves of different current rating, and avoiding the cost of a large H.T. transformer.

fed direct to the rectifier anode. Furthermore, in such an arrangement the heaters are wired in parallel and thus enables valves of similar heater voltages to be used but with different current ratings (Fig. 5).

In A.C./D.C. circuits an essential is free ventilation, and the cabinets should therefore be of material that has a good insulation property against heat as well as electrical power, bearing in mind that it is advisable for it to be free from all metal trimmings.

The next consideration is that of the mains switch, which is more than likely to be incorporated in the volume control. This should, however, be of the double-pole type, so that both mains feeds are broken when switched off. It is also advisable to include fuses, although not essential, one being in each mains input feed. This naturally depends upon the equipment under construction, but it does, however, offer further safeguards. With the absence of the mains transformer, the H.T. voltage is limited, and it is, therefore, advisable to use a P.M. speaker.

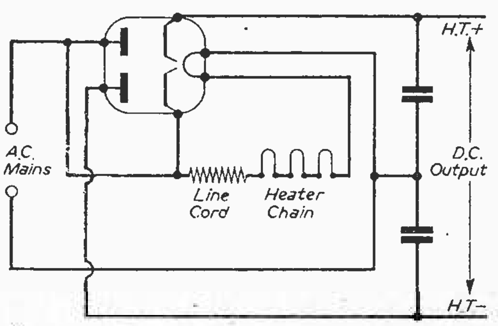


Fig. 7.—Basic voltage doubler circuit (full-wave).

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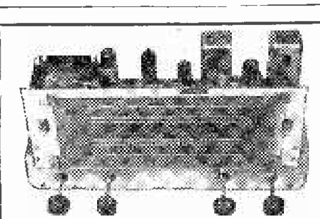
				35Z4



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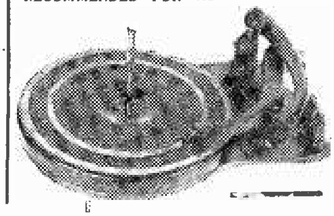

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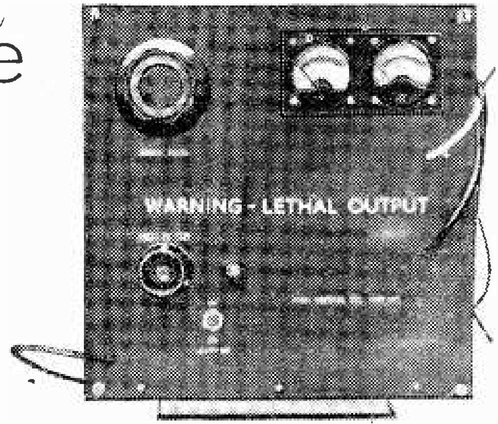


The finished instrument. Note the warning notice.

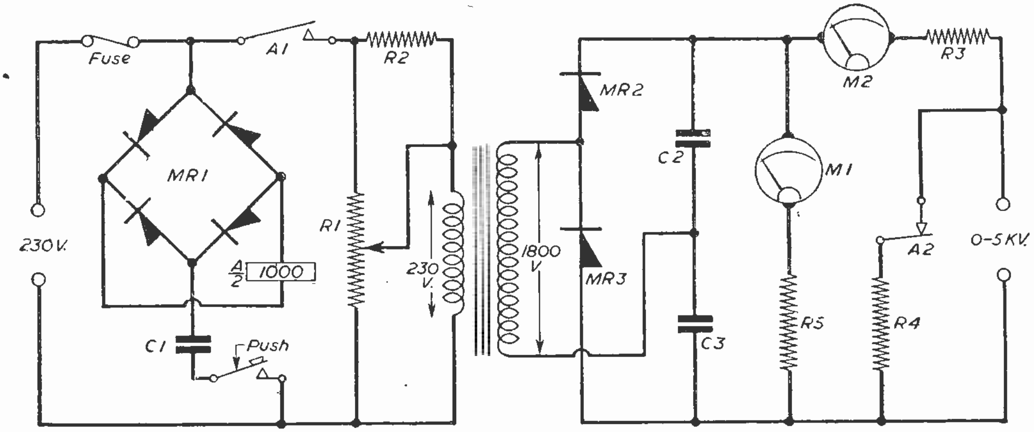
THIS instrument was constructed to provide a source of variable high-voltage D.C. for use in testing components and locating insulation breakdowns in equipment which normally operates with anode potentials of the order of 2,500 volts.

The power supply is entirely conventional, and the main points of interest lie in the measures taken to ensure the safety of the user and in low cost. The latter was considered of some importance in an instrument likely to have only infrequent use, and with the exception of the metal rectifiers most of the components were obtained from surplus equipment dealers.

A voltage-doubler circuit is used, which, with the particular transformer, gives a no-load output of approximately 5 kV. when operated from 230-volt mains. Should a higher voltage output be required, a trebler or quadrupler circuit or a different transformer may obviously be incorporated. Output adjustment is made by feeding the primary of the transformer from a heavy-duty potentiometer across the mains, in place of the more usual but more expensive Variac. To minimise heating of this potentiometer, current is passed only during the actual testing period.

Two points seemed of paramount importance from the aspect of safety. There should be no possibility of the output leads being alive except during the actual operation of a test, and, further, any capacitors in the apparatus being tested together with the capacitors in the instrument itself should be discharged rapidly upon removal of the testing voltage. This was accomplished by means of a Post Office type 3,000 relay, modified to handle the high voltage involved, and controlled by a push-button. The energising current is obtained from a small metal rectifier fed through a 1 μF capacitor from the mains. When in the released (non-energised) position this relay disconnects the mains from the transformer and potentiometer, and also places a discharging resistor (50 K ohms) across the output leads. A dangerous voltage is therefore available only whilst the push-button is depressed, and immediately this is released all capacitors are discharged rapidly. Breakdown of the apparatus under test may be noted from the milliammeter if a visible or audible arc is not observed.

The series resistor R3 comprises a chain of eight 100 K ohms 5 watt resistors, and serves to limit the short-circuit current to 5 mA. It is permissible, if desired, to increase this to 8 mA, the maximum rating of the rectifiers.



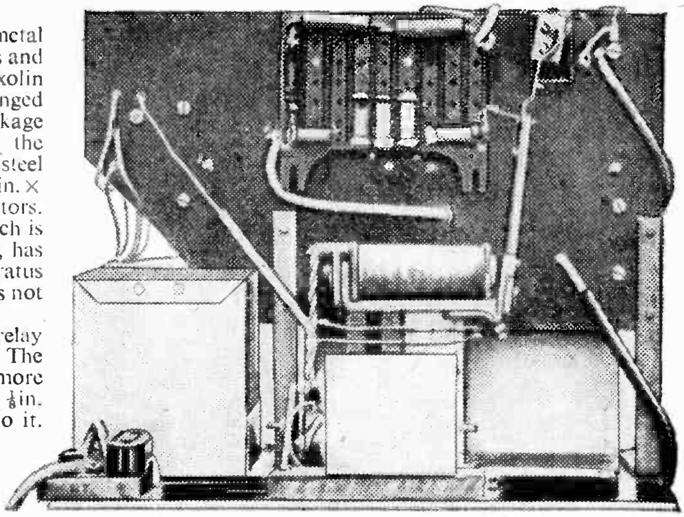
Theoretical current of the unit described above.

Construction

Constructionally the minimum of metal is used, all high potential components and connections being mounted on a paxolin sub-panel and paxolin brackets, arranged to give maximum possible surface-leakage paths and adequate clearance from the metal case. The latter is a pressed steel adaptable box measuring 12in. × 12in. × 6in., as used by electrical contractors. Incidentally, this type of box, which is obtainable in a large variety of sizes, has been found very useful for apparatus cases and chassis, where appearance is not of first importance.

The method of modifying the relay may be seen from the illustration. The armature is bent to give considerably more travel than normal, and a strip of ⅛in. paxolin about 4in. long is screwed to it. At the extremity of this strip a contact cut from an old relay spring is attached, connection being made by means of a short copper flexible braid. In the non-energised position this moving contact closes on a fixed contact which again is an old relay spring, suitably bent, fixed to the paxolin sub-panel. The normal relay contacts are used for switching the mains supply and are of the type specially insulated for this purpose. The spacing of these from the relay yoke requires to be modified to accommodate the abnormal armature travel.

In the interests of safety, in view of the high voltage available, it is desirable that the box should carry a suitable warning notice, as shown in the illustration on page 117.



Interior of the unit showing arrangement of the parts.

LIST OF COMPONENTS

R1—14 KΩ 20 watt.	C2, C3—0.1 μF 3.5 kV. wkg.
R2—3.3 KΩ w/w 5 watt.	MR1—32 v. 30 mA.
R3—8x100 KΩ 5 watt.	MR2, MR3—Westalite 16 H.T. 144
R4—5x10 KΩ 1 watt.	M1—500 μA scaled 0-5 kV.
R5—10 MΩ 3 watt high stab.	M2—5 mA.
C1—1 μF 500 v. wkg.	

Start of Pontop Pike V.H.F. (F.M.) Transmissions

THE V.H.F. sound broadcasting station at Pontop Pike near Newcastle-upon-Tyne is now in service. It is the first of the newly-built V.H.F. stations to be completed since the BBC's development plan for V.H.F. was announced in July, 1954. Wrotham was already built by that date. The station came into service at 6 p.m. on Tuesday, December 20th, and transmits the North of England Home Service on 92.9 Mc/s, the Light Programme on 88.5 Mc/s and the Third Programme on 90.7 Mc/s. The transmissions will be horizontally polarised.

The effective radiated power of the Pontop Pike transmissions will be 60 kW for each programme, and the area in which satisfactory reception is expected includes the county of Durham, almost the whole of Northumberland, and most of the North Riding of Yorkshire. This provides a valuable reinforcement of the existing long-wave and medium-wave transmissions and gives listeners in the north-east who provide themselves with V.H.F. receivers and suitable aerials the means of getting good reception of the three sound programmes free of interference. The Home Service programme broadcast as one of the three V.H.F. transmissions is the North of England Home Service and not the combined North of England and Northern Ireland programme which is, and will continue to be, radiated by the medium-wave transmitter at Stagshaw.

Practical Television

JANUARY ISSUE

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The January issue of our companion paper, "Practical Television," contains the preliminary constructional details for a tuner for use with straight, or T.R.F., receivers. Designed primarily for the "View Master" this tuner utilises a printed circuit—the first time that this type of component has been used in home-constructed equipment. The tuner has a three-position switch to provide the BBC Band I station and one Band III station, with the third position available at a later date for either another BBC station or an I.T.A. transmitter. Each position of the switch also has its own gain control so that each station may be adjusted to give an identical strength of picture.

Amongst the other items in this issue are a Viewing Lamp with adjustable brilliance, and a Two-band Signal Input Filter (often known as a "Diplexer" or "Combiner"), both practical constructional features. Other articles include the completion of the short series on the Alignment of Television Receivers, Converter Problems, the EF50 Valve, Band III Aerial Siting, Cathode-modulating the VCR97, Ion Trap C.R. Tubes and Aerial Feeder Design for Band III. The regular features also appear.

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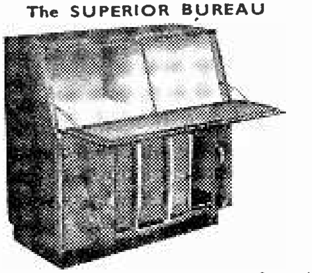

An elegant cabinet in richly figured walnut veneer, internal panels in polished sycamore. A drop front lid covers a sloping, uncut control panel (16in. long x 10¾in. high) alongside which is an uncut base-board (15¾in. long x 13½in. back to front). The inside of the drop front lid is panelled in beige leatherette. In the lower part of the cabinet are two large storage cupboards (13½in. high, 7½in. wide, 16½in. deep). The lid and cupboard handles are in chased Florentine bronze. Overall dimensions (33in. high, 34in. long, 16½in. deep).
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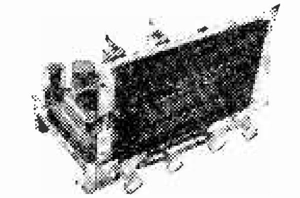

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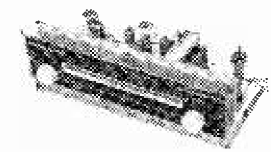

Convert your old radio or amplifier into a high quality F.M. Receiver. Simply plug into pick-up socket of old receiver and connect to Mains. Designed round Gorler components, permeability-tuned, five valves—ECC85, 6BJ5, 6BJ5, 6AL5 and EZ80. Attractive black and gold illuminated horizontal dial size 11¾in. long, 2½in. high. Frequency coverage of 85/101 mc/s. Overall chassis size 11¾in. long, 4in. high and 5½in. back to front. Fully guaranteed.
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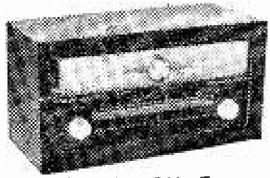

This contains the F.M. Tuner plus a magic eye tuning indicator. These are housed in a highly polished dark walnut veneered cabinet. The complete unit is ideally suitable for standing on top of your existing radio. Overall size of cabinet 12¾in. long, 7in. high, 6in. deep.
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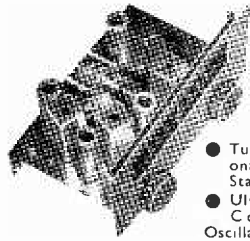

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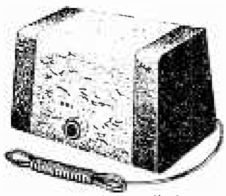

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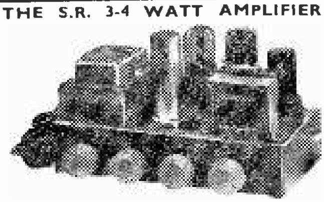

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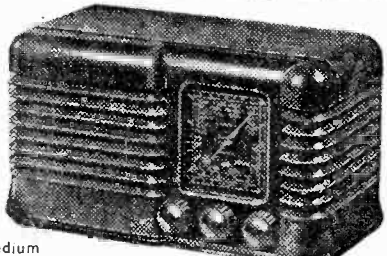

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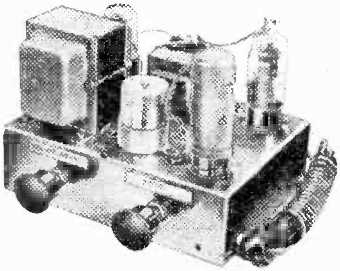

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THE COSSOR MODEL 494U

By Gordon J. King, A.M.I.P.R.E.

THIS receiver is more popularly known as the Cossor Melody Maker and was put on the market early in 1950; it takes its name from a range of receivers produced by the firm before the war. The Model 494U is universal and can be operated on either A.C. or D.C. mains of between 190 and 250 volts. There is an A.C. only model, which in appearance is identical to the universal one about to be described, but it varies, of course, so far as circuit make-up is concerned. It should also be mentioned that a Model 501U was later produced to supersede the 494U, but, apart from slight circuit alterations, the two models are essentially the same.

The receivers are housed in moulded brown and beige cabinets. They employ five valves, including the H.T. rectifier, and an all-wave circuit is used, giving waveband ranges of 15.8 to 51.3 metres, 187 to 575 metres and 940 to 2,050 metres. A simple frame aerial is installed on the back cover of the set which is for use primarily in areas of high signal strength or where the listener is interested only in local reception.

The Circuit

A full circuit diagram of the Model 494U is shown in Fig. 2. Here it may be seen that a triode-hexode valve V1 (Cossor OM10) operates as frequency changer with internal coupling between the local oscillator. The aerial signal is inductively coupled by reason of L1 to the three aerial coils L2, L3 and L4, selected by the first section of the wavechange switch.

Inductive reaction coupling is used on the oscillator coils L5, L6, L7, L8 and L9, and the appropriate coils are selected by the second and third sections of the wavechange switch (the function of the various trimmers will be revealed under the section on "Alignment").

The intermediate-frequency signal occurring across the first I.F. transformer (I.F.T.1) is taken to a variable-mu R.F. pentode valve V2 (Cossor OM6) operating as an I.F. amplifier.

The amplified I.F. signals developed across the second I.F. transformer (I.F.T.2) are fed to the signal diode in the double-diode triode valve V3 (Cossor OM4). The A.F. content of the signal is thus extracted and developed in this form across the manual volume control R1. The required degree of A.F. signal may, therefore, be fed to the grid of the triode section of V3. This valve section functions as an A.F. amplifier and develops its signal across the 680K resistor in the anode.

The signal at this point is fairly conventionally passed on to the control grid of the pentode output valve V4 (Cossor 332 Pen), which is wired in output stage mode to drive the loudspeaker in the usual way.

A degree of fixed tone correction is provided by the 0.005 μF capacitor shunting the primary winding of the loudspeaker transformer, and a variable control of tone is given by the tone control resistor R2 and associated components in conjunction with the negative feed-back winding L10 on the loudspeaker transformer.

The receiver is energised by H.T. current derived from the half-wave indirectly heated rectifier valve V5 (Cossor OM1). Mains power is applied via the two 0.5 amp. fuses, the mains on/off switch S1/2 and the two R.F. filter chokes L11 and L12. The 47 ohm resistor in the anode circuit of the valve functions as a surge limiter, and thus offers a degree of protection to the valve.

H.T. smoothing is given by the 32 μF and 16 μF electrolytic capacitors C3 and C4 and by the 6.8K resistor connecting the 230 volts H.T. line to the main 140 volts H.T. line; it will be noticed that this

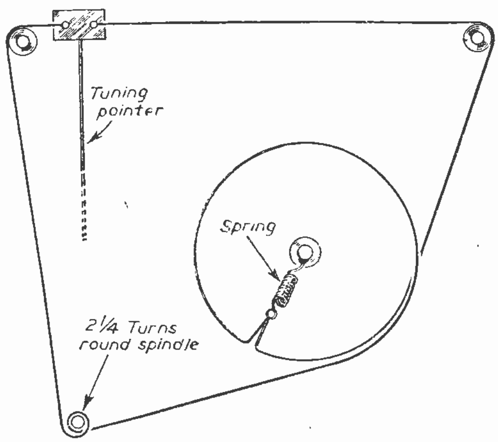


Fig. 1.—Details of the tuning drive cord.

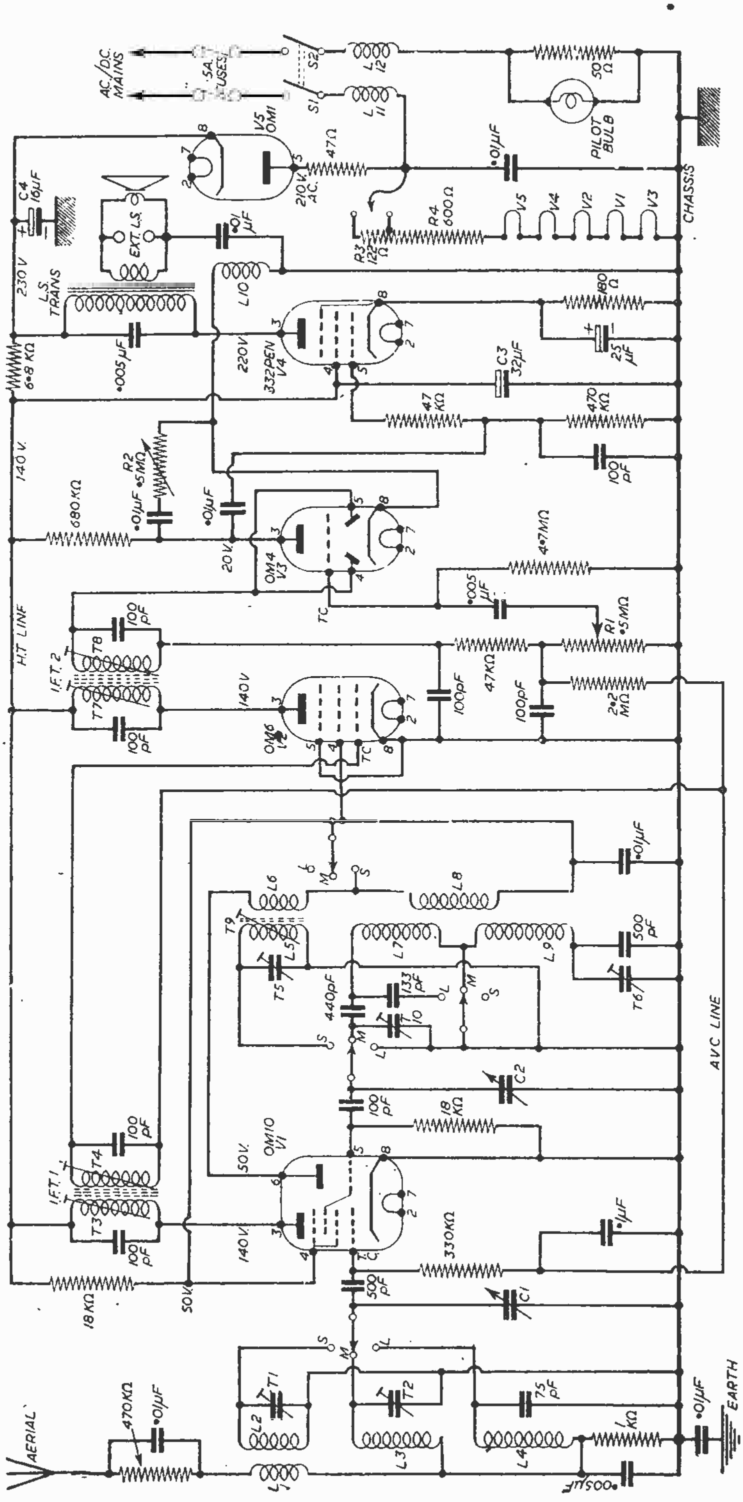


Fig. 2.—Theoretical circuit of the Cossor Model 494U.

additional smoothing is not applied to the anode circuit of V4.

The valve heaters are connected in series with the ballast resistor and pilot bulb, as is usual practice on a set of this kind.

A.V.C.

It may be seen that both diodes in V3 are connected to a common point; nevertheless a D.C. potential of magnitude dependent on the amplitude of the I.F. signal is present at the top end of the manual volume control R1. It is this potential, which is negative with respect to chassis, which is used as an A.V.C. bias for valves V1 and V2. This control voltage is conveyed through the 2.2 megohm resistor and filtered by the associated 0.1 μF capacitor.

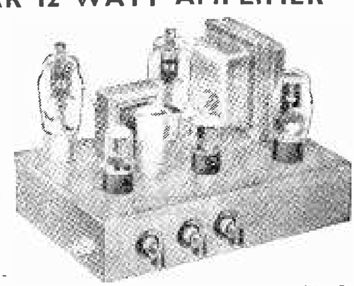
Alignment

As is general practice, the I.F. transformers should be aligned before making adjustments to the R.F. and oscillator trimmers. For the purpose of alignment it is desirable to have at hand an accurately calibrated modulated service oscillator or signal generator, an output meter to match 3 ohms impedance, and a non-metallic trimming tool. The output meter should be connected in place of the loudspeaker, and at all times the R.F. signal input to the receiver should be maintained at a sufficiently low level so as not to give an output in excess of 200 mW; as the circuits are brought into alignment the input signal should be suitably reduced to maintain this stipulation and to avoid alignment errors as the result of the A.V.C. action.

As the chassis of this receiver is in connection with one side of the mains (care should be taken to ensure that it is the neutral side), connections between the signal generator and the receiver should be made only through good quality

(Continued on page 125)

R.S.C. ULTRA LINEAR 12 WATT AMPLIFIER



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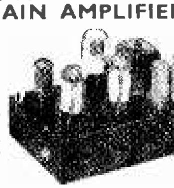
R.S.C. 4-5 WATT A5
HIGH-GAIN AMPLIFIER



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0.1 μF capacitors, and in the first place a modulated 470 kc/s signal should be applied between chassis and the control grid (top-cap) of V1; the receiver should be switched to M.W., the tuning gang set at minimum capacitance and the volume and tone controls set fully clockwise.

Trimmers T8, T7, T4 and T3 should then be adjusted in that order for maximum output; the process should be repeated until no improvement is possible.

Medium Waveband

Before commencing it is as well to ascertain that the tuning pointer is set correctly in relation to the tuning gang. This is done by adjusting the gang to its mechanical minimum and adjusting the pointer on the tuning drive cord to the line marked " min " on the top left of the tuning scale (this is visible when the chassis is removed from the cabinet).

Inject a 1,550 kc/s signal via a standard dummy aerial between the receiver aerial and earth terminals, set the tuning pointer to the line marked " M.W." (or sometimes " M ") at the top of the scale and adjust the M.W. oscillator trimmer T10 (Fig. 3) for maximum output. Adjust the M.W. aerial trimmer T2 for maximum output.

Long Waveband

Inject a 160 kc/s signal, set the tuning pointer to the line marked " L " on the top right-hand of the scale and adjust the L.W. oscillator padder T6 (Fig. 4) for maximum output.

Short Waveband

Inject a 18 Mc/s signal, set the tuning pointer to the line marked " S " on the top left-hand side of the scale and adjust the S.W. oscillator trimmer T5 (Fig. 3) for maximum output. It will be found that two peaks are given by this trimmer, the correct one, however, is that of minimum capacitance. Adjust the S.W. aerial trimmer T1 (Fig. 4) for maximum output.

Inject a 6 Mc/s signal, adjust the tuning pointer to the line marked " S " on the top right-hand side of the scale and adjust the core in the S.W. oscillator coil L5 (T9, Fig. 3) for maximum output.

Finally inject a 18 Mc/s signal, adjust the tuning pointer to the line marked " S " on the top left-hand side of the scale and re-adjust trimmers T5 and T1 for maximum output while slightly " rocking " the tuning gang.

General

The diagrams at Figs. 3 and 4 depict the top and bottom views of the chassis showing trimmer positions, the layout of the valves and major components. Fig. 1 shows the arrangement of the tuning drive cord; when replacement becomes necessary good quality nylon drive cord is recommended. Approximately 40in. of cord is required.

After removing the back cover and frame aerial plugs by unscrewing the five self-tapping securing screws, the chassis can be removed from the cabinet by withdrawing the four control knobs (observing that the two smaller knobs are taken from the centre spindles), extracting the insulated chassis guard strip secured by two self-tapping screws, removing the two chassis securing screws located beneath this strip and removing the screw from the top of the tuning scale assembly.

Servicing Notes

If the receiver appears to be lively and slight " clicks " are heard when the waveband switch is operated and yet no signals can be received, the trouble most likely lies in the oscillator section of the frequency changer. In the first place it would be advisable to check the condition of V1 by substitution. If this fails to bring the set to life the voltage at the oscillator anode (pin 6) should be checked, and if necessary the 18K resistor should be replaced. If this seems all right, however, attention should be

(*Concluded on page 138*)

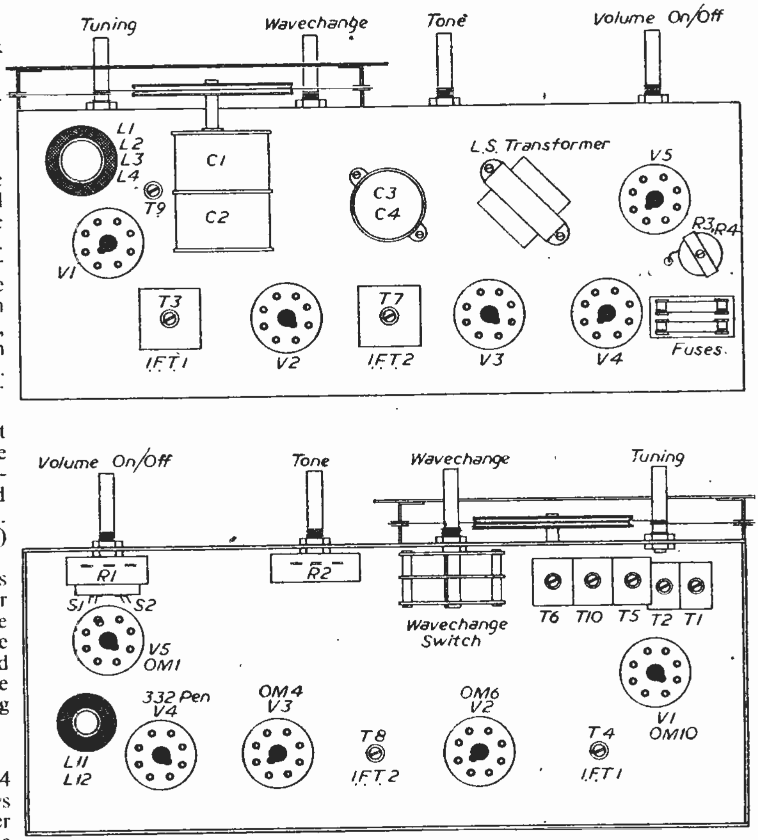


Fig. 3 & 4.—Top and bottom chassis layout.

Programme Pointers

Our Critic, Maurice Reeve, Reviews Some Recent Programmes

Opera

IT was a pleasure to "visit" Covent Garden Opera House one Monday evening as a change from the customary theatrical presentation. The occasion was the first appearance there of the new director, Rafael Kubelik, which made of it something of an event. The chosen opera was Verdi's masterpiece, "Otello." Together with the remarkable libretto of Boito this work can rank easily with Shakespeare's tragedy, on which, of course, it is founded. The music of the 74-year-old giant—he was to write the equally great "Falstaff" when turned eighty!—contains miracles of dramatic portraiture and psychological expression: the equal of Wagner though entirely different.

The broadcast was an excellent one, but it could hardly have been if the performance had not been, too.

An issue of Eric Barker's "Just Fancy" dealt exclusively with two sketches: one of two ancient gentlemen, living on their dividends and getting information of losses mixed up; the other of language difficulties likely to have arisen when Wellington and Blücher met at Waterloo—the Belgian village of that name and not the station. The former was very funny. With Eric Barker are Pearl Hackney, Deryck Guyler and Charlotte Mitchell.

"A Passage to India"

E. M. Forster's novel, written about 20 years ago, is justly rated as one of the best of our times. It deals, in no measured terms, with some of the social aspects of the British occupation of India and the harsh laws imposed on the people. Although the English girl in the story turns up trumps in the end and leaves the Indian doctor with his honour and self-respect unsullied, it also leaves him prophesying that "the English will be cleared out into the sea, even if it takes 50,000 years"—my words. It took less than 20.

It made an excellent Monday night theatre and was played and produced with much sincerity and conviction, chiefly by Mary Wimbush, Gladys Young, Richard Williams, Peter Howell and, among many others, Hamilton Dyce. But I didn't much care for Roger Delgardo's Dr. Aziz. He might just as easily have been taken for a French hotel proprietor or a German music teacher as an Indian gentleman. There even seemed a glimpse of Cardiff at odd moments. The skilful adapter was Lance Sieveking and the producer, Donald McWhinnie.

Musical Curiosities

The first of three programmes, on the Third, of "Musical Curiosities" was mildly interesting and amusing. Containing such oddities as a one-man opera and a Rossini overture played on, I think, 14 pianos, it called itself "seriously comic and comically serious." It rather fell between the two opposites, though through no fault of Fritz Spiegel, who introduced it. It should have dealt more with the verities of which there are many among the great composers, such as Debussy's parody on Tristan in his "Golliwog's Cake Walk."

"Our Day and Age"

The fifth of Stephen Grenfell's series, "Our Day and Age," "The Case of the Fiery Lady" was an exciting reconstruction of a remarkable murder carried out at the height of the blitz in 1941, and nearly perfect. Well retold by Carleton Hobbs, James McKechnie and others.

Plays

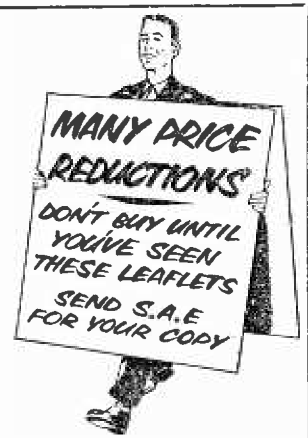
"Dangerous Corner" was the first of J. B. Priestley's many plays and was consequently chosen to open the "Priestley Festival." I liked it, because I like all Priestley. But, as the author said in some introductory remarks, it is really only a clever bag of tricks. At least every one seemed to be falling in love with everyone in turn, and the ingenuity with which the pieces in the puzzle were finally put together was fascinating craftsmanship. The "pieces" were Grizelda Hervey, Denise Bryer, John Carol, Valentine Dyall, Brian Hayes, Molly Rankin, Geoffrey Hodson and Catherine Nangle.

From time to time the BBC performs a service in giving us, in narrative form, either the life of one of the famous sons of Britain or an episode in such a life. One of these was forthcoming in "Livingstone," one of the most remarkable of our progeny, commemorating the centenary of his discovery of the Victoria Falls. The name part was excellently played by Duncan McIntyre and the narrator was the experienced Leslie Perrins. A moving story.

"Three Men in New Suits" is very good Priestley and was given one Saturday as a kind of "additional" to the "Priestley Festival" on Wednesday. Telling of the reactions to civil life of three men returning from service in the Second World War, it contains much Priestley horse-sense and contentious views, all of which go to make up an absorbing play.

County Count

It will be a pity when that engaging quiz, "County Count," has run through all the counties and, presumably, closes down. I find it very interesting and entertaining—and there are not so many programmes combining both these qualities—listening to all the history, folklore and tradition, speech and song, unfolded for us by the clever people running the show. Cities and country towns are being dealt with on Sundays and should be sufficient in number to last for ages.



We cannot show the complete contents on these pages, but we give a brief summary and some examples.
COMPLETE DETAILS OF : AN ILLUSTRATION and DESCRIPTION IS GIVEN OF EACH ITEM.

- AMPLIFIERS. By Armstrong, Goodsell (Williamson), Leak, W.B., THE MULLARD 5-10 (Grampian), Stern's Kits of Parts for a High Quality 8-10 watt and a High Fidelity 12-watt Amplifier having separate Pre-amplifier/Tone Control Unit.
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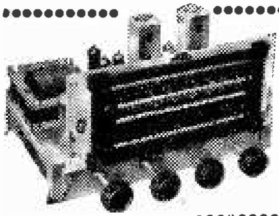

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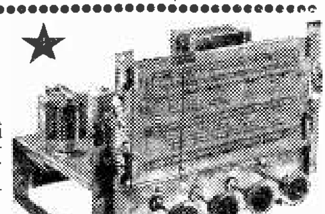

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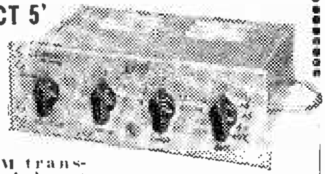

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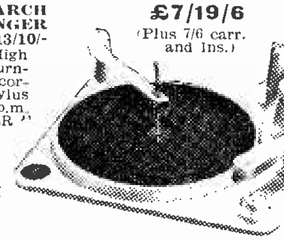

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Using TEST INSTRUMENTS

Part 14 of a Series of Articles Dealing with the Practical Application of Standard Test Equipment

(Continued from page 22 January issue)

The Wobbulator (49)

BEFORE we can deal successfully with alignment of broadcast (A.M. and F.M.) receivers aided by the oscilloscope, we shall have to learn something about the wobbulator. Essentially, the wobbulator is an R.F. oscillator, which, instead of being amplitude modulated with an A.F. signal as is the service oscillator and signal generator, is frequency-modulated with a signal derived either from the timebase of an oscilloscope, or from some other source; hence its somewhat popular notation of "frequency-modulated oscillator."

Now, when an oscilloscope is used for alignment purposes the aim is to have revealed on the screen

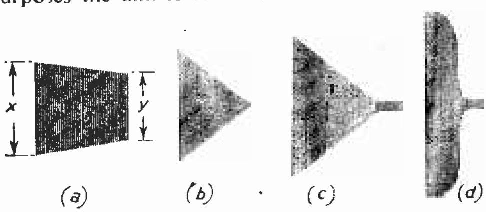


Fig. 64.—Modulation waveforms which were fully described in the last issue.

the R.F. response curve of the section under adjustment, i.e., the overall response curve or the response curve relating to the I.F. stages. In order to do this, it is necessary to swing the frequency of the R.F. signal applied to the receiver in accordance with the horizontal sweep of the 'scope's timebase, so that the frequency *deviation* embraces the appropriate section—within the limits of the passband circuit—of the frequency spectrum. This is, of course, achieved by the wobbulator.

As this series is not intended to delve too deeply with the design consideration of pieces of test gear, we shall not consider the function of the wobbulator in detail; nevertheless, it is desirable to get a rough idea of how it works as a means of assisting its application.

Almost all wobbulators of the type in which we are interested employ an electronic means of sweeping its internally generated R.F. signal in synchronism with the 'scope's timebase. For this purpose a reactance valve is invariably employed. A valve so used exhibits characteristics synonymous to a capacitive or inductive reactance, that is, the current related to the artifice either leads or lags the voltage by an angle of 90 deg. Moreover, the magnitude of the reactance can be made to vary quite easily by altering the voltage applied to the control grid of the reactance valve.

Usually, the valve is arranged to represent a capacitive reactance, the virtual effect of which is connected in shunt with the tuned circuit of the wobbulator's R.F. oscillator. Clearly, then, a means of varying the frequency of the oscillator is readily possible simply by modifying the repetition pattern of the potential applied to the control grid. In practice, the actual potential used for this purpose is picked up from the 'scope's timebase; a terminal (marked "X plates") is generally incorporated on the front panel of the instrument to assist a connection in this mode.

In some wobbulators the internal R.F. oscillator may not be continuously variable over the entire conventional frequency spectrum as is the case so far as service oscillators and signal generators are concerned. Wobbulators of this kind are generally designed for relatively wideband purposes, such as for the aligning of TV circuits. In order to achieve the desired output frequency the injection of an R.F. voltage from a calibrated signal generator is demanded. When so used, this signal, together with the F.M. signal generated in the wobbulator itself, is fed to a mixer valve, also embodied in the wobbulator, and the difference frequency thus produced used for injection to the set under adjustment.

Wobbulator/'Scope Application (50)

The alignment signal from the wobbulator is applied to receiver in the usual way as for I.F. and/or overall alignment, but additionally it is necessary to

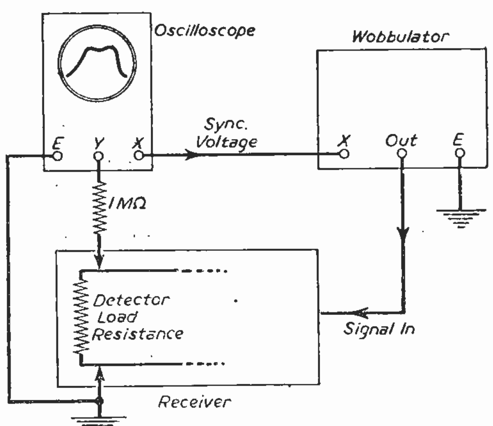


Fig. 65.—Showing how a wobbulator and oscilloscope are connected to a receiver to produce a response curve.

convey the signal appearing across the detector load resistor in the receiver, through a 1 megohm resistor, to the input of the 'scope's deflection amplifier, as shown in Fig. 65. If the wobbulator requires the addition of a signal from a separate generator, Fig. 66 illustrates the arrangement.

Now, as the spot travels across the screen of the C.R.T., so the frequency of the signal fed to the receiver changes linearly, causing the voltage across the detector load resistor to vary according to the receiver's R.F. (or I.F.) response characteristics. And since the detector output voltage provokes a vertical displacement of the spot against the horizontal trace

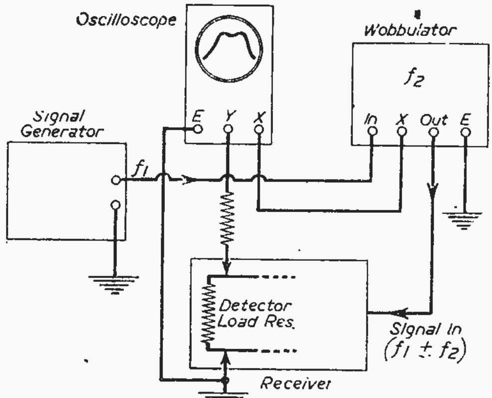


Fig. 66.—Showing the mode of connection when a separate signal generator is required.

given by the 'scope's timebase, it is easy to realise that a frequency versus amplitude curve will be displayed on the screen.

It is important to bear in mind that the frequency *deviation* of the wobbulator signal is dependent on the *amplitude* of the 'scope's timebase voltage; too large a voltage will thus provoke a frequency deviation extending outside the bandwidth characteristics of the receiver. This condition will limit the width of the response curve display, and in certain cases make it too narrow to be of any useful purpose.

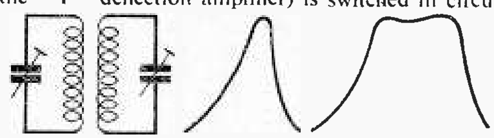
As a means of permitting ready adjustment of the width of the curve shown on the screen, most wobbulators incorporate a variable potentiometer connected between the "X" deflecting voltage and the grid of the reactance valve.

The actual repetition frequency of the timebase is of little consequence in this respect, however, but for optimum results a frequency exceeding 50 c.p.s. should not be used. The frequency range between 12 and 50 c.p.s. is generally quite suitable, but distortion of the trace on some instruments is observed if too low a frequency is used.

As is normal practice, before the tuned circuits can be correctly aligned the A.V.C. must be made inactive, and the receiver's local oscillator should be muted when the I.F. stages are being tuned. If the receiver is totally out of tune, it may be necessary to apply a fairly heavy signal to the grid of the last I.F. valve so that a reference curve can be obtained, after which the signal may be transferred to the grid of the first I.F. valve, and as the associated circuit are brought into alignment the wobbulator's output signal should be suitably reduced.

It is most important to avoid overloading the receiver by applying the smallest signal possible, consistent, of course, with sufficient vertical deflection of the trace. The result of overloading will produce a curve with a very much flattened top, which, unless one is well versed in this mode of alignment, will almost certainly give the impression that the receiver is ideally aligned.

It may be observed that the response curve is not the normal way up on the screen of the C.R.T.; if it does, in fact, appear inverted the cause is solely that of phase. We have already seen that a C.R.T. cannot say which way up a curve is since the vertical deflection is relative to the potentials on the "Y" plates. For example, if a negative voltage, relative to earth, occurs across the detector load resistor, and this is applied direct to the "Y" plates, an upward deflection of the spot may result. Now, if a single stage amplifier (i.e., the "Y" deflection amplifier) is switched in circuit.



(a) (b) (c)

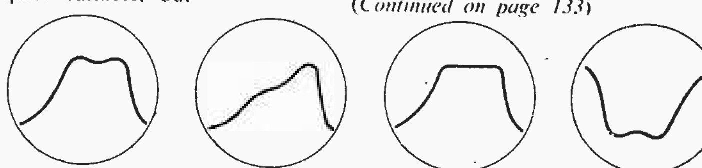
Fig. 67.—If incorrectly adjusted the band-pass circuit at (a) may produce the peaky response curve at (b) instead of the correct response curve at (c).

the deflection will be reversed owing to the phase shift of the valve—the magnitude of deflection will also be increased, of course, as the result of the valve's amplification.

The curve may be reversed by simply changing over the connections across the detector load resistor, but this is liable to disturb the balance about earth of the system and consequently give rise to the effects of hum pick-up. Since all the information relating to the response is available whichever way it appears on the screen, it is hardly worth while making modifications in an endeavour to invert it.

When the equipment has been arranged in conjunction with a receiver, as in Figs. 65 or 66, a response curve may not immediately be displayed on the screen. For example, if the wobbulator output frequency does not correspond precisely to the circuits which are to be tuned, all that will result on the screen will simply be a horizontal line. As the wobbulator tuning is altered, however, and its deviation enters the pass-band characteristics of the circuits under examina-

(Continued on page 133)



(a) (b) (c) (d)

Fig. 68.—The desirable band-pass response at (a) may be distorted as shown at (b) due to mistuning. The effect of overloading is shown at (c), and an inverted response is shown at (d).

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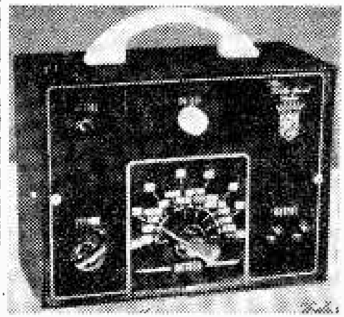

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tion, one side of the line will be seen to tilt, and as the tuning is further altered a bulge will occur along the line and will eventually pass along its length and disappear again the other side. The wobbulator tuning with respect to the frequency of the tuned circuits should be adjusted so that the bulge occurs in the centre of the screen.

The bulge does, in fact, represent a graphical indication of the response curve, though to get it in useable form it may be necessary either to increase the signal amplitude from the wobbulator to the receiver, or increase the gain of the deflection amplifier, whilst bearing in mind the possibilities of overloading.

Alignment with the oscilloscope is most desirable on broadcast receivers embodying band-pass circuits, on which the use of a signal generator and output meter might produce a response of undesirable shape, even though the circuits are tuned for maximum indication on the output meter. The output meter method works quite well on simple circuits tuned to a common frequency, but if complex circuits possessing band-pass characteristics are aligned by this means, the only way that one can be sure that the resultant overall response is symmetrical is by making point-to-point graphic measurements at different frequencies within the pass-band after each trimming adjustment.

The 'scope and wobbulator performs this function automatically, so that the effect of any trimmer adjustment is immediately revealed as a modification of the shape of the response display. The aim of alignment by this means should, of course, be for maximum symmetry of response, coupled with sufficient bandwidth and amplitude.

It is often a good idea to make the adjustments first of all for maximum amplitude, and then afterwards readjust judiciously the trimmers until a response curve of optimum shape is obtained. It is surprising how the quality of reproduction of a band-pass receiver is improved by realigning it with a 'scope and wobbulator, if it was previously aligned with an output meter.

Fig. 67 (a) depicts a band-pass circuit which if aligned by the use of an output meter might produce a peaky response as at (b), but if aligned with a 'scope the correct response at (c) is easily obtained.

Fig. 68 (a) again shows a band-pass response, but if the associated circuits are mistuned it is liable to resolve as shown at (b). The curve at (c) illustrates the effect of overloading, while curve (d) shows an inverted band-pass response.

Before concluding this section, it will perhaps be interesting to mention that modulated envelopes of a tuned circuit response curve can be obtained by applying the frequency-modulated R.F. developed across the circuits direct to the "Y" plates. The receiver's detector stage is thus omitted, and responses after the style of those shown in Fig. 69 (a) and (b) can be obtained.

The 'Scope as an Aid for Aligning F.M. Receivers (51)

Although it is possible to align almost all kinds of F.M. receivers either by means of a sensitive voltmeter and a suitably calibrated signal generator, or by the use of a sine-wave modulated F.M. signal generator and a standard output meter, it is much more satisfactory to use an oscilloscope and wobbulator and actually observe the effect trimmer adjustments have on the I.F. response curve, including the discriminator stage.

The operation of aligning, or re-aligning, F.M. receivers is considerably more exacting than the alignment of an ordinary A.M. broadcast receiver, and in some cases might be considered almost as complex as aligning a television receiver. We must remember, in this respect, that the advantages inherent to F.M. reception are attainable only on properly aligned receivers.

The lack of background noise and interference, which is one outstanding feature of F.M. reception, can be fully realised only when the discriminator is correctly balanced with respect to its tuned circuits. The same applies to the high quality which is expected of F.M. Many constructors and experimenters are often more than a little disappointed with the results

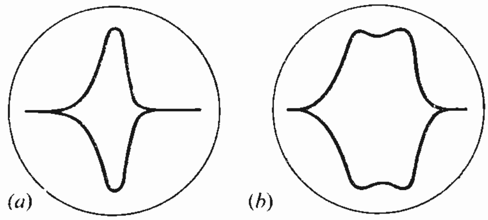

Fig. 69.—Responses of this kind are obtained by picking up the signal before the detector.

given on their newly constructed F.M. receiver or tuner unit. They find the distortion and interference levels somewhat higher than expected and frequently come reluctantly to the conclusion that their A.M. receivers and tuner units provide better overall quality and interference-free reception.

In nearly all cases the trouble is not caused by faulty wiring or poor circuit design, but boils down to the hard fact that the alignment of the tuned circuits is far from what it should be.

Bandwidth and Symmetry of Response (52)

As is well known, the frequency spectrum occupied by a frequency-modulated signal is much greater than that occupied by a similar amplitude-modulated signal. In the main this is due to the extended side-bands of the F.M. signal for a given frequency of modulation as compared with a similar A.M. signal. In order to carry the signal through the R.F./I.F. stages of the receiver, therefore, it is necessary for the receiver to have a fairly flat response extending plus and minus 100 kc/s either side of the nominal frequency. A response smaller than this would be liable to provoke considerable side-band cutting, with a consequent fall off in quality.

Moreover, it is essential for the response to be as symmetrical as possible, that is it should tail off and diminish in amplitude equally either side of the nominal frequency or mean carrier or intermediate frequency. With an A.M. receiver this is not so important, and it is often possible to get reasonable results simply by peaking the I.F. transformers to a stipulated spot frequency. With F.M., however, it is absolutely essential for the response to remain substantially linear 100 kc/s either side of the stipulated intermediate frequency. For example, if the I.F. were, say, 10 Mc/s, the output at the end of the I.F. chain should not change very much due to a signal swung over the range of 9.9-10.1 Mc/s. The rate of fall off of response outside these limits should also be even either side. If the R.F. and I.F. stages are not up to this standard, then full advantage of the

F.M. signal cannot be taken. Impaired quality of reproduction and probably more interference than necessary will be exhibited.

Another factor which affects both quality and the level of interference due to amplitude variations of the carrier wave is the balance in the two halves of the discriminator circuit. Indeed, the elimination of amplitude interference, especially where the circuit features a ratio detector, depends upon an exact balance here. This balance is governed, of course, on valve and circuit tolerances, but it is also governed to a very large degree on the final alignment of the secondary winding on the discriminator transformer.

Instrument Application (53)

The application of the wobbulator and oscilloscope for alignment of F.M. receivers is very much similar to A.M. alignment application considered earlier. As will be remembered, the wobbulator is connected to the "X" plates (terminal) of the 'scope, so that the 'scope's timebase swings the output signal of the wobbulator over a frequency range governed by the setting of the "deviation" control. It was also mentioned that some wobbulators require the application of a calibrated R.F. signal from a standard signal generator or service oscillator.

The wobbulator should have a 70-80 ohms output impedance and cover both the intermediate frequency and Band 2 frequencies, 88-109 Mc/s with an obtainable frequency deviation of at least plus and minus 300 kc/s.

It is also desirable to have available a signal generator in addition to the one which may be required by the wobbulator itself, for the purpose of creating a "pip" on the displayed response curves as a means of frequency identification.

Certain commercial wobbulators carry a terminal for the injection of a frequency marker-pip from a signal generator, but if such a facility is not incorporated it is a relatively simple matter to convey the two signals to the receiver through a common lead by means of a matched "T"-pad or star network.

Methods of Obtaining a "Y" Plate Voltage for the 'Scope (54)

It will be remembered that when a 'scope is used to assist with the alignment of an A.M. receiver, the "Y" terminal, probably via the deflection amplifier, is connected to the detector load resistor. Normal A.M. demodulation (rectification) thus occurs and a vertical deflection is given on the C.R.T. On F.M. receivers, however, a simple rectifier of this kind is not embodied in the detector circuit (remember a balanced discriminator is used here).

It is therefore necessary to make use of either one of the diodes in the discriminator or employ a temporary rectifier circuit during the alignment process. As it is not very difficult to use one of the discriminator diodes for this purpose, the method appears to be most favoured. It simply involves considerably de-tuning the secondary winding of the discriminator transformer (this is the transformer prior to the ratio detector or discriminator). When so maladjusted one of the diodes will work as does an ordinary A.M. detector and thus produce a trace on the C.R.T. which corresponds to the output of the I.F. channel. Connection to the "Y" plate (or deflection amplifier) is made fairly easily at the "hot" side of the volume control, or if the gain of the 'scope deflection amplifier is not great enough to give sufficient vertical deflection, the connection can be made to the anode circuit of the valve following the F.M. detector.

Alternatively, a temporary rectifier circuit may be wired up to the anode of the final I.F. valve, and the deflection amplifier connected across the load resistor of the rectifier. *(To be continued.)*

Scottish Police Radio

TOWARDS the end of last year, His Grace the Duke of Buccleuch officially inaugurated an extensive V.H.F. radio control scheme on behalf of the police forces of Berwick, Roxburgh and Selkirk. The ceremony took place at Jedburgh.

This radio network has been supplied and installed by Marconi's Wireless Telegraph Co., Ltd., of Chelmsford, England. Its range extends over some 1,250 square miles of the three Border Counties, and is an important addition to existing police radio installations, which already cover a large proportion of the country.

The new network consists of a Master Control Room at the Police Headquarters at Jedburgh, with repeater stations at Hardens Hill and Meigle Hill. A further sub-control station is located at Hawick, the latter feeding into the main network via Meigle Hill. From these points two-way radio-telephonic communication is established with the radio-equipped police patrol cars. Owing to the hilly nature of the eastern part of the area, very intensive technical tests were carried out by Marconi's to select the best sites for the project.

The equipment supplied includes four Marconi 10 watt Fixed Station V.H.F. installations Type H16H, eleven Marconi 10 watt Mobile V.H.F. equipments Type H16 and one Marconi 5 watt Mobile V.H.F. equipment Type HP10.

An interesting technical feature is the principle of reversed frequency triggering, which was introduced into the Scottish police communications systems by Chief Inspector W. N. Bruce of Edinburgh, and has proved highly successful. This system can effect considerable economies in capital cost and, contrary to standard practice, the Master Control Room does not communicate with the patrol cars directly, but via one of the repeater stations. As a practical example, Master Control may be transmitting on a frequency of 80 Mc/s and receiving on 90 Mc/s. When a message is transmitted from Master Control it is received by the repeater station, the receiver of which is tuned to 80 Mc/s. This receiver is connected directly to the input of the repeater station's transmitter which re-transmits the message, this time on a frequency of 90 Mc/s.

The receivers in the patrol cars are tuned to this frequency and therefore receive the re-transmitted message in the normal way. Conversely, the mobile transmitter in the patrol car transmits on 80 Mc/s, to be picked up by the repeater station receiver and re-transmitted on 90 Mc/s, the frequency to which the Master Control receiver is tuned.

(It is emphasised that the frequency figures quoted are hypothetical and given only as an example.)

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3A5	9/-	6U4GT	18/-	DF33	11/6	GZ32	15/-
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3S4	7/6	6V6GT	7/6	DK32	11/6	MU14	9/6
3V4	8/6	6X4	7/6	DK92	7/6	P61	5/6
5U4G	8/6	6X5GT	6/9	DL33	11/6	PCC84	10/9
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5Z4G	9/-	7C5	8/6	EABC80	9/6	PL33	13/6
6AK5	6/6	7C6	8/6	EB91	6/9	PL38	23/9
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6AM5	5/-	7S7	8/6	EBC41	10/-	PL82	9/6
6AM6	7/6	7Y4	8/6	EBF80	10/6	PL83	12/6
6AQ5	8/-	10F1	10/-	ECC40	15/6	PY80	10/-
6AT6	8/6	10P13	10/-	ECC81	10/-	PY81	10/-
6BA6	7/9	10P14	12/6	ECC83	10/6	PY82	8/6
6BE6	6/6	12AT7	10/-	ECC91	6/-	PZ30	18/-
6BH6	6/-	12AU7	9/-	ECH35	11/9	T41	15/-
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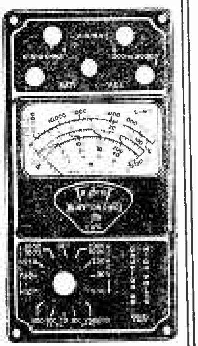

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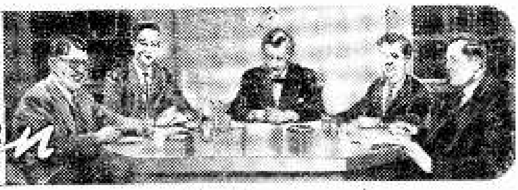

The Editor does not necessarily agree with opinions expressed by his correspondents

School Radio

SIR,—May I take this opportunity of thanking you for publishing our appeal for radio equipment in your November issue of PRACTICAL WIRELESS and those of your readers who answered the appeal.

The response has been quite magnificent and has enabled us to make a successful beginning with our project.—A. W. ROWE, B.A.(Hons.), L.R.A.M., Dip.Ed. (Headmaster, Holme Green C. School).

Ex-Service Sets

SIR,—In the January issue of PRACTICAL WIRELESS I notice the frequency range of the 38 set is given as 6-9 Mc/s. This set has, in fact, a range only from 7.4-9 Mc/s. The 18 set is from 6-9 Mc/s. Also these others may be of some use:

R 107 } 1.2-17.5 Mc/s.
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—J. E. TANNER (Apsley Guise, Bucks).

A Recording Critic

SIR,—Although I do not profess to be an expert on the subject of getting the best out of L.P. discs, the letter in your January issue from Mr. B. L. Kershaw has prompted me to write and offer to him what little advice I can. First, I believe he is incorrect in stating that only one manufacturer makes three-speed manual players; Garrard, Collaro and B.S.R. all offer inexpensive models complete with pick-up, and the Collaro transcription unit is no dearer than a good autochanger.

I agree with Mr. Kershaw on the subject of autochangers. If he values his records and wants good results a manual player is essential.

I do not agree with him with regard to record and stylus wear. The important point to remember with pick-ups is that it is not so much the stylus pressure, but inadequate lateral and vertical compliance that causes excessive wear.

I think that if he obtains a copy of G. A. Briggs's "Sound Reproduction," he will find much useful information on pick-ups and record wear in general.

A good motor is expensive but well worth it. It should be clamped down firmly to the motor board; spring mounting is not much good if the loudspeaker has a good response in the bass, because the motor plate is only supported on four points and vibrates with the motor. These vibrations travel up the pick-up arm bearings, along the arm to the head and the result is a hum from the loudspeaker. Use at least ½in. plywood for the motor board and see that the corner of the motor plate on which the pick-up is mounted is bolted to the board as firmly as possible.

A good crystal pick-up will give excellent results, but choose one which allows easy changing of the stylus, because if you cannot afford a diamond then do not play more than 200 L.P. sides with a sapphire. This amounts to about three months' regular use.

Handle your L.P. discs very carefully, for with a very silent background even the smallest scratch is easily heard: also, due to the slower speed, a scratch does not sound "click" but goes "pop," which is much more annoying!—E. T. HURST (Manchester).

Whilst we are always pleased to assist readers with their technical difficulties, we regret that we are unable to supply diagrams or provide instructions for modifying commercial or surplus equipment. We cannot supply alternative details for receivers described in these pages. WE CANNOT UNDERTAKE TO ANSWER QUERIES OVER THE TELEPHONE. If a postal reply is required a stamped and addressed envelope must be enclosed with the coupon from page iii of cover.

Atomic Power

SIR,—I was interested to read Mr. G. S. Benson's letter published in the December PRACTICAL WIRELESS. In it he suggested using hot air instead of steam for driving turbo-alternators in atomic power stations, in order to eliminate the "water recovery and feed conditioning systems necessary to render the water and resulting steam pure, for operation in the turbine."

It seems to me that it might be necessary to purify the air before it is passed into the turbine via the heat exchanger. Apart from this small detail, Mr. Benson's idea appears to be practicable but not economical. This is because the exhaust pressure from the turbine would be relatively high in comparison with a steam arrangement in which the vacuum at the condensers at economical rating is usually about 29.1 in mercury.

It is important that this vacuum be maintained so that the turbines run at a maximum efficiency, since about 50 per cent. of power-station energy losses appear as heat in the condenser cooling water. —J. R. D. BROWN (Pinner).

Radio-controlled Tractor

SIR,—I was interested in the item on a radio controlled tractor on page 733 of December PRACTICAL WIRELESS, particularly as "it is believed to be the first radio-controlled tractor to be shown in this country."

A radio-controlled tractor made by Tractors, Ltd., was demonstrated in 1946 to the Press with the co-operation of the Ministry of Supply. It is fully described in *Radio-Craft* for October, 1947, pages 20, 21, 54 and 64.—J. POTTER (Stockport).

SIR,—Two recent news items in your periodical call for comment.

Solderless connections. These were used considerably on radio-controlled models about 1930 and an attempt to patent the idea was refused as this was apparently used generally on radio receivers used by the Royal Flying Corps in the first World War.

An eyelet, which is very like those used in shoes, holds the two wires or flat metal together on a star-shaped washer.

The joint is made with a tool you can buy in any leather arts-and-crafts shop. It can be broken open as quickly. A combined tool is in use among my equipment.

This means of making a connection was proved to be far more resistant to corrosion than solder, and its advantages when subjected to vibration are obvious —solder crystalises.

What the radio trade told those who used it is easy to imagine. "We are tooled for soldered joints and for the next 40 years nothing else will be used."

This is not true. The "form-recognition circuits" on a guided missile, which came into the hands of one of the former members of the Inventors Circle, has this type of connection.

The only reason why solderless connections are not used is that the trade does not like them. For prototype work they are invaluable. The resistance is lower. There is no mess of flux, and the saving of time is three times the value in money of the extra cost of "star-washers," etc.

Radio-controlled Tractors

When the writer saw a demonstration abroad it was made clear that one man can, on big fields, manage five big crawler tractors.

Among other uses are the radio control of tractors and tanks used in clearing radio-active matter.

The controller can be, say, 2,000 metres up in a helicopter. By aircraft the control of a group of appliances by radio is much easier than by giving orders to a crew. The job the writer saw was in the finishing of a large canal. Nine men in control of roughly 12,000 h.p.

An operator controlling a big mechanical shovel from above, where he can see, is more accurate than controlling from inside the cabin.—J. DENNIS (Sheringham).

Making Transistors

SIR,—I have made up a transistor, somewhat on the lines of the article published in May last in your journal. Whilst I am very pleased with my results, there is one point which troubles me and that is that vibration (or perhaps loud signals ?) seem to dislodge the contact point. I wonder if any other readers have made up these components and perhaps have experienced similar trouble. Could the points be "cemented" in contact with some form of thick paste which would not affect the working ? It would be interesting if other readers could supply details of their experiences with these new components.—F. H. GRECY (Mill Hill).

Modern Design

SIR,—Many years ago you published an article on modern design, in which the author suggested that the time would come when the radio receiver would be housed in a cellar or cupboard out of sight, and all controls carried out with a small box plugged into any room in the house. This is an admirable idea but has not yet come to fruition. When will a manufacturer make a receiver which can be used in this fashion. Your recent articles on remote control go some way towards this end, but surely a radio and a gramophone (with auto-changer) as well as a television receiver may be easily operated by remote control to-day. What about it designers ?—R. MERRIDREW (Clapton).

SERVICING RADIO RECEIVERS

(*Continued from page 125*)

given to the 100 pF capacitor in the grid circuit (connected to pin 5) and the 0.01 μF capacitor at the earthy end of L8.

Although lack of signals on one band may indicate a fault in one of the appropriate coils or associated components, the trouble sometimes occurs if the oscillator grid capacitor reduces in value. Poor tracking should lead one to suspect a fault in the 500 pF capacitor shunting trimmer T6.

Low sensitivity on these models, generally accompanied by flat tuning of one of the I.F. transformers, often means that one of the 100 pF fixed I.F. tuning capacitors has become leaky or low in value.

Excessive distortion accompanied by V4 overheating nearly always means that either the 0.01 capacitor coupling V3 to V4, or the 25 μF bias capacitor in V4 cathode is leaky.

If the valves are lighting up and H.T. is present, but the receiver is totally dead, a test should be made on the 0.005 μF capacitor which shunts the primary of the loudspeaker transformer, for this sometimes tends to become short-circuited.

A short in V5 or on the H.T. line often causes the 47 ohm resistor in the anode circuit (pin 5) of this valve to burn out. It is not simply necessary to change this component, the cause of the trouble must first be found ; trouble locating in this connection can often be aided by temporarily connecting a 230 volt 25 watt bulb in place of the resistor.

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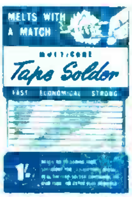

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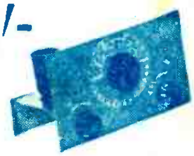

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