THE BEGINNER'S GUIDE TO RADIO

PRACTICAL WIRELESS

1/-

MARCH 1955

EDITOR: F. J. CAMM

Building an 8 Valve Super-Het Radiogram

BUILD THIS

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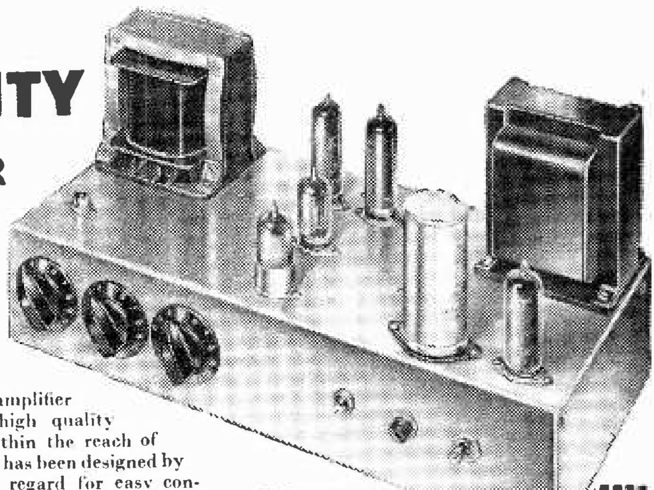
LOW COST

AMPLIFIER



★ Circuit designed by Mullard research engineers.

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Here's an entirely new amplifier circuit which brings high quality sound reproduction within the reach of thousands more enthusiasts. It has been designed by Mullard research engineers with special regard for easy construction and low cost. Full details of the circuit are included in the 2/6 book which is obtainable from radio dealers or direct from Mullard Ltd. Valve Sales Department—2/10 post free. Get your copy now.

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- GOOD TRANSIENT RESPONSE
- LOW OUTPUT RESISTANCE
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- DESIGNED ROUND 5 MULLARD MASTER VALVES — EF86, ECC83 2 x EL84, GZ30 or EZ80

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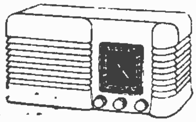

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GUARANTEED A.C. or A.C./D.C. Mains

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All Equipment

97/6

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You could almost do this job with a knife and fork—it's so simple! Screwdriver, pliers and soldering iron will make this spot-on 3 valve, 2 wave band set. Valves, Ready-to-use Chassis, Brown or Ivory Moulded Cabinet.

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Built to Highest Technical Standards

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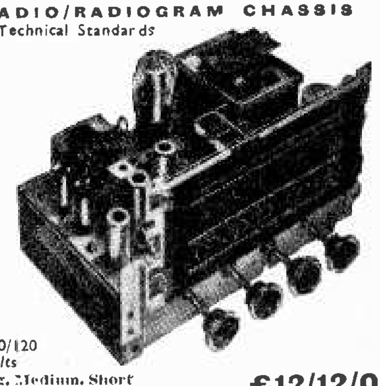

All chassis 11½in. x 7in. x 8½in. high. Latest type valves 6BE6, 6BA6, 6AT6, 6BW6, 6X4. Flywheel tuning. Negative feedback over entire audio section. Engraved knobs. 3 tone positions for radio and gram.

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Escutcheon for 9in. x 5in. dial, 4/9 extra. Matching speakers P.M. type 3 ohms. 8in. or 10in. available. Chassis sent under money back guarantee conditions against remittance. Free particulars from the manufacturers.

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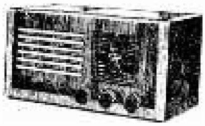
BUILD THESE NEW PREMIER DESIGNS

3-BAND SUPERHET RECEIVER

MAY BE BUILT FOR **£7.19.6** Plus 2/6 Pk. & Carr.



Latest type Superhet Circuit using 4 valves and metal rectifiers for operation on 200/250 volts A.C. mains. Waveband coverage — short 16-50 metres, medium 180-550 metres, and long 900-2,000 metres. Valve line-up 6K8 freq. changer, 6K7 IF, 6Q7 Detector AVC and first AF. 6V6 output. The attractive cabinet to house the Receiver size 12in. long, 6½in. high, 5½in. deep can be supplied in either WALNUT or IVORY BAKELITE or WOOD.

TRF RECEIVER

MAY BE BUILT FOR **£5.15.0** Plus 2/6 Pk. & Carr.

The circuit is the latest type TRF using 3 valves and Metal Rectifiers for operation on 200/250 A.C. mains. Wave band coverage is 180/550 metres on medium wave and 800/2,000 metres on long wave. The dial is illuminated and the Valve line-up is 6K7 H.F. Pentode 6J7 Detector and 6V6—Output.

INSTRUCTION BOOKS 1/- each, (post free) which includes Assembly and wiring diagrams, also a detailed Stock List of priced components.

4-WATT AMPLIFIER

MAY BE BUILT FOR **£4.10.0** Plus 2/6 Pk. & Carr.

Valve line-up 6SL7, 6V6 and 6X5. FOR A.C. MAINS 200/250 VOLTS. The output Valve is of the beam type and feeds 4 watts into a specially designed output Transformer which is suitable for either 3-ohm or 15-ohm Speakers. Negative feedback is applied from the secondary of the output Transformer over the whole Amplifier to the input stage giving an excellent frequency response. Due to the high gain and wide range tone controls any type of pick-up may be used. Overall size 9 x 7 x 5in. Price of Amplifier complete, tested and ready for use, £5/5/-, plus 3/6 pkg. and carr.

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Brown Rexine covered, **22/6.**
Overall dimensions 15in. x 13½in. x 5in. Clearance under lid when closed 2½in.

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Overall dimensions 15in. x 13in. x 6in. Clearance under lid when closed 3in.

Model PC/3
Rexine type covering in various colours, **69/6.**
Overall dimensions 16½in. x 14½in. x 10½in. Clearance under lid when closed 6½in.

All the above Cabinets are supplied with Panel, Carrying Handle and Clips. Packing and Postage 2/6.

Send for details of the Premier Wide angle Televisor design which may be built for £30.

DECCA MODEL 37A

DUAL SPEED RECORD PLAYER
Includes turnover crystal pick-up with sapphire stylus and a light-weight plastic spring-balanced arm. Heavy gauge pressed steel case with brown enamel finish in good quality for operation on A.C. mains 200/250 v. 50 c.p.s. Supplied complete, **£6.19.6.** Plus pkg. and carr. 5/-.

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GARRARD Rim Drive 78 r.p.m., complete with magnetic pick-up and turntable, **£4.19.6.** plus 2/6 pkg. and carr.

TERMS OF BUSINESS : CASH WITH ORDER OR C.O.D. OVER £1.

C. R. TUBES

VCR 517C 6½in. picture. This tube is a replacement for the VCR97 and VCR517. Guaranteed full size picture. **PRICE, 35/-.** Plus 2/6 pkg., carr. ins. **VCR 516** 9in. Blue picture. Heater Volts 4, Anode 4 Kv., in Manufacturer's original Carton. Plus 5/- pkg., carr., ins. PRICE, **£1.19.6.**

COMPONENTS AVAILABLE FOR THE MULLARD AND OSRAM AMPLIFIER DESIGN.

HENRY'S
(RADIO LTD.)

"R.F. 26" F.M. CONVERTER UNIT
88/100 Mc/s

We can now offer this self-contained Unit comprising 6 valves : 2—6BA6, EB91, VR137, EF54, EF54. Two I.F. stages and separate local oscillator, also Muirhead Graduated Vernier Drive ensuring easy tuning.

Components Offered to Complete F.M. Unit

- New RF "26" Unit with 3 valves, VR137, EF54, EF54. Chassis stamped out for easy conversion **£1.15.0**
- Complete set of all components for conversion including 2—6BA6 and EB91, tuning condenser, I.F.T.'s and Osc. coils, resistors and fixed condensers, plugs, wire and tag strips **£4.12.6**
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We have purchased large quantity of the above "38" Sets, and can now offer same complete with 5 valves : 4—VP23 and ATP4. Throat microphone, headphones, junction box and collapsible aerial. Freq. range 7.4 to 9 mc/s. Range approx. 5 miles. In absolutely new condition and Guaranteed Air Tested at **59/6,** carriage 5/-.

We have over 20,000 American and B.V.A. valves in stock.

ALL VALVES NEW AND GUARANTEED.

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1N5GT	10/-	75	8/6	12SK7GT	8/6	EL32	7/6	HL23DD	6/6
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EY51	12/-	UL41	11/-	EF80	10/6	PL81	12/6	12AT6	8/-
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EM34	10/-	50B5	10/-	EM80	10/-	PCC84	12/6	12BE6	10/-
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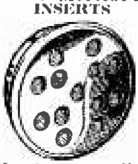

Ideal for tape recording and amplifiers. No matching transformer required.

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Type V.E.D. Patt. 563562 by English Electric in original wood case. A Cathode Ray Tester for checking ignition of internal combustion engine while engine is operating, will operate from 6, 12 or 24 volts D.C. or 230 volts A.C. Built into black crackle case with hinged front and carrying handle. Dim. : 15½in. x 8½in. x 11½in. No leads or instruction book available.
Ask for P/H535 **£15** each Carriage 10/- extra.

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R.F. UNIT TYPE 24
In Original Carton.

With valves 3-VR65 (SP61), etc. Range 20-30 Mc/s. switched tuning. Dim. : 9½in. x 7½in. x 4½in. Weight 7lbs.
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R.F. UNIT TYPE 25
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40-50 Mc/s. otherwise as R.F. 24.
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Range 65-85 Mc/s. Valves 2-VR135 (EF54), VR137 (EC52), etc. Variable tuning. Dim. and weight as R.F. 24.
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250 volts 15 amp. 3 way. A " Simplex " iron-clad 14 amp. distribution board with 6 rewirable fuses, highly efficient fuse unit, mounted on hinged battens and fireproof fillet between poles. Size 8in. L. x 6½in. B x 3½in. D. Weight 8lbs.
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Ask for P/H951.
All unused but slightly marked externally due to being stacked.
SPECIAL QUOTATION FOR QUANTITIES.
6/6 each Post paid.

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Input 24 v. D.C. 5 a. Output 230 v. A.C. 50 c/s. 100 w. Complete in metal case. Dim. : 13in. x 11in. x 8in. with carrying strap.
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Contains 4 H.F. chokes and 4 tubular condensers 0.1 mfd. 250 v. D.C. carrying 5 amps. (2 sets on each lead) each choke and condenser separately screened in compartments of aluminium alloy box 4½in. x 4in. x 2in. 4-hole fixing.
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⅜in. diam. In three lengths : 1⅛in., 1in., 1¼in. Bore ⅜in.
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Medium/High powered for C.W.-M.C.W. R/T 3 ranges 10-5.5 Mc/s. 500-200 kc/s. Complete with 4 valves, etc., in metal case 14in. x 16½in. x 8½in. External power supply required.
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Ref. 100/2.

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JEFFERSON TRAVIS UF-2 TRANSCEIVER CHASSIS (U.S.A. made)

Less valves and partly stripped by the M.O.S.
Ask for P/H518. **17/6** each Carriage Paid.
Circuit at 2/3.

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Ex-Canadian Army in original wood case. Input 110 v. A.C. 50/60 c/s. 1.7 kVA. Output (H.T.1) 2,000 v. 375 mA. ; (H.T.2) 500 v. 400 mA., plus H.T. lines 450 v., 265 v., also 383 v., regulated and neg. bias 250 v., 150 v., 80 v. Making three complete power supplies all fed via double choke condenser. Input circuits. Valves are 4/866A/866, 5Z3, 6S17 2/6A3, VR150/30 (Stab.) and 1V (time delay). The complete unit mounted in metal case with lid chock mounted. Dim. : 2ft. 6in. x 1ft. 8in. x 1in. Finish, olive drab. Weight 420lbs.
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PEN25	8/-
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PX25	15/-
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S130	8/6
SP220	6/9
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SP41	3/6
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U25	14/6
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1A7	11/6
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1S4	7/6
1S5	7/6
1T4	7/6
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220VSG	6/9
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3Q5	10/-
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6AC7	6/6
6AG5	7/6
6AJ5	9/-
6AK5	9/-
6AL5	7/-
6AM5	7/6
6AM6	7/6
6AQ5	8/6
6AT6	8/-
6B4	6/-
6B8G	4/-
6BA6	8/-
6BE6	8/-
6BR7	9/6
6BW6	8/6
6C4	8/-
6C5GT	7/6
6C6	6/6
6C9	8/-
6D3	7/6
6D6	7/3
6F6G	7/6
6F6M	8/6
6F8G	7/-
6F13	12/6
6F14	12/6
6F15	11/6
6G6G	6/6
6H6	3/6
6J5G	5/-
6J5GT	5/6
6J5M	6/6
6J6	8/-
6J7G	6/6
6K6GT	6/6
6K7G	6/-
6K7GT	6/6
6K7M	6/9
6K8G	8/-
6K8GT	9/6
6L1	11/6
6L19	12/6
6L6G	9/-
6L7M	7/6
6L18	11/-
6N7	7/6
6Q7G	9/-
6Q7GT	9/-
6R7G	8/-
6SA7GT	8/-
6SG7	7/6
6SH7	6/-
6SJ7GT	8/-
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25Z5	9/-
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PRACTICAL WIRELESS

EVERY MONTH
VOL. XXXI, No. 581, MARCH, 1955

EDITOR : F. J. CAMM

23rd YEAR OF ISSUE

COMMENTS OF THE MONTH

BY THE EDITOR

V.H.F. and F.M.

THIS year will see a vast improvement in radio reception and the improvement will commence to take place in May, when V.H.F. and F.M. will be introduced into the Home, Light and Third Programmes. V.H.F. and F.M. have already been introduced in America and in Germany, and the new techniques have been found to provide a crisper and clearer reproduction. Most of the experimental work in connection with the new techniques has been undertaken at Wrotham in Kent. It employs very short wavelengths and as a result has a very limited range, but the BBC plans will bring the benefits of the new techniques to about 75 per cent. of the listening public.

It is the ever-increasing congestion on the normal medium wavelengths in Europe which has forced the BBC to adopt V.H.F. and F.M. in order to provide an answer to the problem of foreign interference. It is known that there are many areas in England where it is almost impossible to listen to the BBC programmes because of this form of interference, especially at night, and frequency modulation undoubtedly provides the answer. The areas to which we have referred have complained for a long time concerning the fading, hissing noises, and the superimposition of foreign programmes on the BBC programmes. As at present planned there will be nine V.H.F. stations, each of which will transmit all three of the BBC programmes designed for home listening, and they will be located at the same sites as the television stations. The first station is due to commence operations in May, whilst others near Newcastle and Belfast will follow. The remainder near Manchester, Birmingham, Plymouth, Aberdeen and Norwich and in West Wales are due to begin operation at intervals during the next 18 months. The present long and medium wave transmission will, however, continue for many years.

Frequency modulation owes its origin to E. H. Armstrong, who during the 1914-18 war invented the superheterodyne reception.

Unfortunately, with frequency-modulated transmissions, it will be necessary to purchase a new receiver designed to take advantage of it, since existing broadcast receivers are not designed for F.M. It will, of course, be possible to convert existing sets by means of an adaptor, but that will merely be a stop-gap measure. In fact, an adaptor will be a miniature receiver in itself.

British manufacturers intend to produce receivers capable of operating on the long, medium and V.H.F. bands and in some cases to drop the so-called short wave band, which has never proved popular on commercial receivers. Only a very few F.M. sets will be available during the first year of its introduction. Competition from Germany, where F.M. receivers have been in mass production for several years, may force British manufacturers from their lethargy in connection with the new technique.

BOOM YEAR

DURING 1954 set manufacturers sold 1,500,000 radio sets, including radiograms and car receivers, on the home market, and this is about twice the number sold during 1953. The number of television sets sold in 1954 was slightly in excess of the figure of 1,145,000 of 1953. There are about 4,250,000 TV receivers in operation at present.

No doubt, the removal of hire purchase restrictions has resulted in these boom sales. As far as radiograms are concerned, the increase in the number of L.P. records available and the public demand for improved quality of reproduction has undoubtedly accelerated the sale. It is estimated that at least 5 million sound radio receivers of pre-war vintage are still in use.

AMERICAN COMPETITION

OWING to our economic position it has been impossible for constructors in this country to purchase the kits of test gear which are one of the specialities of the American amateur market. Now, however, British amateurs can purchase them, for with the easing off of dollar restrictions these kits of test gear are now being imported into this country. Perhaps this competition will inspire British manufacturers to market similar kits in competition with America. If they do not, the market will be left clear for this American "invasion." For years there has been a call in this country for such kits, but only complete expensive apparatus has been available. Fortunately, amateurs have been able to construct a great deal of test gear from the instructions which have appeared in this journal.—F. J. C.

Round the World of WIRELESS

By "QUESTOR"

Broadcast Receiving Licences

THE following statement shows the approximate number of broadcast receiving licences issued during the year ended November, 1954. The grand total of sound and television licences was 13,794,195.

Region	*Number*
London Postal ...	1,511,761
Home Counties ...	1,441,887
Midland	1,197,828
North Eastern ...	1,572,798
North Western ...	1,214,235
South Western ...	984,555
Wales and Border Counties	615,578
Total England and Wales	8,538,642
Scotland	1,036,257
Northern Ireland ...	219,672
Grand Total	9,794,571

British Institution of Radio Engineers

THE following meetings will be held during February:

London Section. — Wednesday, February 23rd, 6.30 p.m., at the London School of Hygiene and Tropical Medicine, Keppel Street, W.C.1. "A Versatile Electronic Engine Indicator." R. K. Vinycomb, B.Sc. (Southern Instruments, Ltd.).

North-eastern Section.—Wednesday, February 9th, 6 p.m., at Neville Hall, Westgate Road, Newcastle-upon-Tyne. Papers by students.

West Midlands Section.—Wednesday, February 9th, 7.15 p.m., at Wolverhampton and Staffordshire Technical College, Wulfruna Street, Wolverhampton. "Electronic Motor Control Systems." J. C. Rankin, B.Sc. (British Thomson-Houston Co., Ltd.).

Scottish Section. — Thursday, February 10th, 7 p.m., at the Institution of Engineers and Shipbuilders, Elmbank Crescent, Glasgow. "Radio Telephone Systems to the Islands." T. Moxon (G.P.O.).

South Wales Section.—Wednesday, February 23rd, 6.30 p.m., at the Glamorgan Technical College, Treforest. "The Training of Radio Engineers." H. W. French, B.Sc.

Cheerful Charlie Chester, Marian Miller and Ken Morris seen during rehearsals for the new Charlie Chester radio series.

Obituary

IT is with deep regret that we announce the death, on December 15th last at the age of 66, of Mr. Bernard Warner, manager of the E.M.I. record factory at Hayes, Middlesex.

Mr. Warner joined "His Master's Voice" as a clerk in 1912 at the age of 24. He became manager of the record factory in 1935 and played a leading part in establishing many significant developments, among them the technique of producing records from magnetic tape instead of waxes.

Agreement With N.U.J.

THE BBC has announced an agreement under which it recognises the National Union of Journalists as a negotiating body, in addition to the BBC Staff Association, on staff matters concerning news and editorial staff and foreign language and English monitors employed by the Corporation.

Twice as Many

RADIO manufacturers in this country calculate that 1,500,000 radio sets were sold during 1954, including radiograms and car radios, which is approximately double the number sold in the previous year.

Only for Timekeeping

A LISTENER summoned at Nottingham recently wrote to the magistrates saying that he could not afford to pay for a licence until he had finished paying the hire-purchase instalments on the set.

Another plea received from a radio "pirate" was: "We only use the radio to get the time in the morning."

"Europe No. 1"

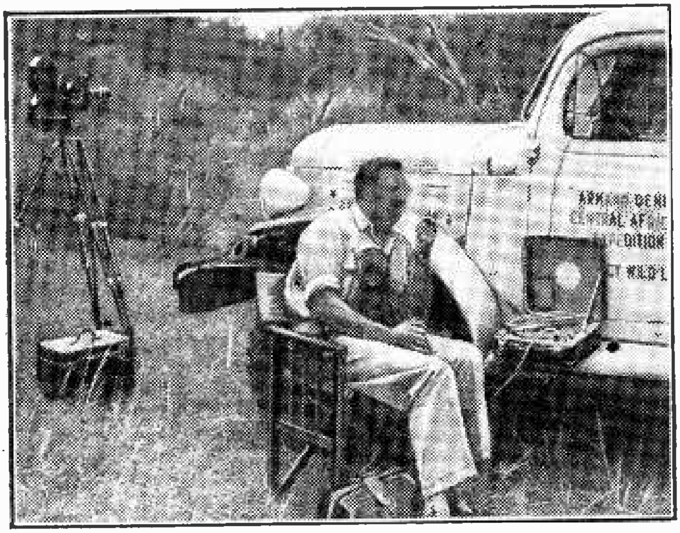
IT is reported that transmissions are about to begin from the Saar, France, under the auspices of a new station claimed to be "the world's most powerful private wireless station" and which will be known as "Europe No. 1."

The station is situated on the Felsberg plateau, 180 miles from Paris. Programmes will be broadcast in French for 18 hours a day.

"People Are Funny"

PYE'S "People Are Funny" radio programme on Radio Luxembourg is now embarking on its second year and the new schedule includes visits to Lowestoft, Luton, Sheffield, Plymouth, Aldershot, Norwich, Aberdeen, York, Grimsby and Oxford.

Lucky number leaflets, bearing the names and addresses of local Pye dealers, are being distributed to members of the audience at the recordings.



Armand Denis records part of the sound track for his latest film on jungle life.

Marconi Appointment

MR. G. R. TYLER, having reached the normal retiring age, has relinquished his position as manager of the Maritime Division of Marconi's Wireless Telegraph Company Ltd. He is, however, continuing his work for the company as their representative in West Africa.

Mr. Tyler has been succeeded as manager of Maritime Division by Mr. B. G. H. Rowley, M.A. (Oxon), A.M.I.E.E., formerly the Company's technical representative in U.S.A. and Canada.

African Safari

ON their recent African safari to film a BBC television series, Armand and Michaela Denis carried an "Emidicta" recorder which they powered from the electrical system of their truck. They found the recorder invaluable for making "on the spot" background commentaries.

"Martinet" Electronic Helmsman

ARRANGEMENTS are announced for the development and marketing of the new "Martinet" automatic steering device which was shown for the first time on the joint Marconi-Hartley stand at the National Boat Show at Olympia.

The "Martinet," developed by Hartley Electromotives, Ltd., will be produced by them at their Shrewsbury factory, the sole concessionaires being the Marconi International Marine Communication Co., Ltd., whose comprehensive servicing organisation, established at all principal ports, will also be available for attending to the fitting and subsequent maintenance of "Martinet" installations.

Desert Communications

FOUR complete Cossor Wireless Station 53 equipments have been purchased by the ruler of Kuwait, Sheikh Abdullah el Mulbarak, for desert communications. The last of these were delivered in January this year.

The complete wireless station 53 is a general-purpose, medium-powered communications equipment, operating either as a static or mobile unit. Remote control facilities are provided and C.W., M.C.W. and R/T transmissions are possible.

Ethiopia Buys Radio Equipment

AN important contract was signed to-day between the Imperial Board of Telecommunications of Ethiopia and the two well-known British firms, Standard Telephones and Cables, Ltd., and Marconi's Wireless Telegraph Co., Ltd., for a new international radio communications system working from Addis Ababa.

The system will provide radio telephone and telegraph communication with London, Nairobi and important centres in the Middle East. Additional services may be inaugurated later to other European centres.

V.H.F. Transmitting Station

THE BBC is to be permitted to build a V.H.F. transmitting station at Wenvoe, in South Wales. This brings the number of V.H.F. stations so far approved by the Government to 10.

The purpose of these V.H.F. broadcasting stations is to provide a powerful reinforcement of the coverage given by the existing long-wave and medium-wave stations radiating the Home, Light and Third Programmes. Up to the present, this coverage has been restricted on account of the limited number of wavelengths available for the broadcasting service in the United Kingdom.

British Radio Compasses

THE initial 40 Viscounts ordered by Capital Airlines (U.S.A.) are to be equipped with Marconi automatic direction finders, a dual installation in each. This equipment, manufactured by Marconi's Wireless Telegraph Co., Ltd., has been specified by Capital Airlines in their order upon the makers of the Viscount, Messrs. Vickers-Armstrongs, Ltd.

Swansea Transmitter

THE new Third Programme low-power transmitting station at Swansea, Glamorgan, has now been completed and was brought into operation on Sunday, December 19th, 1954. It has a power of 1 kW and will radiate on a wavelength of 194 metres (1,546 kc/s).

This station has been designed to operate automatically without the attendance of staff.

Radio's Big Future

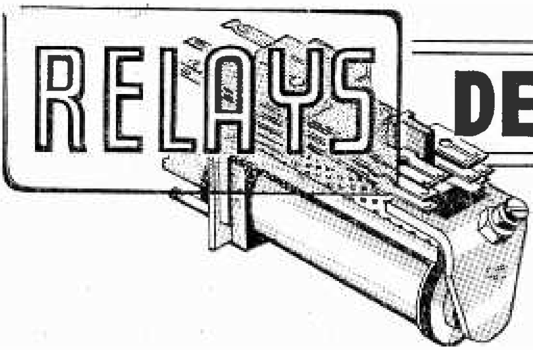
AT a recent Press conference, Mr. Gerald Beadle, BBC West Region Controller, was asked whether he considered sound radio as being finished as a medium of entertainment.

"No," he replied, "all the evidence is for a big future for sound radio."

Luxembourg Listening Increase

MORE people listened in to Radio Luxembourg in November than at any other period since the end of the war.

The average audience now for Radio Luxembourg is 2.55 million.



RELAYS DESIGN & USES

THE FIRST ARTICLE IN A NEW SERIES DEALING WITH A MOST USEFUL TYPE OF RADIO ACCESSORY

By J. R. Davies

ONE of the most fascinating aspects of electrical and radio engineering lies in the ability to control equipment from a distance. The flight of a model aeroplane guided by radio or the process of dialling a telephone number provide two of many instances which are nowadays accepted as being quite commonplace. Methods of control by what appear to be, at first sight, unconnected phenomena also figure largely in modern life. Burglar alarms which function when a light ray is broken are no less taken for granted than are those devices which ring a bell when a baby starts crying !

All the various types of apparatus used for these processes rely entirely upon electrical or electronic circuit design to enable them to work. And at the heart of the equipment itself there is always found at least one of those reliable little components which carry out the important task of automatic switching. In other words, a relay.

It should be pointed out that relays do not lend themselves only to devices intended for control purposes, however : in simpler circuits, for instance, they may be employed to enable small currents to switch larger currents (or currents at dangerous voltages), to give automatic operation of complicated switching sequences, or to provide a means of switching out equipment which becomes faulty.

Finally, owing to one of the peculiar attributes of relays, by means of which their contacts may switch circuits entirely separate from those which energise them, they can be utilised in various combinations to give some extremely interesting and ingenious effects ; some of which almost convey the impression that the relays are thinking for themselves !

It is intended in this series of articles to describe the construction and operation of those relays which are most likely to be encountered and used by radio mechanics ; and to follow the descriptions with typical examples of the many different circuit arrangements in which such relays can be employed.

The Relay

A relay is a device which, when energised by an electric current at a suitable voltage, causes two or more contacts either to make or to break. In the magnetic relay the energising current is passed through a coil and thus induces a magnetic field. This field causes physical movement in a piece of metal which, in its turn, moves the appropriate contacts of the relay.

One of the most common types of relay likely to be encountered nowadays by radio mechanics in this country is that which was originally designed for telephone exchange work. A cross-sectional diagram of this relay is given in Fig. 1. The action and construction of this relay is typical of almost all other types ; and it affords a good basis on which to give the names of the various parts.

Referring to the diagram, it will be seen that the moving part of the relay, the armature, is pivoted on what is known as the " knife-edge," this latter being part of the top end of the yoke. An extension of the armature, usually referred to as the armature lever, is used to transmit the movement of the armature to the contacts. The armature is held in position on the knife-edge by means of a screw and spring-washer.

The core of the relay is fixed (by a single nut in most cases) to the heel of the yoke. (The coil is fitted around the core during manufacture and cannot normally be removed.) The connecting lugs of the coil usually appear at the heel of the relay ; as, also, do the lugs from the various contacts. This method of construction allows the relay to be mounted upright on a chassis with its lugs projecting through, thus enabling all connections and wiring to be kept below.

In the de-energised position of the relay the armature is held away from the top of the core by means of the spring contacts which press against the armature lever. When the relay is energised the armature is attracted towards the core, thereby actuating the contacts ; the magnetic circuit between the core and the armature being completed by the

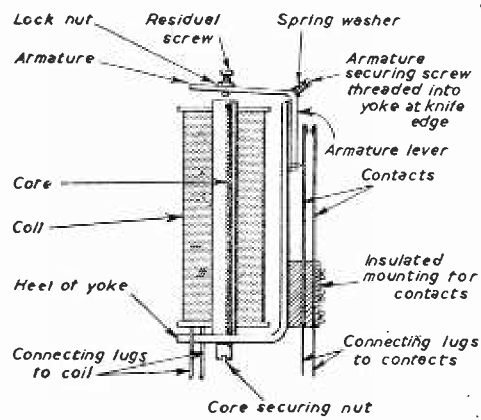


Fig. 1.—Cross-section of a typical relay. The coil lugs pass through holes in the heel of the yoke. An extension on the moving contact nearest the yoke bears against an insulated inset on the armature lever.

yoke. The armature, core and yoke are all made of high-permeability metal.

If it should happen that the armature were allowed to make direct physical contact with the core when

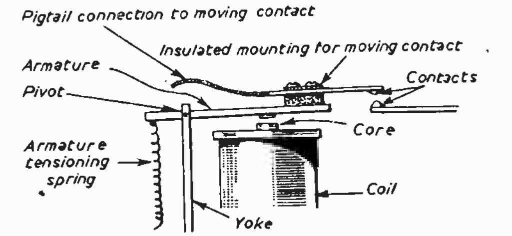


Fig. 2(a)—An alternative type of relay construction permitting the switching of heavy currents.

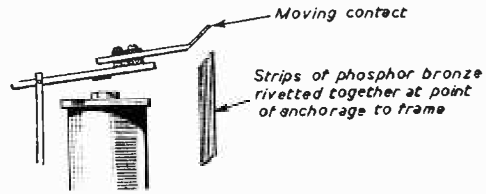


Fig. 2(b)—Another heavy current relay. In this case the contacts are, to a certain extent, self-cleaning.

the relay energised, it would be found that it would not release immediately when the energising current was removed. This delay would be due to the fact that the field in a closed magnetic circuit takes some time to die away. To obviate this trouble a "residual screw" is fitted to the armature, as shown in the diagram. This screw is made of brass (or some similar non-magnetic material), its function being to prevent the armature from making direct contact with the core in the energised position. The screw can usually be adjusted and is fitted with a lock-nut or similar device. Sometimes, however, a fixed stud is used instead of a screw.

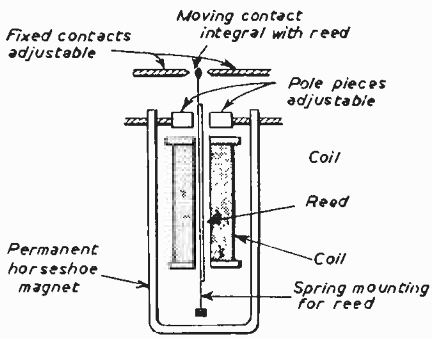


Fig. 3.—A simplified cross-sectional diagram of a high-speed polarised relay. The moving contact need not necessarily be insulated from the reed.

Other Types

The construction of the Post Office type relay of Fig. 1 is typical of most non-polarised relays. Such a relay can be used for a great number of low-voltage and low-current jobs, and is very often found in "surplus" equipment.*

Relays designed to switch heavier currents often have their contacts fitted to the armature in the manner shown in Fig. 2(a). This method allows a greater and quicker movement of the contacts with consequently less arcing. An alternative scheme is shown in Fig. 2(b), in which the contacts are not only capable of switching a heavy current, but are also, to a certain extent, self cleaning.

* Small American relays appear to use a similar method of construction. So far as the writer is aware, American models use an axle for pivoting the armature instead of the knife-edge.

When high currents are being switched by a relay it is occasional practice to use two sets of contacts, one set making before the other. The first contacts are carbon faced and bear the brunt of whatever arcing may occur.

Polarised Relays

A large field of experiment for the amateur lies in the use of polarised relays. These relays make use of a permanent magnet, and are capable of reacting in different manners according to the polarity of the voltage applied to their coils. A usual form of construction consists of a reed made of magnetic material mounted inside a permanent magnet, in the manner shown in Fig. 3. The energising coil is stationary. It will be seen that if the reed is adjusted to lie midway between the two pole-pieces a current applied to the coil in one direction will cause the reed to be attracted to a particular pole of the permanent magnet; whilst should the current be applied in the opposite direction it will be attracted to the other pole.

In practice it is possible to make a polarised relay of this construction work at much higher speeds than can the type shown in Fig. 1. The relative sluggishness of the relay of Fig. 1 is due to two main reasons: first, the large mass of metal in the magnetic circuit gives a slow rate of magnetic "build-up" and decay, and, secondly, the magnetic force applied to the armature varies considerably as it moves to and from the core. With the polarised relay of Fig. 3 these disadvantages are overcome since the magnetic changes are applied to the reed, and this can be given quite a small mass. In addition, the force applied to the reed can remain reasonably constant over its travel (so long as the latter is kept small).

When a polarised relay of the type shown in Fig. 3 is used for high-speed work the construction is made such as to render it capable of being delicately adjusted. Such adjustments are usually made possible by providing both the fixed contacts and the permanent magnet pole-pieces with threaded bodies which enable them to be screwed nearer to or farther away from the top of the reed. The spring support at the bottom of the reed is often capable of adjustment as well, this adjustment being

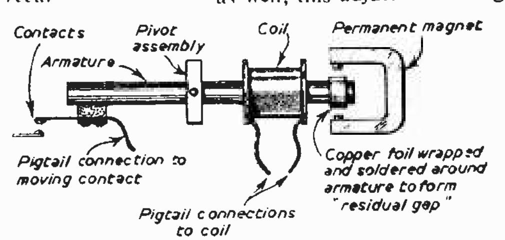


Fig. 4—A suggested design for a relay which can be easily constructed in the amateur workshop. The possible contact assemblies are not, of course, limited to the simple arrangement shown here.

such as to alter the position of the reed relative to the contacts and pole-pieces when the relay is de-energised. (This process is known as "biasing.") By means of this adjustment the reed can be biased either to rest against one or other of the contacts or to stay in the middle.

Owing to the capabilities of this type of polarised relay for high-speed working it is often used in a two-contact circuit for this purpose alone. (In other words, the energising current is applied in one direction only, and the relay contacts function as a simple S.P.S.T. switch.) The fact that the relay also reacts differently according to the polarity of its energising voltage is then considered as being an incidental quality. High-speed relays are used very frequently for keying transmitters, etc.

Apart from high-speed work, polarised relays are also used for functions where their ability to differentiate between energising voltages of opposite polarities becomes definitely useful. A typical example is given by the reverse current cut-out, as used for accumulator charging. It is common in such cases to dispense with the permanent magnet and to use, instead, an electromagnet energised continually from the source of supply or from the accumulator.

Remote Switching

Another type of polarised relay which may be used for remote switching at low speed is shown in Fig. 4. The construction of this relay is very simple and it can be built by the average amateur quite easily. (The writer has not met a commercial version of this particular type of relay.)

The relay consists of a fairly long armature, pivoted at its centre. One end of the armature is fitted with contacts, the other end swinging between the poles (or pole-pieces) of a permanent magnet. A coil is wound around that part of the armature which lies between the pivot and the pole-pieces, connection to it being made by flexible pigtails. When an energising voltage is applied to the coil the armature swings to the north or south pole of the permanent magnet according to the polarity of the voltage. When the polarity of the energising voltage is reversed the armature swings over to the other pole. On being energised the end of the armature is not only attracted by the permanent magnet pole-piece of opposite polarity, but is repelled also by the pole-piece of similar polarity. The armature is, therefore, capable of travelling over a greater distance than would occur if it relied on attraction alone.

To prevent the armature "sticking" at either pole a residual gap has to be provided. This may be given by wrapping several thicknesses of brass or copper foil around the armature: or by fitting adjustable brass screws to the pole-pieces.

One of the advantages of this relay lies in the fact that it may be operated over two leads alone, and that it is necessary only to use momentary energising voltages. A control circuit is given in Fig. 5(*a*).

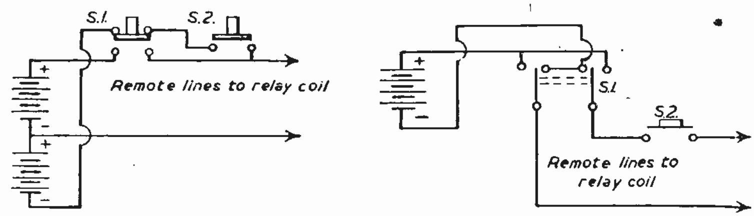


Fig. 5(a)—A remote circuit for controlling the relay of Fig. 4. S1 and S2 are push-buttons which when pressed cause the relay armature to move in the desired direction. The double-pole arrangement at S1 is included to prevent damage should both push-buttons be accidentally pressed at the same time. Fig. 5(b)—An alternative control circuit using only one battery. In this case the D.P.D.T. switch S1 selects the desired movement of the relay, push-button S2 being pressed to actuate it.

Another control circuit, using a commutating switch and a single battery, is shown in Fig. 5(*b*).

A further advantage peculiar to this relay is given by the fact that once the armature has swung over to one of the magnet poles the force of the magnet holds it there even after the energising voltage has been removed. Thus, the armature is capable of maintaining contacts closed under pressure without being continuously energised.

So far, we have discussed two types of relay: the conventional "Post Office" type and the polarised relay. There are several further types of relay in common use and we shall consider these briefly before we pass on to the circuits in which they may be used.

High-speed Relays

When we referred above to polarised relays we showed how these could be designed for operation at high speeds. Polarised relays, however, are not the only types used for this purpose, and it would be worth while to devote a few paragraphs to some of the other types of high-speed relay in common use. (These other types do not normally operate at the *very* high speeds made possible by the polarised design.)

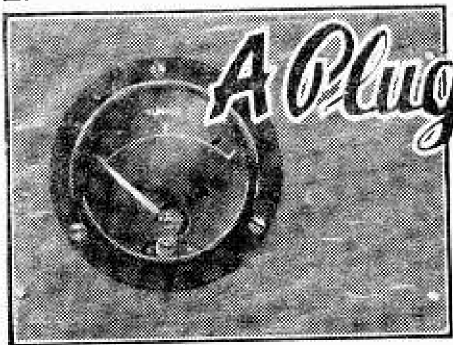
The construction of a non-polarised high-speed relay (which will be illustrated next month), enables high-speed working to be obtained by reason of the fact that the energising coil is fitted to a core of horse-shoe shape, both poles of which attract the armature equally. Thus the armature may be made with a small mass and be correspondingly more capable of following quick changes in the energising field.

The contact bar, or "lever," to which the armature of this relay is fixed, is pivoted on a specially-designed axle which reduces friction. The core could, preferably, be laminated. Relays of this type are usually provided with very delicate contact and biassing adjustments, the movement of the armature and the contacts being kept as small as possible. When so adjusted, the relay can only be used for switching light currents.

Another high-speed relay which certainly deserves mention here is that used for keying the ex-R.A.F. transmitter, the T1154. The armature of this relay imparts a rotary movement to a bar made of insulating material, the moving contacts of the relay being mounted to this bar. (Connection to these contacts is made via pigtails.)

(*To be continued*)

A Plug-in Tuning Meter



A USEFUL ACCESSORY WHICH MAY BE MADE FROM SPARES

By F. G. Rayer

THE usual type of commercially manufactured receiver does not have a tuning meter; nor do many home-constructed receivers and the simpler type of communications receiver. With such receivers it is often undesirable to cut the panel or cabinet to provide a position for the meter. Or, if this permanent modification would be permissible, it may not be possible to find space in a suitable position. These difficulties can be overcome by housing the meter in a separate case, with a sloping panel, and making provision to plug in the required connections at the back of the receiver. The small meter desk may be placed at any convenient position by the receiver, and can be immediately disconnected, the appearance of the receiver being in no way damaged.

The meter described here can be connected to any A.V.C. controlled stage, e.g., R.F., F.C. or I.F. stage. The complete circuit is shown in Fig. 1, and it is necessary to disconnect the lead in the receiver which passes from I.F. transformer secondary to H.T. positive. This circuit is then decoupled, a resistor of about 1 K. to 5 K. being suitable, with a condenser of about .1 μF to .5 μF. This is shown in Fig. 1, and serves to keep intermediate frequencies out of the meter circuit. Connections to chassis and H.T. positive are also required. These connections are taken to a 3-way socket or valveholder, mounted at the back of the receiver chassis. In order that the receiver can function in the usual way when the meter is disconnected provision must be made for completing the H.T. circuit to the I.F. transformer. This may be done by inserting a further valve base which has these pins wired together or by shorting the two sockets concerned by means of two plugs on a short length of wire, or any other suitable means.

Mounting Desk

Constructional details of the desk are shown in Fig. 2, and its size may be as small as the meter permits. The actual size of the meter is of no importance as regards working, but will govern the dimensions of the panel and the depth required to accommodate the meter and 1 K. wire-wound pre-set potentiometer or variable resistor.

Wiring is shown in Fig. 3, and 1-watt resistors of ordinary tolerance values are suitable. The three-core flex and plug, or valve base, should be wired up so that connections are correct when the unit is plugged in or proper operation will be impossible.

Setting Up

When first used the 1 K. potentiometer requires to be adjusted, and this adjustment will have to be repeated if the meter is used with another receiver. The receiver should be tuned to a position on the dial where no station is received, and the potentiometer adjusted until the meter pointer is at zero, showing no current is passing through it. With an average 1 mA. meter and a valve such as the 6K7 the potentiometer will require to be set at about midway position. When a station is tuned in the pointer will rise. The higher the movement the stronger is the transmission being received. Correct tuning is the position of highest movement. With powerful local stations the meter pointer may pass beyond the full scale position. This, however, can be overcome only by fitting a switch to shunt the meter to 2 mA. full scale, or by using a meter of a higher current rating than 1 mA., unless sensitivity for "average" stations is to be reduced by changing component values.

I.F. Circuit

It will be found that definite changes in reading can be obtained with changes in volume quite inaudible to the ear. The increase in reading obtained with any improvement in the aerial or earth system of the receiver is very apparent. So is any increase in sensitivity in the receiver obtainable by very careful alignment of R.F., F.C. and I.F. circuits. This fact makes the meter very useful for alignment purposes.

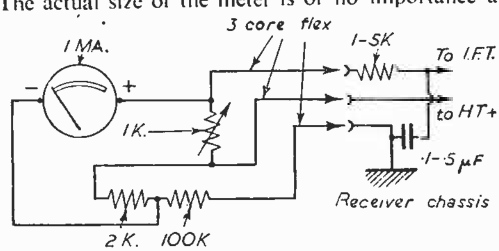


Fig. 1.—Theoretical circuit.

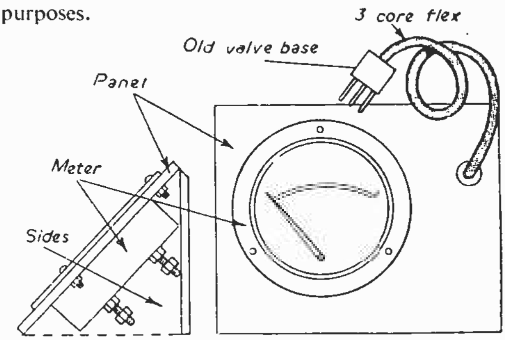


Fig. 2.—Constructional arrangement.

When choosing the I.F. transformer circuit with which the meter will be used it should not be overlooked that in some receivers the F.C. or I.F. stage is no longer controlled by the A.V.C. circuit on the short-wave bands. The meter operates by the change in anode current caused by the A.V.C. circuit; hence a valve A.V.C. controlled on all bands must be chosen. With distant M.W. stations, in particular, the pointer may rise and fall during the reception of a transmission. This shows that fading is present and that the A.V.C. system is endeavouring to maintain a stable output despite fluctuations in the actual signal strength at the aerial.

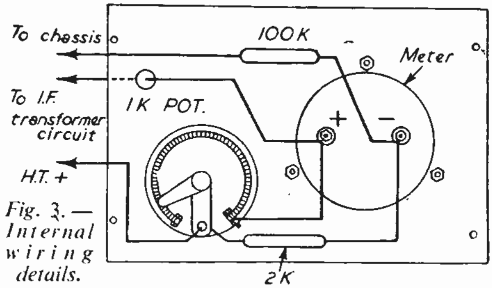


Fig. 3.—Internal wiring details.

Modifying the Ex-R.A.F. R1132A Receiver

SOME USEFUL HINTS FOR A POPULAR SET

FIRST make sure that your receiver is working correctly. Remove the D.B. attenuator switch, complete with all resistors which are attached to it on a small paxolin panel, trace wires through the chassis and disconnect from their various soldered connections.

Remove the output transformer and output choke situated under the chassis, replace by an output transformer which matches into a 6V6GT. Note that this new output valve must be a 6V6GT, as a 6V6G will not fit because the glass bulb is too large. Remove the bias resistor and condenser from the output stage and replace by a 240Ω ½ watt and 25μF 25 volt bias condenser. Remove all wires to the 'phone jacks, and rewire one jack across the secondary of the new output transformer. The other jack is removed altogether and a small panel indicator light fitted in the hole. This panel light can be wired across the heaters of the nearest valve-holder, and a 6 volt .04 amp. bulb is quite suitable.

Where the D.B. attenuator switch used to be a tone control may be fitted. This consists of a 50 kΩ potentiometer in series with a .01μF mica condenser, which are wired across the primary of the output transformer. This control is almost essential when listening to Wrotham.

Next, remove the screening cover from the R.F. sections and remove the four coils. The easiest way of removing these is to cut the coils with wire cutters—then with a very hot soldering iron use for as short a time as possible, as the insulation may suffer damage and shrink and tend to loosen the solder sockets of the coil holders. Also note that a fairly heavy soldering iron is needed for this operation.

Coil Details

As the solder is melted, with a twisting action remove each portion of the coil by pulling away from the sockets. When all coils are removed you can now rewind new coils, making sure they are wound in the same direction as the old ones otherwise the ends will not be facing the sockets and will not enter them. All coils are wound with 14 s.w.g. copper or silvered copper wire. L1, L2, L3 are all ⅜in. inside diameter and spaced 5/16in., ⅛in., 1/64in. respectively. L4 is ⅜in. inside diameter spaced 3/32in. L4 is nearest to the front panel. L1 is the aerial coil; L2 is the band-pass primary coil; L3 is the band-pass secondary coil; L4 is the oscillator coil. With coils now in position replace the screening cover over the R.F. sections, adjust the four trimmers to maximum capacity, i.e., screwed right down. See that sensitivity pre-set VR1 is fully clockwise (this is adjusted by a screwdriver through the front panel, and is to the left of the R.F. gain control). Set tuning dial to read 107 deg.; R.F. gain to maximum; B.F.O. auto gain and manual gain switch to Manual gain; L.F. gain to approximately 75 per cent. of maximum. Now with power supplies and aerial connected, trim the oscillator trimmer, C22 (nearest panel), until Wrotham is heard. Adjust the other three trimmers in turn, working from the front to the back until maximum signal is received. These three trimmers, if adjusted too near minimum capacity, will cause their associated circuits to oscillate. If this does occur, retrim to maximum capacity and start trimming again. When maximum signal strength has been obtained retune to approximately 125 deg. Here the other Wrotham transmission should be heard. If this is not the case tune down to approximately 89 deg. If Wrotham is then heard this setting should be trimmed to 107 deg. by the oscillator trimmer only (nearest panel). Wrotham should now be received both at 107 deg. and 125 deg. approximately. Peak up the other three trimmers again for maximum signal still on 107 deg. The conversion is now complete and can be carried out in about 2½ to 3 hours. Wrotham uses F.M. transmission and, therefore, you should tune to the L.F. side of the carrier. This is the same for any F.M. stations received by the R.X. There are several stations either side of Wrotham as the operator will find out.

Aerial

A fairly good aerial for these frequencies is the ½λ vertical dipole, each half being 28in. long spaced in the centre ¼in., and fed with 80Ω coaxial. The vertical dipole is preferred to the horizontal dipole as there is only Wrotham that is transmitting a horizontally polarized carrier, all others are vertical, and Wrotham is received very well indeed. The antenna elements can be ¼in., ⅜in. or ½in. outside diameter tube, copper, brass or aluminium, which is fixed to a length of 1in.×1in. wood batten by spring clips. The elements are sprung into the clips, no other fixing is needed as the clips hold the tube elements quite rigid.—L. H. Cox.

On Your Wavelength

BY THERMION

More About the I.S.W.L.

As a result of my remarks in the February issue on the International Short Wave League, I have received a number of letters from members of it. Not one of them, however, answered the main points of my criticism which were: Is an Annual Balance Sheet issued and circulated to members?; is such Balance Sheet independently audited?; is an Annual General Meeting held?; and are the officers elected annually? All of my correspondents avoid these important issues. A member of a club is entitled to have a hand and a say in its affairs. If members are dissatisfied with the conduct of a club they should have an opportunity of changing their officials. If a club is run as a business the executives are self-appointed proprietors of it and the only redress a dissatisfied member has is to leave.

It is wholly unsatisfactory to the members to say that the books are open to inspection by any member at any time. It would take several days to analyse books, compare revenue with expenditure and analyse receipts and in any case few members have accountants' minds or would be able to analyse books. However, Mr. John E. Alban (G3JEA) has written an explanatory letter. He was chairman and treasure of the league up to April 1st, 1954, and he retired through pressure of business. He assures me that the interests of all members are the first and foremost consideration of the council, although he is disappointed in the reluctance of the league secretary to answer my questions. The league was formed in 1947, by Dr. Arthur Gee (G2UK), and at that time it was sponsored by a journal which in 1951 announced that it was no longer able financially to support such a venture and members were told that they were welcome to carry it on between themselves. The short-wave listener was poorly catered for and the British Short-wave League went out of existence. A few enthusiasts, however, managed to resuscitate the league under its present title.

I am informed that the management of the club is entirely voluntary and the only expenses paid are rail fares for out of town committee members, when general meetings are held thrice yearly. The present council consists of two licensed amateurs, a radio technician, the secretary and the present chairman and treasurer. When council meetings are held they usually occupy a whole week and "all members carry out unbiased inspection of the books and accounts." It is here that I quarrel with league methods. As custodian of members' subscriptions and other revenue, if any, it is the duty of the league to prepare and to circulate to every member an independently audited balance sheet, not one prepared by the council itself.

There are two grades of league membership, associate and corporate, as is the case with the R.S.G.B. Associates pay 2s. 6d. per annum which entitles them to the free use of the Q.S.L. Bureau, permission to enter all contests and use of all free advice services which includes translation, a book section which advises members on suitable literature and a technical advice service. I am informed that the league has been abused "by jealous members of the ex-B.S.W.L. crowd."

The corporate member enjoys the same privileges as an associate but he pays 10s. 6d. per annum and gets 12 monthly issues of a duplicated magazine which contains "calls heard" lists from members all over the world, both broadcast and amateur.

Mr. Alban tells me that the membership is not more than a third of the total number that have been enrolled since 1947 which is 6,000. The revenue is obtained from subscriptions and the sale of headed stationery and league badges and the expenditure includes the duplicating of the magazine, printing of stationery, postage, maintenance of copying machine, and cups and prizes for three annual contests. I am told that the profit may be £30 per annum out of a membership of, say, 2,000. I am not told how many associate and how many corporate members there are, so it is impossible to assess what the revenue should be. A list of members is not printed or issued to each member. I gather from those who have seen the books that this figure is not disclosed —merely a round figure being given as receipts and subscriptions.

The Q.S.L. service is the main feature of the league. One reader says, re my comment on the Radio Amateur Invalid and Bedfast Club, that it is "doing a grand job of work" which only goes to show how people will use extravagant language without being in possession of the facts. For the fact is that with a membership of about 30 it *cannot* be doing a grand job. This club appeals for gear and books, but no member is informed as to how these are disposed of.

I still invite the International Short Wave League to answer my questions and, if necessary, to allow an independent accountant, nominated by me, to inspect the books. They may rely upon me publishing a fair report on the result.

I should point out that the I.S.W.L. has no official premises, its affairs being conducted from the home of the secretary.

Incidentally, if any of my readers are members of clubs which appeal for subscriptions, funds, gear or books, I should be glad if they would write to me about it. Whilst many of them may be run on sound lines, to my certain knowledge some of them are not. Some years ago I spent a whole week-end interrogating the secretary of one of these racket clubs and, under threat of police exposure, extracted from him the information that all of the second-hand components which he had obtained on the pretext that they were required for members had been sold, as also had the books.

The World Friendship Society of Radio Amateurs, which I criticised some time ago, seems to have gone out of existence. Before joining any club readers should take particular care to enquire what benefit they are likely to receive and whether they are able to have a say in the club's affairs.

AMPLIFIER DESIGN

12.—TUNED AMPLIFIERS—CONTINUED

By R. Hindle

(*Continued from page 110, February issue*)

A Series of Articles Dealing with the Theoretical Considerations of Amplifier Design, and Containing at a Later Stage Constructional Details of Various Types of Amplifier.

Circuit Impedance

WHERE the Q of the circuit is more than 10 (which refers to all normal circuits used for radio) the impedance at resonance (designated Zo) is equal to Q times the reactance of either leg, i.e., the reactance of an inductance is multiplied by Q when brought to resonance by means of a capacitor—with the series circuit the voltage was amplified, but with the parallel circuit the reactance is effectively amplified.

This high impedance refers only to the resonant frequency; to frequencies higher and lower than the frequency of resonance the impedance falls. This means that when used as a load the tuned circuit will give a greater amplification at resonant frequency, so that apart from giving a greater amplification, a high Q circuit also discriminates between wanted and unwanted signals—high Q for high selectivity. Fig. 47 gives the curve for impedance to frequencies on either side of resonance, and can be looked upon as the response curve because the gain of a pentode amplifying stage is roughly proportional to the size of the load. Below resonance the inductive branch has the lower reactance and therefore the greater current flows through this branch. The current to be supplied by the source (the valve in our case) is as if the load were inductive; to frequencies above resonance the load appears to be capacitive by a similar argument.

Basic Circuit

The basic design for the R.F. amplifier is thus as in Fig. 48. The source of signal is the tuned circuit L1C1, which is a parallel tuned circuit, because the imput impedance of the valve is high and so a high-impedance circuit is required to match it. A high-impedance parallel-tuned circuit L2C2 forms the anode load. A pentode valve is shown; a tetrode could just as easily be used so long as the operating circumstances did not run the valve into the kink in the characteristic. A triode would also be satisfactory but for the inter-electrode capacitances that caused trouble with the audio theory. Unfortunately the much larger grid-anode capacitance of the triode causes feedback which makes the circuit unstable. Before the introduction of tetrodes triodes had to be used, and the effects of feedback were avoided by neutralising, that is, by feeding back deliberately a signal equal and opposite to that fed back unintentionally by the inter-electrode capacitance. How this can be done is indicated in Fig. 49. The anode tuning inductance is centre-tapped and the H.T. fed to the centre. There will now be a signal at the top end of the inductance of exactly opposite phase to that at the anode end. It is a part of the signal at the anode end that is accidentally fed back via Cga (shown dotted in Fig. 49); a second feedback circuit is via Cn, the neutralising capacitor, from the top of the anode tuned circuit. Now if the centre tap is in fact exactly in the centre the inductance, the voltages at the extremes will be equal and opposite, and if Cn is made equal to Cga, the two voltages fed back will be equal and opposite and so will cancel each other out. In practice, Cn is made variable so that the neutralising feedback can be adjusted to the exact value required and can be set to allow for a tap somewhat off centre.

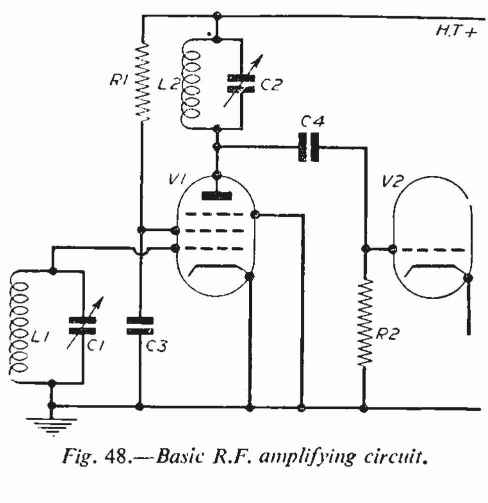


Fig. 48.—Basic R.F. amplifying circuit.

It has to be pointed out that though the pentode or tetrode has a much smaller Cga than the triode, and indeed it is for this reason that it was developed, it has nevertheless some such capacitance and because of this the amplification possible even from a pentode is limited, and the Q of the tuned circuits must be kept below the value that would give a gain sufficient to introduce instability. If higher gains are required from the pentode and a sufficiently high Q is attained in the tuned circuits, neutralising can be resorted to just as with a triode. This is well worth remembering because neutralising is out of fashion and consequently generally completely out of mind, though it might often be used even now with advantage.

Sideband Cutting

There is a good reason, of course, why neutralising is not often found in normal radio circuits these days. The effect of a circuit with high Q, as well as to increase the stage gain, is to narrow the resonant curve (Fig. 47). If only the carrier frequency were required to be passed all would be well, but, of course, the required signal comprises the sidebands that exist on each side of the carrier, and the higher the audio signal modulating the carrier the wider the bandwidth required (it is as well not to introduce confusion at the present stage by mentioning other methods and purposes of modulation besides audio, but the principle remains substantially the same); if satisfactory results are to be obtained the R.F. stages must pass the whole band of a width equal to twice the highest modulating frequency. This, then, limits the Q of the circuit for practical purposes and with careful construction generally the bandwidth limitation comes into play before the limitation of instability and neutralisation is not required in such cases.

Interstage Coupling

The tuned anode stage is coupled to the following stage exactly as was the audio amplifier, a capacitance being interposed to prevent the H.T. being passed

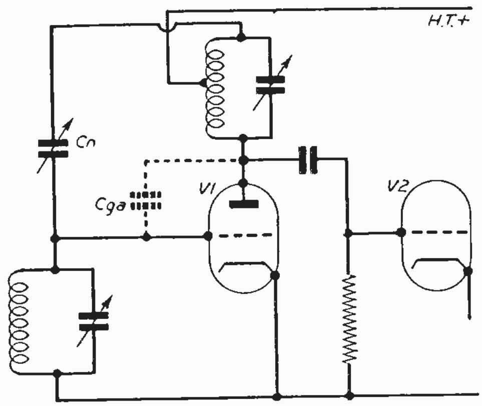


Fig. 49.—Method of neutralising grid anode capacitance.

to the next valve and a grid return resistor being connected to provide a D.C. path from grid to cathode of the following valve. Bias resistors and by-pass capacitators are also used in exactly the same way as with audio amplifiers and for the same purpose. The screen grid will generally have a dropper resistance between it and H.T., and a by-pass capacitator to earth, though some such valves will take the full H.T. to the screen grid if desired.

Again, as with audio amplifiers, the grid resistor of the following valve is effectively in parallel with the anode load tuned circuit and will modify the gain obtained, as well as the selectivity, by reducing the Q of the circuit ; but generally the resistor can be made big enough for its effect to be negligible. The by-pass capacitators used are calculated to have a reactance considerably less than the resistances that they by-pass, but as the frequencies present are high the capacitance is considerably smaller than was used for audio work. A common value for normal broadcast frequencies is .1 μF.

Gain

The dynamic impedance of a tuned circuit to the resonant frequency (Zo) is purely resistive, the reactances of inductance and capacitance having cancelled each other out (the value of the equivalent resistance being Q multiplied by the reactance of either component) and consequently the gain can be calculated exactly as was done for audio work, i.e., as a pentode is used the gain will be gm $\times$ Zo. The stray capacitances have not the effect of reducing the gain because they are now part of the tuned circuit itself.

The reader will be familiar now with the argument that the anode load (in the present case the tuned circuit), is effectively in parallel with the following grid resistor, because the coupling capacitor is made of such a size that its reactance at the operative frequencies is negligible, and will also appreciate that if two components are in parallel it does not matter which is put to the left and which is put to the right. Thus it is easy to see that the tuned circuit and the grid resistor can be interchanged without altering the operation of the circuit. This is shown in Fig. 50. There is the distinction that if the resistor is in the anode circuit it must be made smaller than would be used in the grid circuit of the following valve or else the valve will be starved of H.T. Consequently the effective load will be less and the gain lower. Also the resulting reduction in H.T., even with a smaller anode resistor, will affect gm, again reducing gain, and will cause the characteristics to have more curvature, reducing the size of signal that can be accepted without distortion. These effects are not of great importance under normal circumstances but in special cases (such as, for instance, where an exceptionally large signal is being fed in) they might need more consideration. On the other hand, there is the advantage that the tuning capacitor has one side at earth potential so far as the H.T. is concerned and so renders it more convenient if a ganged tuning condenser is used.

Transformer Coupling

When an alternating current is passed through an inductance an alternating field of force is set up and if a second coil is placed near the first so that the field from the first cuts the turns of the second, an alternating voltage is produced thereby in the second coil. This is, of course, the principle of the transformer, but it will be seen to be particularly applicable to the case of intervalve coupling. Here we have an alternating current passing through a valve and we require to pass to a succeeding valve a voltage varying in sympathy.

The application of a transformer to an R.F. amplifier is indicated in Fig. 51. Now if there are exactly as many turns on the primary as on the secondary, and assuming that all the field of force of one coil cuts the turns of the other coil, that is, assuming perfectly tight coupling, the load on the valve will be exactly as though the tuned circuit were actually in the anode circuit and not just inductively coupled to it. The gain will then be exactly as in the

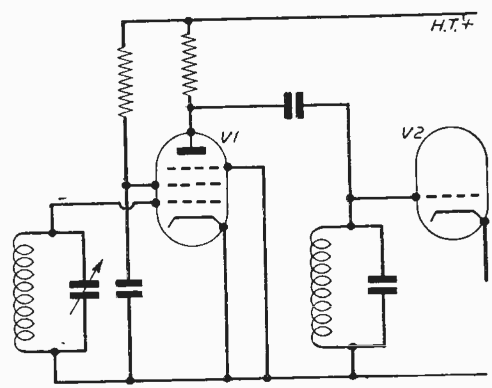


Fig. 50.—Tuned circuit transferred to grid of V2.

case of the tuned anode capacitance coupled circuit previously considered, but the grid of the following valve is isolated from H.T. without the use of a coupling capacitor, and the grid return is completed through the secondary of the coil so a grid leak is not required. In actual practice there will be some loss because perfect coupling cannot be set up.

Instability

One of the difficulties in R.F. amplification design already referred to is the risk of instability due to feedback from anode to grid. This feedback can be reduced either by increasing the impedance of the feedback path, as is done by introducing the screen grid in the tetrode though this measure is not completely effective, or by reducing the signal voltage existing at the anode from where the fed back voltage emanates. Now supposing that the primary of the

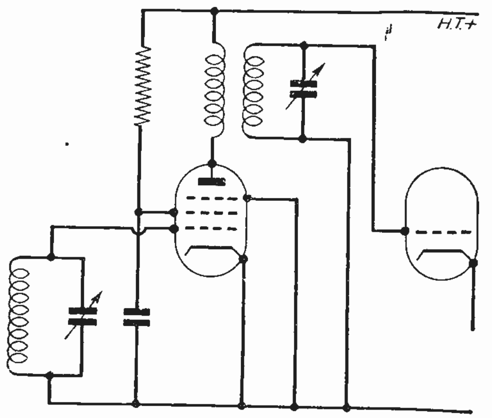


Fig. 51.—Basic transformer—coupled circuit.

R.F. coupling transformer in Fig. 51 is given fewer turns than the secondary. The load in the anode of the valve will no longer be the dynamic resistance of the tuned secondary but will be something less, and the actual load is worked out exactly as is done in the case of an audio output transformer, i.e., the reflected load is proportional to the square of the turns ratio. For instance, if there were only half as many turns in the primary as in the secondary the load into which the valve would work would be only a quarter of the dynamic resistance of the tuned secondary. But gain, we have seen, is the anode load multiplied by gm, and so the voltage at the anode of the valve is reduced to a quarter of what it would be with tuned-anode coupling. Clearly, therefore, with a given degree of feedback caused by the valve and the associated circuit there will be less voltage fed back and therefore less risk of instability. Maybe the reduction in gain by n^2 (where n is the turns ratio and the secondary has the greater number of turns) will seem rather a large price to pay, but it is not really quite so bad as that because the transformer has a step-up ratio of 2:1 and so twice as many volts will appear in the tuned circuit at the secondary as is at the anode of the valve. Thus, though the gain is reduced in proportion to n^2 and the improvement in stability is in that ratio, the step up of voltage in the transformer will be n times, and so the overall gain from the grid of the amplifying valve to the grid of the following valve will be reduced by only n times.

Adjustment of the turns ratio is thus seen to be a convenient method of determining the gain of the stage, whilst at the same time permitting a higher amplification overall within the limits of stability than do other methods of reducing gain. The alternative method would be, of course, to reduce the dynamic resistance either by altering the ratio of inductance to capacitance or by introducing extra resistive damping. In the latter case selectivity would also be reduced. The pattern of design now begins to form. First, the required Q is determined taking into consideration the bandpass required; then, if this results in too great a gain than is required as, for instance, if the resulting gain is above the stability level, the voltage at the anode of the amplifying valve will be reduced by increasing the step-up ratio of the transformer.

Coupling Constant

The effect of a coil on one adjacent to it is called mutual inductance and is usually designated "M". The theoretical maximum value of M, occurring when the flux linkage is complete, is $\sqrt{L1.L2}$; if the two inductances are of the same value this indicates that the maximum mutual inductance is equal to the inductance of either coil, which seems reasonable enough. The point has already been made that the theoretical maximum is unattainable in practice and even if it were it would not generally be desirable so that it is necessary to have some way of indicating the extent of the coupling. Taking the theoretical maximum ($\sqrt{L1.L2}$) as being 1, the actual coupling is indicated by a fraction, known as the coefficient of coupling, and is given by

$$k = \frac{M}{\sqrt{L1.L2}}$$

A k of a half would be considered as close and one of, say, .05 would be looked upon as loose.

The effect of M on the gain of the transformer stage is seen from the following formula for amplification at resonance:

Amplification $= gm \times 2\pi fM \times Q$

whereas gain for tuned anode circuit is:

Amplification $= gm \times 2\pi fL \times Q$

It is seen that M is substituted for L and consequently the modification in gain caused by transformer coupling is in the ratio $\frac{M}{L}$, which must inevitably be a reduction because the mutual inductance in practice must be less than the secondary inductance.

(To be continued)

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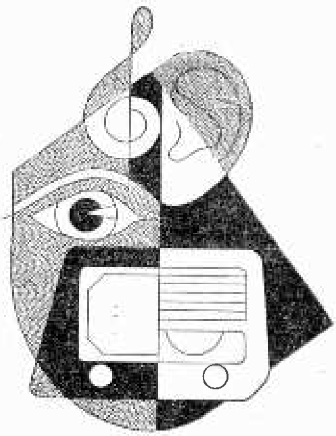

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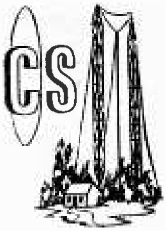
TRANSMITTING TOPICS



A CIGAR BOX AMATEUR TRANSMITTER

By T. W. Dresser

IT is customary for newcomers to amateur radio to think in terms of Hammerlund, Hallicrafter and similar receivers and in transmitters of 100 watts and upwards, complete with lines of meters, V.F.O.s and a whole lot of other gear; a laudable aim, but not one particularly realisable in these days of short pockets and long prices. As regards the fellow living in the country, even if he is in a position to spend a fair amount of cash on his hobby, all too often he is without electrical power and the cost of operating a normal amateur sation from batteries is completely prohibitive—for any ordinary individual, anyway. For the city fellow with little cash, the countryman with no mains, or either of them with little room for a full-sized den of their own, the cigar box transmitter, then, is really the answer to a prayer. It will provide a lot of fun at small cost and when the user has finished his "ragchew" on the band, he can close the lid and put the transmitter away in a bureau drawer until the next time! The power, of course, is in relation to the size of the rig; in other words, it is very low, 1 watt to be precise. But if you imagine that 1 watt will not get anywhere at all, just give this little transmitter a try and you will find that it is quite possible to work DX, even with 1 watt! Given a decent aerial, of course, and having a little regard for the times when the bands are rather less congested than in the evening or Saturday afternoon.

COIL DATA

Range	L1 Turns	L1 Wire	L1 Winding Length	L2*
1.7 Mc/s	50	20 swg enam.	1¾in.	Same as L1. Tap at 18 turns.
3.5 Mc/s	28	20 swg enam.	1½in.	Same as L1. Tap at 8 turns.
7 Mc/s	14	20 swg enam.	1¼in.	Same as L1. Tap at 5 turns.
14 Mc/s	8	20 swg enam.	1½in.	Same as L1. Tap at 3 turns.

All formers 1½in. dia. 4-pin. (only 2 used L1, 3 used L2).
*Tap may have to be adjusted to ensure good loading.

The arrangement is conventional, crystal oscillator and power amplifier, both valves being standard 1S4 types. Switching is provided for the crystals, the rig operating on fundamental frequencies on the 1.7, 3.5 and 7 Mc/s bands, while doubling is used for 14 Mc/s. It is felt that there is not much point in making the transmitter available for 28 Mc/s, but this can be done if the user wishes, and the coil data for this band will be furnished on request. In addition to the crystals, provision for V.F.O. operation is made by a further contact on the selector switch, enabling the V.F.O. to be switched in at will. Metering, too, is very simple, a 100 mA meter, which can be plugged into sockets on the front of the box, permitting all necessary circuits to be checked and tuned for resonance. All components, wherever possible, are miniature types and are so indicated in the components list. Obviously the components should be obtained first, and the cabinet made or obtained to suit.

C1—100 pF.
C2—100 pF, variable.
C3—150 pF.
C4—0.01 μF.
C5—0.01 μF.
C6—100 pF, variable.
C7—0.05 μF.
C8—0.01 μF.
R1—47 kΩ.
R2—1 kΩ.
R3—22 kΩ. R4—1 kΩ.
L1—(see table).
L2—(see table).
L3—3H, RFC.
V1—1S4. V2—1S4.

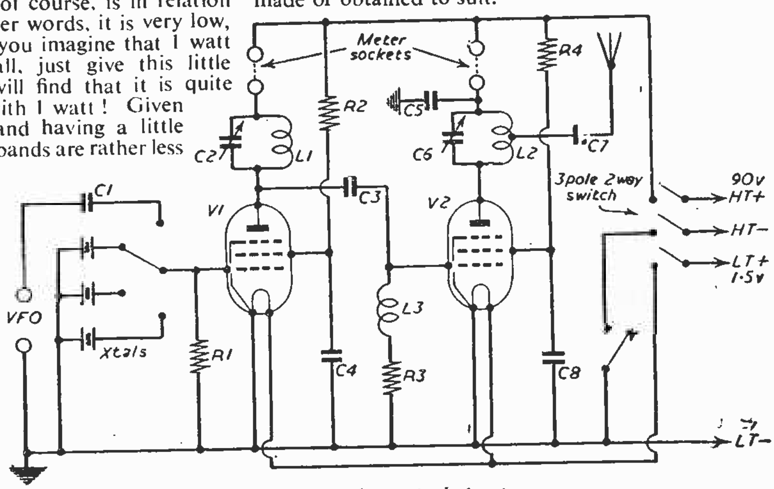


Fig. 1.—Theoretical circuit.

C.W. only

The station is solely intended for code work as it stands, keying being carried out in the negative H.T. circuit of the oscillator valve. The theoretical diagram is given in Fig. 1 and the layout in Fig. 2. The batteries, naturally, are not included in the cigar box case; that would be asking too much. However, as originally planned and constructed, a simple three-valve T.R.F. receiver, using miniature valves, occupied one half of the case and the transmitter the other half. It is felt that readers would not be greatly interested in the receiver and would probably prefer to use one they already own or to build one to their own design rather than attempt to build both receiver and transmitter into such a small case. Nevertheless, if readers express interest in the receiver too, all pertinent details will be given at a later date.

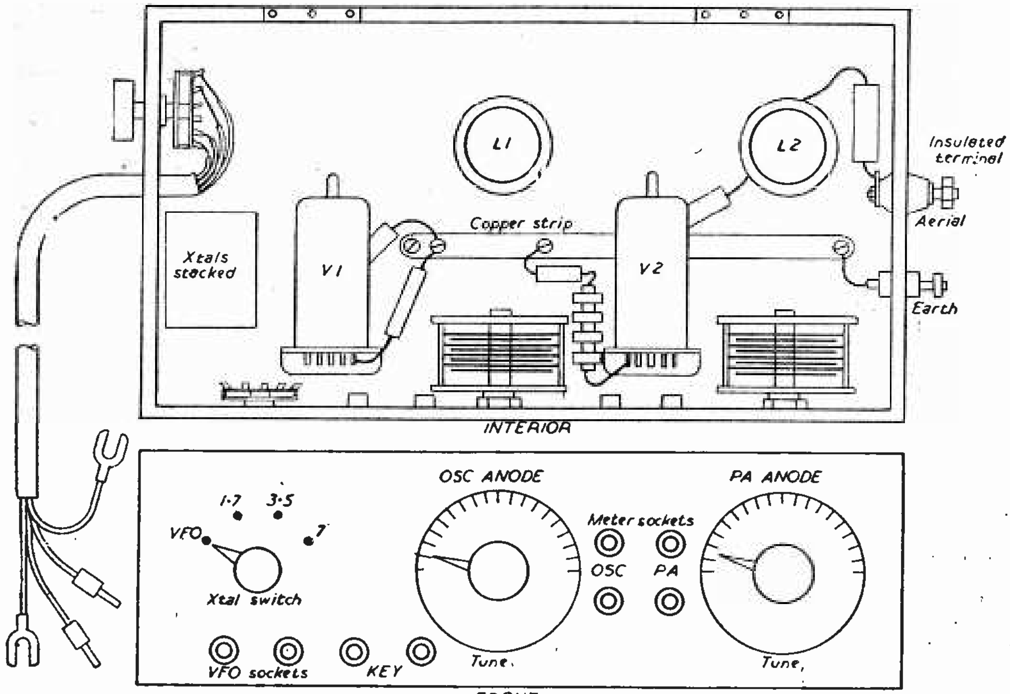


Fig. 2.—Layout and panel details.

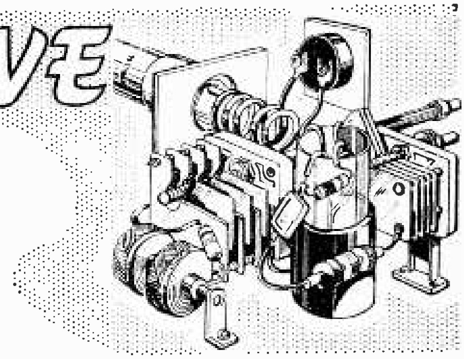
LIST OF COMPONENTS

- Xtals for 1.7, 3.5 and 7 Mc/s.
- 1—Single pole 4-way wafer switch (miniature).
- 1—3 pole 2-way wafer switch (miniature).
- 2—Valveholders.
- 2—1S4 valves.
- 1—100 mA moving coil meter.
- 3—.01 μF fixed condensers.
- 1—.05 μF fixed condenser (mica).
- 1—150 pF fixed condenser.
- 1—3 Henry R.F. choke.
- 2—100 pF variable condensers.
- 6—Banana sockets.
- 4—Banana plugs.
- Resistors as in Fig. 1.

The coil data is given on page 149 for all bands in common use. When these coils have been wound and the little transmitter assembled and its wiring checked it should be attached to a half-wave end-fed aerial of 66ft. in length, and the 7 Mc/s crystal switched into circuit. The meter should be plugged into the sockets in the anode circuit of the oscillator valve, and the circuit tuned to resonance by means of the variable condenser in the circuit. This will be indicated by a "dip" in the anode current as shown on the meter, in other words a reduction in the anode current. The meter should then be removed and the socket shorted together with a "U" link, two plugs joined by a sturdy piece of wire. The same procedure should then be gone through with the power amplifier, then the transmitter is ready to go on 7 Mc/s. Naturally it will be necessary to tune in this way whenever the frequency is changed, but the procedure takes only a minute or two at most.

Provided the components are bought judiciously—and many of them can be obtained at surplus dealers—the cost of this transmitter will be very small and the subsequent enjoyment out of all proportion to the time and cost involved in the construction. One can hardly say more of any transmitter, however powerful and expensive it may be.

SHORT-WAVE SECTION



BUILDING COMMUNICATIONS RECEIVERS

4.—THE B.F.O. STAGE

(Continued from page 87 February issue)

THE standard type of domestic superhet which is employed for the reception of speech and music only is not suitable for the reception of I.C.W. Morse, as such signals would be inaudible. This also applies to any type of superhet in which no means of generating local oscillation is present, and a Beat Frequency Oscillator stage is for this reason almost universally employed in communications type receivers. A separate valve is frequently employed, but a similar result is obtainable if the second detector can be made to oscillate, and this method is used in some equipment of moderate cost and size. If space, current consumption and cost are not important, the separate stage is preferable.

With I.C.W. Morse, no audio-frequency modulation, or audible component, is present in the signal. With the usual 465 kc/s intermediate frequency, the signal at the detector will consist of a 465 kc/s radio-frequency oscillation, interrupted by keying. This can be rendered audible by mixing a R.F. oscillation of slightly different frequency with the signal. The A.F. output frequency will equal the difference between the receiver I.F. and the locally-generated (or B.F.O.) frequency. A B.F.O. frequency of either 466 or 464 kc/s would, for example, produce an A.F. note of 1,000 cycles per second. The B.F.O. is usually tunable, so that the audio output can be adjusted, both to suit the personal preferences of the user and to increase tonal separation between desired and undesired stations of adjacent frequency which may be present on congested bands.

Separate B.F.O. Stage

Any small triode, screen-grid valve, or pentode may be used in a B.F.O. stage, and the circuit employed frequently resembles that in Fig. 1. The B.F.O. coil is tunable by means of C1 and C2. C1 may best be a pre-set of fairly large capacity (about .0003 μF) and is initially adjusted to bring the tuning range of the B.F.O. coil to the desired value. Final adjustment may then be made by C2, which may be fully variable and panel operated. C2 is of small value—e.g., 25 pF. To obtain good frequency stability, the inductance of the B.F.O. coil is relatively low and the parallel capacity relatively high. However, any coil tunable to around the receiver I.F. can be used.

The oscillations are taken to the detector stage through a very small coupling condenser. A high value should be avoided, as the B.F.O. may then override weak signals and a high background hiss may be caused. The B.F.O. stage output should only be adequate to cause a good A.F. tone, with average signals, and increasing the B.F.O. output beyond this point will not increase receiver sensitivity.

The stage is rendered inoperative by the switch shown, and it is essential the stage be switched out when speech is received. Similarly, when I.C.W. Morse is being received, the A.V.C. system must be switched out. (This can be done by shorting the A.V.C. line to chassis.) Frequently a combined B.F.O./A.V.C. switch is used, so wired as to provide the following settings: A.V.C. in, A.V.C. out, A.V.C. out with B.F.O. in. The two former switch positions would be used for speech, according to circumstances, with the latter for I.C.W. Morse.

In a few cases the B.F.O. may operate upon a harmonic of the receiver intermediate frequency. The final result is similar, with the advantage that in some cases the possibility of interference between the B.F.O. stage and earlier stages in the receiver is reduced. But with a suitable layout, the B.F.O. may operate upon a frequency near that of the receiver I.F. stages without difficulty.

A further circuit employing a triode with bottom-end coupling is shown in Fig. 2. Here, C1 and C2 will fill the purpose already described. C3 is the bottom-end capacitor, and its value will depend on

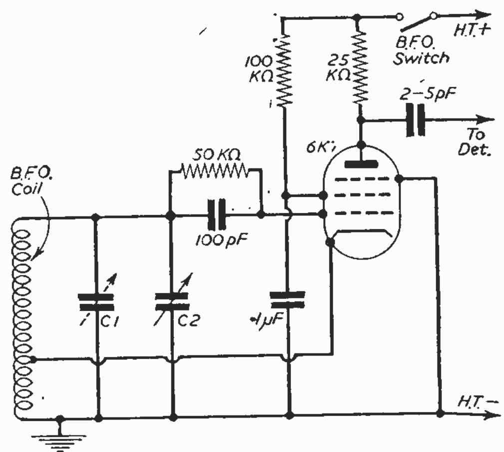


Fig. 1.—A typical B.F.O. stage.

the coil, valve and H.T. voltage. Values in the neighbourhood of .001μF will frequently be satisfactory. This circuit has the advantage that a tapping is not required on the coil, which may consist of a standard

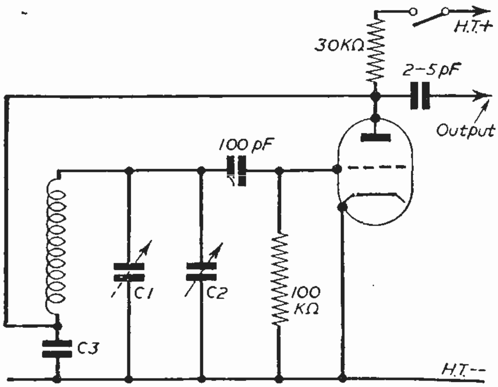


Fig. 2.—A triode oscillator circuit.

465 kc/s I.F. transformer winding. Satisfactory operation does, however, depend upon the use of a suitable value for C3, according to circuit conditions.

Input Circuits

The beat frequency oscillation requires to be mixed with the signal in the detector stage, and Fig. 3 illustrates a method of doing this when a diode, double-diode, or double diode-triode valve is employed. Wiring of this stage will remain unchanged, the B.F.O. signal being applied to the detector diode through the small coupling capacitor already mentioned. In home-built equipment this capacitor may be formed by twisting together two insulated wires for a short distance.

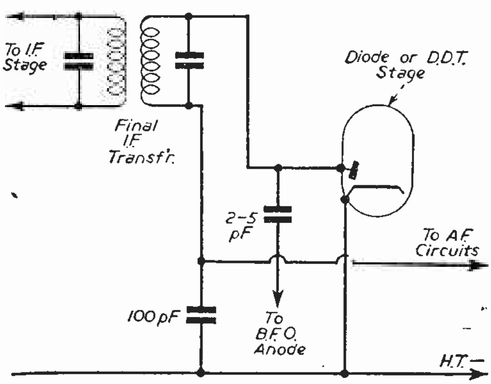


Fig. 3.—A diode input circuit.

Where a grid-leak or anode-bend detector is used, in the interests of high sensitivity, coupling may be directly to the valve control grid, as in Fig. 4. Here, an anode-bend detector is shown, but the same connections would be suitable for feeding a grid-leak type of detector. In all cases the B.F.O. input should be adjusted to obtain a suitable note. Excessively high inputs (as would arise from a large coupling condenser) must be avoided as only causing an increase in background noise.

Combined B.F.O. Stage

In battery equipment, low-cost receivers and midget sets, the detector stage is sometimes made to operate as B.F.O., thus avoiding a further valve. Any method of causing oscillation in the detector stage may be used, and the valve will of necessity be a triode, double-triode, or pentode type, since a diode cannot be used in an oscillator circuit.

One method of obtaining oscillation in this way is shown in Fig. 5. Here, the 1K variable resistor is an oscillation control, and excessively violent oscillation is to be avoided. A grid detector of this type has high sensitivity, but is easily overloaded. It is thus most suitable for a small receiver having a limited amount of R.F. and I.F. gain. The coil may be home wound. For 456 kc/s use, 75 turns of 28 S.W.G. double silk covered wire pile wound on a ½in. diameter former can be used. With the anode-bend type of detector, oscillation is likely to be somewhat erratic. In very compact designs a double triode may be used, one section acting as detector and B.F.O. as indicated, and the other as first A.F. amplifier. The local oscillation may be cut out by a switch in parallel with the coil, or by adjusting the 1K resistor until oscillation ceases.

A further method of combining functions is to employ a feed-back winding near the final I.F. transformer secondary. This winding is wired in the detector anode circuit so that the valve goes into oscillation.

Layout Points

The actual layout of the B.F.O. stage can be of great importance. With a poor layout the fundamental oscillation and harmonics may reach the earlier stages of the receiver, causing whistles on some bands. Where whistles of this type arise, they will always cease when the B.F.O. is switched out, thus indicating this stage is the source of the trouble.

To avoid such difficulties, the B.F.O. stage is often enclosed in a screening can as shown in Fig. 6. For the average stage, a can about 2in. by 3in. by 3½in. high will be of ample dimensions. *All* the components associated with the stage are enclosed in it. Stray coupling by heater or H.T. circuits may be

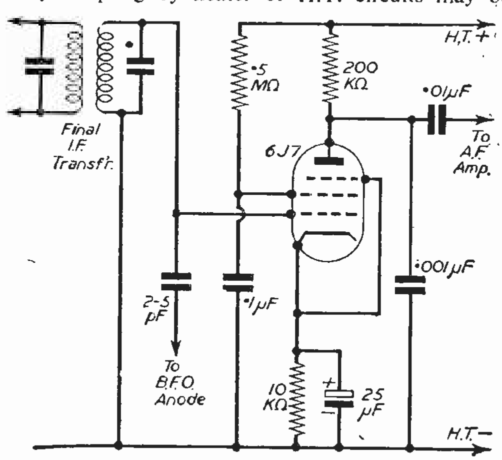


Fig. 4.—Grid detector with BFO input.

avoided by adding by-pass capacitors or decoupling. For the heater circuit (if required) values of about .05 μF will be suitable. For the H.T. positive circuit, a .5μF condenser with 10 K decoupling resistor will normally be adequate.

It is not essential that a panel control be provided

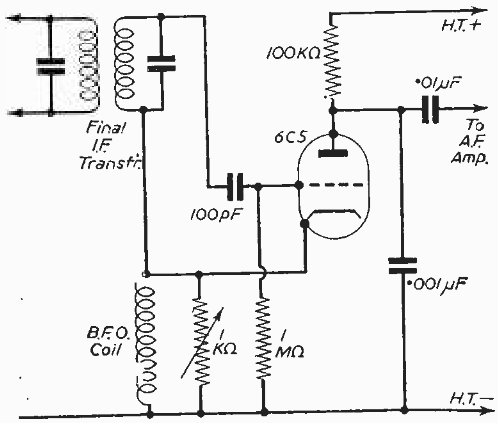


Fig. 5.—A cathode-coupled det./B.F.O. stage.

for the B.F.O. tuned circuit, though this has the advantages mentioned. When initially setting up, the pre-set C1 is adjusted so that a suitable tuning range or frequency range is obtainable with C2. Where adjustable dust-cored coils are employed, C1 may be a fixed condenser of suitable value.

If for any reason it is not possible to fit a screening can for the whole stage, then the B.F.O. coil should be enclosed in a small can and the valve be of screened or shielded type. Without this, trouble due to pick-up by earlier stages is very likely except in very small receivers with comparatively low sensitivity.

Oscillation may be tested for, if necessary, by inserting a meter in the B.F.O. anode circuit and shorting the B.F.O. coil. If the anode current does

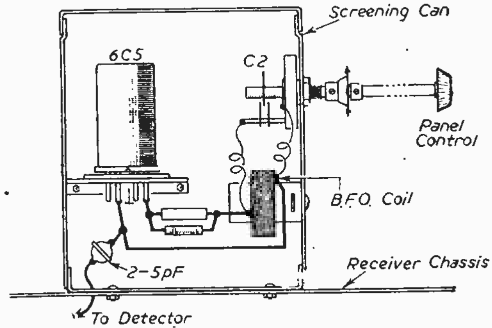


Fig. 6.—A typical B.F.O. stage layout.

not change, the stage was not oscillating. If oscillation is present but no A.F. output obtained when an I.C.W. Morse transmitter is tuned in, then the B.F.O. may be incorrectly tuned. Adjustment of C1 should remove this difficulty. The A.F. note will be at its lowest frequency when B.F.O. and I.F. stages are almost tuned together, rising in frequency as the B.F.O. is tuned away from the receiver I.F.

News from the Clubs

EAST BERKSHIRE COLLEGE RADIO SOCIETY

Hon. Sec.: F. H. Rickards, East Berks College, Royal Albert Institute, Windsor.

THE East Berks College Radio Society was formed at the end of September, 1954, in response to many requests from past and present students of the College. It has met with great success and membership is rising steadily.

Among the amenities offered to members are: extensive equipment, visits to places of interest, technical film-shows, lectures, a club transmitter (G3/KAL), a congenial clubroom and, if desired, the use of a licensed bar.

Meetings are held from 7 p.m. to 10 p.m. every Thursday at the Royal Albert Institute, Windsor.

All who are interested are cordially invited to the meetings.

CLIFTON AMATEUR RADIO SOCIETY

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

OVER 40 members and friends attended the Christmas party which, as in previous years, was a great success. Two guests, G6NU and G3CFO, undertook the judging of the constructional contest in which the first prize was won by G3IXL with a SSB exciter.

Meetings are held every Friday at 7.30 p.m. at the clubrooms: 225, New Cross Road, London, S.E.14.

LEICESTER RADIO SOCIETY

Hon. Sec.: W. N. Wibberley, 21, Pauline Avenue, Belgrave, Leicester.

THE Society, which meets every alternate Monday in the month, has now prepared its mid-winter programme of lectures and demonstrations.

February 28th, 1955.—Chairman's lecture: "The Grid Dip Oscillator," by G3DVP. An oscillator for all the amateur frequency bands will be demonstrated.

March 14th, 1955.—"National Field Day," a discussion of the proposals for this year's attempt for the RSGB Trophy.

March 28th, 1955.—"Radio Frequency Heating," a lecture on the application of radio frequencies to industrial electronics.

The above lectures will be given in the clubroom at the Holly Bush Hotel, Belgrave Gate, Leicester.

COVENTRY AMATEUR RADIO SOCIETY

Hon. Sec.: J. H. Whitby, 11, St. Patrick's Road, Coventry.

MEETINGS are held on alternate Mondays at 9, Queen's Road.

Amongst future events are the following:—
25th February: Annual Dinner (Barras House Hotel).
28th February: Lecture.
3rd March: Night-on-Air.
14th March: "Radio Aids to Navigation" (G3RF).
28th March: Receiver Servicing (G3HDP).
11th April: No meeting.

STOKE-ON-TRENT RADIO SOCIETY (G3GBU),

Sec.: A. Rowley 37, Leveson Road, Hanford, Stoke-on-Trent.

THE club activity has centred around the top band contest during the last few week-ends. All members took part in the setting up of the station and keeping it on the air during the contest.

At the same time, regular meetings have been held at the club headquarters, 2, Racecourse Road, Oakhill, Stoke-on-Trent. New members are always welcome at the general meetings on Thursday nights at 7.30 p.m.

A comprehensive lecture and practical work programme is organised for the winter season and the club magazine will soon be in print again.

NEW CLUB

A RADIO society has been formed locally—The Hawick Radio Society, of which the hon. sec. is G. Shankie, of 17, Ettrick Terrace, Hawick, Roxburghshire.

Twenty members are on the roll so far and already they have obtained a clubroom and workshop. It is expected to make entry to them in February/March. All visitors will be welcome at the above address.

Meetings are held every fortnight in Hawick Public Library.

A RESISTOR PITFALL

A REMINDER THAT THE WATTAGE RATING IS NOT THE ONLY THING TO WATCH

By S. C. Murison

OVER the years the idea has gained ground that in choosing a resistor for a circuit it is only necessary to select one of the correct resistance and power rating (wattage). Several other factors are concerned, in fact. Among these may be mentioned ambient temperature and the voltage across the resistor terminals. Ambient temperature enters into the consideration because the thing which determines how much power can be dissipated is how hot the surface of the resistor can be allowed to get. If the surface of the resistor is at a temperature of 70 degrees, say, before it starts to dissipate power, this resistor cannot be allowed to dissipate as much power as one which starts at, say, 40 degrees. Most carbon composition resistors have maximum surface temperatures in the region of 110 to 120 degrees Centigrade. From this figure, it will be obvious that the temperature limitation is not a severe one—in this country, at least.

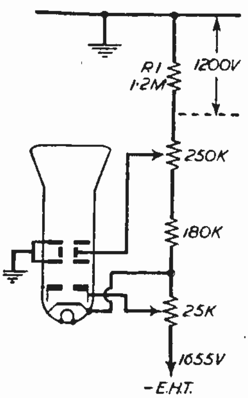


Fig. 1.—A Network which is commonly used, and which is described in this article.

A more pressing limitation is the maximum voltage which can be tolerated across the ends of the resistor. Most experimenters make a rapid appraisal of the power rating of each resistor in the course of their experiments. Frequently, this is based on experience and no calculation is made; sometimes a calculation has to be made because the conditions in the circuit to be built are so different from any previously encountered. At any rate, the power rating calculation is easy. Three convenient forms of it are given below:

$$W = IE \quad W = I^2R \quad W = \frac{E^2}{R}$$

where E is the voltage across the resistor.
I is the current in amps flowing in the resistor.
W is the power dissipated by the resistor.

Having made the power rating calculation, most experimenters are content to rest assured that all will be well. This is not necessarily true as can be shown by considering a typical potential divider network for an oscilloscope. Fig. 1 shows a common arrangement. To simplify matters, it is assumed that an EHT, having a value resulting in a current of 1 mA. is in use. Consider R1: the voltage across its ends is 1,200; consequently, the power dissipated by it will be 0.001 times 1,200 which is 1.2 watts. A conservative experimenter would probably fit a two-watt resistor and feel well satisfied with this generous under-rating.

His satisfaction would be ill-founded and might be short-lived. Most carbon composition resistors of two watt rating have a maximum voltage rating of 1,000 volts. In practice most resistors of this type seem tolerant of voltages in excess of this; but the experimenter must not blame the manufacturer if a resistor fails when so operated. The table gives maximum voltages permissible for the commonly used carbon composition resistors. From this, it will be seen that R1 in Fig. 1 can most easily be kept within rating by fitting two type eight resistors in series. Suitable values would be 560 kΩ and 680 kΩ, the difference from the nominal value not being of any consequence.

TABLE

Watts	Type	Max. Volts	Maker
5	0	1,500	Erie
3	1	1,000	Erie
2	2	1,000	Erie
1	BTB	500	Dubilier
1	8	1,000	Erie
$\frac{1}{2}$	BTS	350	Dubilier
$\frac{1}{2}$	7AD	700	Erie
$\frac{1}{2}$	9	700	Erie
$\frac{1}{2}$	16	700	Erie
$\frac{1}{4}$	5BD	250	Erie
$\frac{1}{8}$	5B	125	Erie
	High Stability Types		
2	R850	800	Dubilier
1	R627	600	Dubilier
1	100	750	Erie
$\frac{1}{2}$	R425	500	Dubilier
$\frac{1}{2}$	108	500	Erie
$\frac{1}{4}$	R417	350	Dubilier
$\frac{1}{4}$	109	350	Erie
$\frac{1}{8}$	R310	250	Dubilier

From the foregoing, it will be seen that the procedure for rating a resistor once its wattage has been determined, is to check that the maker's maximum voltage rating is not likely to be exceeded. In doing this, allowance should be made for the possibility that the voltage may rise above the nominal value due to such things as the mains voltage rising. Attention to this matter of maximum voltage across resistors is well repaid by the resulting freedom from trouble due to strange defects arising in resistance chains.

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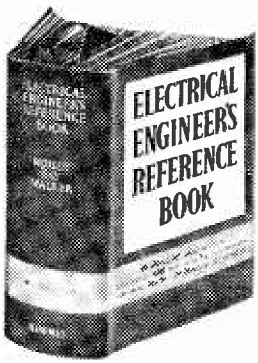

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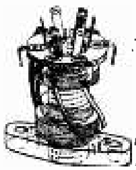

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The Beginner's Guide to Radio

The Twenty-third and Concluding Article of a Series Explaining the Fundamentals of Radio Transmission and Reception

By F. J. CAMM

WE have now, I hope, obtained a clear idea of how wireless transmission brings the signal to your set and what happens to the signals within the set. We have traced the function of each component and seen how the very weak signal picked up by the aerial is amplified, how the signal is detected and the receiver tuned to the wavelength of the transmission. We have also noted that a receiver may be operated by the mains or batteries.

I have not, however, explained what an accumulator is, and how it works. It is a device for storing electrical energy, and it consists of a container made of either glass or plastic, in which are fitted two sets of plates—positive and negative. The number of the plates and their area decide the capacity of an accumulator in ampere hours and the number of cells will govern the voltage. The E.M.F. of an acid cell is 1.75 volts approximately. Thus, to obtain a particular voltage value, any number of cells may be connected in series. Similarly, if we wish to increase the ampere-hour capacity the cells may be connected in parallel. Hence, it will be obvious that a large accumulator possesses greater storage capacity than a small one, and that size does not affect the voltage. To connect cells in parallel, all the negative terminals are connected together and also all the positive. To connect cells in series the negative terminal of one cell is connected to the positive terminal of the other.

The ampere-hour capacity of an accumulator is always stated according to a known rate of discharge, but its real capacity is obviously determined by the amount of current taken from it and the time during which that current is taken. If an accumulator has an 80-ampere-hour capacity, and is fully charged, it may be connected to any circuit taking 1 ampere, for example, and under these conditions its charge will last for 80 hours. If it is connected to a circuit taking half an ampere it will last 160 hours. Remember, then, that the ampere-hour capacity of an accumulator is dependent on the current taken from it.

The two plates are, of course, immersed in a solution of sulphuric acid, and this solution is known as the electrolyte. In certain cases the acid is in paste or jelly form, as in the case of portable battery sets, where a wet cell would be likely to spill. An accumulator differs from a dry battery in that it needs to be charged. That is to say, an electric current must be passed through it. It is thus known as a *secondary cell*. A dry battery is a *primary* cell, because it provides an electric current by the immersion of two dissimilar plates, such as carbon and zinc in a chemical solution.

I mentioned that the electrolyte consists of dilute sulphuric acid, and the dilutant is distilled water. It is necessary from time to time to "top-up" the battery, because the water from the acid evaporates. Remember that the acid never evaporates. Acid of the correct strength can, of course, be purchased, but should an occasion arise when you wish to dilute sulphuric acid yourself, remember that the acid should be added to the water and not the water to the acid. In the latter case, a miniature explosion would occur, with possible damage to your face, hands and eyes.

If electrolyte is spilled it should be immediately treated with a neutralising solution, such as ordinary soda water, or ammonia and water. Particularly is this necessary if the acid is spilt on carpets or clothing.

If you intend to charge accumulators yourself, it is important to remember that the correct charging rate should be employed. The maximum safe charging rate of an accumulator is approximately one-tenth of its actual capacity. For instance, the charging rate of a 60-ampere-hour cell would be 6 amps. An excess would cause damage.

In the case of an A.C. mains supply the voltage must be transformed to a low value and then rectified, but in the case of a D.C. mains supply some form of resistance is merely added to reduce the voltage to a suitable value. The value of these resistances will differ according to the voltages of charging supply and also with cells of different capacity. The ideal voltage for charging a six-volt battery would be approximately 8, and in this case there would be no necessity to interpose a resistance, the difference of the voltage of supply and that of the battery being charged not being sufficient to cause an excess amount of current to flow. With increase of the voltage of supply, however, such as by the use of lighting mains, suitable resistances are necessary, and the higher the voltage the greater must be the resistance. Incidentally, high voltages are wasteful; inasmuch as no use is made of the excess.

Electric fires, and lamps used for normal room lighting, may be used for voltage dropping to reduce the cost.

In the case of the A.C. supply the transformer and rectifier will be expensive initially, but will enable costs to be kept down during charging, as there is not so much waste as with D.C. Chargers of this type may deliver small currents, i.e., a quarter or half an amp., in which case they are known as trickle chargers, delivering the charge in the form of a trickle of current, or larger currents of the order of 3 or 4 amps., but in all cases a series resistor and ammeter are worth-while additions to ensure that the accumulator is not damaged due to overcharging.

Interests, Listening, and Viewing Habits of Minors

SOME INTERESTING DETAILS REVEALED BY THE LATEST BBC RESEARCH DEPARTMENT

THE BBC's Audience Research Department has made a survey of the 5-20 year-olds of the United Kingdom which, for the first time, makes it possible to express their interests, listening and viewing habits and daily time-tables in quantitative terms. Over 3,700 young people were personally interviewed. They were drawn from nearly 100 localities, spread over England, Wales, Scotland and Northern Ireland, and may be taken as a substantially representative sample.

The following table illustrates the kind of information which the survey provides about "interests" (an asterisk indicates no information):

TABLE I

Proportion interested in	Boys 5-7 yrs. %	Boys 8-11 yrs. %	Boys 12-15 yrs. %	Boys 16-20 yrs. %	Girls 5-7 yrs. %	Girls 8-11 yrs. %	Girls 12-15 yrs. %	Girls 16-20 yrs. %
Keeping pets	60	64	47	*	58	60	51	*
Knitting, sewing, etc.	*	12	5	2	*	87	78	74
Collecting stamps	21	47	46	*	8	23	24	*
Model making	*	22	17	9	*	5	4	1
Playing football	*	63	66	35	*	1	1	1
Playing tennis	*	1	3	9	*	3	24	18
Swimming	27	42	62	51	17	48	64	42

Questions about membership of youth organisations and clubs revealed that about one in three of 8-11 year-olds belong to an organisation such as the Cubs or Brownies; about a third of the 12-15 year-old boys (but rather fewer of the girls) belong to the Scouts or Guides or a similar organisation; youth clubs include about one in four of the 16-20 year-olds. 16-20 year-olds were asked where they usually met their friends. More than half the boys and two thirds of the girls said at "home" or at friends' houses, 26 per cent. of the boys and 14 per cent. of the girls said "on club premises," "the street corner" was the reply of 11 per cent. of the boys and 9 per cent. of the girls, and the "dance hall" that of 4 per cent. of the boys and 10 per cent. of the girls.

Most children and young people said they "liked listening to music," but music is so wide a term that they were asked to specify the *kinds* of music they liked. Some of the results are given below:

TABLE II

Like	Boys 8-11 yrs. %	Boys 12-15 yrs. %	Boys 16-20 yrs. %	Girls 8-11 yrs. %	Girls 12-15 yrs. %	Girls 16-20 yrs. %
Jazz	5	11	18	2	8	10
Dance Music	13	29	50	32	43	57
Light Music	15	20	25	19	31	32
Serious Classical Music	4	9	15	4	19	18

A detailed record was made of how each child had spent the day preceding the interview. In addition, questions were asked about the frequency with which they listened to various programmes. The figures below (Table III) relate to Children's Hour listening by those living in homes which have sound receivers but do *not* have TV:

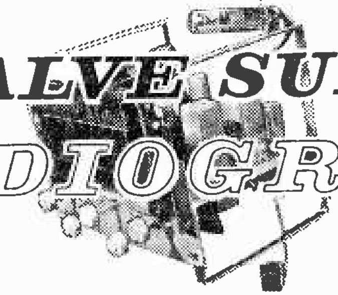
The proportion of children who haven't a television set in their own home, but who nevertheless manage to view is very large indeed. For example, no less than 11 per cent. of the 8-11 year-olds without television at home saw Children's Television on the day before they were interviewed.

These findings lead to the estimate that, at the time the enquiry was made (November, 1953), it was usual for some 1,600,000 children to be listening to "Children's Hour" and for about 2,200,000 to be watching Children's Television at 5 p.m. on a weekday—and this at a time when there were TV sets in only one home in four.

TABLE III

Listen to "Children's Hour"	5-7 yrs. %	8-11 yrs. %	12-15 yrs. %	16-20 yrs. %
Every day	17	21	15	2
Two/three times a week...	36	36	29	7
Less often, if ever ...	47	43	56	91
	100	100	100	100
Listened "yesterday" ...	18	23	18	3

The kind of information provided by the detailed records of how this sample of children spent their time may be illustrated by taking the Sunday time-table of 8-11 year-olds as an example. By 11 a.m. more than half these children were out of their homes, but by 1 p.m. most of them were back, 1.15-1.30 being the most common midday mealtime. At 3 p.m. less than two-fifths were at home, though only about one in twenty were at Sunday School. 5 to 5.30 p.m. was the most usual time for Sunday tea.



AN 8 VALVE SUPERHET RADIOGRAM

A SELF-CONTAINED A.C. MAINS RECEIVER, WITH MAGIC-EYE TUNING INDICATOR

By S. A. Knight

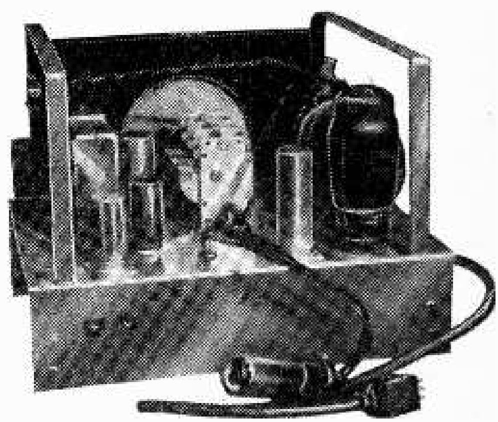
THIS receiver might well be described as an eight-valve "quality" radiogram, but the meaning of the word "quality" seems to hold so many interpretations among enthusiasts that it has been omitted from the main title. The receiver is designed, however, for those constructors who want a sensitive and powerful station getter, together with a tolerably high standard of reproduction on both radio and gramophone, without elaborate circuitry or complex amplifier design. With a good aerial system this receiver will compare with any commercial set in all the above aspects and will, even allowing for new components to be used throughout, work out considerably cheaper than the market equivalent.

The complete circuit diagram of the main receiver chassis is shown in Fig. 1, the power supply being built on a small separate chassis. The aerial input is fed to the grid of the R.F. amplifier V1 (6BA6) through switch bank S1A and B, AVC being applied to the stage through R1 and decoupled by C2. The use of an R.F. stage enables a good signal-to-noise ratio to be achieved, and is particularly useful on the short-wave bands where the added sensitivity and freedom from second-channel interference alone justifies its inclusion. Anode coupling from this stage through S2A feeds through S2B to the grid of the frequency-changer V2, an all-glass triode-hexode type 12AH8. Here, again, the choice is particularly important on the short-wave bands, the high conversion conductance and oscillator slope making for a high efficiency circuit. The screens of V1 and V2 are potentiometer fed from the junction of R5 and R6, a better system to series feed from a point of view of AVC action, the latter's action often being reduced or upset by a screen feed that is not stable with the valve bias. V1 is separately decoupled by R3 and C3.

The oscillator is a conventional tuned-anode oscillator, with damping resistances R11 and R12 operative on the medium and short-wave bands respectively. This damping is not critical, but is necessary to maintain the oscillator amplitude at the proper level (200-300 μamps. in R9) over each band. Excessive amplitude will lead to serious whistling and loss of gain and render the circuit useless, a common trouble in home-built superhet receivers. Padders C12, P1 and P2 ensure proper alignment in conjunction with trimmers T7, T8 and T9. The system is not normally so precise as padding carried out with iron-cored inductances and fixed capacitors, but the specified coils are particularly easy to mount and trim, and are electrically and mechanically efficient. A ready assembled coil pack may be easier for the amateur, but the requirements of layout in this design were not readily met by this means, and, in any case, the builder should have sufficient experience to be able to work to separate coils. There is no danger of instability if the layout is followed faithfully.

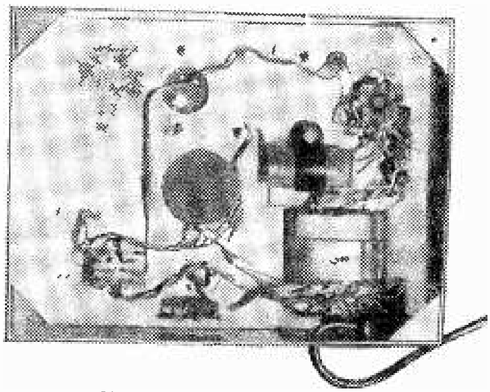
The output of the mixer is tuned by the first I.F. transformer I.F.T.1 at 465 kc/s. The transformers specified are chosen in preference to those normally tunable by adjustable cores as giving a rather higher degree of tuning stability, an important aspect in I.F. amplifier design where the bulk of the receiver H.F. amplification takes place. There is a small modification to the first transformer which will be detailed later. The output feeds to the I.F. amplifier V3 (9D6), a lower slope valve than the R.F. amplifier. AVC is fed via R13, this stage receiving about one-half of the AVC voltage applied to the two earlier stages, being derived from the junction of the AVC diode load R22 and R24. This reduces the possibility of harmonic distortion arising in the stage.

The second I.F. transformer I.F.T.2 is coupled greater than optimum to feed into a diode detector, this being one-half of V4 (6AL5). The AVC diode, with delay voltage developed across R19, forms the other half function and is fed through C21 from the anode of the I.F. amplifier. This feed is generally



A general view of the main chassis.

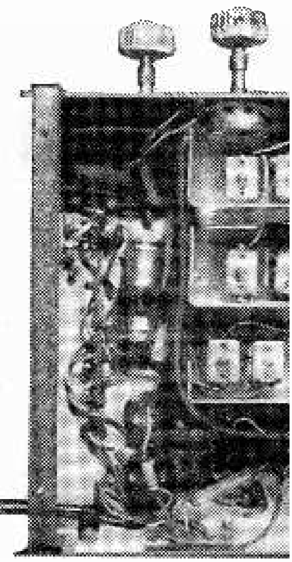
to be preferred to the connection from the diode detector anode, sideband screech being avoided and detector damping lessened. The I.F. filter is conventional (R18 and C18) and the load is a 250 kΩ volume control (radio only) VR1. A tuning indicator is necessary on a receiver designed for good reproduction as accuracy of tuning is vital. A magic-eye



Underside of the power pack.

indicator V5 (6U5G) therefore is included in the design, being fed from the detector load through the filter R17, C17.

The detected output across VR1 feeds via C19 and switch bank S5A to the audio-amplifier, a low-noise pentode in a conventional circuit, V7 (6BR7). The output here then feeds to the output valve, which is a directly-heated power triode, PX4.



Underside view

Output Stage

The use of a single-ended triode stage calls for some explanation. The claims of a push-pull output amplifier are strong in a quality receiver, and the power sensitivity of pentodes against triodes is often used as an argument in their favour. However, with pentodes, feed-back of one kind or another is nearly always used to bring their impedance down to a low figure and so increase the speaker damping, and the advantage of sensitivity is then

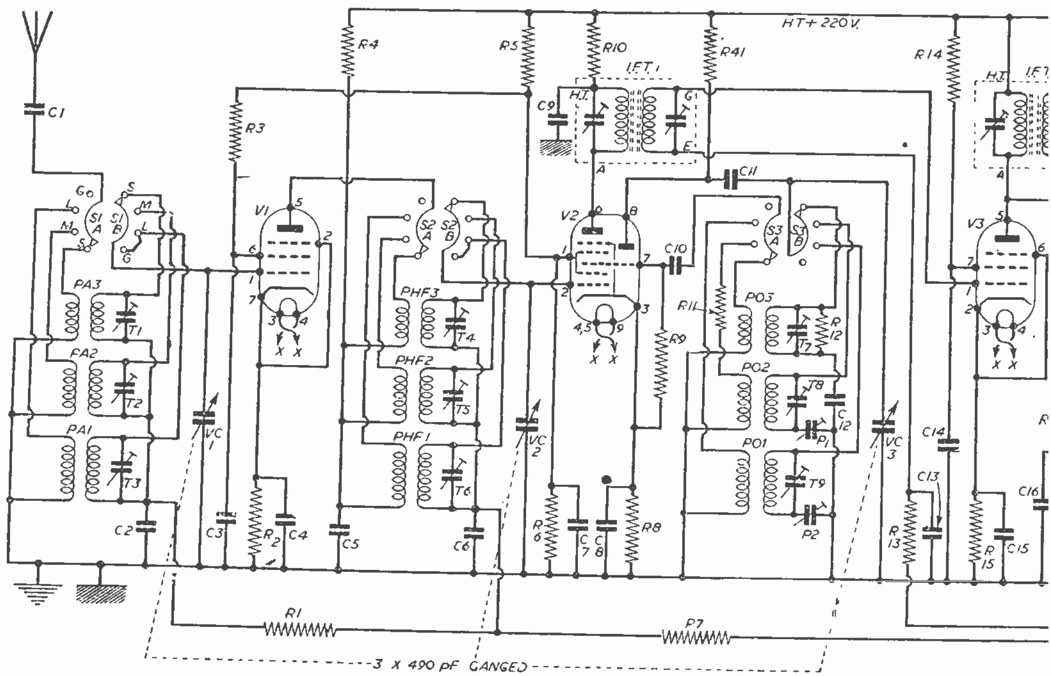


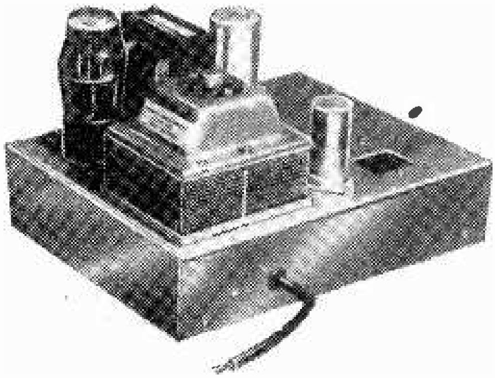
Fig. 1.—Main circuit diagram—excluding the power pack which will be given next month. A full list of co

main chassis.

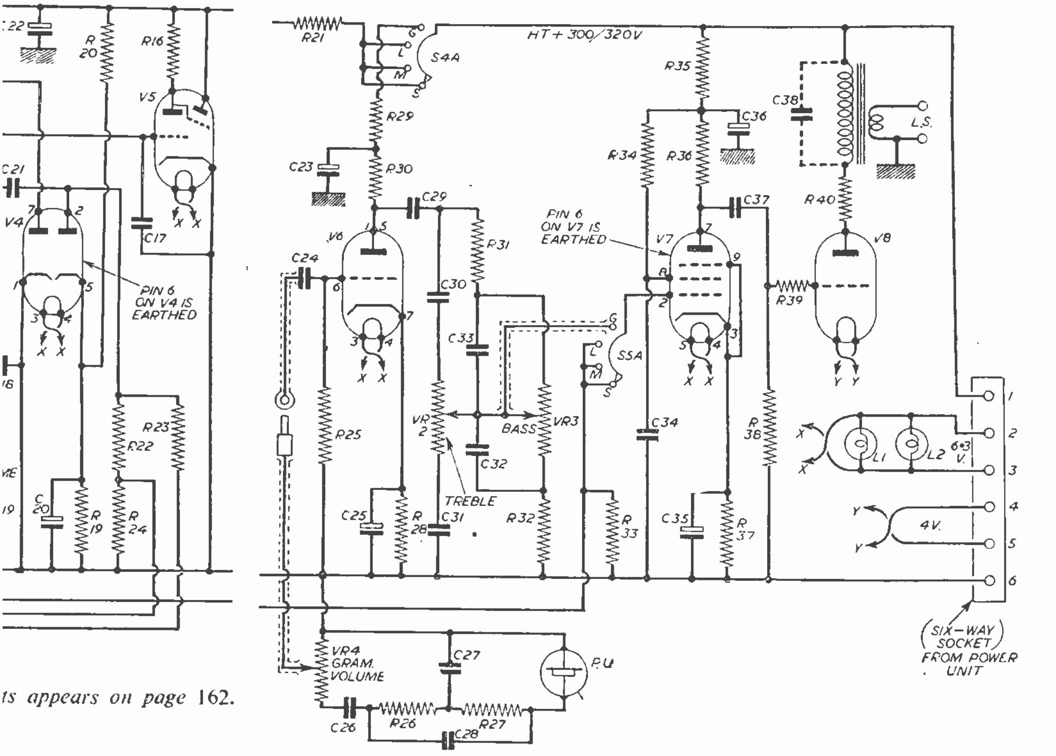
cancelled out. With the triode, complications of feedback which often bedevils the home constructor are avoided, and the good regulation enables a comparatively level output curve to be obtained on the speaker load. With cost also in mind, the single triode was therefore chosen in the present design, the output transformer being specially designed for use with it. It is essential that this transformer is used if proper results are to be obtained and bass response maintained. A power output of 3.5 watts at a total distortion of 4 per cent. is obtainable.

The power unit supplies 300 volts at 100 mA as the H.T. rail supply, with a 6.3 volt heater run for all valves and dial lamps excepting the PX4. This valve has a separate 4-volt winding, centre-tapped for the inclusion of bias. The circuit of the power unit will be given next month and calls for little comment.

The 6.3 volt supply has a humdinger potentiometer VR1 across it, the slider being earthed. The setting of this slider is made with the receiver working on gramophone, when a point of minimum is easily found. Bias for the output triode is derived across R1, C3 in the centre-tap lead of the 4-volt winding. The mains transformer and choke are again specially wound for this receiver and should be used as specified.



A view of the completed power pack.



ts appears on page 162.

Gram. Section

Reverting to Fig. 1, the record amplifier consists of the radio A.F. side V7 and V8, but a preamplifier and tone-control network is arranged to precede it. This stage is a triode V6 feeding from the pick-up into a conventional tone circuit, having bass and treble controls. Although very simple and free from the possibility of feedback troubles, the circuit will cover the requirements of lift and cut of 78 and long-playing records, and will compensate for all present recording systems. In the diagram a pick-up filter is shown preceding the gram. volume-control ; this is used with crystal pick-ups only (a B.S.R. player is used on the prototype). For magnetic pick-up heads the transformer supplied should feed directly into the volume-control, any correction following the advice of the particular maker.

When on Gram., the H.T. is broken to the R.F. and I.F. section of the set and applied to the pre-amplifier. Switch wafer S4A operates this. There is a rise of about 20 volts on the H.T. rail on account of this, but this is of no consequence.

Construction

The main receiver chassis is of 16 s.w.g. aluminium sheet, 12in. by 9in. by 3in. deep, and the drilling details will be given next month. The diagram gives all the main valveholder and control holes, coil fixing centres, I.F. transformer positions and screen positions, but does not include small holes for the fixing of the three-gang tuning condenser or main scale, as these are best marked off the actual parts to avoid stiffness or jamming of the drive. The view is from beneath the chassis, which is shown flattened out. It is easier to drill as marked, and then bend the sides up afterwards, although the work is not difficult even when the chassis is obtained ready folded.

(To be continued)

LIST OF COMPONENTS

RESISTANCES

All resistances are Erie RMA9 unless stated otherwise, tolerance 10 per cent.

R1, R7—470 kΩ
R2—68Ω
R3, R10, R28—1 kΩ
R4, R37—2.2 kΩ
R5—10 kΩ (2 watt)
R6, R9, R18, R30—47 kΩ (R6 is 1 watt)
R8, R15—220Ω
R11, R19—3.3 kΩ
R12, R29, R35—22 kΩ
R13, R26, R27, R31—100 kΩ
R14, R41—27 kΩ (½ watt)
R16, R17, R33, R34—1.2 MΩ
R20, R38—270 kΩ
R21—2 kΩ (2 watt)
R22—680 kΩ
R23, R24—560 kΩ
R25—2.2 MΩ
R32, R39—10 kΩ
R36—220 kΩ
R40—47Ω

CAPACITORS

C1—500 pF mica T.C.C. CM20N
C2, C4, C6, C7, C8, C13—0.1 μF 150 v. Dubilier 418
C3, C5, C9, C14, C15, C17, C19—.05 μF 350 v. T.C.C. CP35N
C10, C16—100 pF Erie N750K
C11—200 pF 350 v. mica T.C.C. CM20N
C12, C38—.005 μF T.C.C. CP31N
C18, C28—47 pF Erie N750K
C20, C25, C35—20 μF 12 v. T.C.C. CE30B
C21—33 pF Erie N750K
C22+C23—16+24 μF 350 v. B.E.C. electrolytic
C24, C30—3,300 pF Erie type GP
C26, C27—.001 μF T.C.C. CP30S
C29—0.5 μF 350 v. T.C.C. CP47N
C31, C32—.02 μF 350 v. T.C.C. CP33N
C33—4,700 pF Erie type GP
C34, C37—0.1 μF 500 v. T.C.C. CP46S
C36—16 μF 350 v. B.E.C. electrolytic.

Wearite "P" coils, 1 each types : PA1, PA2, PA3, PHF1, PHF2, PHF3, PO1, PO2, PO3.
One 3-gang 490 pF condenser (J.B. type MG with feet).
Spin-wheel drive for above with vertica or horizontal scale to taste (J.B. type SL8).
One pair I.F. transformers, Wearite type 500.

NSF-Oak switch, with 7½in. locator spindle and the following wafers : 3 with 2-pole, 4-way ; 2 with 1-pole, 4-way.
Side struts, spacers, nuts, etc.
Postage-stamp trimmers : 6 of 60 pF, 3 of 100 pF.
Postage-stamp padders : 1 of 250 pF (P2), 1 of 600 pF (P1).
One TV type aerial plug and socket, Belling-Lee (for Gram. input).
Carbon controls : 2 at 250 kΩ (log. Morganite, etc.), 1 at 100 kΩ (linear), 1 at 1 MΩ (linear).
Four of B7G valveholders, 2 of B9A valveholders, 2 of IO valveholders, 1 of Brit. (4-pin) — Clix-Ediswan

VALVES

One 6BA6 valve (V1), One 12AH8 „ (V2), One 9D6 „ (V3), One 6AL5 „ (V4), One 6C4 „ (V6), One 6BR7 „ (V7), One 6U5G „ (V5), One 5Z4G „ (V9) — Brimar (or equivalents)
One PX4 „ (V8)—Marconi-Osram
Screening cans for miniature valves above.
Five of 6-way tag strips, ends earthed; One of 3-way tag strip, centre earthed; Three of 1-way tag strips — Bulgin

TRANSFORMERS AND CHOKES

One mains transformer; One choke, 15 H 100 mA; One output transformer, 2.5 kΩ to 3Ω — Morley Transformers, Pawsons Road, W. Croydon
One 8in. W.B. type HF810 speaker.
Two 6.3 volt 0.3 amp dial lamps and insulated holders.
Aerial and earth sockets.
Six 1in. white knobs, engraved : 2 of "Volume," 1 of "Tuning," 1 of "Bass," 1 of "Treble," 1 of "S. M. L. Gram."
Wire, grommets, sleeving, etc.
Chassis to dimensions given in text.

POWER UNIT PARTS

Chassis about 10in.×8in.×2½in.
C1—16 μF 450 v. B.E.C. electrolytic.
C2—32 μF 350 v. B.E.C. electrolytic.
C3—100 μF 50 v. T.C.C. type CE26D.
R1—680Ω 3 watts.
VR1—100Ω CLR5001/15 Colvern wirewound.

ALPHA

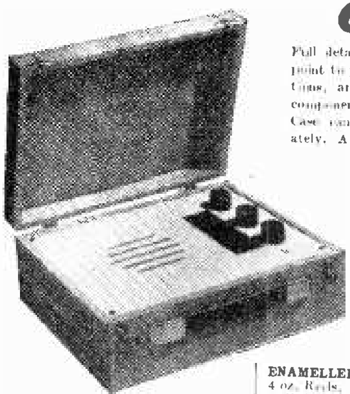
Invite you to build this 4 valve, 2 waveband, superhet portable for only

6½ GNS.

Full details, circuit diagram, point to point wiring instructions, and complete list of components. Available 2/6 ea. Case can be supplied separately. Available in the following attractive colours:

- Lizard Grey;
- Blue;
- Maroon;
- Brown.

All components can be supplied separately.



CARRYING CASE
Suitable for use as a projector or recording case, size 15in. × 9½in. 13in. Internal dimensions: 14in. long, 11½in. deep, 5½in. front H.T., 8½in. rear H.T. With a black rexine finish. Weight 8½lb.... **13/6 ea.**
Post and packing 2/6.

CHOKES
20H, 250 Ω. 60 mA. Clamp construction .... **6/- ea.**
10H, 200 Ω, 90 mA. Clamp construction .... **9/3 ea.**
5H, 250 mA, 200 Ω. Fully shrouded.... .... **18/3 ea.**

TRANSFORMERS FOR BATTERY CHARGERS
230 v. Input Tapped 6-12 v. 1 amp. .... **13/6 ea.**
230 v. Input Tapped 6-12 v. 3 amp. .... **18/- ea.**
Both with tap on Primary for 2.5 v. Pilot light.

HEATER TRANSFORMERS

230 v. Input	2 volt	.5 amp.	4/6
230 v. Input	2 volt	3.0 amp.	7/9
230 v. Input	4 volt	1.5 amp.	5/-
230 v. Input	4 volt	3.0 amp.	10/-
230 v. Input	5 volt	2.0 amp.	10/-
230 v. Input	6.3 volt	.5 amp.	5/-
230 v. Input	6.3 volt	1.5 amp.	6/-
230 v. Input	6.3 volt	3.0 amp.	9/-
230 v. Input	12 volt	.75 amp.	5/-

SENTERCEL RECTIFIERS
RM1, **3/9** ea.; RM2, **4/2** ea.; RM3 **5/-** ea.; RM4, **16/-** ea.

METAL RECTIFIERS
12 v. ½ amp., **1/6** ea.; 12 v. 1 amp. **4/6** ea.; 2 v. 1 amp., **3/-** ea.; 250 v. 45 mA., **6/3** ea.; 250 v. 75 mA., **7/6** ea.; 300 v. 60 mA., **7/6** ea.

GOLDRING PICK-UP HEADS. Pick-up head type No. 112 (2,000 ohms), complete with lead. Price **17/6** each.

TINNED COPPER WIRE—All 4 oz. Reels.

16 S.W.G.	2/-
18 S.W.G.	2/2
20 S.W.G.	2/4
22 S.W.G.	2/6
24 S.W.G.	2/8
26 S.W.G.	2/10

ENAMELLED COPPER WIRE—All 4 oz. Reels.

S.W.G.	Price	S.W.G.	Price
16	1/11	30	3/1
18	2/1	32	3/3
20	2/3	34	3/5
22	2/5	36	3/7
24	2/7	38	3/11
26	2/9	40	4/2
28	2/11		

CHASSIS
Aluminium Undrilled with Reinforced Corners. Available in the following sizes.

6in. × 4in. × 2½in.	4/6 ea.
8in. × 6in. × 2½in.	6/3 ea.
10in. × 7in. × 2½in.	7/3 ea.
12in. × 8in. × 2½in.	8/6 ea.
14in. × 8in. × 2½in.	9/6 ea.
16in. × 9in. × 2½in.	12/- ea.

All are four sided—ideal for radio receivers — amplifiers — powerpacks, etc.

PERSPEX IMPLOSION GUARDS
Incorporating escutcheon and filter. 12in. type, **11/6** ea.; 16in. type, **14/6** ea.

POCKET TEST METER
Ex-Govt., volt meter two ranges 0-15 v.; 0-250 v. D.C. Complete in case, **17/6** ea.

IRON ELEMENTS
Standard adaptable type, 230 v., 450 w., **1/8** ea. Morphy Richards, replacement type, **3/9** ea. H.M.V. replacement type, **3/-** ea.

PLIERS, with side cutters, **4/3** pair.

NYLON DRIVE CORD
25 yard reel nylon drive cord on wooden reel, **2/9** ea.

CRYSTAL DIODES
Plastic case, wire ends, 2 for **2/1**.

BI CONDENSERS
Waxed cartons, with flying leads. 4 mfd., 500 v., **1/6** ea; 4 × 4 mfd., 500 v., **3/4** ea.

LOUDSPEAKER UNITS

Rola 5in. Speaker with transformer..........................	16/- ea.
Elac 5in.	16/9 ea.
Plessey 6½in. lightweight unit	16/6 ea.
Rola 6½in. standard type......	17/6 ea.
Lectrona 6½in. with transformer..........................	18/- ea.
Truvox 6½in. wafer type......	20/- ea.
Plessey 8in. lightweight unit	17/6 ea.
R. & A. 8in. Standard type...	17/6 ea.
Plessey 10in. unit	19/6 ea.
Elac 10in.	22/6 ea.
R. & A. 10in.......................	22/6 ea.
Goodmans 10in. unit with transformer	26/6 ea.
Elliptical 4in. × 7in. unit......	18/6 ea.
Mains energised 8in. unit, 1,000 Ω	21/- ea.
Mains energised 6½in. unit, 600 Ω	17/6 ea.

BAKELITE CASED BI CONDENSERS
0 mfd., 1,000 v.; .01 mfd., 4 Kv.; .001 mfd., 4 Kv.; .03 mfd., 4 Kv.; .03 mfd., 500 v. All **1/6** ea.

DUBILIER NITROGOL CONDENSER
12 mfd., 350 v., **5/6** ea.

OSMOR COIL PACKS
Type H.O., **48/-** ea. Type LM, **40/-** ea. Type T.B., **50/-** ea. Type TRF, **40/-** ea.

SPRAGUE CONDENSERS
.05 mfd., 500 v.; .01 mfd., 1,000 v.; .1 mfd., 350 v.; .02 mfd., 750 v. All **9/-** doz.

TCC VISCONOL CATHODRAY CONDENSERS
Type CP57XO, .002 mfd., 18 Kv., **7/6** ea. Type CP55QO, .001 mfd. 6 Kv., **5/-** ea. Type CP55TO, 500 pF., 10 Kv., **5/-** ea.

VIBRATORS, ETC.
Vibrator unit for 6 v. operation, **14/6** ea. Post 1/6. 6 v. and 12 v. Vibrators, 4-pin UX types, **6/6** ea.

DOUBLE TRIMMERS
250/250 pF; 100/100; 100/50. All **6d.** each.

YAXLEY SWITCHES
3 pole, 3 way, 1 bank, **1/6** ea.
3 pole, 3 way, 3 bank, **1/6** ea.
Octal Plug and Socket (screened), **1/-** ea.

PRE-SET CONTROLS (CARBON)
50 K Ω, ½ Meg Ω, 1 Meg Ω, 2 Meg Ω, **1/9** ea.

GOLDTONE BAKELITE CASED BUZZERS .... **2/6** ea.

PENCIL RECTIFIERS
K3/25, **5/8**; K3/40, **7/6**; K3/45, **8/2**; K3/50, **8/8**; K3/60, **9/8**; K3/100, **14/8**.

HUNTS CONDENSERS
Type W99, 200 pF., 350 v., **7d.** ea.
Type W99, .005 mfd., 150 v., **7d.** ea.
Type W48, .1 mfd., 400 v., **1/-** ea.
Type L44, .1 mfd., 500 v., **9d.** ea.

RESISTORS 2 WATT
2.2 K Ω, 470 Ω, 7.5 K Ω, 22 Ω 150 Ω, 5.6 K Ω, 390 Ω, 150 K Ω ¼ meg. Ω, 39 Ω, 1.5 meg, 56 K Ω. All **4d.** ea.

★ ★ ★ ★ ★ ★

EX GOVERNMENT AND SURPLUS CONTROLS
This popular range is suitable for all Television constructors, etc. Keep your costs down when building the "Argus" or "Simplex" receivers. Available: 500 Ω, 600 Ω, 1,500 Ω double type, 2 K Ω, 5 K Ω, 10 K Ω, 20 K Ω, 25 K Ω, 50 K Ω, 200 K Ω, 100 K Ω, ¼ meg. Ω, ½ meg. Ω, 1 meg. Ω, 2 meg. Ω, 50 K Ω double type. All **1/2** each.

COLVERN PRE SET CONTROLS
Type CLR 1106 88 1,000 Ω ... **1/9** ea.
Type CLR 1126 78 250 Ω ... **1/9** ea.

★ ★ ★ ★ ★ ★

RESISTORS
The following range of Resistors is available in ¼, ½ watt and 1 watt.
Prices ¼/½ watt **3d.** ea. 1 watt **6d.** ea

10 Ω	120 Ω	1.5 K Ω	18 K Ω
12 Ω	150 Ω	1.8 K Ω	22 K Ω
15 Ω	180 Ω	2.2 K Ω	27 K Ω
18 Ω	220 Ω	2.7 K Ω	33 K Ω
22 Ω	270 Ω	3.3 K Ω	39 K Ω
27 Ω	330 Ω	3.9 K Ω	47 K Ω
33 Ω	390 Ω	4.7 K Ω	56 K Ω
39 Ω	470 Ω	5.6 K Ω	68 K
47 Ω	560 Ω	6.8 K Ω	82 K Ω
56 Ω	680 Ω	8.2 K Ω	100 K Ω
68 Ω	820 Ω	10 K Ω	120 K Ω
82 Ω	1 K Ω	12 K Ω	150 K Ω
100 Ω	1.2 K Ω	15 K Ω	180 K Ω

SOLDERING IRONS
Solon type 964 fitted oval bit .... **19/11 ea.**
Solon type 968 fitted pencil bit .... **19/11 ea.**
Both types are complete with approx. 6ft. of Henley 3 core cable and are suitable for 230/250 v.

SOLDERING PASTE
Large tin soldering paste by Tyne Chemical Co., approx. 1 lb. .... **1/9** per tin

CONDENSERS
The following is a selection of our stocks of manufacturers' surplus condensers all by well-known makers—DUBILIER, B.I., BEC (EDISWAN), SPRAGUE, etc.
Aluminium Can Types Clip Fixing:

	each		each
8 × 8 mfd. 450 v.......	4/-	32 × 32 mfd. 350 v. 25 mfd. 25 v.......	5/9
8 × 16 mfd. 450 v. ...	4/-	60 mfd. 450 v.......	2/9
8 × 24 mfd. 350 v. ...	3/-	64 mfd. 350 v.......	2/-
8 × 32 mfd. 475 v. ...	3/9	Dubilier (B.R. Range):	
12 × 4 mfd. 450 v. ...	2/-	BR. 850. 8 mfd. 500 v.	2/9
16 mfd 450 v.	3/-	BR. 1650. 16 mfd. 500 v.	3/3
16 × 8 mfd. 350 v. ...	4/-	BR. 2050. 20 mfd. 500 v.	3/6
16 × 16 mfd. 350 v.	3/6	8 × 8 mfd. 500 v. ...	4/-
16 × 16 × 8mfd.350v.	3/6	BR. 501. 50 mfd. 12 v.	1/9
20 × 20 mfd 500 v....	4/9	16 × 16 mfd. 500 v.	5/-
24 mfd. 450 v... ...	2/9	16 × 8 mfd. 500 v....	4/9
24 × 16 mfd. 350 v.	3/6		
32 mfd. 450 v.......	3/-		
32 × 8 mfd. 350 v....	3/6		
32 × 16 mfd. 350 v.	4/6		
32 × 32 mfd. 450 v.	6/11		
32 × 32 × 8mfd.350v.	5/6		

CONTROL KNOBS in MODERN STYLING
Tastefully and clearly engraved in gold.
Size A. Diameter 1⅜in. Depth ⅞in.
Size B. Diameter 1¼in. Depth ⅞in.
These Mouldings are available in two colours: Walnut and Ivory.
They are suitable for use with ¼in. spindles and are simply and firmly held by means of a grub screw and locking nut.
Prices:
Type "A"—1/6 each.
Type "B"—1/2 each.
Plain Knobs can be supplied in either size or colour: Price 1/- each and **8d.** each respectively. Inscriptions available:—
RADIO: "Volume," "VI On-Off," "Wave-change," "Tuning," "S.M.L. Gram.," "Radio-Gram.," "Tone," "On-Off." TELEVISION: "Contrast," "Brilliance," "Brilliance, On-Off," "Focus," "Brightness."
AMPLIFIER: "Treble," "Bass" (plus any of those shown above). TAPE RECORDER: "Record-Play."

TERMS: Cash with order or C.O.D. Postage and Packing charges extra, as follows: Orders value 10/- add 9d.; 20/- add 1/-; 40/- add 1/6; £5 add 2/- unless otherwise stated. Minimum C.O.D. fee and postage 2/3.

MAIL ORDER ONLY

WHEN ORDERING PLEASE QUOTE "DEPT. P.W."

ALPHA RADIO SUPPLY CO.

5/6 VINCES CHAMBERS, VICTORIA SQUARE, LEEDS 1.

Oscillatory Circuits

AN EXPLANATION OF THE WORKING OF THE VALVE AS AN OSCILLATOR

By E. E. Apps

(*Continued from page* 114, *February issue*)

The Three Valve Relaxation Oscillator

As stated in Part II, the relaxation oscillator generates a waveform that is non-sinusoidal, owing to the sudden change-over from one state of quasi-equilibrium to another. A method, however, of producing nearly pure sine wave form from a relaxation oscillator, can be achieved by the circuit shown in Fig. 1.

Action

Each valve, taken as a separate amplifier, produces a phase change between its input and output voltages, the amount of phase change varying rapidly with the frequency. For any given set of *equal* values of the coupling resistances R and condensers C there is one frequency for which the phase change is exactly 120 deg. If an oscillation of this frequency is applied to the grid of V1, then in its journey through all the 3 valves it will have changed in phase 3 x 120 deg. or 360 deg. This means that it will return to the grid of V1 exactly in phase and will tend to maintain the oscillation. This 3-stage network is very sensitive to frequency changes, thus in a way it resembles a tuned circuit. The anode resistances r are small compared with the valve resistances. Frequency of oscillation is given by

$$f=\frac{1}{2\sqrt{3}\pi CR}$$

Very low frequencies indeed can be obtained by means of this circuit, as for example if C = 15 μF and R = 10 megohms, the periodic time is 28 minutes.

To produce radio frequencies, it is necessary to use tetrodes or pentodes in place of triodes, so as to reduce valve capacitance in parallel with the grid resistances R.

Frequency Drift

It can be stated, that it is of the utmost importance that provision should be made for accurate frequency control, both in radio frequency receivers and transmitters.

In the case of transmitters, this can be achieved by using low-power oscillators of constant frequency, and then amplifying these oscillations up to the power required. This is generally carried out by means of piezo-electric crystals, which are less subject to frequency variations and are practically frequency standards. With the receiver, however, the piezo-electric crystal can only be used in fixed frequency receivers, or in the intermediate frequency stages of superheterodynes. The variable frequency superheterodyne receiver must rely upon a valve oscillator, and to ensure accuracy of calibration this valve oscillator and its associated circuits must have high stability.

Causes of Frequency Drift

When a valve oscillator is supplied with current from either batteries or rectified mains supply, it will be found that the frequency varies with time from the moment of switching on. This variation may be between 200 and 2,000 parts in a million, and may take place during the first 15 minutes. Now this is undesirable, as may be seen from the fact that in a short-wave receiver the variation of frequency, if only 1,000 parts in one million, would cover the whole of the audio range. This state of affairs would render reception very precarious during this period and perhaps afterwards, so it becomes necessary to examine the factors that could cause this frequency variation.

The Valve

The characteristics of a valve are non-linear, and as the curvature of this characteristic gives rise to an oscillation of finite amplitude (owing to the saturation point), it will also result in distortion of wave shape of the current in the oscillator circuit.

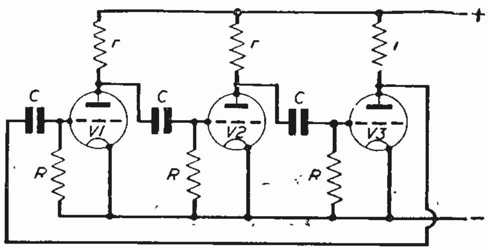


Fig. 1.—Relaxation oscillator for nearly pure sine waveform.

Now this distortion will produce harmonics. These harmonics are necessary to self oscillation and will have an effect upon the fundamental frequency. It has been observed that this change of frequency, which occurs with increase of harmonic content, is positive, and is due to the change of inter-electrode capacitance of the valve. Although this should appear to be constant, such is not the case. It can be shown that the anode cathode capacitance and the grid cathode capacitance will vary according to the change of anode and grid volts. These inter-electrode capacitances are independent of the main tuning capacitance, so that if that is large, the effects of these capacitances will be small. At very high frequencies, however, the effect will be appreciable.

From the foregoing it will be seen that for normal frequency working the variations of frequency due to the valve itself, and the harmonic content of the oscillations generated, are small. Variation of supply voltages, if kept within a few per cent., also have little effect upon the frequency, and variation in temperature of the valve itself is also nearly negligible on frequency.

Having thus eliminated some factors, we must now examine the remainder to locate where these variations can occur.

The Oscillator Circuit

When a receiver is switched on, there is a gradual rise in temperature which will affect, to some degree, all the components in the receiver. This especially applies to the inductances and condensers which comprise the oscillatory circuit, which are liable to cause frequency variation of as much as 1,000 parts to 1 million under ordinary atmospheric temperature changes.

The Inductance

The coil or coils of an oscillatory circuit can undergo a change in inductance due either to (a) variation of temperature (atmosphere); or (b) variation of temperature (conductor); or (c) ageing of constructional materials.

A coil when subject to temperature variation will have its specific resistance altered with the variation; also it may alter its shape. Thus, as can be seen, it will therefore alter its inductance and so the frequency of the circuit.

Temperature variation of the conductor must also include the former on which the coil is wound. Expansion of the metal of which the coil is made will cause deformation of the winding and so cause change of inductance. The former on which the coil is wound will also alter in shape unless made of a material that has a high degree of thermo-mechanical stability.

The Capacitance

In radio-frequency circuits condensers of both fixed and variable capacity are used and are both subject to variation of capacity due to temperature changes. In the case of fixed condensers, which are in some cases of interleaved sheets of metal and dielectric, the metal is not in close contact with the dielectric over the whole of its surface and air gaps will be present. This allows temperature changes to affect the electrical properties of the dielectric and thus cause variation of capacity.

In the case of the air-spaced variable condenser, temperature variation will cause variation in the electrical properties of the insulating parts, and, due to the fact that these condensers are made up of several different parts which have different thermal properties, slight distortion may occur and the air gap subject to variation. All these occurring at once will cause variation of capacity and thus affect the frequency.

Conclusions

To ensure that variation of frequency is kept to the lowest possible amount the following points should be noted.

(1) Judicious selection of the values of various constituents of the oscillator circuit.

(2) High value of C/L.

(3) Equalisation of the resistances of the inductive and capacitive branches.

(4) High quality components such as silvered mica fixed capacitors, high-class material for coil formers.

(5) Layout of components to take care of heat radiation from valves, etc.

(6) Valves with high mutual conductance and high internal resistance.

When these points are observed there is no reason why a high degree of stability cannot be maintained in normal oscillatory systems.

Presentation to Mr. J. Clarricoats

AT the 28th annual general meeting of the Radio Society of Great Britain, held in the lecture theatre of the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, on Friday, December 17th, 1954, Mr. John Clarricoats was presented with an illuminated address on vellum, a hand-made pigskin brief-case and a cheque in recognition of 25 years of service to the Society, first as hon. sec. (from January 1st, 1930) and later as general secretary (from December 3rd, 1932).

Mr. J. Clarricoats.

In making the presentation, the president, Mr. Arthur O. Milne, referred to the fact that when Mr. Clarricoats first became hon. sec., the membership of the Society, then 17 years old, stood at less than 1,000. At the outbreak of the war the number had increased to 3,500. During the war years when the work of the Society was conducted from Mr. Clarricoats' home in Palmers Green, membership rose to nearly 10,000. Five years later it had reached the high figure of 14,000.

Mr. Milne spoke of Mr. Clarricoats' wide knowledge of international amateur radio affairs and of his work on behalf of the Society at international radio conferences. Mr. Milne remarked that more han 400 personal friends of Mr. Clarricoats, in addition to members of many R.S.G.B. town groups, had contributed to the presentation.

In acknowledging the presentation, Mr. Clarricoats paid tribute to the help he had received, particularly during the war years, from his wife and, throughout the 25 years, from his personal secretary, Miss May Gadsden.

International Friendship Award

At the same meeting, Mr. Clarricoats was awarded the Calcutta Key, one of the Society's most treasured trophies, for the year 1954, in recognition of his outstanding service to the cause of international friendship through the medium of amateur radio. The presentation was made by the donor of the trophy, Mr. W. A. Scarr, M.A., a past president of the Society and Director of Studies, British Council.

Honoured by International Radio Society

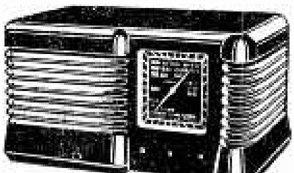
To mark the occasion of the completion of his 25 years as secretary to the Radio Society of Great Britain, the Council of the International V.H.F. Society has elected Mr. Clarricoats an honorary life member. The International V.H.F. Society exists to further international interest in V.H.F. radio communication problems.

Mr. John Clarricoats is an Alderman of the Borough of Southgate and a governor of both Enfield Technical College and Southgate Technical Institute.

PLASTIC CABINET as illustrated, 11½ x 6½ x 5½in., in walnut or cream, ALSO IN POLISHED WALNUT, complete with T.R.F. chassis, 2 waveband scale, station names, new waveband, backplate, drum, pointer, spring, drive spindle, 3 knobs and back, **22/6.** P. & P., 3/6.

As above with Superhet Chassis, **23/6.** P. & P., 3/6.

As above complete with new 5in. speaker to fit and O.P. trans. **37/6.** P. & P. 3/6 with Superhet Chassis, **39/6.** P. & P. 3/6.



Used metal rectifier. 230 v. 50mA., **3/6** ; gang with trimmers, **6/6** ; M. & L. T.R.F. coils, **5/-** ; 3 Govt. valves, 3 v/h and circuit, **4/6** ; heater trans., **6/-** ; volume control with switch, **3/6** ; wave-change switch, **2/-** ; 32 x 32 mfd., **4/-** ; bias condenser, **1/-** ; resistor kit, **2/-** ; condenser kit, **4/-**.

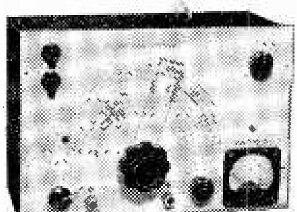
M & L Superhet Coils with circuit, **6/6** ; iron cored 465 IFs, **7/6** ; min. gang, **5/6** ; volume control with switch, **4/-** ; wave-change switch, **2/6** ; heater trans., **7/6** ; 4 v/h, **1/6** ; 4 Ex Govt. valves, metal rectifier and Xtal diode with circuit, **14/6** ; 25 x 25 mfd., **1/-** ; 16 x 16 mfd., **3/3** ; condenser kit (17), **7/6** ; resistor kit (14), **3/6.**

Medium and Long Wave Crystal set, in attractive plastic cabinet incorporating Germanium diode, **16/-**.

Headphones to match above, per pair **7/6.**

COMPLETELY BUILT SIGNAL GENERATOR

Coverage 120 Kc/s-320 Kc/s., 300 Kc/s-900 Kc/s., 900 Kc/s-2.75 Mc/s., 2.75 Mc/s-8.5 Mc/s., 8.5 Mc/s-25 Mc/s., 17 Mc/s-50 Mc/s., 25.5 Mc/s-75 Mc/s. Metal case 10 x 6½ x 4½in., size of scale 6½ x 3½in., 2 valves and rectifier. A.C. mains 200-250 v. Internal modulation 400 c.p.s. to a depth of 30%. Modulated or unmodulated R.F. output continuously variable 100 millivolts. C.W. and mod. switch, variable A.F. output and moving coil output meter. Black crackle finished case and white panel, **£4/19/6**, or **34/-** deposit and 3 monthly payments of **25/-**. Post and Packing 4/- extra.



High impedance plastic recording tape by famous manufacturer. 1,200 feet complete on spool, **17/6.** P. & P. 1/6. 600 feet **8/-**. P. & P. 1/-.

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Drop thro' 280-0-280, 200 mA., 6 v. 5 amps., 5 v. 3 amps., **27/6.**

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32 mfd., 350 wkg.	**2/-**
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100 + 200 mfd., 350 wkg.	**9/6**
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Ex Govt. 8 mfd. 500 v. wkg., size 3½ x 1½, 2 for	**2/6**
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Volume Controls. Long spindle and switch, ¼, ½, 1 and 2 meg., **4/-** each ; 10 K. and 50 K., **3/6** each. ½ and 1 meg., long spindle, double pole switch, miniature, **5/-**.

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Constructor's parcel, comprising chassis 12½ x 8 x 2½in., cad. plated, 18 gauge, v.h. IF and trans. cut-outs, back-plate, 2 supporting brackets, 3-waveband scale, new wavelength stations names. Size of scale 11½ x 4½in., drive sp. drum, 2 pulleys, pointer, 2 bulb holders, 5 pax I.O. v/h, 4 knobs and pair of 465 IFs, twin gang, 16 x 16 mfd. 350 wkg., mains trans. 250-0-250 60 mA. 6.3 v. 2 amp., 5 v. 2 amp. and 6½in. M.E. speaker with O.P. trans. P. & P. 3/6. **39/6.**

R. & A. M.E. 6½in. speaker with O.P. trans., field coil 175 ohms. **9/6.** P. & P. 2/6.

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Pri. 200/250. Secondary 9 v. 3,5 amp., 6.3 v. 3 amp., **12/6.**

Pri. 230 v. Sec. 500-0-500 and 500-0-500 250 mA. both windings. 4 v. 3 amp., 4 v. 3 amp., **39/6.** P. & P. 5/-.

Mains Transformer, fully impregnated, input 200, 220, 230 and 240. Sec. 600-0-600 275 mA., and 200 v. at 30 mA., complete with separate heater transformer. Input 210, 220, 230, 240. Sec. 6.3 v. 2 amp. three times, 0, 4, 6.3 v. at 3 amp. and 5 v. 3 amp., **45/-**. P. & P. 5/-.

Mains Transformer, fully impregnated. Input 210, 220, 230, 240. Sec. 350-0-350, 100 mA., with separate heater transformer. Pri. 210, 220, 230, 240. Sec. 6.3 v. 2 amp., 6.3 v. 3 amp., 4 v. 6 amp., and 5 v. 2 amp. 50/-. P. & P. 5/-.

Terms of business : Cash with order. Despatch of goods within three days from receipt of order. Where post and packing charge is not stated, please add 1/6 up to 10/-, 2/- up to £1 and 2/6 up to £2. All enquiries S.A.E. Lists 5d. each.

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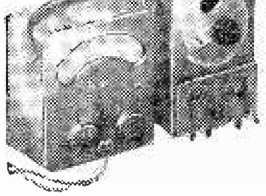


Part 3 of a New Series of Articles Dealing with the Practical Application of Standard Test Equipment

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

(Continued from page 78 February issue)

WE should now be clear on the fact that any voltage reading obtained from a high-resistance circuit of a television or broadcast receiver is not a one hundred per cent. accurate indication of the voltage distribution under normal operating conditions, but at best should be considered only as a comparative indication.

Getting used to a particular instrument assists considerably in this respect, for then a good idea as to the extent of needle deflection on a certain voltage range at a given test point in a receiver can be acquired. Practice will enable the operator to know whether the reading is too high or too low, and thus readily determine whether or not the associated circuit should be subjected to more detailed examination—always assuming, of course, that the voltage test figures for the receiver under examination are not at hand.

When comparing potentials existing between two high-resistance circuits—for instance, between the cathode and grid electrodes of a picture-tube—it is desirable to compare the potentials as a DIRECT voltage reading between the two points, as opposed to taking two voltage readings relative, say, to chassis, and then subtracting the lesser reading from the greater in order to get the answer. The former method is the less involved and the more accurate.

Measuring E.H.T. (5)

One bewildered experimenter recently consulted our "Query Service" to discover why the screen of his television receiver went blank and the E.H.T. voltage disappeared when he endeavoured to measure the E.H.T. on a 500 ohms per volt instrument. Our reader also mentioned that E.H.T. in his set was derived from the line flyback, and that he had been especially careful to ensure that the correct value resistor had been used in series with his instrument to extend its range to 10,000 volts.

If we examine this we discover that our correspondent's instrument, adjusted to provide a f.s.d. of 10,000 volts, possesses a terminal resistance of 5 megohms (500 x 10,000). This value resistance connected across, say, 10,000 volts will incite a current flow of 2 milliamperes. Now the maximum loading of a normal flyback E.H.T. system is little more than 200 microamperes (0.2 milliampere), owing to the extremely high inherent resistance of this kind of circuit.

Clearly, then, endeavouring to obtain 10 times its maximum loading current simply as a means of measuring its output voltage is bound to provoke a severe fall, or a total collapse, of voltage. In certain cases, the resulting heavy load will also tend to damp the line output stage and disturb the normal operation of the associated amplifier valve.

The 50 microamperes necessary to provide f.s.d. on a 20,000 ohms per volt instrument can be given by a flyback E.H.T. system without causing a serious drop in voltage, for such an instrument, adjusted for 10,000 volts f.s.d., will have a terminal resistance of 200 megohms.

For the purpose of E.H.T. measurement, high-voltage adaptors can be obtained for certain 20,000 ohms per volt instruments, though it must be stressed that instruments of a lower sensitivity than 20,000 ohms per volt should never be used in an attempt to measure E.H.T. voltages.

Measuring Current (6)

The measurement of current will usually be quite straightforward, as the meter will be in series with the various components in the circuit, and very little, if any, error will be introduced due to its resistance. On the lower current ranges the resistance of the instrument will, of course, be more predominant, since the resistance value of the associated shunts will be correspondingly higher. This will be of negligible consequence, however, owing to the fact that the network carrying the small current will

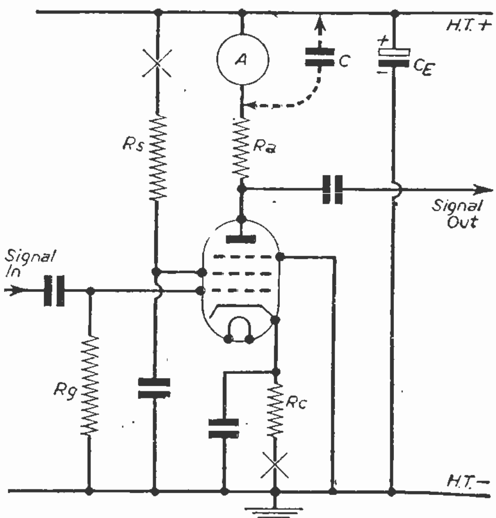


Fig. 9.—Always make current tests at a low signal potential point in the circuit.

nearly always possess a resistance value far higher than the internal resistance of the instrument itself.

Let us look at the circuit of a voltage amplifier again—Fig. 9. This might well be arranged to amplify audio frequency (A.F.) signals—going in at the grid and coming out amplified at the anode. Here, our current meter is shown connected between the H.T. line and the anode load resistor Ra. The same current would, of course, be present between the anode of the valve and Ra, but at this point the A.F. signal is developed—across Ra.

Therefore, if we connected our meter between the anode and Ra, the meter connecting leads may cause some of the A.F. signal—which will be in them—to couple up with the signal in another section of the circuit to instigate oscillation (instability). This

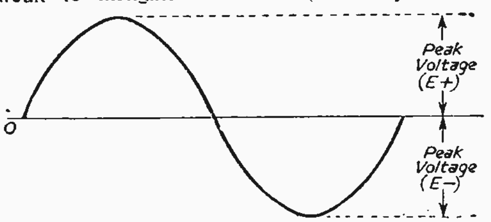


Fig. 10.—One cycle of sine-wave.

undesirable effect would upset the normal operation of the circuit under test, and most likely give rise to an erroneous current reading.

This is less liable to occur if the meter is connected directly to the H.T. line, because the H.T. line itself is at zero A.F. potential by reason of the decoupling capacitor CE, and the resistance of the meter is very small compared with Ra, so that very little A.F. voltage will be developed across it and carried by its leads. In very critical circuits it is sometimes desirable to eliminate the possibility of instability completely by shunting the meter with a suitable value capacitor, as shown by the dotted connections in Fig. 9.

When measuring screen or cathode current there is less likelihood of instability cropping up, but, even so, it is always a good idea to introduce the meter at a low-impedance point so far as the signal is concerned. These points are indicated by X on the amplifier circuit.

A good indication of valve cathode current can be obtained, without disconnecting the circuit in any way, by measuring the voltage developed across the cathode resistor Rc. Let us assume that Rc is 100 ohms, and that 0.5 volt is measured across it, then, by applying Ohms law, we discover that the cathode circuit is passing 5 milliamperes—0.5 x 1,000/100.

As we are now well aware, we can only adopt this method accurately when the resistance of the meter is high compared with the resistance of the circuit resistor.

The A.C. Ranges (7)

On A.C. ranges our multimeter will almost certainly be calibrated directly in "root-mean-square" values of current and voltage. Although it is not intended to delve too deeply into the mathematics of A.C. theory in this series, there are one or two things we should know in this respect to assist us interpret the readings given on our universal multimeter.

In the first place let us remove the mystery from the term "root-mean-square," or, as it is more usually written, R.M.S. Simply, and quite correctly, we can say that the R.M.S. value of the current is that value of D.C. which would have the same heating effect as has the A.C. flowing.

We can enlarge on this in the following way: We know that the direction of needle deflection on a moving-coil meter is dependent on the direction of the current flowing through its coil. Clearly, then, if we connect a moving-coil meter directly across an alternating voltage, the resulting alternating current through its coil will subject the needle to a push one way when the waveform is going positive and a push in the opposite direction when the waveform is going negative.

Unless the frequency of the A.C. was very low we

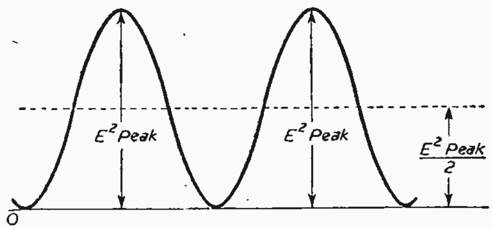


Fig. 11.—This curve is evolved by plotting against time all the squares of the instantaneous voltage values in the sine-wave at Fig. 10.

should not observe these "kicks" owing to the inertia of the coil and needle. If, however, the meter were connected to a 50 c.p.s. A.C. supply we should probably discern a slight vibration of the needle about the zero mark, but that is all.

In effect, then, a meter so connected is reading the AVERAGE value of the A.C. supply, for it is easy to realise that, since the average value is taken over a whole cycle (Fig. 10), the positive and negative half-cycles cancel out to ZERO.

The heating value or the R.M.S. value of an alternating waveform can, therefore, only be arrived at by investigating the ENERGY dissipated in the circuit in very short time-passages. We know, of course, that heat or power given by electricity is proportional to the SQUARE of the current or voltage, thus, to find the power of a whole cycle it is necessary to square all the instantaneous voltages in the waveform.

Now, since the square of a positive number is the same as the square of the same number negative, all the instantaneous values squared of the sine-wave in Fig. 10, plotted against time, would form the curve of Fig. 11. This again is a sine-wave, but now it is double the original frequency and raised above the zero line—this is, of course, due to the fact that the SQUARE of all the NEGATIVE instantaneous values in Fig. 10 are resolved POSITIVE in Fig. 11.

The peak value in Fig. 10 is thus the peak value squared in Fig. 11, and since we are considering a sine-wave which is symmetrical above and below its centre horizontal axis, the mean value of the waveform is obviously $\frac{E^2 \text{ peak}}{2}$.

This is, of course, a factor of POWER, being proportional to the SQUARE of the voltage, so conversely, the R.M.S. value of the sine-wave voltage is proportional to the SQUARE ROOT of the power; or in

(*Continued on page* 186)

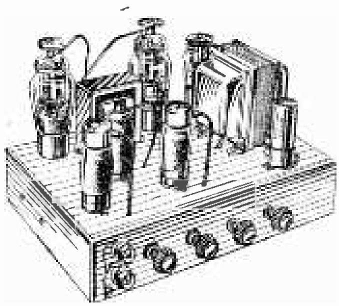
R.S.C. A3 10 WATT "PUSH PULL" HIGH FIDELITY AMPLIFIER.

With Self Contained Pre-amplifier and Tone Control.

This amplifier, whilst having sufficient output to fill a small hall, is the ideal amplifier for the quality enthusiast who knows that though the average listening level is less than one watt it is necessary, for the very highest quality, to have an output of at least ten times this figure in order to obtain completely distortionless reproduction of sudden loud sounds.

Large safety factors in every component, A.C. and H.T. fuses, punched chassis with baseplate, screened input plugs, valves, and with easy-to-follow point-to-point wiring diagrams.

Two independent inputs are provided with two associated independent volume controls so that programmes can be mixed together if desired, such as microphone announcements superimposed on a musical programme, or two independently controlled microphones, or even just gramophone/radio, fading over from one to the other. Variable base lift and cut with variable treble lift and cut tone controls are fitted, giving full long playing record equalisation for uncorrected pick-ups. They are also provided so that the user can alter the tonal values to suit his personal taste. Terminals are provided for 3 ohm and 15 ohm loudspeakers. H.T. and L.T. available for the supply of a Radio Feeder Unit.



Only 130 millivolts input required for full output.

Six Negative Feedback Loops.

Maximum input for full output 130 millivolts.

Frequency response ± 3 DB 50-20,000 cycles.

Negligible hum and distortion.

For A.C. mains input 200/230/250 v. 50 c/s.

COMPLETE Kit of Parts, (carriage 5/-). **7 GNS.**

Supplied assembled and tested for **45/-** extra.

Louvred Metal Cover with 2 carrying handles available for **17/6**.

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Ideal for LARGE HALLS, CLUBS, DANCE BANDS, GARDEN PARTIES. For ELECTRONIC ORGAN OR GUITAR. For STANDARD OR LONG PLAYING RECORDS. For almost any "mike" or pick-up.

Complete with integral Pre-amp. Tone control stage (as A3 amplifier), using negative feedback, giving humproof individual bass and treble lift and cut tone control. **Six Negative Feedback Loops.** Completely negligible hum and distortion. Frequency response ± 3 db. 30-20,000 c.p.s. Two independently controlled inputs. Six B.V.A. valves. A.C. mains 200-230-250 v. input only. Outputs for 3 or 15 ohm speakers. Kit of parts complete in every detail. **9 Gns.**, plus 7/6 carriage or ready for use, **50/-** extra. Illustrated leaflet, **5d.**

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For mains 200-250 v. 50 c/s.
To charge 6 v. acc. at 2 a., **25/6.**
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Above consist of transformer, full wave rectifier, fuses, fuseholders and steel case. Any type assembled and tested, **6/9** extra.

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8µF 450 v.	1/11	24µF 350 v.	2/11
8µF 500 v.	2/11	32µF 350 v.	2/11
16µF 350 v.	2/3	32 mfd. 450 v.	4/9
16µF 450 v.	2/9	40µF 450 v.	4/11
24µF 350 v.	3/6	64µF 450 v.	3/9
32µF 350 v.	3/6	8-8µF 350 v.	3/9
25µF 25 v.	1/3	8-8µF 450 v.	3/9
50µF 12 v.	1/3	8-16 mfd. 450 v.	2/11
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2/6 v. ½ a. H.W.	1/9	6/12 v. 10 a.	35/-
6/12 v. ½ a. H.W.	2/9	24 v. 10 a.	59/6
F.W. Bridge Type		**H.T. Types H.W.**	
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6/12 v. 1.5 a.	7/6	250 v. 50 mA	5/9
6/12 v. 2 a.	8/9	250 v. 80 mA	7/9
6/12 v. 3 a.	12/3	RM4 250 v. 250 mA	11/9
6/12 v. 4 a.	14/9		

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350-0-350 v. 100 mA, 6.3 v. 4 a C.T., 0-4-5 v. 3 a **22/9**
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250-0-250 v. 100 mA, 6.3 v.-4 v. 4 a, C.T. 0-4-5 v. 3 a **22/9**
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350-0-350 v. 100 mA, 6.3 v.-4 v. 4 a, C.T. 0-4-5 v. 3 a **23/9**
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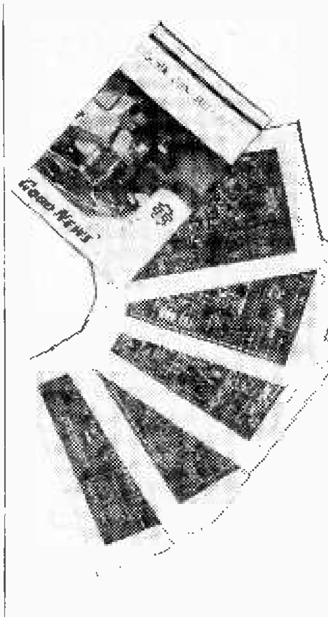

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6BJ6	6/6	12Q7	8/6	EC70	9/6	SP4	7/6
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6F33	9/6	18	8/-	EF37A	10/6	U16	12/-
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6G6	6/6	19H1	10/-	EF50(E)	5/-	U25	13/6
6H6G	2/6	19Y3	10/-	EF54	5/-	U50	7/6
6H6M	3/6	25L6	8/6	EF70	12/6	U52	8/-
6J5G	5/-	25Y5	8/6	EF73	10/6	U78	8/6
6J5M	6/-	27	7/6	EF80	10/-	U329	10/6
6J6	7/6	30	7/6	EF91	6/6	VLS492	
6J7G	5/-	30L1	12/6	EF92	5/6		80/-
6J7M	7/6	35L6	8/-	EF95	7/6	VP2	8/6
6K6	7/-	35W4	10/6	EL32	6/6	VP4	8/6
6K7G	5/-	35Z4	8/6	EL41	10/6	VP13K	7/6
6K7M	5/6	35Z5	8/6	EL50	20/-	VP23	6/6
6K8G	8/-	39/44	7/6	EL91	6/6	VR53	5/-
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6K8M	9/-	50C5	10/-	EY91	7/6	VU111	3/-
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6L6M	10/-	57	8/6	FC13	9/-	W77	5/6
6L7	7/6	58	8/6	GZ32	14/-	X66	7/6
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Surplus Gas-filled Discharge Valves

PARTICULARS OF SPECIAL COMPONENTS FOR BATTERY CHARGING

By E. G. Bulley

THE gas-filled discharge valve originally designed for battery charging should not be confused with the conventional mercury vapour rectifier. They exist as half- or full-wave rectifiers, and have an oxide-coated filament, the core of which is either pure nickel or thoriated tungsten.

The gas filling in such tubes is one of the inert gases such as argon. This gas reduces the internal voltage drop, thus enabling large currents to be handled without appreciable loss of power in the valve. The anode or anodes as the case may be are usually of graphite, although on the lower current types nickel is used.

Gas-filled discharge rectifiers have an advantage over other types of rectifiers for battery charging in that they provide low-voltage high-current rectification.

Smoothing

In battery charging a smoothing filter is not really required, but it is advisable to connect a suitable barretter or ballast lamp in series with the gas discharge valve. The presence of such a lamp is to prevent excessive current flow in low resistive loads. A typical circuit showing the conventional method of connecting the ballast lamp is shown in Fig. 1, this being one using a full-wave gas discharge valve and a ballast lamp having a centre-tapped filament. Fig. 2 is a typical circuit in which a half-wave gas discharge rectifier is used with a suitable ballast; the latter in this case does not have a centre-tapped filament.

To clarify the ballast lamp and its actual use in the circuit(s), it is advisable for the reader to study the following brief description. The ballast lamp keeps

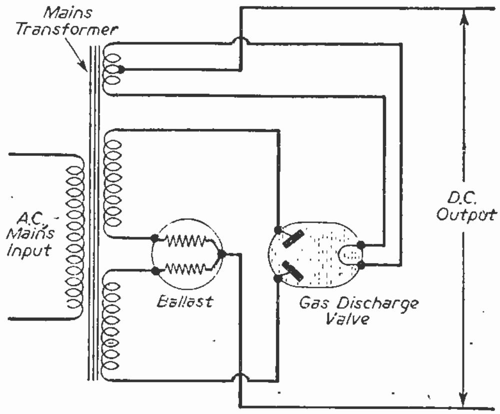


Fig. 1.—The full-wave circuit with centre-tapped filament.

TABLE 1

Type	Fil. Volts	Max. Fil. Current (amps.)	Max. D.C. output voltage	Max. P.K. inverse voltage	Max. D.C. output current amps.	Rectification
CV2774	2.3	18.0	30.0	—	5.0	F.W.
CV2775	2.3	18.0	75.0	—	6.0	H.W.
CV2776	2.0	12.0	75.0	—	1.5	H.W.
CV2777	2.2	17.0	60.0	200 F.W. 300 H.W.	6.0	H.W.
CV2779	2.0	12.0	20.0	90 H.W.	5.0	H.W.
189048	2.2	17.0	60.0	300 H.W.	6.0	H.W.
4B28	2.2	17.0	60.0	300 H.W.	6.0	H.W.
289414	2.2	17.0	60.0	300 H.W.	6.0	H.W.
CE225	2.2	17.0	60.0	300 H.W.	6.0	H.W.
189049	2.2	17.0	90.0	375 H.W.	6.0	H.W.
4B26	2.2	20.0	90.0	375 H.W. 250 F.W.	6.0	H.W.
38116	2.2	20.0	90.0	375 H.W. 250 F.W.	6.0	H.W.
WE289A	2.2	20.0	90.0	375 H.W. 250 F.W.	6.0	H.W.
2000	2.2	17-20	90.0	250 F.W.	6.0	H.W.
289416D	2.2	20	90	375 H.W.	6.0	H.W.
CE226	2.2	20	90	375 H.W.	6.0	H.W.
4B36	2.0	12.0	20.0	90.0 H.W.	5.0	H.W.
20 x 672	2.0	12.0	20.0	90.0 H.W.	5.0	H.W.
859483	2.0	12.0	20.0	90.0 H.W.	5.0	H.W.
966626	2.0	12.0	75.0	—	1.5	H.W.
4B35	2.0	13.5	75.0	—	1.5	H.W.
CV3756	2.0	8.0	30.0	—	6.0	F.W.
WE327A	2.0	12.0	75.0	—	1.5	H.W.
12 x 825	2.0	13.5	75.0	275 H.W.	2.0	H.W.

the current in the circuit constant when the voltage through the lamp varies between certain limits: that is to say, these lamps have a filament whose resistive property is so arranged that when the applied voltage increases within the specified limits, the resistance of the filament increases at the same rate, thus allowing the current to remain constant. One must, however, bear in mind that there is a time lag in this type of lamp when first switched on. Allowance must, therefore, be made so as to enable them to become stable before commencing to charge batteries. Furthermore, it is necessary to avoid mounting these lamps near transformers or in a draught, otherwise current fluctuations will result.

Surplus Components

On the surplus market are various types of these valves (see table 1) around which one can construct a suitable charger. These valves do more or less obey the constants laid down for mercury vapour rectifiers, and by using such constants the reader can easily calculate the ratings of the transformer secondary voltages, etc. These constants do not take into account the voltage drop in the valve or transformer windings. They do, however, give a very good guide to the experimenter or constructor.

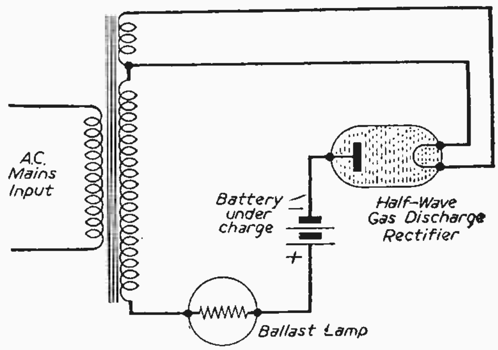


Fig. 2.—This shows a half-wave circuit.

Full Wave Type of Circuit

1. R.M.S. transformer secondary voltage per anode is equal to the PK inverse voltage multiplied by 0.353.
2. D.C. output voltage is equal to 0.318 multiplied by peak inverse voltage.
3. Peak inverse voltage is equal to 2.83 multiplied by R.M.S. transformer secondary voltage per anode.

V.H.F. Radio Facilitates Tug Working

TEN diesel tugs owned by Gaselee and Son, Ltd., have just been equipped with an unusually comprehensive V.H.F. radio system, which brings them under direct central control at all times, and greatly facilitates general administration. Special features of the equipment which was made and installed by the General Electric Co., Ltd., include the selective calling system employed and the exceptional range obtained.

The tugs, which are employed on lighterage, meeting ships from overseas and general river duties in the Thames, are controlled from the company's head office in Fenchurch Buildings, Fenchurch Street. This office is equipped with a G.E.C. remote control unit which is connected by two private lines to a fixed station transmitter/receiver located on Hampstead Heath, the nearest convenient high ground. A second remote control unit, similar to the first, is situated on the depot ship in Limehouse Reach, and this is alternatively connected directly to the fixed station transmitter/receiver. When the London office is closed, control is transferred to this secondary position.

The aerial for the G.E.C. fixed station transmitter/receiver at Hampstead is mounted on a 30ft. tubular mast and its elevated position ensures so wide a coverage that control messages can be passed directly to the tugs at points as far from Fenchurch Street as Sheerness and Ridham Dock in the East and Brentford in the West, beyond which the tugs seldom operate.

Selective Calling

The selective calling system enables control to call any one tug to the exclusion of all the others. When a tug is called a bell mounted on the bridge of that particular tug rings. This arrangement greatly simplifies operating procedure, since it eliminates all unnecessary calling.

The Remote Control Units

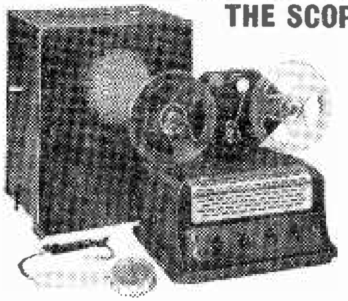
When a tug is required, the request is telephoned to the head office in Fenchurch Buildings. The controller has a map of the river in front of him, together with an up-to-the-minute record of the various tugs' activities. He can, therefore, at once decide which tug is most conveniently placed for a job and immediately direct it where it is required. If the tug is not available at once, the controller can notify the caller as soon as one is free.

Before the V.H.F. radio scheme was installed, the head office passed their instructions to the skippers by telephone or by hand; messages sometimes even had to be relayed by word of mouth to a tug as it passed a wharf. Such a system was obviously difficult to operate. For example, the head office could not readily communicate with a tug returning to base if other work was reported in the area which it was leaving, and fuel was often wasted in needless journeys. It is anticipated that the new V.H.F. system may well pay for itself within a few years in fuel saving alone.

The second remote control at the depot ship is manned 24 hours a day and, equipped with a telephone, acts as a relay point at all the times when the head office in Fenchurch Buildings is closed. Thus the tugs are on call at all times of the day and night, and the skippers themselves can pass messages to, or obtain instructions from, the duty controller at all times. Both the remote control units operate from a 230-volt A.C. supply and special arrangements were made for the installation at the depot ship in the river. Power for this unit is derived from a 24-volt battery and passed through a 230-volt A.C. converter; the battery is charged by a wind generator.

LASKY'S PAGE OF MONEY-SAVING OFFERS

THE SCOPHONY-BAIRD CINE "SOUNDMASTER" New & Unused



LIST PRICE 72 GNS.

A COMPLETE TAPE RECORDER WITH THE EXCEPTION OF THE MOTOR DRIVE. CAN ALSO BE USED AS A STRAIGHT AMPLIFIER

LASKY'S PRICE £17.13.0 (Carriage 7/6 extra)

Originally designed for connecting to a cine projector for synchronising sound to silent films, this superb equipment with the addition of a motor becomes a Complete Tape Recorder of 5 watts undistorted output. Can also be used as a straight Amplifier. Two Inputs for use with Crystal Mike and radio or gram. P.M. Erase. Amplifier uses five valves : 2—6SN7, 2—6V6, 1—5Z4. For 200 240 A.C. Mains. Full instructions and circuit with each Recorder. Write for further details.

Comprising the "SOUNDMASTER" complete with 5 valves. Cover incorporating 8in. Loud Speaker with 24ft. of cable. Spare Input Plug. One empty Tape Spool. Mains Lead. Dimensions : 13½ x 16 x 11in. Nett weight 32lbs.

ROTHERMAL CRYSTAL MIKE complete with lead and plug, 25/- extra (Listed at 5 gns.).

METAL RECTIFIERS

6 or 12 v. F.W. Bridge.
1 amp. 6/6. 2 amp. 11 3. 4 amp. 15/-
6 amp. 23/6. 10 amp. 32/6.
½ amp., 6 v. 2/6. ½ amp., 12 v. 3/11
3 amp., 12 v. 12/6

I.F. TRANSFORMERS

MINIATURE. ¾ x ¾ x 1⅜ins. PRICE 10/6 pair.
WEARITE TYPE 550. 445-520 kc/s. 8/6 per pair.
WEARITE TYPE 500. 450-470 kc/s. 8/6 per pair.

CRYSTAL DIODES

Wire ends. Glass.................... 1/6
Type WX.6. Wire ends............ 1/6

"TELETRON" SUPER INDUCTOR COILS

Full range including the new "Ferrite" rod frame aerials. 5/16in. diam.
4in., medium wave 8/9
8in., med. & long wave......... 12/9
Post extra.

R.F. 25 UNITS.

Complete with 3 valves. New. 19/6. Secondhand, 15/-. Carriage, 2 6 each extra.

SUPERHET COIL PACKS

With Circuit.
No. 1. L.M.S.G. Size : 4¾ x 5 x 2½ins. With ¼in. spindle......... 19/6
No. 2. M.S.S. Size : 4 x 4 x 3ins. With ¼in. spindle 16/-
Both for use with 465 kc s I.F.

LOUDSPEAKERS

First Quality. All 3 ohms speech coil. Less output trans.
3in............... 9/11 8in. 19/11
5in.............. 14/6 10in........... 19/6
6½in. 15/-

ENERGISED SPEAKERS

6in. With O Trans. 600Ω......... 15/6
8in. Less O/Trans. 600Ω......... 12/6
8in. Less O/Trans. 1,200Ω...... 12/6
6½in. With O Trans. 600Ω...... 14/-

PLASTIC ESCUTCHEON MASKS

With dark screen filter.
12in............. 12 6 16in.......... 25/-

BRIMISTORS

Type CZ.1. 1/6 each.
Type CZ.3. 6d. each or 5/- doz.

COMPLETE 5 VALVE RADIO CHASSIS

69/6

Brand New and Unused. A.C. D.C. Mains. 200/250 volts.
* I.F. 465 kc/s. * A.V.C.
* 4 Watts output.
* 3 Station Pre Set.
* Frame aerial.
* Fully aligned.
* Chassis size only 10ins. x 5½ins. Max. height 5½ins.

Completely wired and ready for use, with the addition of a speaker and output transformer. Two controls—Volume and Station switch. Valves used : 10C1, 10F9 or UF41, 10LD11, 10P14, U404 or UY41.

LASKY'S PRICE, 69/6, less Valves. Postage 3/6 extra.
PRICE COMPLETE, £5.19.6.

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NO. 1. A.C. SUPERHET.—4 valves plus metal rectifier. Long, medium and short wavebands. In very attractive cabinet, either walnut veneer or ivory or walnut plastic. For 200/250 v. 50 c.p.s. All components, valves, mains transformer, cabinet, dial and metalwork. LASKY'S PRICE, £7.19.6. Post & pkg. 2 6 extra.

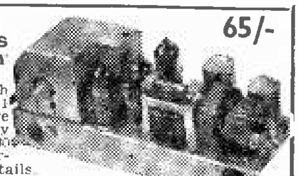
NO. 2. A.C.T. R.F.—3 valves plus metal rectifier. L. & M. wavebands. For construction in attractive wood or plastic cabinet, walnut or ivory finish. For 200/250 v. 50 c.p.s. All components, mains transformer, cabinet, dial and metalwork.
LASKY'S PRICE, £5.10.0. Post & pkg. 2 6 extra.

NO. 3. 4-WATT A.C. AMPLIFIER.—Uses 1 each 6SL7, 6V6 and 5Z4. All components, chassis, valves, output trans., mains trans.
LASKY'S PRICE, £4.5.0. Post & pkg. 2 6 extra.

Instruction Books for the above Kits, price 1/- each.

3-WATT MIDGET AC/DC AMPLIFIERS 65/-

PUSH PULL, VERY HIGH GAIN



4 valves : 2 UL41 in push pull, 1 UCH42 and 1 UAF42. Input voltage 100/110 A.C./D.C. Very easily converted to 230 volts. Supplied with circuit diagram and full details. Size : 9 x 4 x 4ins. Uses 2 metal rectifiers, 1 each RM1 and RM2. Ideal for ships' record players, tape recorders, home record players, baby alarms, etc. etc. Supplied complete, fully assembled and wired, with 4 valves, 65/-. POST FREE.

"SENTERCEL" METAL RECTIFIERS

RM1. 125v., 60 m/A....... 3/10
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RM3. 125v., 125 m/A....... 5/-
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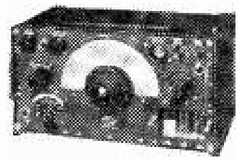
GANGED TUNING CONDENSERS

.0005 Mfd. ¼in. spindle. Standard 2-gang. 2¾ x 1¼ x 2½in., 5/-. Standard 3-gang. 2¾ x 1¾ x 3½in., 7/6. Midget 2-gang with trimmers, 1½ x 1½ x 2½in., 7/6.

RESIN CORED SOLDER.................................. 7/6 per 1-lb. reel

EX-A.M. RECEIVER TYPE R.1155



5 Frequency ranges : 18.5-7.5 Mc/s ; 7.5-3.0 Mc/s : 1,500-600 kc/s ; 500-200 kc/s ; 200-75 kc/s. Supplied in maker's original wood transit case.

LASKY'S PRICE
BRAND NEW, £11.19.6.
Secondhand. Grade 1, £9.19.6
Secondhand. Grade 2, £7.19.6
Carriage 17/6 extra, including 10/- returnable on packing case.

ASSEMBLED POWER PACK/OUTPUT STAGE FOR R.1155 RECEIVER

For use on 200-250 v. A.C. mains. Complete with 2 valves. In metal case size : 12 x 7 x 5½ins.
LASKY'S PRICE 79/6
Carr. 5/- extra.

Power Pack as above. Fitted with 6½in. p.m. speaker.
LASKY'S PRICE £5.5.0
Carriage 5/- extra.

L. & M. WAVE T.R.F. COILS.

With Circuit 4/6 pair

L. & M. DUAL WAVE Superhet Coils.

Aerial and oscillator 5/11 pair

AERIAL ROD SECTIONS

Steel, heavily copper plated. 12ins. long, ⅜in. diameter. Any number may be fitted together. PRICE 2/6 per doz. Post free.

100K. CARBON POTENTIOMETERS.

Less switch. SPECIAL OFFER. 1/6 each

TELEVISION SELENIUM RECTIFIERS

The very latest "Sentercel" S.T.C. range.
K8 40, 3.2 kV.............................. 6/-
K3/45, 3.6 kV.............................. 8/2
K3 50, 4.0 kV.............................. 8/8
K3/100, 8.0 kV............................ 14/8
K3/160, 12.8 kV.......................... 21/6
K3/200, 16 kV............................ 26/-

LASKY'S RADIO

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Car Radio Installation

SOME USEFUL NOTES ON INSTALLING CAR RADIO FOR BEST RESULTS

By M. N. Corbett

THIS article has not been written with a view to describing the complete construction of a car radio. There are many good circuits already in print but a few words as to the type of circuit best suited to operation in a car may be helpful.

Although T.R.F. receivers have been installed in cars, results are usually poor unless the vehicle is near a local transmitter. Unless the motorist is going to remain near the local station the T.R.F. is definitely out of the question. The standard superhet with an R.F. stage makes a good all-round car radio, and although the R.F. stage may be dispensed with if only the "locals" are required the increase in signal-to-noise ratio makes the extra stage well-worth incorporating. The set should cover medium and long waves, but whether tuning is push-button or manual is a matter of choice. If the set has manual tuning the drive to the tuning condenser should be fairly stiff or the set may shake off tune by the vibration of the engine.

Power Supplies

The L.T. is taken straight from the car accumulator and the set is fitted with 6-volt or 12-volt valves to suit the battery voltage. There are two methods of obtaining H.T. Which method is chosen depends on the voltage of the car supply and the amount of space available. One method is to use a vibrator with a suitable step-up transformer, rectifier and smoothing components. Vibrator packs may be purchased ready made or the constructor may prefer to build his own. They are compact and quiet in operation and are obtainable for both 6-volt and 12-volt supplies. It is usual for a car with a 6-volt supply to employ a vibrator pack as rotary transformers with a 6-volt input are difficult to obtain.

Rotary converters are obtainable very cheaply on the surplus market and usually have a permanent magnet field and armature with three commutators. One of these is 12 volts, the second is usually 200-250 volts, and the third is anything from 6 to 50 volts. The third commutator is not required and the brushes should be removed to reduce friction and increase efficiency. These rotary converters have a considerable advantage over vibrator packs inasmuch as they do not need a rectifier. A small choke and a double 8 microfarad electrolytic to smooth the output is all that is needed.

Whatever type of power unit is chosen mount it away from the actual receiver and house the power pack under one of the seats. The leads from the power pack to the receiver can easily be hidden under the floor of the car.

The placing of the loudspeaker sometimes presents a problem. If a miniature speaker is employed, it can easily be incorporated in the receiver itself, but music lovers may prefer the improved quality of a 6in. or even 8in. model. In these cases it is a question of finding some corner in the car where the speaker will not be in the way of anyone. The output transformer should remain in the receiver to avoid having H.T. on the speaker leads.

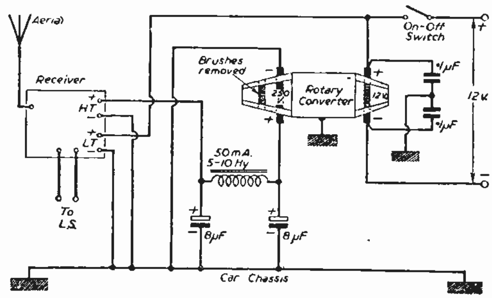
Aerials

The aerial should be as long as is reasonably possible, 3ft. to 4ft. being the best all-round length, and a telescopic type may be used with advantage where the garage roof is low.

When mounting the aerial it should be positioned so that the lead-in is short and direct, and the aerial itself is as far away from the car body as possible. An aerial which is mounted close to the running board and finally sticks a few inches above the roof of the car is very little use. The portion adjacent to the car body will not pick up any signal at all, and so the effective length of such an aerial will be only a few inches. Special attention should be paid to the insulation of the mountings or performance will fall off during wet weather. The actual type of insulator chosen will depend on exactly how and where the aerial is mounted but the insulating material should be non-porous.

Interference

Some cars are worse than others as to the severity of the interference from the ignition system. The standard television suppressor in the distributor lead will do the job in some cases, whilst in others suppressors of a similar nature may have to be fitted to each plug lead. Dynamos and window wipers



Details of a converter power supply.

may be suppressed by .1 µF condensers connected from each brush to the metal case of the offending appliance. Where a rotary converter is employed for power supply, the input commutator should be treated in a similar manner.

Automatic charging regulators are sometimes a source of trouble which can be difficult to trace. Cleaning the contacts and fitting a condenser may do the job, but in extreme cases the regulator may have to be dispensed with and manual charging adjustment fitted. Many car radios crackle while driving, but it is not always the set itself. Loose connections in the electrical system of the vehicle can cause trouble even when such circuits are not in use.

One final point. Car radios will draw anything from 2 amps. upwards from the battery, and even as much as 5 amps. from 6-volt systems. Therefore the charging rate should be increased if the radio is going to be used for long periods at a time.

Designing a Receiver with Screen A.V.C.

CONTROLLING VOLUME BY VARYING THE SCREEN-GRID VOLTAGE

AUTOMATIC volume control on a receiver aims at receiving stations both far and near at the same volume. Prior to the late war many receivers of the more expensive classes employed amplified A.V.C.

This achieved a control ratio that was very high, in fact 6 db change in volume for a 60 db change in input was common. Some receivers used D.C. amplifiers requiring a 100-volt negative supply and, of course, one or two extra valves were required. Screen A.V.C. can be applied in addition to the existing A.V.C. on the receiver, with very little modification and has the added advantage that the control valve draws extra current as the controlled valves draw less. This reduces distortion and renders the action of the normal type of A.V.C. more efficient. For instance, with the normal A.V.C. controlled valves the screens are fed through a series resistor, so that as the bias on the valve is taken negative, the voltage on the screen rises and tends to off-set the effect of the negative grid voltage as regards the anode current and gain of the valve.

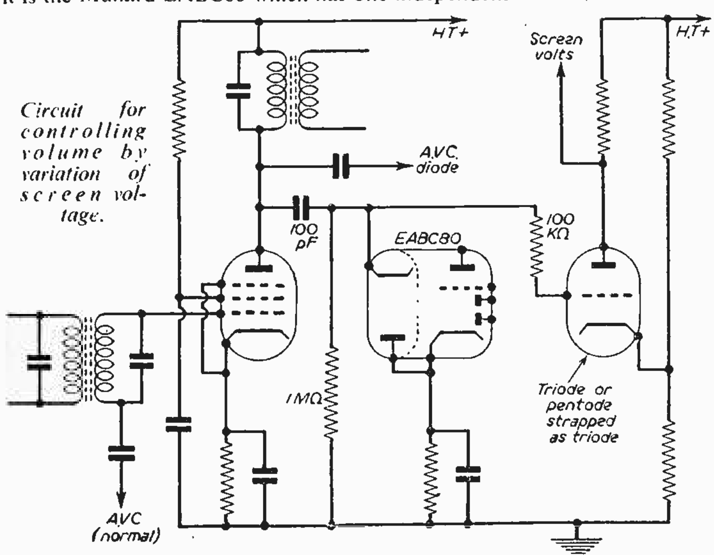
The main feature of screen A.V.C. is that the screen grid voltage is reduced as the signal is increased. This change reduces the gain of the valve, and if the normal A.V.C. is also applied the effect is very great and the control high.

There are many valves that can be used for the control of the screen voltage and the higher the slope of the valve used the better will be the control, but the valve must not have too short a grid base.

There has recently in this country been introduced a valve that is ideal for this type of A.V.C. circuit, it is the Mullard EABC80 which has one independent single diode and a normal double diode triode. It has the same base size as the EBC41, but requires a different holder. This gives it the advantage that it can be used in many of the post-war receivers. The double diode triode portion is joined up in exactly the same manner as the EBC41, the difference being with the "spare" diode, this is connected as shown in Fig. 1. The connections of the remaining electrodes of the valve are the same as in the previous double diode triode.

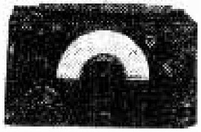
The screen control valve is virtually a D.C. amplifier and its job is to take a D.C. voltage, increase it and reduce the screen voltage. The screen resistors are disconnected and taken to the anode of the control valve. It is here that the experimenter will have to get out his valve data and do a bit of calculating. As every set will have a different valve line up, and every experimenter a different valve for the control valve, we cannot undertake to give a full set of circuit values. Most H.F. pentodes and frequency changers require 150 volts on the screen, so 100 volts has to be lost between the H.T. and the screen. We will assume that the screens take 5 mA between them and the bottom of the curve the control valve draws 5 mA then the value of the feed resistor will be 100 × 1,000/10 ohms or 10,000 ohms. The wattage rating of this component must be ample. The calculation of the bias network for the valve comes next. It is not practical to use just a cathode resistor, and the smaller the value of the resistor in the cathode circuit the better the circuit will work; for instance, if the valve normally carries 15 mA at 150 volts with a 300-ohm bias resistor then a 600-ohm resistor can be used (double normal) with sufficient via the resistance between anode and cathode to reduce the anode current to 5 mA. This will again vary with the valve.

The action of the circuit as a positive voltage is rectified at the cathode of the extra diode and fed to the grid of the control valve, the current through the valve is increased with the result that the voltage drop across the anode load resistor is increased; in the case of a 10,000-ohm resistor 10 volts will be lost for each 1 mA change in anode current. This drop in screen volts reduces the gain of the valves. With this type of circuit it is possible to apply A.V.C. to straight pentodes, especially where it is essential that the input impedance of the valves be kept constant. If required the screen A.V.C. can be used on its own without the use of the normal type of A.V.C. to supplement it.



Circuit for controlling volume by variation of screen voltage.

YOURS FOR £1 DEPOSIT

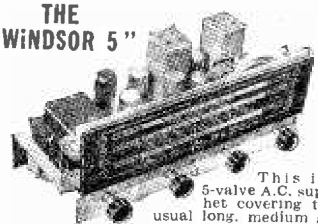


As you know the R1155 is one of the finest communications receivers available today. Covering 75 Kc/s to 18 Mc/s it will give you world-wide reception. Made originally for the R.A.F. it is obviously a robust receiver which will give years of service. The ones we have are, we understand, practically unused but, nevertheless, we have checked and tested them and guarantee them for 12 months. Price, complete with 10 valves ready to operate is **£9/19/6** or H.P. deposit of **£1**, balance by 12 monthly payments of 17/3. If not collecting please include 15/- carriage and transit case.

BATTERY 3-VALVER 19/6

Employs modern circuit ensuring good reception on both medium and long waves. All parts including three valves, resistors, tuning condensers, in fact, everything except loudspeaker, cabinet and chassis (available if you haven't something suitable) costs only **19/6**; data available separately, price **1/6**.

THE "WINDSOR 5"

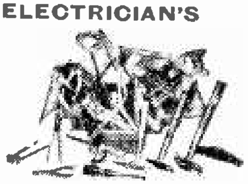


This is a 5-valve A.C. superhet covering the usual long, medium and short wavebands. It has a particularly fine clear dial with an extra long pointer travel. The latest type loctal valves are used and the chassis is complete and ready to operate. Chassis size 15in. x 6in. x 6in. Price **£9/19/6** complete with 8in. speaker. Carriage and insurance 10/-. H.P. terms **£1** deposit. Walnut cabinet available, price **39/6**, post 3/6.

ANOTHER CLEVELAND CHASSIS—THE "TREMENDO"

The first Cleveland chassis is good, but this one is really superb. It has a 7-valve circuit with 6 watts output, fitted with independent bass and treble controls. It is really an efficient R.F. circuit coupled to a high-fidelity amplifier. The chassis size is the same as the Organtone, namely 12 x 7 x 7 with the 10½ x 4½ multi-coloured scale, and it is built to the same exacting specification as the Organtone. Price **£14/10/-**, carriage and packing 7/6. H.P. terms if required.

COMPLETE TOOL KITS—THE ELECTRICIAN'S



This is as illustrated and contains 55 fine tools arranged on 5 trays in an automatic steel tool-box. The box opens under slight pressure of the hand and closes automatically when lifted. The tools are all that a practical electrician needs, including tenon saw, ratchet brace, hacksaw, chisels for wood, brick and steel, pliers, side counters, hammers, spanners, socket wrenches, pad-saw, etc. Price **£15/10/-**, or H.P. if required.

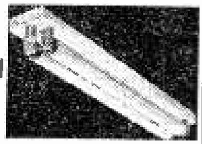
RADIO ENGINEER'S

This again is fitted into an automatic tool-box and contains 50 tools including pliers, side counters, screwdrivers, side and straight snips, hammers, spanners and socket wrenches, hand-drill, B.A. taps, drills, etc. Price **£11/10/-**. H.P. terms if required.

COST UNDER £4 MINI MAINS 4

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, **£3/19/6** plus 2/- post. Constructional data free with the parts, or available separately 1/6.

THE TWIN 20



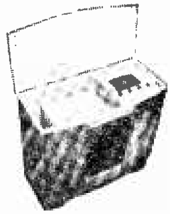
Complete fluorescent fitting. Has built-in ballast and starters —stove enamelled white and ready to work. Ideal for the kitchen, over the work-bench, and in similar location. It uses two 20-watt lamps. Price complete, less tubes, **29/6**, or with two tubes, **39/6**. Post and insurance 2/6. Extra 20-watt tubes **7/6** each.

THE FINE MODERN RADIO CLEVELAND ORGANTONE

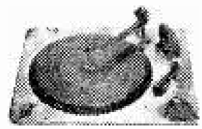
5-valve 3-waveband (L., M. & S.) superhet with special high fidelity 4-watts output—modern B.V.A. miniature valves and parts—gram. position with plugs for extension speaker—ideal for modernising existing equipment. Price **£11/10/-**, or £3/16/- deposit, carriage 7/6.

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, 32 in. wide, and 16in. deep. Price **16 guineas** or **32/-** deposit, carriage 12/6. The centre one is The Empress, our most popular cabinet, size 32in. high, 36in. wide, and 16½in. deep, walnut finished, lined sycamore. Price **15 guineas**, or H.P. deposit **32/-**, carriage 12/6. The lower one is The Contemporary, size 29in. high, 30in. wide and 15½in. deep. Oak finished with contrasting mouldings. Price **£8/15/-**. H.P. deposit **19/-**, carriage 12/6.

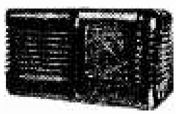


GRAMOPHONE AUTO-CHANGER



The latest model by very famous manufacturers. 3-speed with crystal turn-over pick-up, brand new and perfect, in original cartons. Price **£11/10/-**, carriage, etc., 12/6.

TERRIFIC NEW CIRCUIT



OCCASIONAL '55—we have evolved a new T.R.F. circuit and have had really amazing results, equal, in fact, to many superhets. You really should try this circuit. All parts including valves (6K7, 6J7, 6SG6 and 6X5) and bakelite case with back cost only **£5 10/-**, plus 2/6 post and insurance. Data included with the parts is also available separately, price **2/-**.

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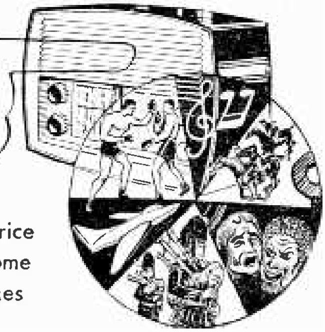
Programme Pointers



Our Critic, Maurice Reeve, Reviews Some Recent Programmes

Regional Orchestras

AMONG the many pleasures to be enjoyed from the feasts of music continuously provided for us are the programmes of those accomplished and hard-working bodies of people, the Regional orchestras. Every day, one or other of them plays to us at some time or other, maybe when we are at work or at play or imbibing our sustenance without which, neither could we listen nor they perform. Always are they efficient and pleasing. Their programmes frequently duplicate each other in close proximity, so that we get the same Saint-Saëns Symphonic Poem, Delibes ballet music or Grieg Norwegian Dance, perhaps three times within the same week. This is probably not their fault. But they are always satisfying and enjoyable.

If any has the edge on one of its rivals it is perhaps the Northern, under either John Hopkins or Vilem Tausky, closely followed by the Scottish under Ian Whyte or Gerald Gentry. But the Midland—Leo Wurmser and Gilbert Vintner, the Welsh—Rae Jenkins and Arwel Hughes, the West—Frank Cantell, and Northern Ireland—David Curry, are all good and no competitive criticism is intended where so much pleasure is given.

The programmes are always fresh and interesting and, as one would expect, free from the heavier things one comes up against in the symphonic programmes from London. Personally, things like "Caisse Noisette," "Sylvia," Elgar's Bavarian Dances, German's incidental pieces, and Coleridge Taylor's too, together with countless others of the same genre, are a constant pleasure. Would that the Proms had not vigorously boycotted the whole school. More of a spirit of irresponsible gaiety and light-heartedness, as was the case yesteryear when the "Eroica" might have been heard rubbing shoulders with "Peer Gynt" or "Carmen," would do those over-worked and over-rated audiences of too self-satisfied and self-conscious intellegentsia a power of good.

Worthy Musical Broadcasts

Two highly important musical events occurred just before Christmas, each producing excellent broadcasts. Sir Thomas Beecham, with his own orchestra and the BBC chorus, conducted a noble performance of Mozart's rarely heard "Requiem Mass." This not-quite-finished masterpiece was commissioned by the incognito envoy of an aristocrat who, evidently, wished to depart this life with both ducal and Mozartian trappings. But fate ruled that His Serene Highness should not only travel unaccompanied but that the Master himself should be laid in his unconsecrated grave, leaving it to his faithful pupil Süssmayr to supply the finishing touches. To-day "*H.S.H.*" and Mozart occupy their rightful places, in this world at any rate.

The other event was the first production of Sir William Walton's first opera, "Troilus and Cressida," commissioned by the BBC, with libretto based on Chaucer by Christopher Hassall and conducted by Sir Malcolm Sargent. It came over magnificently, not only as perfect radio, but as a new British masterpiece in its own right. It is good to relate that few modern works have received or deserved such praise as the new opera was accorded. We could count on the composer of "Belshazzar's Feast" to give us a colourful and dramatic piece. We were not disappointed.

Another "Rural Ride"

Ralph Wightman's second series of "Rural Rides," based on Cobbett's classic, came to an end and a third is due to begin before these words appear in print. I am very glad as I find them wholly delightful and grand and instructive entertainment.

"Take It From Here" is, with other features, back again and I suppose, by and large, it must be considered the best. It is amazing how Denis Norden and Frank Muir keep up the standard of their script week after week. The topical and the permanent are always balanced just to a nicety, whilst Jimmy Edwards, Dick Bentley and Co. never flag in their cheeky innuendo and suggestive *double entendre*.

Drama

John Buchan's powerful tale of Scotland's seventeenth century internecine feuds, with the romantic and heroic Montrose in the background, "Witch Wood," made an effective play as adapted by John Keir Cross. Everybody was as bigoted and intolerant as they could be and that ruthless and sad period came well to life. Denise Edwards, in particular, was most appealing as the faithful-unto-death sweetheart of the harried young parson, made very manly by Robert Urquhart.

"The Second Mrs. Tanqueray" is one of those virtuoso-starring vehicles which probably doesn't deserve the large number of productions it receives. Whether it could be sub-titled "The Woman Who Did," "The Woman Who Didn't" or "The Woman Who Tried To And Failed," probably depends on the sympathies and the social conscience of the listener. That it is effective entertainment and good stagecraft no one will dispute. Gladys Cooper, that ever-youthful and perpetual adornment of our stage, had another go at it in *The Stars in their Choices* series, and once more brought off all the old tricks—certain winners.

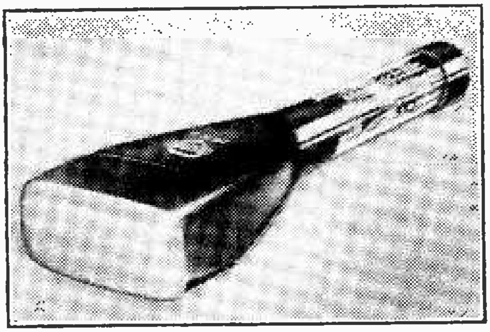
Want of space compels me to abbreviate my commendations on "The Old Reliable"—Wodehouse, "The Moon and Sixpence"—Maugham, and "The Nutmeg Tree," with the irrepressible Yvonne Arnaud—Margery Sharp.

News from the Trade

Rectangular 'Scope Tube.

IN radar and oscilloscope displays, it often happens that only a small, horizontal strip in the centre of the screen of a cathode-ray tube is occupied by the trace. If, instead of a conventional circular face, a face of rectangular form is used, the trace can occupy the whole of the working screen area. Such a rectangular screen has been adopted in the new Mullard DG16-21 tube, which enables much equipment space to be saved. It is the first British tube of its kind.

The tube will find particular application in radar range-finding, decoding I.F.F. or beacon signals, and echo sounding equipment.



A rectangular tube by Mullard

Where it is desirable to compare visually the signals in several channels, DG16-21 tubes, because of their bulb shape, can readily be stacked close together, thus facilitating easy direct comparison.

The DG16-21 tube has a screen size of 5½in. x 1⅛in. The deflection sensitivity is of the order of 0.2mm./V. The angle alignment between X and Y plates is kept within one degree of the nominal value of 90 degrees; this close tolerance ensures the high degree of perpendicularity necessary where accurate measurements have to be made. The tube has a 6.3 volt heater, and would normally operate at a final anode voltage of 6 kV.

Mullard, Ltd., Century House, Shaftesbury Avenue, W.C.2.

A New Measuring Oscilloscope

AN advanced and extremely versatile new oscilloscope is now introduced by E.M.I. Factories Ltd.

Known as Type WM.5, it is an all-purpose wide-range measuring oscilloscope capable of meeting all requirements in the fields of research, design, production, testing and servicing. It has been developed as an invaluable aid in the design and testing of advanced electronic equipment.

The basic instrument comprises the display and power units, but provision is made for the incorporation of one or more standard sub-units to meet almost any specialised requirements. Four types of sub-unit are at present available, suitable for use in conjunction with the X Y Z or Time-base Drive channels.

Among the new features of the basic oscilloscope are the following:

Instantaneous A.C./D.C. voltage measurement by means of a multi-range voltage measuring bridge circuit combined with Y shift and long scale meter, giving by direct reading precise and immediate measurement of the displayed waveform.

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The Y amplifier affords switch selection of two conditions of gain/bandwidth—(1) High Gain D.C.—9 Mc/s and (2) Low Gain D.C.—25 Mc/s without overshoot on transients.

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Leaflets with full technical information are available from E.M.I. Factories Ltd., Hayes, Middlesex.

Wolf Cub Planer

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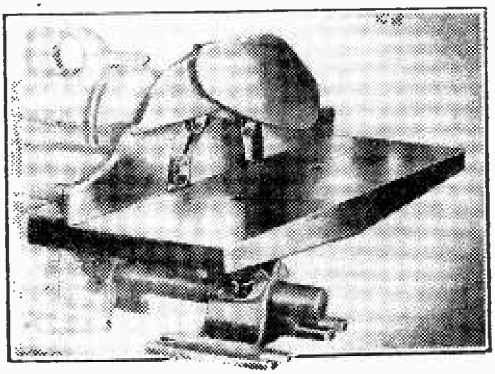
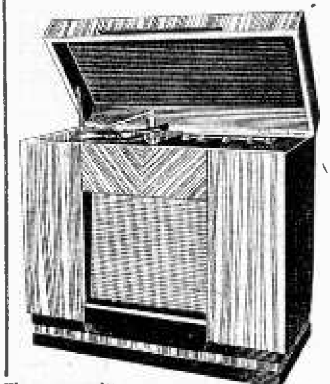


The new Wolf Planer

CABINETS



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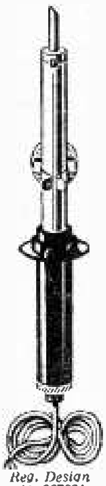

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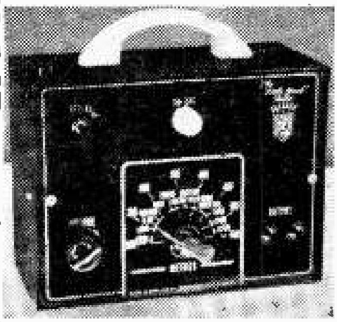

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Open to Discussion

Correspondent Wanted

SIR,—I have been a reader of your excellent magazine for six years and keenly follow up on the data of ex.-W.D. equipment which you often print. I would like to contact another radio enthusiast of my own age—seventeen years.—BRIAN WHEADON (44, Thornton Road, Stanwix, Carlisle).

One-valver

SIR,—On page 85 of your book "Wireless Coils, Chokes and Transformers" you show the windings of a dual short-wave coil. I have made one of these on a 1in. former, paper rolled up and soaked in paraffin wax. I am using it in a one-valve set for headphones.

The results are very good indeed. I get several stations at loud phone strength, some are too loud for comfort. One station I had was Tangiers and it was loud and clear. I have inserted half of a binocular H.F. choke and a home-made short-wave choke in series between the plate and phones terminal, and a short-wave choke in the H.T.+ lead to phones and have long extension handles to the three condensers: one on the main aerial tuning condenser, one on a small band spread condenser across the aerial tuning condenser and one on the reaction condenser.

I also have a small variable condenser in series with the aerial input. The set is very stable and almost entirely free from any capacity effects. I am using a good 2 volt valve and about 45 volts on the plate. I find it is best not to use a high voltage on the plate as it gives too fierce a reaction effect. The H.T. is derived from a mains unit. The L.T., of course, is a 2 volt accumulator. Hoping this will be of interest to you, I also received a station in India, which I fancy was Pakistan, and one from Israel, which would be Jerusalem.—C. HARRISON (Chester).

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 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.

Car Radio Design

SIR,—As an old and enthusiastic reader and amateur (A.D.1922), may I make a few remarks. First is that PRACTICAL WIRELESS is a fine bob's worth, also that radio and television is more interesting than ever. For the young it is cheaper to experiment now than then. Remember valves 15s. to 25s. (now surplus 2s. 6d.), grid leaks 2s. 6d., now resistors 3d. These are the golden days of experiment.

However, in PRACTICAL WIRELESS, Jan. 1955, you state that car radio is no good unless superhet. I have built a three-valve T.R.F. with germanium diode and vibrator which is very successful off a car battery (standard). It is under the dashboard, but the vibrator pack is separate. It receives in this area Home and Light (medium and long) and foreign stations.

The set uses Premier coils, SP61, SP61, 6V6 valves, germanium detector, and the volume is more than adequate.

This arrangement gives better results than four valves superhet, generally speaking, and easier for alignment. The SP61 makes an amateur set into a commercial for results.—R. JONES (Stoke-on-Trent).

Mains Dropper

SIR,—Your correspondent, H. Parker (Feb. issue) mentioned the use of a 60 watt lamp as dropper. Twenty years ago I fitted a 75 watt lamp with batten holder to a four valve T.R.F., with 3 valves. The original vitreous dropper had a life of roughly six months and was difficult to obtain. This arrangement worked quite well until three weeks ago, when the lamp gave out. At the same time I replaced the original valves, saving the old ones as spares. Another twenty years? I wonder.—H. SMITH (St. Albans).

A New Formula?

SIR,—I would be very obliged if any of my fellow readers could give me some information. The information I seek is on the following equation $X^c = \frac{160,000}{fC}$ f is in c/s and C is in μF and X^c is in ohms, while finding the reactance of a capacitor one day, using the equation $X^c = \frac{10^6}{2\pi C}$ I decided to try and find an easier method of calculating X^c, so working on the theory that a 1μF capacitor has a reactance of 160 kΩ at 1 c/s, we could then multiply f by C and divide into 160,000 and get the answer in ohms, but what I should like to know, has anyone seen or used this equation before as I have never come across it in any text book. I find the accuracy is well within one per cent. as well as being simple to use and from $X^c = \frac{16 \times 10^4}{fC}$ we also get $f = \frac{16 \times 10^4}{X^c C}$ and $C = \frac{16 \times 10^4}{X^c f}$, from $f = \frac{16 \times 10^4}{X^c C}$ we can find at what frequency a stated capacitor will have a stated reactance, or from $C = \frac{16 \times 10^1}{X^c f}$ we can find what capacitor will have a stated reactance at a stated frequency.—H. DOBSON (Co. Durham).

Six Valve Superhet

SIR,—H. Sexton describes in the February issue of PRACTICAL WIRELESS how his 6 valve A.C. superhet worked on switching on.

The phenomenon could be explained away to a certain extent by pointing out that the coilpacks and I.F.T.'s are roughly aligned before dispatch; my experience with this set, however, will do much to remove even that criticism.

Principally for the sake of economy, I dispensed with the coilpack suggested, and constructed my own, using Osmor coils. Another reason for this modification was that I wanted only two wavebands, a gram. position and two preset stations.

After all this, imagine my surprise, when I set the dial pointer to 1,500 m, switched on and immediately heard the familiar cry of "Wakey, Wakey!"

I might mention that I had also modified the layout to suit a smaller chassis, and that it is the only superhet I have built.

I consider this a great credit to the design and confidently recommend it to any other beginners.—D. R. COUVELA (Sidmouth).

Time and Frequency Checks

SIR,—Seeing the important part which radio now plays in the lives of each and every one of us, is it not time that more practical use was made of it—apart from being a medium of entertainment (?) or education. I refer to the radiation of time checks at fixed frequent hours, and the broadcasting of frequency checks at either musical or other frequencies which are in more or less general use. I believe that in America a short-wave station under government control radiates frequencies at certain fixed times, but seeing what an important part time plays in our lives (refer to the London telephone service "TIM" for instance) the radiating of six pips at hourly intervals on a special frequency, plus the addition of certain frequencies, either silent in a prearranged order, or with voice accompaniment in the form of explanation, would surely fill a much-felt gap. The lining-up of signal generators, and many scientific instruments would thereby be standardised if everyone used the same standard in this way. What do other readers think?—G. PRENTIS (N.W.9.).

Battery Amplifier

SIR,—Much has been written from time to time about the merits of various mains-driven quality amplifiers, and designs have appeared frequently in the pages of PRACTICAL WIRELESS.

But what of the chap who must content himself with batteries and the belief that good quality reproduction is out of his reach?

I enclose circuit of a battery amplifier (not reproduced) which, before mains became available to me, was in use for some considerable time and was a source of great envy amongst my (battery-operated) friends. The main feature is the use of separate valve for boosting bass and treble frequencies.

Two Class B valves in parallel in the output stage may appear to be rather wasteful in so far as current consumption is concerned, and indeed some 60 mA peak swings were measured on heavy passages.

Standing current with no signal was 15 mA.

The valve line-up in my case was V1 PM2, V2 PM1HL, V3 PM2A, V4-V5 PM2B.

I might add that the three main components are the input and output transformer. The latter being wound by Partridge to match the output stage to a Wharfedale W12.

The input transformer was Ferranti make with low resistance windings and a ratio of 1 : 1.

The speaker incidentally was mounted in a vented acoustic chamber with a view to obtaining maximum quality reproduction.—A. KNOWLES (Calverton).

USING TEST INSTRUMENTS

(*Continued from page* 170)

other words, the R.M.S. value equals $\frac{\sqrt{E^2 \text{ peak}}}{2}$ or 0.707E peak, and conversely, the peak value is the R.M.S. value x 1.414. Thus, the peak value of the ordinary mains supply is, say, 240 volts x 1.414, or 339.36 volts.

Generally, the R.M.S. value of the current or voltage is understood, and in consequence the current or voltage is usually stated as a plain figure. For instance, the mains supply is known as a straight 240 volts—hardly ever referred to as 240 volts R.M.S.

As has already been intimated, most measuring instruments give the R.M.S. values of voltage and current, though the point should now be clear that such calibration is for sine-waveforms only, and that if the instrument is used on a supply of different waveform a considerable error in reading must be anticipated.

An illustration in this respect is the pulse current generated in the line-output stage of a television receiver during the line flyback and used for energising the heater of the E.H.T. rectifier valve. Since the waveform at this point is far from sinusoidal, it is impossible to measure it with any degree of accuracy by means of an ordinary multimeter, even though the instrument may possess a suitable voltage range.

There are two other factors that must always be remembered when using a multimeter on A.C. ranges; firstly, the accuracy of the instrument does not hold over a very wide frequency range, and that it is generally most accurate on the lower power frequencies; and secondly, the overall sensitivity of the instrument is often much less on the A.C. ranges than on the equivalent D.C. ranges. Both of these factors are dependent on the type of rectifier employed, but so far as the sensitivity is concerned, a 20,000 ohms per volt instrument often falls to something like 2,000 ohms per volt on the A.C. ranges.

(*To be continued*)

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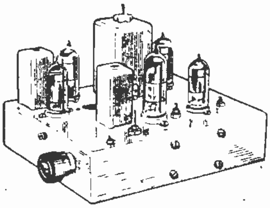

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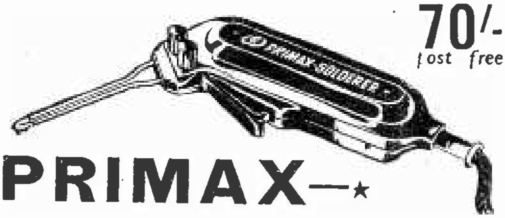

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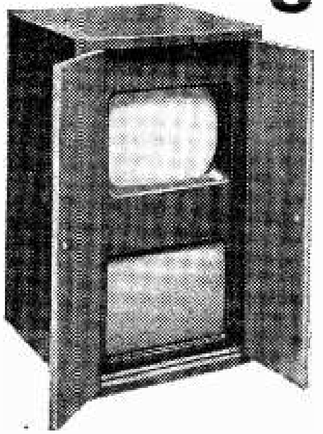

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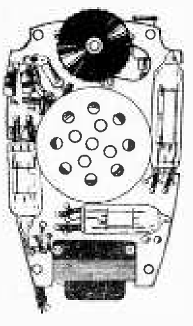

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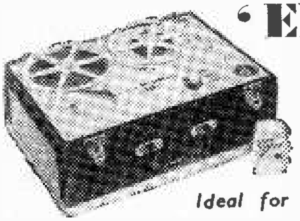

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