

117 CAMM'S
PRACTICAL WIRELESS, AUGUST 1948.

RECORDING TECHNIQUE

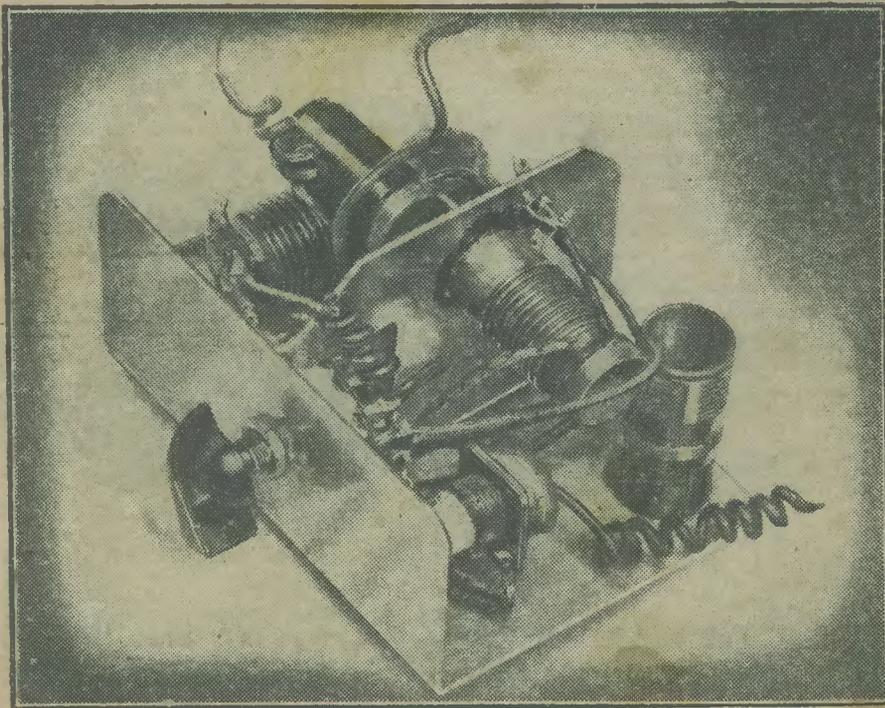
Practical Wireless

9^D
EVERY
MONTH

Vol. 24. No. 505. ||

Editor: F. J. CAMM ||

AUGUST, 1948



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3-Range Coil Pack
Practical P.A. Working
High-fidelity Radiogram
Modulation

||| Television Servicing Examination Paper
Home Intercom. System
Simplicity of the Superhet
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1A7, 1H5, 1N5, 3Q5, 9/6 each, 36/- Set.		
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MAINS TRANSFORMERS at exceptional prices. All are heavy duty and robust. All 230 v. 50 cycles input.

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HEADPHONES—An extremely sensitive pair of lightweight, 'phones of American manufacture. Ideal for crystal sets, and also with low impedance output, but can be matched to high impedance lines with a 4-1 (approx.) transformer. Complete with rubber cushioned ear-pads, leather head-bands, cord and jack plug. Individually boxed and new, 3/9 per pair, plus 1/- post and packing.

CARBON THROAT MIKES—A lightweight, compact and sensitive unit, complete with elastic strap, cord and 2-pin plug. American manufacture—brand new, 1/5 each.

"Q-MAX" CHASSIS CUTTERS—For an easy, quick way of cutting holes in sheet metal or aluminium. The cutter consists of a die, a punch, and an Allen screw. Available in the following sizes: 1/2in. Button base, 9/6; 3/4in. D8G, 9/6, plus 9d. for key. 1 1/2in. Octal base, 1 1/2in., 1 1/2in., all at 12/6, plus 1/- for key.

SPEEDY POSTAL SERVICE C.W.O. or C.O.D.
When sending C.W.O. please include 1/- (minimum charge) for post and packing.

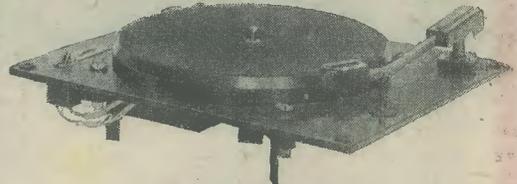
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Specification

Voltage: 200-250 volts A.C., 50 cycles.
Rim drive with speed variation. No governors and no gearing. Heavy non-ferrous turn-table, machined to run dead true, fly-wheel action—no "WHOW." Main turntable spindle hardened, ground and lapped to mirror finish, running in special phosphor bronze bearings. Motor runs in needle-point, self-adjusting bearing. Motor Board 1/2in. plastic. Pressure on Drive-Wheel released when not in use, to obviate forming flats and noisy action.

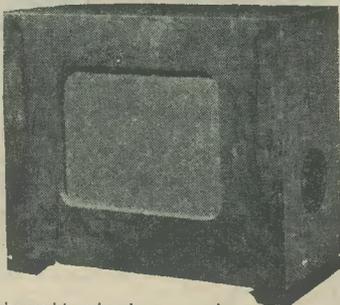
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CONVERTED R.1155 RECEIVER.—In response to numerous requests, we can now supply this famous R.A.F. Communications Receiver modified for normal mains use, and complete with speaker. Unlike other modifications, the power pack, output stage and speaker are fitted into a specially designed cabinet which fits on top of the receiver. The whole makes a presentable installation without using several small units connected by unsightly trailing wires. A really superb Communications Receiver covering 75 kcs.-18.0 mcs. in five wavebands. Fully illustrated leaflet available on request. Only **£18/10/-** (carriage 12/6, returnable transit case 10/-), or the unmodified version **£12/10/-**.

RECORD INSULATION TESTERS.—A special offer of ex-Govt. Insulation Testers by "Record." 500-volt pressure. Brand new and perfect. Only **£9/10/-**.

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(Open until 1 p.m. Saturdays, we are 2 mins. from High Holborn, 5 mins. from King's X.)

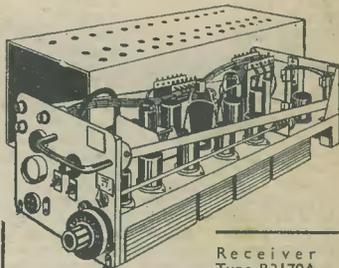
LOOK! Build Your OWN TELEVISION RECEIVER!

At the absurdly low cost of **£7.17.6**, we will supply you with a brand new pair of ex-R.A.F. equipments, as illustrated, which with the addition of a suitable power supply and with minor modifications, will constitute a complete television receiver.

These units are available in several forms as detailed below. A brief specification follows:—

THE RECEIVER UNIT — type R3170A:

A 15-valve receiver covering television frequency, with separate oscillator section. Includes its own power supply which is only suitable for 2,000 cycles and will not be used. The transformer, however, will serve as a method of charging; details of this will be issued. Valve line up: 8 of EF50, 2 of RL37, 1 of RL16, 1 of HVR2, 1 of R3, 1 of EA50, 1 of CV188. The valves alone are worth more than the cost of this equipment. Packed in wooden transit cases. **FULL CIRCUITS.**

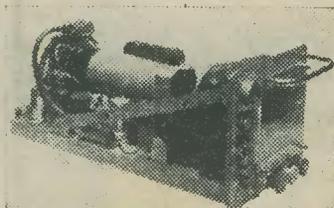


Receiver Type R3170A Complete with 15 New Valves— and **BRAND NEW**

THE INDICATOR UNIT— type 6

A complete vision unit comprising 6in. Electrostatic C.R.T., 4 of EF50, 3 of EB34 valves. See *Wireless World*, May, 1948, issue for full circuits and modifications. Will also make a very fine Oscilloscope. Two models, available, new and slightly used.

Full modification instructions and circuits.



Indicator Unit Type 6 Complete with 6" C.R.T. and 7 valves **BRAND NEW**

Matched pair of brand new units, **£7.17.6** (15/- carriage and pkg.). Matched pair of units comprising brand new R3170A and slightly soiled Indicator, but in good condition, **£7.7.0** (15/- carriage and packing).

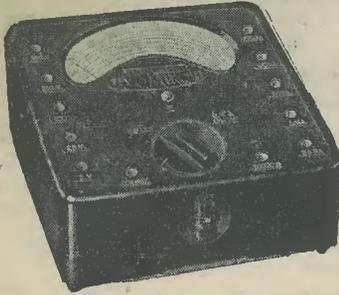
R3170A (brand new) only, **£4.5.0** (7/6 carriage and packing). Unit type 6 (brand new) only, **£3.19.6** (7/6 carriage and packing). Unit type 6 (slightly used) only, **£3.5.0** (carriage and packing 7/6).

Callers for indicator units preferred to obviate possible transit damage.

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Registered Trade Mark

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D.C. Voltage	A.C. Voltage
0-75 millivolts	0-5 volts
0-5 volts	0-25 "
0-25 "	0-100 "
0-100 "	0-250 "
0-250 "	0-500 "
0-500 "	
D.C. Current	Resistance
0-2.5 milliamps	0-20,000 ohms
0-5 "	0-100,000 "
0-25 "	0-500,000 "
0-100 "	0-2 megohms
0-250 "	0-5 "
0-500 "	0-10 "

GUARANTEE: The registered Trade Mark "Avo" is in itself a guarantee of high accuracy and superiority of design and craftsmanship. Every new AvoMinor is guaranteed by the Manufacturers against the remote possibility of defective materials or workmanship.

The UNIVERSAL AVOMINOR

(as illustrated) is a highly accurate moving-coil instrument, conveniently compact, for measuring A.C. and D.C. voltage, D.C. current, and also resistance; 22 ranges of readings on a 3-inch scale. Total resistance 200,000 ohms.

Size: 4½ ins. x 3½ ins. x 1½ ins.
Nett weight: 18 ozs.

Complete with leads, interchangeable prods and crocodile clips, and instruction book.

Price: £8:10:0

The D.C. AVOMINOR

is a 2½-inch moving coil meter providing 14 ranges of readings of D.C. voltage, current and resistance up to 600 volts, 120 milliamps, and 3 megohms respectively. Total resistance 100,000 ohms.

Size: 4½ ins. x 3½ ins. x 1½ ins.
Nett weight: 12 ozs.

Complete as above.

Price: £4:4:0

Sole Proprietors and Manufacturers:—

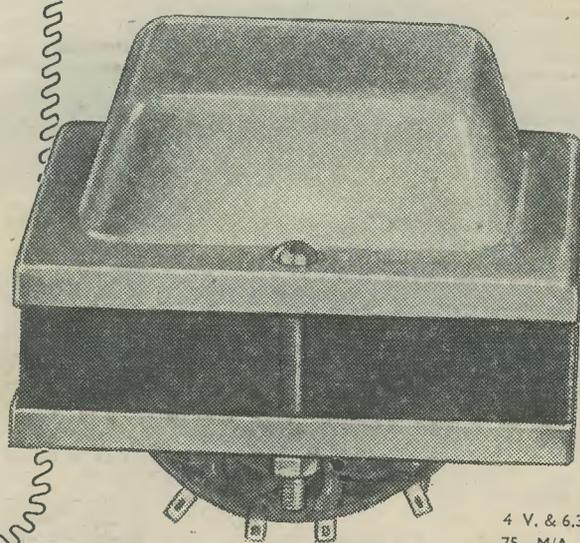
AUTOMATIC COIL WINDER & ELECTRICAL EQUIPMENT CO., LTD.

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4 V. & 6.3 V. types.
75 M/A .. 37/6d.
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R. M. ELECTRIC LTD., TEAM VALLEY, GATESHEAD, II.

Practical Wireless

16th YEAR
OF ISSUE

and PRACTICAL TELEVISION

EVERY MONTH
VOL. XXIV. No. 505 AUGUST, 1948

Editor F.J. CAMM

COMMENTS OF THE MONTH

BY THE EDITOR

Reduction of Purchase Tax

THE Chancellor of the Exchequer may wave his magic export wand, and impose heavy purchase tax on radio and kindred equipment to force manufacturers to export, but he overlooks one or two important points.

In the first place he is mistaken in his belief that the British public will bear any financial burden which he imposes. The second is that you cannot expect other countries to bear the cost of the Social Security schemes instituted in this country. Manufacturers have been advised that in order to provide dollar credits and foreign currencies we must export a large percentage of our goods, and this manufacturers have been unable to do, because our prime costs are higher than those of competitive countries which believe in getting back their world markets before considering other questions.

When this was pointed out to the Chancellor of the Exchequer, manufacturers were advised to sell their goods abroad at cost or even less and to make their profits out of home sales. This is strange advice, because it means that the British public is to pay excessive prices in order to meet the losses incurred on export, and that manufacturers, representatives of private enterprise, are expected, after all the criticism they have suffered, to bolster up this new policy.

This means that the Exchequer is exploiting the British public. The purchase tax was designed, of course, to kill home sales. This it has effectively succeeded in doing, and as high production costs have also succeeded in hampering exports, the ill-considered export policy has destroyed both markets.

The Chancellor also did not take into consideration apparently the valuable advice given to him by trade associations. Realising his mistake he has considered the reduction of purchase tax to 33½ per cent. on all domestic, portable and vehicle radio wireless, including television, valves, and cathode-ray tubes.

We do not think that in doing this the Government is recognising the vital importance of radio in the life of the country, as a representative of the Radio Council seems to suggest. We think the Government is more concerned with unemployment than any consideration for the public. The

latter has done a public service in refusing to pay the further impost at a time when the Government is pegging wages and telling manufacturers that prices have to come down.

It may be that the Chancellor, on second thoughts, in spite of the advice given to him by the R.I.C., has acted too late, and that the public will not be tempted to buy radio receivers even with the purchase tax at 33½ per cent.

The most effective way of forcing down prices is for the public to refuse to buy. The effect of the two increases since last autumn and the commercial uncertainty of the last two months have between them generated severe difficulties which it will take some months to overcome. The industry will take some time to revive from the blow it received in the April Budget. The industry has evolved a recovery plan, but it is not until the autumn that we shall be able to test public reaction.

The whole principle of purchase tax is wrong in peacetime. A healthy home trade should first be encouraged and any excess overspilled into the export markets. The public has deserved after five years of war a replenishment of those goods it was unable to buy during the war.

The country at present is running on a system of taxation and control on a wartime basis, whilst other countries, particularly some of those which we fought to liberate, are rapidly shedding controls. It is a healthy sign indeed that the public is turning. It is, indeed, adopting the methods which have been found effective by particular sections of the public in imposing their will, namely, we think there is a strike of purchasers. It is not an organised strike, it is just that conditions have been made so onerous that people have stopped buying. As a result the Chancellor can see the effect of killing home sales at a time when exports are declining.

Several firms have either closed or have sacked a goodly percentage of their workers who are unable to find jobs in other branches of the industry, which finds itself in the same boat.

It is our view that the purchase tax on wireless equipment should be removed altogether. There is little wonder that people are saving less.

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

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ROUND THE WORLD OF WIRELESS

Broadcast Receiving Licences

THE following statement shows the approximate numbers of licences issued during the year ending, April 30th, 1948.

Region.	Number.
London Postal	2,102,000
Home Counties	1,472,000
Midland	1,605,000
North Eastern	1,737,000
North Western	1,455,000
South Western	973,000
Welsh and Border	649,000
Total England and Wales ..	9,993,000
Scotland	1,060,000
Northern Ireland	183,000
GRAND TOTAL ..	11,236,000

This number includes 49,200 television licences, an increase of 3,650 over the previous month.

Prosecutions in April for operating wireless receiving apparatus without a licence numbered 591.

Ice-screens

SUPPRESSORS to eliminate interference with television reception have been fitted to the engines of 500 vans and cars of T. Wall and Sons, ice-cream and sausage manufacturers. The device screens the radiation of electrical impulses which cause flashing on television receiving sets.

"Although the G.P.O. are fitting suppressors to their transport," says Mr. Cecil W. Rodd, chairman of Wall's, "we believe we are the first private firm to introduce them. We hope that other organisations will follow suit, since at present enjoyment of television programmes is often marred by this type of interference."

Walls recently equipped a number of their vans with car radios for the benefit of their drivers on long-distance runs.

X-ray Equipment for Argentine

ONE of the largest consignments of X-ray equipment ever to leave these shores sailed from the Port of London recently in the s.s. *Highland Princess*.

Bound for Buenos Aires, this equipment is worth £20,000, and will earn many valuable dollars for Britain in her fight for recovery. The consignment consists of apparatus manufactured by Philips Electrical, Ltd., London, and comprises six heavy duty diagnostic

units and six motor-driven tilting couches, as well as the latest in ultra short-wave electro-medical treatment equipment.

Hospitals in various parts of the Argentine will be equipped with these installations and it is hoped that the present consignment will be the forerunner of many more.

Ekco "On the Air"

THE last broadcast in the recent series of "Works Wonders" programmes took place from the stage of the Ekco canteen, at the Southend factory of E. K. Cole, Limited.

Presented and produced by Brian Johnston, the show consisted of eight turns from the following members of the Ekco Players: Winnie Clark, Bill Fraser, Mona Williams, Jack Cowlshaw, Len Jones, John Spreadborough, Norma Bourne, Frank Cove, John Cole, and the Len Chandler Orchestra. The artistes are representative of all the company's divisions—radio, heating, lighting and plastics—and were fully supported by a large and enthusiastic audience including many throughout the organisation listening in on Ekco radios.

Training Telecommunications Engineers

STARTING next month (September) at Norwood Technical College, the London County Council is to provide a new course to train young men for careers in electronics and telecommunications engineering. It is being arranged with the full



Presentation of the Eddystone "640" Receiver at Grimsby Town Hall. Left to right: Mr. R. Jennison (G2AJV), the winner; the Chairman of the G.A.R.S.; Mr. W. Grieve (G5GS), Chairman of the Presentation Committee; the Mayor of Grimsby (Councillor W. B. Bailey, J.P.); Mr. A. C. Edwards (G6XJ), Director, Stratton & Co., Ltd.

support of the radio industry, and during the two years of the course the students will have at least six weeks' practical experience with one or more firms producing telecommunications equipment. They will learn to design, build and maintain a modern radio receiver, and will study the newest developments in this rapidly expanding field—television, radar, frequency modulation and ultra-high-frequency techniques; many of their lecturers will be specialists from industry and technical establishments. Further information can be had from the Principal, Norwood Technical College, Knights Hill, S.E.27 (Telephone: GIPsy Hill 2268).

Amplifier for M.C.C. School

A COMPREHENSIVE amplifying system by Philips Electrical, Ltd., has been installed, to the order of the architect, Mr. Howard V. Lobb,



At the Bourne Secondary School the science master, Mr. Fenton, demonstrates the control console to a few pupils.

F.R.I.B.A. in one of the most up-to-date schools, in this country. This is the Bourne Secondary Modern School, Southbourne Gardens, Ruislip, Middlesex.

The main amplifier has been installed in the assembly hall with four microphone positions on the stage, while automatic priority over all other signals is taken by the microphone in the headmaster's study. Loudspeakers have been fitted in the assembly hall and each of the eighteen classrooms. Thus staff and pupils, individually or collectively, can be summoned or addressed by the headmaster at any time; in the case of general announcements, the waste of time by assembly in the hall has now been obviated.

The new system, by incorporating a radio unit, permits B.B.C. broadcasts to schools to be relayed throughout the building if required, and the system is also used for dramatic productions and concerts performed by the pupils in the assembly hall, which has been treated to render it acoustically suitable.

Radio Research

THE B.B.C., for the first time in its career, has appointed a scientific committee to advise on research in correlation with outside concerns. Its appointment is recognition of the important developments pending in frequency modulation, television and other phases of broadcasting.

Sir Edward Appleton, 55, secretary of the Department of Scientific and Industrial Research, who was recently awarded the Nobel Prize for radio research, is chairman, Sir John Cockcroft, 51, director of the Atomic Energy Research Establishment, will be vice-chairman.

Grimsby Radio Exhibition

A UNIQUE ceremony took place at the Grimsby Town Hall on the evening of Friday, May 7th, when the Mayor of Grimsby, Councillor W. B. Bailey, J.P., presented an Eddystone "640" communications receiver to Mr. Roger Jennison (G2AJV), the winner of the recent competition organised by Stratton & Co., Ltd.

To mark the occasion the Grimsby Amateur Radio Society organised an amateur radio exhibition, which was open to the public for the whole evening. A very good show was put on, with many excellent examples of amateur constructed transmitters, receivers and auxiliary equipment. Much interest was taken in the actual operation of the club station (G3CNX/A), which was active on the 3.5 Mc/s band and made many contacts during the evening.

Radio Funerals

IT is reported that two-way radio for funerals is planned by the Catholic archdiocese of Chicago. An application was filed with the Government recently to set up a permanent land station and two mobile field units at Mount Carmel cemetery near

Chicago.

According to the petition submitted by the Rev. William P. Casey, cemeteries director, radio communication among cemetery workers would eliminate confusion when several funerals are handled.

Relayed Television

A TELEVISION show using the delayed technique was presented for the first time recently at the Paramount Theatre in New York City.

The broadcast consisted of two amateur boxing bouts. It was sent by 7,000 megacycle microwave relay from the arena to the top of the *Daily News* building and from there again relayed to the top of the theatre building.

At the theatre the picture was transposed almost instantaneously on to 35 m.m. film by a special recorder, and the film was projected through the standard 35 m.m. projector. Only 66 seconds elapsed from the time a scene was broadcast to the time it appeared on the screen.

High-fidelity Radiogram-2

This Month C. W. HAGE Gives Details of the A.F. Amplifier Section of the Radiogram

Chassis

THE size used was 10½ in. x 9 in., and was 2½ in. deep. Plywood stained and polished was used as a front panel. The chassis was provided with complete screening, i.e., base-plate, and internal screens inside chassis between each stage.

The coils, tuning condenser and valves are mounted above chassis as shown on diagram so that each stage has its own components above or below the chassis, giving the shortest leads. On the front of the panel are mounted tuning indicator, demodulator diode bias potentiometer, and wave-change switch at top; tuning knob and dial in centre, and A.V.C./manual switch at bottom left. R.F. gain control is at bottom right. Aerial and earth connections are brought out to a 6-pin ceramic valve base (U.X. type)—two large pins both used for earth, and smaller sockets for aerial taps on primary coil (added) and original (Cossor) aerial input connection.

Power leads are taken from a 5-pin plug and socket at back of chassis to power unit.

Each stage of set has its own earth point on the chassis and a lead to this is taken from frame of three-gang condenser for each section.

Special Pointers

I had a great deal of trouble with the .05 and .1µF decoupling condensers. Those commercially available appear to be extremely variable and develop leaks. While even a 10 megohm leak will not greatly affect an anode or screen by-pass condenser (except that its early complete demise is extremely probable), I object to such a condenser in an A.V.C. system, where very high insulation resistance is imperative. As 1,000-volt working 0.01—1 µF mica condensers are now available at 1s. 6d. each (ex-Government), it is suggested that these be used wherever possible.

It is suggested that the leads to top caps (grids) of V₁, V₂ and V₃ be screened and top cap connectors be used. The low capacity coaxial wire lead is the best type I find. The grid lead of V₄ is the danger point, as it carries high R.F. voltages easily leaking back to earlier stages with subsequent instability. Tuning dial and also tuning indicator are illuminated by two small 12-volt bulbs run from the 6.3 volt heater supply. Eight-volt bulbs can be used if desired and will give a brighter light but need frequent renewing. Heater leads to valves should be twisted and kept as near chassis as possible. Run grid (and anode) leads as short and well spaced as possible and connect screen grid by-pass condensers direct to S.G. contacts on valveholder—do not make a nice neat job with "group boards" for resistors and condensers, it encourages instability.

Adjustment and Lining Up

With 250 volts H.T. and 6.3 volts A.C. available from power pack, connect aerial to one of the aerial taps, e.g., "A100" or "A150." Put A.V.C.

manual switch on A.V.C. position and turn R.F. gain control well down. Tune in a station at lower end of medium wave-band, e.g., European News Service, or the Light Programme, if available in your area. Now adjust trimmers roughly to give best "dip" on meter, i.e., deepest dip when tuned over the station. Remove aerial lead and adjust diode bias potentiometer *slowly* until standing D.C. current through tuning meter is just reduced to zero. Reconnect aerial and again tune in a good, steady signal—best done during daylight. Now adjust trimmers to give sharpest peak (i.e. "dip") when tuned over station. If aerial circuit is pulled out of line by aerial capacity (especially if using coaxial feeder), reduce aerial tapping to A100 or A50. This will reduce this effect but will also increase selectivity. Incidentally, fine adjustment of the trimmers will show up best if A.V.C./manual switch is put on "manual" temporarily, although care should be taken when tuning over a strong signal (i.e., turn down manual control) or else tuning indicator needles may slam hard over and even stick!

Finally (on A.V.C.) adjust tuning indicator shunt so that needle tips just cover each other on your strongest signal. If this is a local station it may be necessary to use the manual gain control to avoid overloading the demodulator. If the output is not sufficient it can be increased by using a higher H.T. voltage for the triode section (cathode follower). Increased H.T. voltage increases the handling capabilities and also increases anode current and may reduce valve life if carried too far. As it stands the unit should have an output of 12 to 15 volts A.F., which should be more than sufficient for any normal amplifier.

A.F. Amplifier and Power Pack

A way has been shown of obtaining a large high-quality output (from the circuit given) from any station giving primarily a clear, undistorted signal of good programme value.

It is now necessary to pass this signal into the A.F. amplifier in which it must be built up to a signal large enough to operate the output stage, and also to introduce such frequency correction as may be required by deficiencies in R.F. amplifier, A.F. amplifier, and in the loudspeakers used. In the circuit given it will be seen that the first valve (VR91 or EF50) is used solely as gramophone pre-amplifier. An E.M.I. type 12 miniature needle pick-up is used with the special 1-100 step-up transformer supplied by the makers. The secondary leads are kept as short as possible by mounting the transformer near to the valve on the amplifier chassis.

This means longer leads on the primary side from the pick-up, but it has not been found necessary to screen these leads (about 18 in. long in my case). It will be seen that the EF50 is triode connected, as are the other three EF50s used, and as little data appeared to be easily available characteristic curves of several specimens so connected were

plotted and the results averaged out as follows:
 At heater volts 6.3v., VA 150v., gm=4.2 mA per volt, $\mu=66$ and RA 1,700 ohms. Then with actual H.T. volts of 300v. and RL of 30,000 ohms, M for a stage is approximately 50. At -Vg 1.5v. IA 5.2mA VA 147 and Rk 290 ohms. With an RL of 60,000 ohms (H.T.+250v.). VA=120 approx. IA 2.3 mA and -Vg 1.5v. Rk=660 ohms.

I do not know what the maker's values are, but these are working figures from normal ex-Government specimens.

In case the use of EF50s for A.F. work is queried I must say that they have advantages over normal triodes. They are small in size, very well screened, and particularly free from hum pick-up, and highly efficient. Occasional specimens may be found to be microphonic if used in the first stage, but are usually O.K. in later stages.

Tone Controls

Returning to the first stage it will be seen that top cut is provided by means of a 50 μF variable condenser connected between anode and grid, giving feed back to top notes, thus cutting their amplification. Bass boost is given by a .05 μF condenser and 20,000 ohm variable resistance across the output. This is prevented from upsetting the valve loading to a large extent by a 50,000 ohm resistance. Output is then passed to a volume control in the grid circuit of left-hand section of second valve. This is a VR102 (only obtainable as such). Each triode section was found to have the following approximate characteristics: gm 4.5 mA per volt μ 11.6 RA 2,770 ohms and that if used with RL of 20,000 ohms (with 250 volts H.T.) VA=93 v. IA 7.6 mA -Vg 4.5 Rk 592 ohm and stage gain (M) would be 10 approximately.

It was not desired, however, to obtain high gain from this stage, but to use the two sections solely for volume control and mixing purposes; one section for gramophone and the other for radio. In this way independent tone control for gramophone and radio can be achieved so that, owing to the widely differing requirements for such tone control in gramophone and radio, adjustments do not have to be made when changing over from gramophone to radio or vice versa. This also means that gramophone or radio can be faded into each other, even used together if necessary, without affecting each other at all.

The radio input is taken through a .125 megohm stopper resistance to the top-note boost. This consists of a .5 megohm resistance with a 300 μF differential condenser. The impedance of this condenser becomes less as the frequency rises so that adjustment of the condenser gives full top-note boost at one end of the scale and quite a large top-note cut at the other end. (Insulate bush from panel when mounting.) Incidentally, the condenser gives easy passage to R.F., too—hence the .125 megohm stopper.

Signals then pass to the volume control, which is shunted by the bass boost—a .05 μF condenser in series with a 50,000 ohm variable resistance. The condenser by-passes medium and high notes, but as the frequency is reduced its impedance rises, giving increased bass amplification. The variable resistances are used to control the effective boosts.

This system is not ideal—it causes variation of volume at the same time as variation of boost required, needing adjustment of volume control after each variation of high or low-note boost. It does, however, give a wide variation of control without extra valves. A more complicated control

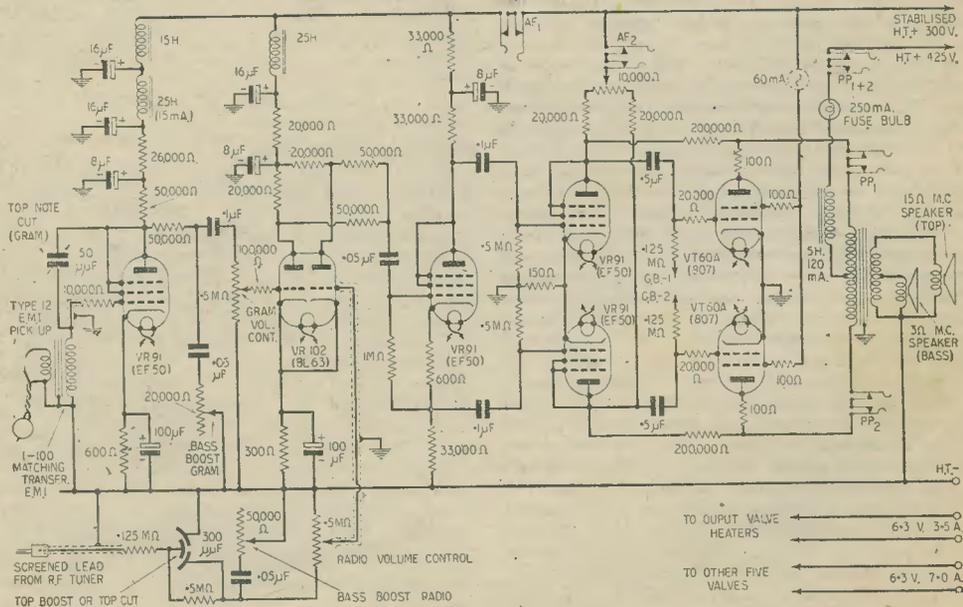


Fig. 4.—Theoretical circuit of the amplifier section referred to above.

system using two extra double triodes has been worked out and tried and worked well, but this more simple system was installed owing to demands on space. It will be seen that the outputs from both triode sections are taken to input of phase-splitter valve through isolating 50,000 ohm resistances. These, of course, cause further loss, so that the amplification obtained by the double triode stage is lost in the tone control and isolating networks. However, ample gain is available more than fully to load the output valves.

The Phase Inverter

The phase inverter circuit is quite straightforward and normal and again uses an EF50, triode connected. Half of its load is in the anode circuit, half in the cathode circuit, and care should be taken to use load resistors (33,000 ohm) which are equal in value. The slight unbalance due to the 600 ohm cathode resistor is compensated for in the intermediate push-pull stage, again consisting of triode-connected EF50s, but with lower values of load resistance and of cathode resistor to deal with the large voltage swings without distortion. The anode loads are each of 20,000 ohm fixed and a 10,000 ohm potentiometer. H.T. lead is taken from the moving arm, variation of this potentiometer allowing balancing of the gain on each side of the amplifier to be adjusted until gain is equal.

Output then passes via .5 μF condensers to the push-pull 807 output stages, and here there are several points to explain. It was decided to use 807s (or UT60A) as these are easily available ex-Government types and will be found to be somewhat more hardy than the 6L6 type.

After some experiment it was found that best quality was obtained (with extremely high output power) if the 807 was used with stabilised screen supply and fixed bias. Unfortunately, fixed bias causes the valve to be much less tolerant of high grid-leak values, .2 megohm being about the highest grid-to-earth resistance which can be used without danger of grid blocking occurring on strong signals. As far as possible throughout the amplifier, coupling condenser leak ratios have been kept at .05 or better (e.g., .1 μF and .5 megohm or .05 μF and 1 megohm) to reduce bass attenuation and phase change as far as possible, so that with the output valve grid leaks at about .1 megohm a .5 μF coupling condenser from previous stage were necessary. Some considerable trouble has been experienced with these coupling condensers, many commercially available having relatively low insulation resistance. Those at present in use are large 1,000 volt working types and were "meggered" before use and found to be O.K.

Allowing for the .125 megohm grid leaks actually used and 20,000 ohm grid stoppers, even with maximum bias from the bias pack the total grid-to-earth resistance is less than 200,000 ohms. Both anode and screen stoppers of 100 ohms are used and present parasitic oscillation. Approximately 10 per cent. negative feedback is used direct from each output anode to the anode of its driving valve via a 200,000 ohm resistance. This with the 20,000 ohm anode load of the previous valve forms a potentiometer giving about 10 per cent. feedback. These have been tried as variable resistors, but they have not been found to have any advantage.

Owing to the use of push-pull, even harmonics are cancelled out, and as the amount of odd harmonics produced by triodes is very low (especially when care is taken that they are running well on the straight part of the characteristic and never overloaded) the distortion produced by the amplifier up to the grid circuits of the 807s can be neglected. With push-pull beam tetrodes without feedback, distortion when well driven will be mostly third, fifth and seventh harmonics. These can be reduced: (a) By stabilising screen-grid voltage to prevent variation with anode voltage variation; even heavy bleeder resistances do not prevent variations altogether; (b) By matching the valves to the speakers as accurately as possible; (c) By running the valves in Class A push-pull; (d) Matching anode currents to within 1 milliampere.

But Class A for 807s means an anode current of 75-80 mA per valve if screen-grid voltage is 300 and anode voltage 425 volts, and although the power pack given will take even this load it was found that if feedback was used then the anode current could be cut to 65 mA with no audible effect. Feedback also has the advantage of greatly reducing the sensitivity of the valve to exact loading. After all, loudspeakers are not a resistive load, and can only be matched approximately at one frequency (usually about 400 cycles).

Of course, the use of feedback means that increased drive is needed, but there is plenty in reserve in the circuit shown. It is quite easy to try out the valves under straight Class A or Class AB as variable bias is provided in the power pack for each output valve. Incidentally, this type of bias also rules out a common form of distortion; that occurring in the cathode bias systems normally used. If the cathode bias resistance normally used is by-passed, a large value of condenser is needed to avoid frequency distortion; and leaving out the condenser altogether, as often advocated, while causing little trouble in the intermediate push-pull stage does not work so well in the output stage, where heavy voltage swings are occurring, and can cause a peculiar form of distortion owing to feedback of odd harmonics.

Balancing Output Stage

It will be seen that a choke of relatively low inductance and high current handling capacity is inserted in the H.T. lead to the centre tap of the push-pull output transformer, and that no by-pass condenser is shown. This is correct; the use of such a choke having been found very helpful in forcing the output valves to balance and to keep the output voltage swings from anode to anode and out of the H.T. supply. It will also be seen that jacks are inserted in the H.T. leads. (1) To the first four valve sections. (2) To the intermediate push-pull stage. (3) In the main H.T. lead to the choke in the 807 anode circuit. (4) In each 807 anode lead to the output transformer. These are self-shorting types now easily obtained and, with the use of one 150 mA meter and plug mounted on the front panel, permit adjustment and checking in all important circuits. Normally, this is left in the jack marked PPI+2 serving as monitor over the behaviour of both 807s and indicating any abnormality.

A 250 mA flashlamp bulb is also used in series with 807 H.T. feed and serves as a fuse, preventing damage in the event of bias failure.

(To be continued)

A Home Intercom.

A Room-to-room Telephone of the Loudspeaking Type

By E. N. BRADLEY

INTERCOM. systems in shops, offices and factories are, by no means novel, but it would appear that only recently has the home intercommunication system gained real popularity.

An intercom. set should not be thought of as merely a sort of "telephone," for it is far more intimate and personal. At each station is situated a small loudspeaker which acts either as the microphone or as a speaker proper, and the loudspeakers at the various stations are coupled through a high-gain amplifier which means that close speech is totally unnecessary. Conversation can be carried on from room to room in a normal or quieter-than-normal speaking voice from any part of the room whilst, if desired, one station can take complete control of the system.

There are obviously many uses in which such a communications network can be employed. An invalid, confined to the bedroom, can, in effect, be present at every family gathering in another part of the house; the lady in the kitchen can speak to the male in the cellar or workshop without the need of touching knobs or switches with her floured hands; the amateur photographer in the darkroom can still remain in touch with the outside world; the baby who commences to cry can be made to give his own warning—all these and a host of other services immediately come to mind.

The design for a satisfactory intercom. system may be considered in two parts: the amplifier and the extension or microphone-speaker wiring.

Whatever type of switching is used to couple the extension wiring into the amplifier the latter must provide a single input and a single output line, both the input and the output circuit being common to earth if very complicated cabling is to be avoided, and so the amplifier circuit shown in Fig. 1 can be used for any intercom. system.

The amplifier, designed to operate from either D.C. or A.C. mains, is highly sensitive and in the form shown has a voltage gain for the first two stages of more than 10,000. Such sensitivity is not always required and in many cases perfectly satisfactory volume will be obtained if the input stage is coupled straight into the output stage via the volume control; nevertheless, a three-stage circuit is shown for the benefit of those who require a really sensitive system.

The amplifier circuit is straightforward, although special attention has been given to decoupling. The input transformer, loaded by R_1 , feeds into an EF37, the non-microphonic version of the EF36; this pre-amplifier feeding, through a volume control, into a second identical voltage amplifier. The output from stage two is passed to the output stage, which has a measure of negative current feedback applied since this stage has no by-pass capacitor across the cathode bias resistor, and the secondary of the output transformer has one side earthed, as has the primary of the input transformer.

It may be said immediately that the amplifier

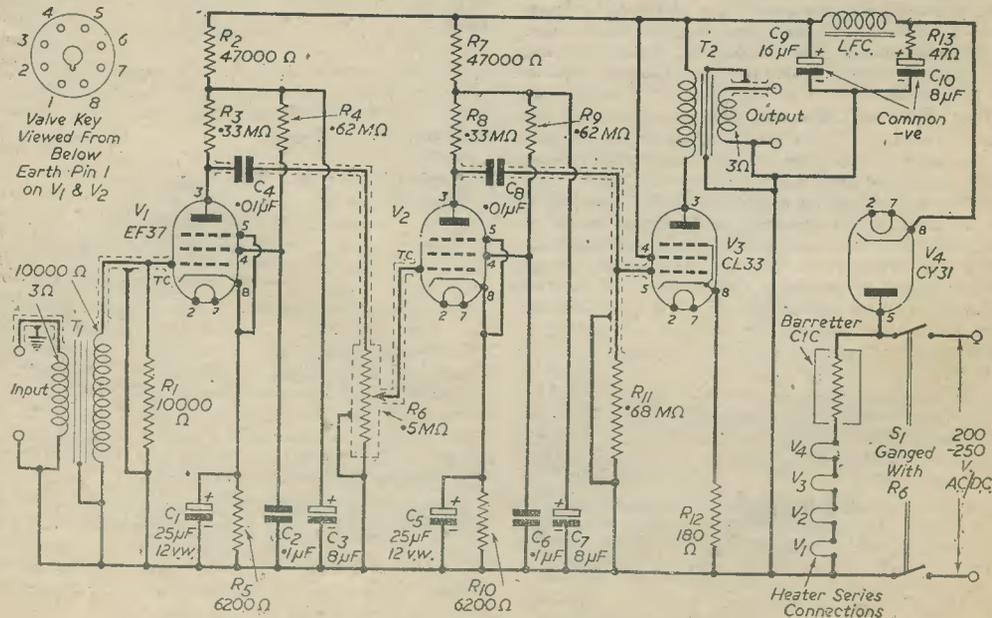


Fig. 1.—Circuit of the A.C./D.C. Intercom. Amplifier.

must not be operated with the secondary of the output transformer unloaded, as it is shown in Fig. 1. A correct load must always be connected across the output terminals—it has been assumed that 3-ohm voice-coils will be in use and so the correct load is 3 ohms.

Self-regulating Circuit

The valve heaters are supplied through a Barretter or regulator lamp and such a device is always to be preferred to a tapped dropping resistor for the whole heater chain is then self-regulating. Any mains fluctuations are absorbed and there is no chance at any time of overloaded heaters. As only

Input and Output Transformers

The input transformer, T1 in Fig. 1, is acting as a moving-coil microphone input transformer. Taking the impedance of the moving-coil as 3 ohms, and accepting 100,000 ohms as a desirable load between the grid of V1 and earth, the input transformer ratio is

$$\text{Ratio} = \sqrt{\frac{100,000}{3}} \\ = 182.5:1$$

or, in round figures, 180:1. To obtain such a transformer is not a simple matter, and tests show that a much lower ratio gives quite satisfactory working, whilst at the same time the impedance of the grid circuit of the first stage is lowered considerably, making the pre-amplifier less sensitive to hum. Transforming the 3 ohms impedance of the voice coil to a 10,000 ohms grid impedance is a task which can be performed by a small output transformer of ratio approximately 55:1.

The output transformer, T2, has to match the anode load of V3, a CL33, to the voice coil. The anode load of the valve is 4,500 ohms, and so the ratio of T2 should be 38.7:1, or, in round figures, 40:1.

These two transformers may be purchased with the loudspeakers or, if a multiple system is to be used, with two of the loudspeakers. Small speakers only are needed—they give better voice response when used

as microphones, having higher resonant frequencies than larger speakers, and provide ample volume. If they are ordered with transformers, one to match to 10,000 ohms and one to match to 4,500 ohms, the transformers may be dismantled from the speakers and mounted on the amplifier chassis; alternatively the transformers may be ordered unmounted.

Extension Wiring and Switching

With the amplifier completed and tested, attention can be turned to the extension wiring and switching, and here there is room for personal choice and ingenuity.

At each "station" the loudspeaker should be mounted within a small cabinet—a square box with 5in. sides and a depth of about 4in. is adequate. The speaker aperture should be covered with gauze or very light cloth. The "home" or "master" speaker can be mounted in the case containing the amplifier, or it may also have its own cabinet, the amplifier being contained within a cupboard or placed out of the way on a shelf. At this speaker will be a control switch.

There are several ways of wiring even a simple intercom. system, and a first consideration is the gauge and length of the wiring. As the input and output transformers are within the amplifier itself, all the wiring is of low impedance, and so particular care must be taken to keep the wiring resistance to as low a value as is possible. If 4 watts are being

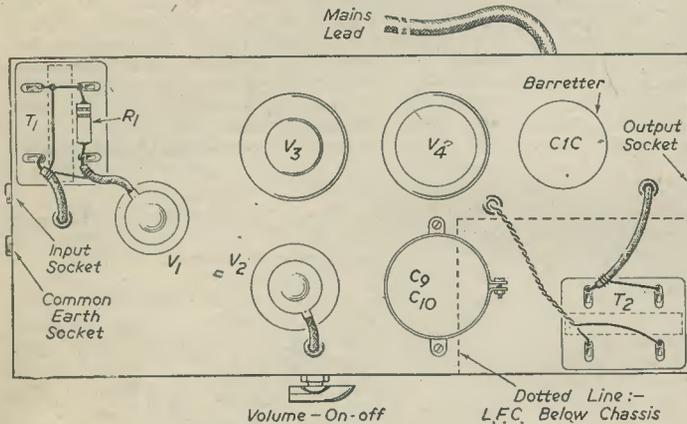


Fig. 2.—Top Chassis Layout (to scale).

one heater can be at earth potential, this, of course, is chosen to be the heater of V1; particular precautions against hum must be taken in a high-gain amplifier working from A.C./D.C. mains when it is impossible to utilise a "humdinger" across the heater chain.

The whole amplifier can be accommodated on a 9½ in. x 4½ in. x 2 in. chassis, as is shown by the layout diagram of Fig. 2, an aluminium chassis being suitable and easy to work. The under-chassis wiring can be either point-to-point, as in the prototype, or group-board wiring may be used. Construction should follow ordinary methods; under one fixing bolt of each component secure a soldering tag in order that plenty of earthed soldering points are available. By-pass circuits from each stage should be earthed separately at the stage itself, just as in the wiring up of a U.H.F. receiver.

Note the screening on all grid leads. The use of screened sleeving is recommended, for then the wiring proceeds just as when plain sleeving is used, the sleeving being cut to length and slipped over the wire.

All wires passing through the chassis should do so via holes fitted with grommets. Few components are above chassis; note the disposition of the cores of the input and output transformers, which are placed at right-angles.

The L.F. choke is mounted below the chassis, and screwed to the side wall.

supplied to a 3 ohms voice-coil through wiring whose resistance is another 1 ohm, then 1 watt, or 25 per cent. of the available power, will be lost in the wiring, without considering other losses due to mismatching and other inefficiencies.

The length of the wiring is determined chiefly, then, by the resistance added to the system. Tonal losses are not of great importance; a low-impedance line suffers relatively little from wiring capacitances, and the amplifier has no treble attenuation so that some high-note loss can well be sustained. For runs of about 100ft. ordinary household flex may be used; for greater runs a stouter cabling will be needed.

Broadly speaking, the intercom. system can be operated in two different ways.

In the first arrangement the home station acts as "Master," and the distant station or stations as "slaves." Take the circuit of Fig. 3 as an example of a simple "Master-slave" combination.

A is the master speaker, since it has attached to it the main control switch, a two-pole two-way switch. With the switch down A transmits to B, and B cannot answer until A throws the switch up. The usual method of using such a circuit is for A to leave the switch in the up position. The station B is then always "live," and can call A at any time, whilst if A wishes to call B it is only necessary to depress the switch. This type of circuit is suitable for shops and offices; if desired B can have the "privacy switch" shown at the left-hand side of the diagram. When B throws the privacy switch down a dummy load is connected into the input circuit and no instability or howling results; at the same time the station is dead and A cannot overhear private conversations. To

clear the line, or to call A, B throws the privacy switch up.

Should A call B when the privacy switch is down and B is dead, some indication is needed, and this is given by making part of the dummy load at B a small bulb. If A calls B and finds the line dead (A has, of course, depressed the main control switch), he speaks again close to his loudspeaker. This gives full output and the bulb at B glows, showing that the line should be cleared.

The dummy load at B must total 3 ohms, and in general any small bulb will require shunting by a resistance to make this value. A 2.5 volt 0.2 amp. bulb shunted by a 4 ohms resistance is suitable, but it must be confessed that a not overbright glow is obtained, and there is room here for experiment. The worker who can purchase or who has a pea-lamp might find this of use; whatever lamp is employed it should require a low current and voltage and be shunted by a resistance such that the total resistance of the parallel combination is 3 ohms.

As most readers will know, the formula for this is

$$3 = \frac{L \times R}{L + R}$$

where L is the lamp resistance and R the shunt resistance in ohms.

(To be continued.)

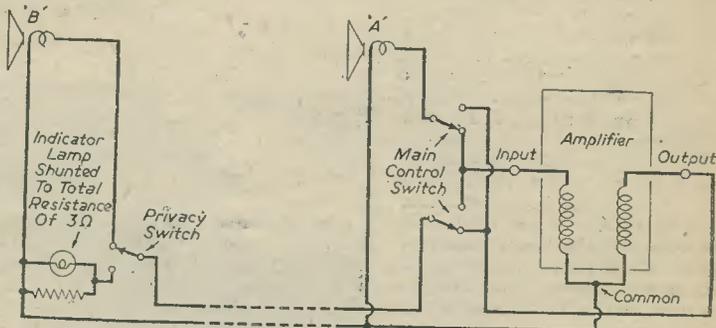


Fig. 3.—Simple "Master-slave" Wiring.

COMPONENTS LIST FOR THE INTERCOM. AMPLIFIER (Fig. 1.)

R1	10,000 ohms, ½ watt.
R2, R7	47,000 do.
R3, R8	330,000 do.
R4, R9	620,000 do.
R5, R10	6,200 do.
R11	680,000 ohms do.
R12	180 ohms do.
R13	47 ohms, 1 watt. (Ripple limiter.)
R6	0.5 megohm volume control with D.P. On-Off switch.
C1, C5	25 μF 12 v.w. Electrolytic.
C2, C6	0.1 μF 350 v.w. Tubular
C3, C7	8 μF 450 v.w. Electrolytic.
C4, C8	0.01 μF 500 v.w. Tubular.
C9, C10	16 plus 8 μF. 450 v.w. Electrolytic. (Can.)
T1	To match 3 ohms to 10,000 ohms, 55 : 1.
T2	To match 3 ohms to 4,500 ohms, 40 : 1.

- L. F. C. 25 H. 60 mA's. Partridge C25/60/VSE.
- V1, V2 EF37 Mullard.
- V3 CL33 Mullard.
- V4 CY31 Mullard.
- Barretter, Philips, C1C.
- 4 International octal chassis mounting valveholders.
- 1 British 4-pin chassis mounting valveholder for Barretter.
- S1, D.P. On-Off switch ganged with R6.
- "Input," "Output" and "Common" sockets or terminals.
- 2 shielded grid caps, V1, V2.
- 1 can clip for C9, C10.
- Wire, screened sleeving, plain sleeving, soldering tags, nuts, bolts (4 and 6 B.A.), etc.
- Chassis, aluminium, 9½ in. x 4½ in. x 2in.
- 1 control knob.
- Loudspeakers as required.
- Extension switches as required. See wiring diagrams.

Popularising Australian Radio

A.B.C. Demonstration at Sydney's Radio Show

TO bring top-line radio entertainment right to the people and show how it is produced, the Australian Broadcasting Commission broadcast national and local programmes non-stop for 13½ hours a day from a publicly conducted demonstration studio at Sydney's 1948 Royal Show.

Biggest agricultural and industrial exhibition in Australia and among the most comprehensive held anywhere in the world, Sydney Royal attracts more than 1,000,000 visitors during its ten days' run each year.

The A.B.C. (the Federal Government system) wanted to make contact with as many as possible of the 100,000 people who visited the show each day and grasp a ready-made opportunity to demonstrate broadcasting to country dwellers who invade Sydney at show time. It selected a pavilion housing an electrical trades exhibition to set up a glass-fronted demonstration studio designed to give the public a full view of what happens when their favourite feature is on the air.

Crowds standing outside the studio watched a continuous presentation of the biggest features on the national network, news sessions, talks, plays, dance bands, commentators and recorded music.

Operating from 9 a.m. to 10.30 p.m. each day, the studio was one of the most popular exhibits at the show. More than half the time was devoted to features heard in all States of Australia. In addition there were sessions exclusive to the New South Wales A.B.C. stations, as well as entertainments staged in the studio and amplified to the public watching the proceedings from outside the glass-fronted studio.

A feature of the presentations was the participation of people from the crowds of onlookers. Picked at random, they were brought into the studio to take part in small impromptu radio plays, give short talks, sing, or be interviewed by well-known radio personalities. Anyone showing promise was offered an audition with the possibility of becoming an announcer or artist.

Country Hour

The Country Hour, a midday session with a large following in rural areas, gave farmers visiting the show a chance to meet the commentators and experts whose voices and practical advice were so familiar. Full advantage was taken of the presence of several overseas judges at the show for personal appearances on the Country Hour. Latest up-to-the-minute market reports were telephoned or

telegraphed from all over Australia to the Showground studio for use in this session.

Biggest crowds gathered to hear the news sessions, at 12.30 p.m. and 1.30 p.m. on the national network and to see the announcers who read the news daily in the regular programmes. As in other countries, more Australians listen to news broadcasts than to any other radio feature. Surveys among listeners have shown that the voices of the men who read the news are more familiar to the public than any other.

"The Lawsons"

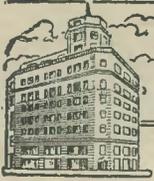
In the history of radio serials in Australia, no play has ever been so generally popular as "The Lawsons," the story of an average farming family, their trials, hopes, successes and disappointments. Broadcast daily at 1 p.m., when most country folk are sitting down to lunch, "The Lawsons" is now in its fifth year. Begun on February 21, 1944, the 1,100th episode was broadcast during May of this year.

Equally popular with country and city listeners,



Probably the most generally popular radio serial in the history of Australian broadcasting is "The Lawsons," the story of an average country family, presented daily on the A.B.C. National network. Some of the cast are seen here during an actual performance at Sydney Show, where fans waited hours to see the players.

episodes from the serial presented daily from the showground studio attracted thousands who wanted to check up on their own mental pictures of the real people whom they knew only as voices and to see for themselves whether they were really like the characters portrayed by the author in the play.



ON YOUR WAVELENGTH

By THERMION

Television Servicing Examination

I AM glad to see that the Radio Trades Examination Board of 9, Bedford Square, London, W.C.1, have announced their syllabus for an examination in television service work, to be held in May, 1950, or earlier, if there is sufficient number of candidates. Success in the radio servicing certificate of the board is an essential qualification for admission to the Television Servicing Examination, full details of which can be obtained from the address given. The next Radio Servicing Certificate Examination will take place in May, 1949, and applications to sit must be lodged not later than March 1st, 1949. Details of the written paper and the practical test in television servicing will be published in September of this year, but in the meantime as a guide to the student the Board issues the following syllabus:

Basic principles, television principles, the cathode-ray tube, the television camera, time bases, B.B.C. standard transmission, reception of standard transmission, T.R.F. receiver, superhet receiver, demodulation, video-frequency amplification, synchronising pulse separation, sound receiver, power supply circuits, aerial and feeder systems, interference, and servicing equipment.

The board will also publish in September a revised booklet dealing with both the radio servicing and television servicing examinations, together with a list of schools and colleges offering coaching for these examinations. In the meantime there are a number of colleges in London and the Midlands which are offering courses in preparation for these examinations.

Two-way Radio for Racing Drivers

RADIOTELEPHONY maintaining a two-way contact between mobile units and a central base was applied to motor racing for the first time on May 25th in the Isle of Man, where three cars competing in the Manx Cup Race at the British Empire Trophy meeting were fitted with radio telephone units. The drivers used throat microphones and earphones instead of the standard hand mikes and loudspeakers. The mobile units, weighing only 40 lbs. and measuring less than 1 cubic foot, were installed in the cars, and the master station was in the pits.

The radio telephone is now extensively used in taxi and tug fleets, police forces, fire brigades, marshalling yards, and for many other purposes. The range is normally between 15 and 20 miles. The radio telephone is amplitude modulated V.S.W. system with crystal controlled tuning for bands between 27 and 100 Mc/s. No tuning is required.

The Buyers' Market

BEFORE the war there were between 40 and 50 manufacturers of radio sets. Now there are nearly 120. As a result the shops are stocked with

wireless receivers which cannot be sold and apparently cannot be exported. If allowance is made for lack of purchasing during 1939 to 1946 there should have been a demand for about 7,000,000 sets a year. The public, however, is not buying them. In 1943 supplies to the home market were less than 170,000, in 1944 about 180,000, and in 1945 252,000. Manufacturers have responded nobly to the objections of the Government to increase production. During that time, however, the Government have instituted certain political changes which have increased the price, and so manufacturers having embarked on an increased production programme found that they were turning out goods faster than they could sell them.

In 1947 1,500,000 wireless receivers came on to the home market, but large numbers of them are still in the shops. I am not at all surprised to find them still there.

We must also remember that the listening habits have changed. During the war the public became B.B.C. conscious. There were not so many foreign programmes and people, because of air raids and the black-out, early closure of theatres and restaurants, etc., were compelled to spend their time at home listening to the B.B.C. programmes.

There is thus not the demand for expensive all-wave receivers.

In view of the reduced number of B.B.C. stations interference is less of a problem to-day, so that the receiver which is ten years old or more still satisfies the listening public. They are not likely to be tempted to spend £30 or so on a wireless receiver which before the war could be purchased for about £10. It may be that the abolition of the purchase tax when it comes may persuade the public to spend a little more freely, but I do not think that the real boom will come until world broadcasting is undertaken on a less tendentious scale than it is to-day. It has become a world propaganda machine.

The great scarcity of foreign news owing to the smallness of English newspapers is another reason why listeners have lost interest in foreign programmes and hence in expensive superhets. Wireless prices have also increased much more than other electrical equipment.

A wireless receiver to-day costs more than twice what it did before the war. No wonder there is mass reluctance to buy. There is also an uncertainty about the future of broadcasting. Television is on the way and it will spread. It is possible that in three years' time 500,000 television sets will be sold. By the end of 1949 a second television station will be operating to serve Birmingham and the Midlands.

The projected setting up of a frequency modulation transmitter at Wrotham, in Kent, suggests that this method of transmission will shortly add to the problem of radio marketing.

Recording Technique—3

Valve-operated Indicators and Devices That Do Not Incorporate Pointer Instruments are Dealt With This Month.

By K. KEMSEY-BOURNE

SO far we have dealt with pointer instruments reading A.C. volts direct, all of them based on copper-oxide or similar rectifiers. We now come to valve-operated circuits, and V.I.s of the "no-needle" type.

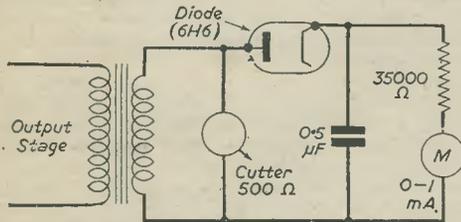


Fig. 1.—Diode-rectification V.I. shunted across medium impedance recording head.

Valve Rectification

The bridging impedance of a V.I. may be increased by using a valve, such as a diode or triode, as rectifier, and if a stage of amplification is introduced then the sensitivity can be raised as well. Figs. 1-4 give details of various valve-operated circuits, in each of which a low-current D.C. meter serves to give readings.

In Fig. 1 a diode, such as an acorn or half a 6H6, is used to rectify the A.C. voltage across the cutter-head, and the D.C. voltage built up across the condenser is read on a meter. For heads having impedances other than 500 ohms the only change needed in the circuit will be the value of the high resistance in series with the meter, which is decided by the voltage range required. This circuit is the simplest of all valve-operated types, but is very effective. The rectification is half-wave. Strictly speaking, readings for non-symmetrical waves will not hold for an indicator calibrated on sine waves. Readings are peak values.

Fig. 2 represents a V.I. in which grid-leak rectification is used. In this case the anode current drawn by the triode is varied by the applied A.C. voltage.

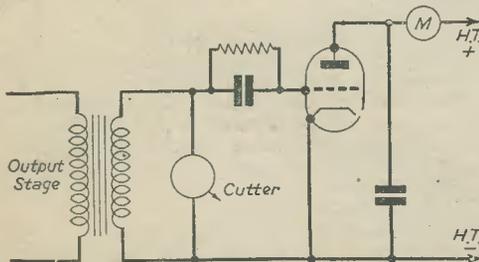


Fig. 2.—Grid-leak rectification V.I., using a triode.

Another modification appears in Fig. 3. The inductance L and shunt capacity C can be adjusted to give different time-periods over which the meter gives an average reading. Obviously the damping characteristics of the particular meter used have an effect; L may be 250-400 henries and C 1-2 microfarads.

To increase sensitivity an amplifier circuit, followed by rectification and measurement, is used. An example is shown in Fig. 4. The primary of the input transformer T carries the A.C. signal to be indicated, and passes it to a linear amplifier stage A through a variable sensitivity control. The amplified signal passes through the full-wave rectifier B , and the D.C. voltage output actuates a meter M in the anode circuit of a linear D.C. amplifier stage C . This arrangement will give readings whose amplitudes are linearly proportional to the peak values of the input waves. If it

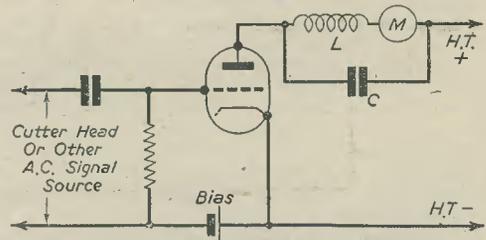


Fig. 3.—Another type of triode-operated V.I., in which L and C control time-period over which the meter gives an average reading.

is necessary for the V.I. to have a linear decibel scale then the amplifier stage C is replaced by another one designed to have an exponential response.

We come now to V.I.s that do not give pointer readings.

Cathode-ray Tubes

An ordinary cathode-ray oscilloscope can be used directly as a volume indicator. It has the advantages that it shows peak voltages directly, regardless of frequency variations over the whole audio-frequency spectrum, and it indicates fundamentals and harmonics alike. Its indication is instantaneous since its inertia is virtually nil, and, unlike a pointer instrument, it is "un-bumpable" or undamaged by overload. The Y-plates of the tube are connected across the cutter (or any other convenient point for measurement) with or without previous amplification, depending on the voltage range to be covered and the sensitivity of the tube itself. The ordinate or Y-deflection of the tube trace is at any time directly proportional to the applied voltage. The applications and advantages of the C.R.O. will be well known to readers, and

straightforward methods need not be detailed further here.

An ingenious method of visually monitoring A.F. modulation on a C.R.O. has been used for commercial recording applications in the U.S.A. Like other C.R.O. devices it shows steep transients of very short duration that would not register on a normal meter V.I. The apparatus is outlined by the block diagram of Fig. 5. R.F. oscillations locally generated are modulated by the audio-frequency input, suitably amplified. The A.F. and R.F. inputs to the modulator are independently adjusted so that envelope distortion will occur when the A.F. level fed from amplifier 1 is such that the output to the recorder is just inside the upper limit for satisfactory record-groove modulation. Any tendency to over-modulation of the R.F. carrier is immediately apparent on the C.R.O., just as is the case with visual monitors for normal transmitters. Since the maximum permissible modulation of both the R.F. carrier and the recording cutter are pre-set to correspond, the C.R.O. gives effectively a picture

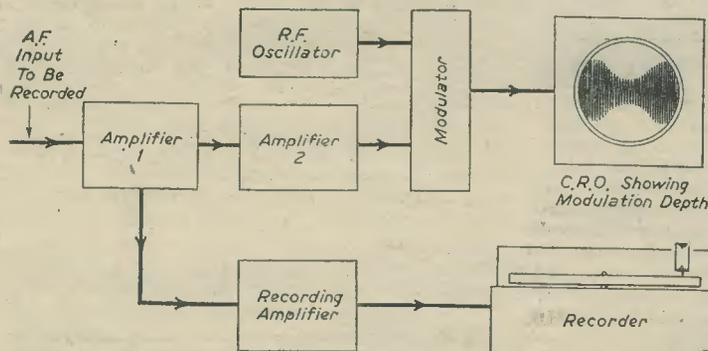


Fig. 5.—Block diagram of the C.R.O. device for following groove modulation by the shape of modulation envelope on the tube.

of the degree of groove modulation, so that the correct gain setting of Amplifier 1, which feeds both the recording amplifier and the modulator channels, is obtained by watching the modulation envelope shown on the tube, and adjusting as necessary.

“ Magic Eyes ”

In the electron-ray tube or “magic eye” changes of voltage are made to vary the shadow angle on a fluorescent target, and this type of device has been suggested and used as a V.I. In practice it is not satisfactory, since the target itself is small, less than 1 in. diameter, and it is not easy to follow, on an area so small, the rapid variations in voltage that we have to deal with. For recording we need a V.I. that can be read at a glance; a 3½ in. meter is none too big, so why restrict ourselves to reading small angles on a flickering target inside a tube a mere 1 in. across? Keep your “magic eye” for steady-state operation as a tuning or bridge indicator, but do not expect it to make a good V.I.

Neon Lamps

Fig. 6 shows three neon bulbs, each in series with its own resistance, shunted across a high-impedance source, in this case the primary of an

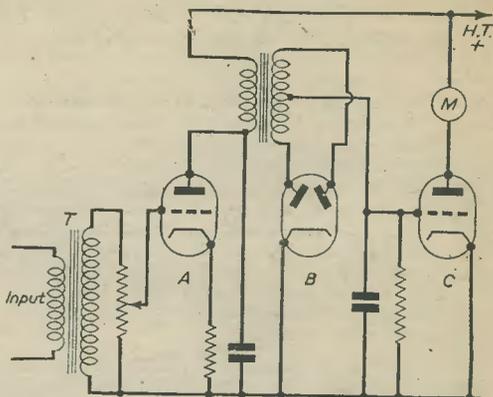


Fig. 4.—Variable sensitivity, linear-scale V.I. consisting of linear amplifier, full-wave rectifier and D.C. amplifier C.

output transformer; they could equally well be shunted across a 2,000-ohm head or a piezo-electric head. These bulbs are of the midget variety, nominal rating ½-watt, and they are quite cheap; as bought they may contain a high series resistance built-in, and this is best removed. A neon tube strikes when the voltage across it reaches a certain peak value, and R1, R2, R3 are set so that N1 strikes at the minimum modulation level for satisfactory signal/noise ratio, N2 strikes at a normal average level, and N3 strikes only when the voltage amplitude is about to exceed the maximum

for good modulation. During recording, gain is adjusted so that N1 is on all the time there is any A.F. input, and N2 flashes continually. N3 should hardly light at all, since when it does the record groove is in danger of being over-cut. To find the values of R1, R2, R3, wire a neon tube in series

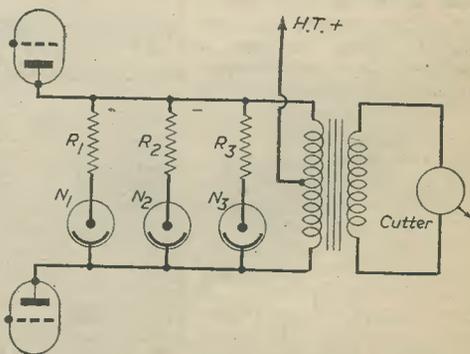


Fig. 6.—A three-neon V.I. One tube flashes at lowest level, second flashes at normal average level, and third gives warning of overload point.

with a 50,000 ohm variable resistor, and bridge across the high-impedance source, taking the necessary precautions if this is the primary of the output transformer, which may be 300-400 volts above earth potential. Adjust the variable resistance so that the tube strikes at the minimum level; measure the resistance in circuit, replace the variable by an equivalent fixed resistor. Repeat the process for the other two neon bulbs and the other two levels.

If you are using a low-impedance head, transformer fed, and you know its minimum, average and overload levels in terms of A.C. volts, then it is easy to set up a three-neon V.I. by feeding a fixed frequency to the cutter-head at the three appropriate levels successively and adjusting one neon to strike at each voltage.

Another Neon Device

An extension of this neon lamp principle is much used in the film industry in sound-film recording. Up to 15 or 20 neon lamps are arranged in a closely-spaced row, each one connected in the anode circuit of an acorn-triode amplifier stage. All these amplifiers are connected to the common input circuit, and the sensitivities of the successive stages are adjusted to a common difference of, say, 3 decibels. Then lamp No. 1 glows at the lowest level, No. 2 at 3 decibels up, No. 3 at 6 decibels up, and so forth up to the last lamp in the chain, which will strike only when the level reaches 57 decibels up. In operation the impression given is of a line of light, whose length varies with the volume of sound.

Ex-Government C.-R. Tubes

The Care and Maintenance of These Components.

By E. G. BULLEY

CATHODE-RAY tubes to the radio amateur were at one time a prized possession. To-day, however, with the release of surplus government tubes, he has the opportunity of purchasing various types at reasonable prices, and so build around him equipment which prior to the war it would be more or less impossible for him to buy.

These tubes are suitable for the construction of measuring equipment such as the oscilloscope, of which many types have already been described in this journal. This article is written for the reader who has had only little practical experience with the cathode-ray tube, in the hopes that it will assist him in maintaining his tube in working order.

Power Supplies

The first consideration in the actual operation of any tube should be the heater voltage. This must never be exceeded even if the trace on the screen is not as bright as it should be. It is common knowledge that if the heater potential is increased the trace will become brighter, but unfortunately the life of the tube will be shortened.

The fading of the trace, assuming, of course, that the circuit in which the tube is incorporated is in order, can be put down to the filament having lost its emissive properties.

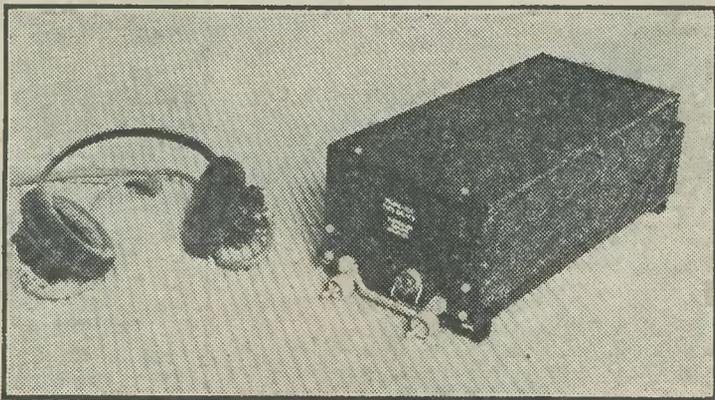
Surplus government tubes are of the electrostatic type, and it should be remembered that the high tension to the tube must never be applied without some sort of scanning voltage being on the deflector plate, this voltage being fed from a suitable time base. Failure to do this will result in an intense stationary spot on the fluorescent screen which will damage it.

Mechanical damage can be done to the electrode structure of the tube if at any time an excess voltage is applied to the first anode. This anode should always be at a lower potential compared with the others in the tube.

If by accident the full high tension is applied to the first anode an extremely powerful electrostatic field will be concentrated around the cathode, which will result in mechanical damage.

In oscilloscopes, the direction of the electron beam is influenced by external magnetic fields; it is advisable, therefore, to enclose the tube in a suitable non-ferrous shield.

When in operation, the tube should be as far as possible from any local sources of interference so as to obtain the best results. However, it is advisable to check the deflection or trace in the case of the oscilloscope, before actual measurements or experiments are carried out; this will ensure that the deflection obtained comes within the effective diameter of the screen.



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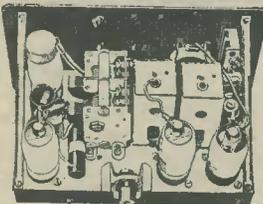
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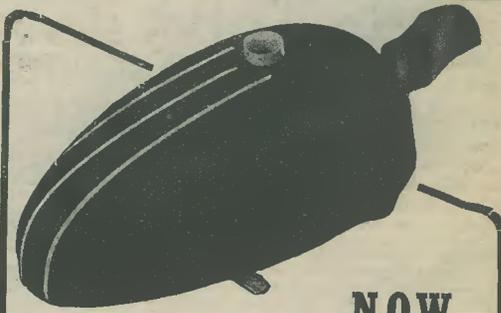
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Television Troubles

An Outline of Faults Which May be Experienced in Home-made Television Receivers

By W. J. DELANEY (G2FMY)

MUCH has been written in the past concerning the difficulties which will be encountered by the constructor of a television receiver. Actually, when once such a receiver has been installed, the location of the source of a fault, should one arise, is in some respects simpler than with a modern multi-valve superhet. Experience with a home-built television receiver has shown that the initial setting up is the most difficult part and one which calls for elaborate test equipment if the receiver is to be worthwhile. Once installed, however, faults can only be due to a breakdown in a valve or component, and, in spite of the fact that there will be such a large number of parts, the whereabouts of a fault will generally be very easy to locate.

In a modern broadcast receiver cessation of signals can be due to a fault in each and every stage, and, assuming that no test gear is available, it is not a simple matter to determine which stage is at fault. In a television receiver, however, with practically all of the more general faults which can arise, its immediate location may be found without any test gear. As an example, suppose that the set is working when suddenly the picture disappears. If the raster still remains illuminated then obviously the vision receiver is the faulty section. On the other hand, if the raster suddenly disappears and a single horizontal line is left, then the frame time base has failed; if a vertical line is left, then the line time base is the faulty section. If the raster disappears entirely, failure of the power supplies or the C.R. tube may be suspected. If the picture remains but the sound goes off, the sound receiver is the faulty part, and so on.

Detailed Examination

From the above very rough outline it will be seen that fault-finding is not likely to be so difficult after all, and as each section (with the exception of the vision receiver) will only consist of a very small number of stages, the tracing of a faulty part is moderately simple. Of course, one needs a general type of tester capable of tracing resistance values, short- and open-circuits. There is another type of fault, however, which may present difficulty, especially to the inexperienced serviceman or the experimenter who cannot obtain access to an oscillograph and similar equipment. The previous details have merely covered the complete breakdown of one of the sections of the receiver, but it is often found that what actually happens is that some component or valve develops a fault such as a partial open-circuit, or a change in value (due to heat) which completely changes the functions of the stage in which it is included. It is then that difficulty may be experienced. For instance, the receiver may be functioning quite satisfactorily when suddenly the picture may be broken into strips horizontally. It may be found that this only occurs at intervals. There are three possible causes of this, one of which is remote. A weak synch-

pulse could cause such a fault and would indicate an overhaul of the synch. separator; the line time base may be faulty, or some distortion of the received waveform may be taking place, although it is probable that in this case picture quality would reveal the fact.

Distortion of the raster is probably one of the most difficult faults to remedy, as it can be caused by such a large number of defects; that is, assuming that it has been working correctly. Probably the simplest cause of such a trouble is an open-circuit in one of the mains smoothing condensers resulting in an unsmoothed H.T. supply to the complete equipment, but weak signals resulting in a weak synch. pulse can give rise to a similar fault, as also can leakage of the picture signals into the time bases.

Using an Oscillograph

There is no doubt that a test oscillograph is invaluable in tracing out the exact faulty part in the modern television receiver. The waveforms at each stage are quite distinct, and it is a simple matter to isolate each of the time bases or the vision receiver and then locate the source of a fault. For the receiver section, of course, a signal generator or a proper television pattern generator may be needed, although standard receiver technique may be adopted in the majority of cases. As most constructors are to-day using the EF50 type of valve, obviously two or three spares at the present low price of the ex-Government surplus are well worth while and may enable a speedy remedy to be effected. In some circuits valves are driven rather heavily, and spares for such a valve should certainly be kept handy.

It is not proposed at this stage to deal with systematic fault-finding, or with the remedying of troubles which are natural in a home-built television receiver when first constructed. Even a commercial receiver can be full of faults unless the pre-set controls are properly adjusted, but at a later date we will deal fully with the faults which are most likely to be met with, their location and cure.

OBITUARY

MULLARD ELECTRONIC PRODUCTS, LTD., announce with deep regret the death, at the age of 49, of one of their joint general managers, Mr. D. F. Harrison, who died on June 8th, 1948.

Mr. Harrison had served with the Mullard Co., in various capacities, for 21 years. He had been under medical attention for 12 months prior to the illness which caused his death, and he leaves a wife and daughter, to whom the sympathy of all his many friends in the trade, and the Mullard Co., goes out.

Mr. Harrison joined the Mullard Co. on June 13th, 1927, as a technical representative. He became, in succession, accessories sales manager, sales manager, and then joint general manager of valve interests.

Novel Factory Extension

An Interesting Development of the Well-known Plessey Factory

A MOST ingenious employment of pre-cast concrete, which has enabled The Plessey Co. Ltd., of Ilford, to increase its production area by approximately 32,000 square feet was recently inspected by Sir Frances Meynell, R.D.I., and the staff of the Cement and Concrete Association.

This extension which is on the original flat roof of the principal multi-floor block of the factory, was necessary as the whole of the site comprising some 14½ acres was already completely built up.

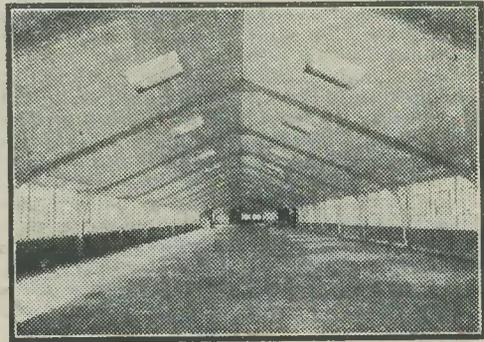
Since this Ferro-concrete building was not designed to carry an extra floor, a number of difficulties arose when deciding to make the extension, particularly as the sub-soil varied throughout the length of the building and great difficulty had been experienced with the foundations. Very careful investigations had, therefore, to be carried out, and it was found that the only foundations capable of carrying the extra load were those around the outside of the building, the intermediate columns being fully loaded. It was thus established that the extension would have to be formed by the use of single span trusses, thereby bringing the load down on the main outside columns, and that the building would have to be of the lightest possible construction.

Pre-cast Trusses

To meet these requirements the trusses were pre-cast reinforced concrete, cast on the roof of the existing building and fixed in position by means of dowel holes cut into the existing building columns. The purlins were pre-cast in concrete. Complicated hips were cast *in situ* by means of shuttering. The sides were formed of 4½ in. dwarf walls, 3ft. high, with continuous steel sashes above, right round the building. Asbestos sheeting was used for the roof which is lined throughout with Cellotex below the purlins, leaving an air space for thermal insulation.

The lighting which comprises three continuous rows of fluorescent tubes, consists of approximately 2,500ft. of troughing and 300 5ft. 80w. tubes, all independently switched.

Lavatory accommodation is provided for 320



An interior view of the roof extension referred to in the accompanying notes.

male and 500 female personnel, while the floor is served by three lifts, two specially arranged without intermediate stops to give express service direct from the ground floor.

The extent of the work involved can be appreciated from the fact that for the concrete work alone 34 tons of cement and 25 tons of steel were used. The main contractors for the work, under the supervision of the Plessey Works Engineer, were J. T. Luton and Sons Ltd., 14, Forest Lane, Stratford, E.15, while the concrete work was carried out by the London Ferro-Concrete Co. Ltd., and the Cellotex lining by C. F. Anderson and Sons Ltd.

I.P.R.E. Midland Section

AN enthusiastic gathering of radio engineers attended the inauguration meeting of the Midlands Section of the Institute of Practical Radio Engineers at the Grand Hotel, Birmingham, on May 26th. Mr. J. P. Parsons was elected chairman and Mr. F. Prosser, secretary. These gentlemen will be supported by a committee consisting of Messrs. C. Booth, E. B. Homer, N. Houlgrave and S. Rogers.

The president of the institute, Mr. J. F. Tomlin, stressed that difficulties lay ahead of the radio retail trade, but that practical engineers, especially I.P.R.E. members, were not altogether dependent on sales, as they were capable of efficiently servicing the many thousands of old receivers already in the homes of the public. That unethical practices were in evidence here and there in the country was undeniable, though in the main, radio dealers and engineers were honest, hard-working individuals

who were endeavouring to make a living under conditions which at the present time could in no way be described as ideal.

The chairman of the institute, Mr. T. E. Fevyer, agreeing with Mr. Tomlin, announced that the institute proposed to stage an exhibition in London later in the year and that the public would be invited to view a display of test equipment as used by the practical radio engineer and actually to see the engineer repairing radio receivers. The plans were to make the exhibition a Radio Servicing Demonstration and an endeavour to convince the public that it was of benefit to them to deal only with qualified engineers or firms employing certificated men. He ventured to say that if the London exhibition was a success the council would seriously consider the advisability of staging similar demonstrations at Birmingham and at other centres. No maker of test equipment would be debarred from exhibiting, but, of course, no sets would be on display.

Practical Hints

Servicing Cradle

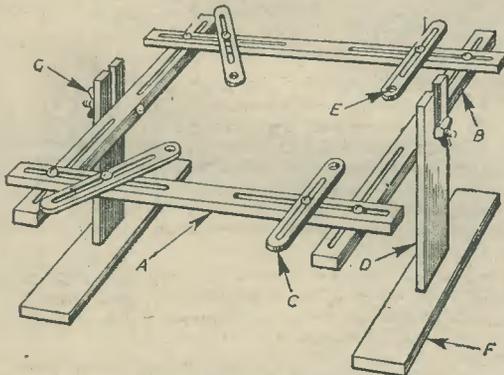
A SERVICING cradle can easily be made as shown; I have been using mine for four years.

It is adjustable to fit almost any chassis; it can be tilted to any angle and locked in position by the wing nuts, "C."

The screws which normally fix the chassis in the cabinet are used to fix chassis to cradle through the holes, "E."

My first model was in wood, but I now have one made from $\frac{1}{2}$ in. channel iron.

A tray with several suitable



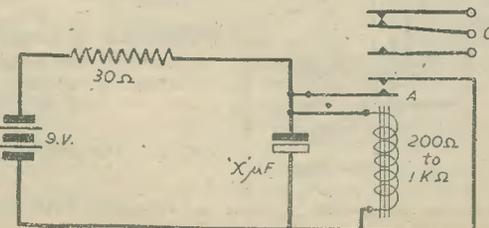
A useful home-made test cradle.

holes (say $\frac{1}{4}$ in.) is bolted on the most suitable end to carry the speaker.—D. SINCLAIR (Droylsden).

A Pulsar

IN connection with some cathode-ray tube work, I used a circuit to demonstrate the working of a time base.

The cycle begins when the battery is connected. It charges up condenser "x" via the 30Ω resistance. The relay is not energised (being of a high resistance compared with the condenser) until the condenser reaches the battery voltage. When this potential is reached the relay energises, closing contact "A" and operating contact "C." This discharges the condenser, opens the contacts and the process is repeated. The values are in no way critical except that the capacity of "x" must be



A pulser circuit as described by Mr. Wilson.

THAT DODGE OF YOURS!

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

SPECIAL NOTICE

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fairly large (500 μ F and over) but can be of low voltage rating. The value of "x" determines the speed of charge.

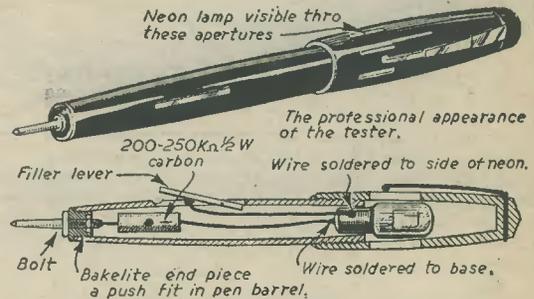
Contacts "C" are also on the relay and these are connected to the circuit which requires to be broken or made, and can have any number of contacts.

A number of non-polarised relays have been tried, all of which were successful. If an output is taken from across the relay coil, an irregular saw-tooth waveform can be obtained. The purpose of the 30Ω resistance is to prevent a shorting of the battery when the relay contacts "A" close.—D. WILSON (Sutton Coldfield, Birmingham, 24).

Neon Tester

A NEON tester may take any form, but I have found that by adapting an old fountain pen it will acquire a professional look. With such a large amount of ex-Service equipment available it is not too hard to obtain a 6-volt neon indicator, which is the heart of the tester.

The diagram is self-explanatory and I will not



A fountain pen as the basis of a tester.

attempt to describe its construction, but leave it to the ingenuity of readers who wish to make one.

One point, however: the pen must be shortened from the nib end, or it will not clip into the top pocket. The top of the pen remains as the neon enclosing end and has holes made in it in order to see the neon. One of its main uses has been to check for the live side of mains leads and to determine quickly the presence of H.T. In operation the filler lever, must be touched and the point applied to the terminal or lead under test. If the lead is alive then the neon will glow.—C. MORGAN (Ferndale, Glam).

NEWNES SHORT-WAVE MANUAL

6/-, or 6/6 by post from
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THIS coil pack forms a unit which can be included in any straight receiver, either mains or battery operated, which has one R.F. stage. The unit covers one short-wave range in addition to the normal long- and medium-wave ranges; all switching is self-contained, and there are only four leads to be connected to the receiver (in addition to the earth-return provided by the metal chassis).

It has many uses apart from forming a basis around which a receiver may be built. One of these is to change a medium-wave utility receiver into a three-range receiver, or to provide a short-wave range on a receiver previously used only for long and medium waves. It is one-hole fixing and is attached to the panel by means of the bush holding the three-way switch and can be mounted in any convenient position near the gang condenser.

Constructional Details

A piece of aluminium $4\frac{1}{2}$ in. by $5\frac{1}{2}$ in. should have a portion bent at right-angles to form a flange $4\frac{1}{2}$ in. by $2\frac{1}{2}$ in. At the centre of this flange a hole is drilled for the switch. For the vertical screen a piece $3\frac{1}{2}$ in. by 3 in. is required, with a small flange which can be bolted to the base of the larger piece. A cut-out 1 in. by 2 in. is left to fit over the switch, where it is bolted above the switch. (Fig. 3 makes this clear.)

The Circuit

Fig. 1 shows the circuit and illustrates how the aerial coils are kept to one side of the screen and the intervalve coils to the other side. In addition, all the coils are arranged so that those which operate together are separated and at right-angles.

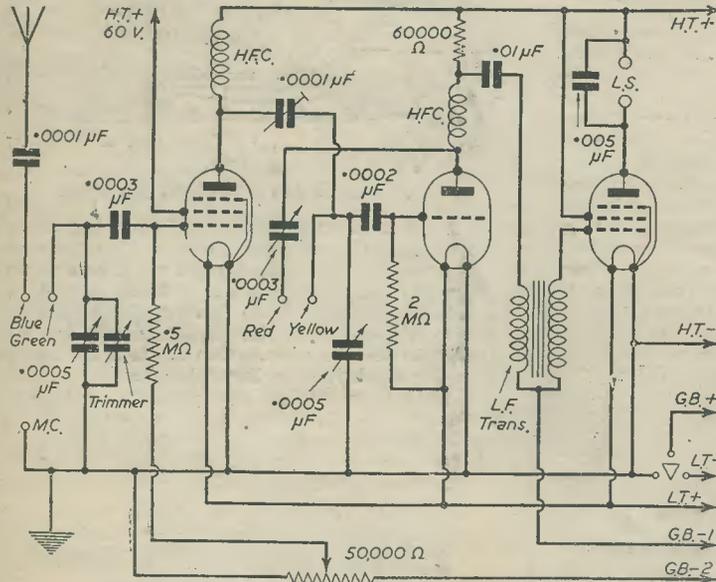


Fig. 2.—Theoretical circuit of a 3-valve set using the coil pack.

Three-range

Constructional Details of a Home-made
By F. G. RAY

Four short lengths of coloured flex are taken from the four contacts of the switch, which is of the four-pole three-way type. (See Figs. 1 and 2.)

All wiring is shown in Fig. 2, which is a "flattened out" plan. Reference to this and to Fig. 1 should make connections clear. Wiring will be simplified if the coils are connected one at a time. Leads should not be longer than necessary. No wires need stray to the wrong side of the vertical screen if the switch is so placed that two poles and the associated tags are each side.

The Coils

Numerous small coils, both iron or air cored, are advertised in the pages of PRACTICAL WIRELESS, and the majority of these are perfectly suitable. Because of the large number of turns, it is difficult to wind long-wave coils which will gang together accurately. 120 turns of 36 s.w.g. enamelled wire side by side on a $3/5$ in. diameter former will be found satisfactory for the medium-wave coils. 50 turns can be used for reaction and 30 for aerial coupling. Ten

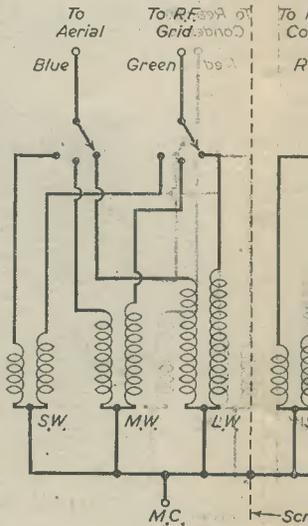


Fig. 1.—Theoretical circuit of the coil pack.

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turns of 20 s.w.g. tinned-copper wire, turns spaced by the diameter of the wire, are suitable for the short-wave coils, the formers also being 3/5in. in diameter. Four turns are used for aerial coupling and nine for reaction.

Chatterton's or other suitable compound adhesive will secure the coils in position. Some coils will have feet or other means of fixing by means of small bolts.

Trimming

A suitable three-valve circuit is shown in Fig. 2, and this illustrates how V.M. bias may be applied. If the trimmers on the gang condenser are adjusted for maximum volume on the short-wave range good results will be obtained on medium and long waves. If the highest possible efficiency is required then the R.F. stage pre-set trimmer on the gang condenser may be set at minimum and a small panel trimmer used instead. This can then be adjusted when necessary to bring the circuits in line on any part of the three ranges.

It is possible to connect a small pre-set trimmer in parallel with each coil and trim each range separately, but this complication gives little advantage.

The aerial series condenser may be of larger value (up to .0003 μ F.) if the aerial is short. The R.F. coupling pre-set condenser (.0001 μ F.) is adjusted for best results. The choke in the anode circuit of the R.F. valve should be a good-quality one and may be screened.

If it is desired to connect the moving plates of the reaction condenser directly to earth, then the lower ends of the three reaction windings should be connected together and to the fixed plates of the reaction condenser. The red lead

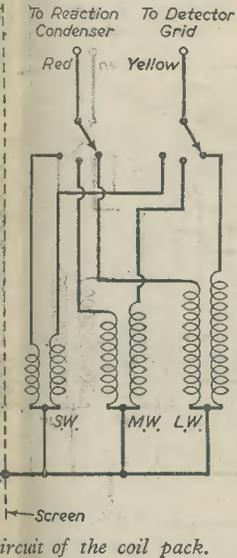
from the switch will then be taken directly to the detector anode.

Superhet Receivers

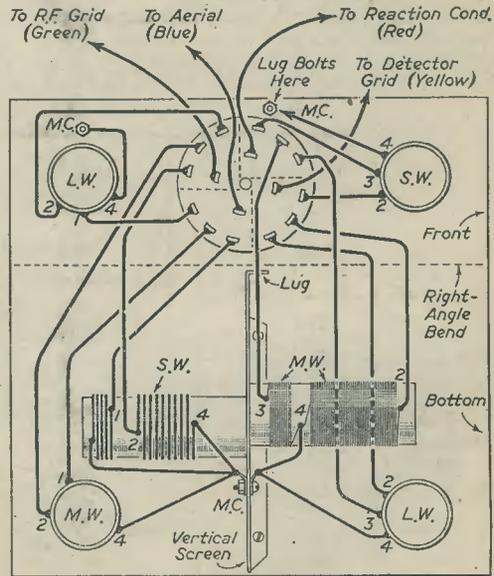
If the pack is to be used in superhet circuits the intervalve coils will not be required. Three oscillator coils should be wired in this position instead. Aerial and oscillator coils for certain intermediate frequencies are available in pairs and they should be provided with trimmers and padders of the capacity specified by the manufacturers. Satisfactory superhet operation is then possible, and the red lead will be taken to the oscillator anode and the yellow lead to the oscillator grid (not omitting the grid condenser, usually of about .0002 μ F.).

Two refinements will no doubt suggest themselves to the keen experimenter. Firstly, small padders may be joined across each of the coils, mounting them either on small stand-off pillars or screwing them direct to the metal chassis. Secondly, a further bent piece of metal may be made to fit over the unit so that it is totally enclosed. This will keep out dust and dirt and also prevent the coils or wiring from being moved, thereby maintaining constant the settings of the tuning condenser. Holes will be required in the cover if trimmers or iron-cored coils are fitted.

If the earthing of the pack chassis is not good it will be found of advantage to take a short lead from one of the chassis tags to the moving-plates tag of the gang condenser. This will provide a direct return between coils and tuning condenser and help in securing maximum efficiency.



Circuit of the coil pack.



Key:— 1. Aerial 2. Grid 3. Reaction 4. Earth

M.C. — Joined To Metal Chassis

Fig. 3.—Wiring diagram of the pack.

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Simplicity of the Superhet

An Argument Favouring the Construction of Superhet as Opposed to Straight Receivers.

By J. R. DAVIES

DURING the past 10 years I have come into contact with many people who have made wireless either their occupation or their hobby. It has been found, however, that out of the vast majority who construct their own sets a surprisingly large amount have never constructed a superhet-type receiver. Many of them turn out beautifully-made straight sets one after the other, but they have never tackled a superhet; or, if they have, have had indifferent success.

Why do these constructors neglect the superhet? I think it is because the superhet is viewed in a somewhat uncompromising light. A straight set is a simple, straightforward job; the signal is picked up on the aerial, amplified probably by an H.F. stage, detected (perhaps with regeneration of some sort), and the detected signal is passed to the audio stage. How simple! But the superhet is not much more complicated and, in the writer's opinion, is often easier to get into good working order than is a straight set.

Let us look at Fig. 1(a), which shows a three-valve straight receiver in block schematic form. As mentioned in the preceding paragraph, the aerial signal is amplified by an H.F. stage, detected, and the audio signal amplified by the A.F. stage. That is a straight set. Now, suppose we tune the H.F. and detector circuits to receive one frequency only (say, 500 kc/s) and lock them in that position. Then assume that we add just one further stage between the set and the aerial, calling this addition the frequency-changing stage, the job of which is

to convert the frequency of any aerial signal desired to 500 kc/s. See Fig. 1(b). The aerial signal desired will now be changed to 500 kc/s by the frequency-changing stage, then it will be amplified and detected in the normal way by H.F., detector and A.F. stages just the same as in Fig. 1(a). Fig. 1(b), by the way, represents a superhet.

The only change required by Fig. 1(b) to bring it

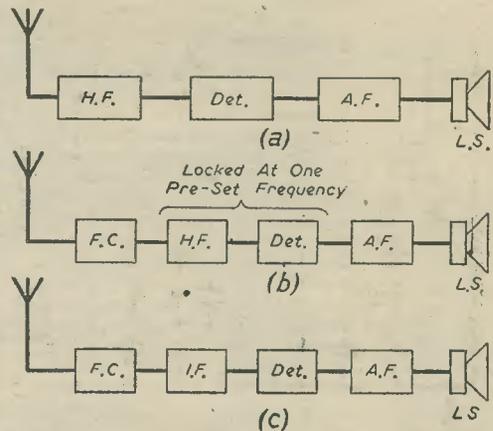


Fig. 1.—Block schematic diagrams illustrating straight and superhet receivers. (See text.)

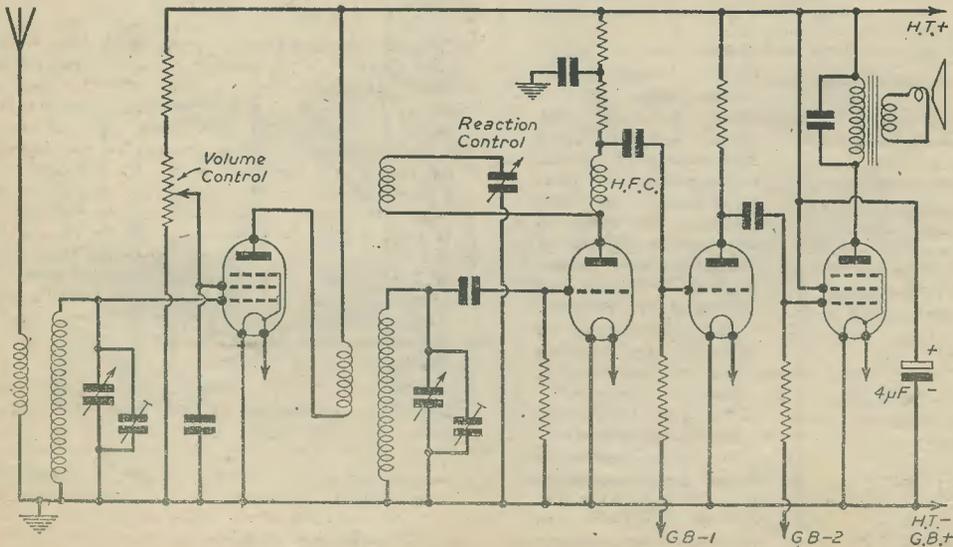


Fig. 2.—A typical straight receiver circuit.

into line with normal superhet nomenclature is to call the second block the *intermediate* frequency stage and not the high-frequency stage. See Fig. 1(c).

I have not enough space at my disposal to enter into the theories of frequency-changing, a subject that has already been well treated in the pages of this journal. The theme of this article is rather to point out the simplicity of superhet construction to those who have not before attempted to build these receivers.

Apart from distortion there is the question of instability. As it is, we have to decouple the anode of the detector with a resistance and condenser to ensure that there is no feedback on the H.T. line. And it will probably be necessary to have some measure of screening on the detector to eliminate hum pick-up and instability. Also grid leads will have to be short and the layout very carefully designed.

The circuits before the detector are also liable to

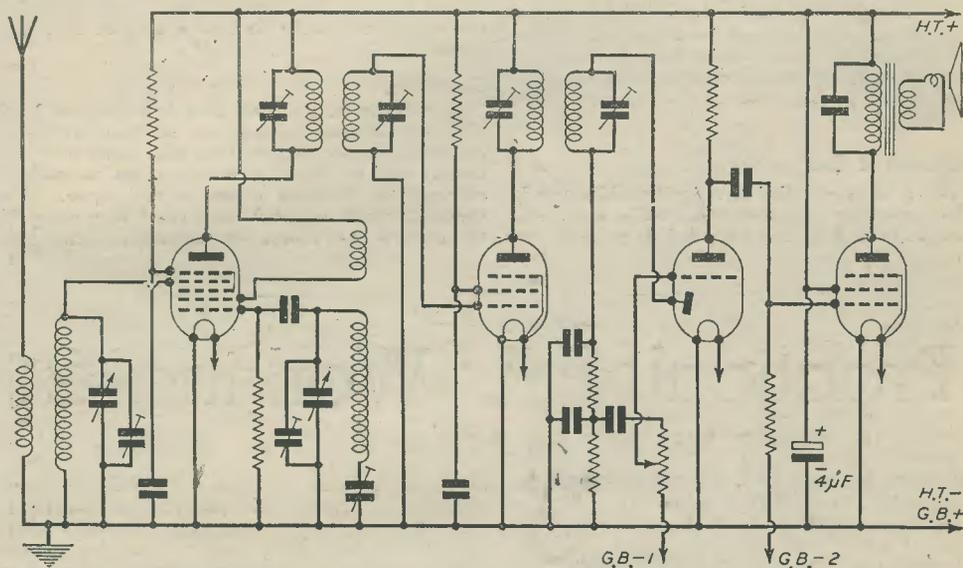


Fig. 3.—A typical superhet circuit. (A.V.C. is not shown in this diagram. If required, it could easily be taken from the diode load via a 2 meg. resistance and decoupled by a 0.1 μ F condenser. It is omitted for the sake of simplicity.)

Differences in Circuit Technique

Let us now look at Fig. 2. This shows the circuit of a four-valve straight set, Fig. 3 the circuit of a four-valve superhet. Both are perfectly good circuits capable of giving good results, the superhet circuit being superior in selectivity but not necessarily so in sensitivity. A good measure of selectivity may be obtained with the straight circuit by use of the reaction control. Unfortunately, unless a great deal of care is taken, the reaction and volume controls are likely to affect each other, so, if a critical setting of the reaction control is needed, both knobs have to be adjusted at the same time. This is not the case with the superhet. There is no need to fiddle-around with reaction controls to obtain good selectivity. It is already there, inherent with the design. The only controls shown in Fig. 3 are for tuning and volume.

However, the writer is more concerned with the design and construction of the sets rather than with their operation. Let us take Fig. 2 again. In this circuit we have three A.F. stages (the leaky-grid detector is also an A.F. amplifier valve). Now, three A.F. valves in cascade can sometimes be the very devil to get into good working order.

be tricky. The problem of ganging the two tuned circuits will not be discussed here as it is applicable to the superhet as well. But the question of *screening* the two coils is one that needs careful attention. Medium- and long-wave coils are rather bulky in size and the usual practice of putting one above and the other below the chassis does not give good results if the straight receiver is to have reaction sufficiently good to bring its performance up to that of the superhet. The H.F. and detector coils will have to be efficiently screened from each other, and, if screening cans are used, up goes the physical size of the set again! Additionally, reaction circuits sometimes need a great deal of alteration and rearrangement before really smooth regeneration can be obtained.

Now let us go back to Fig. 3. The question of instability does not occupy our attention to any great extent. Only two valves amplify the audio signal so there isn't much work needed to get them working efficiently. There is certainly little need to worry about potential instability there. Only one valve amplifies the intermediate frequency. The I.F. coils are supplied in cans that, besides being small in physical size, automatically screen

each coil, one from the other. There is no necessity for reaction at the detector as it is supplied with a good, strong signal from the I.F. valve. As for the H.F. circuit, there is no H.F. amplification, so there can be no H.F. instability. (Any H.F. appearing on the anode of the frequency-changer is taken to H.T. positive, which is at earth potential, via the I.F. transformer primary). The oscillator section will give little trouble as again no amplification takes place.

It will be seen that there is no anode decoupling whatsoever in the superhet circuit.

In addition, the aerial and oscillator coils do not have to be screened from each other. It is usually quite sufficient to have their axes at right angles to each other or to have one above and one below the chassis.

Consideration of Cost

Finally it is interesting to note the difference in cost between the two receivers. The H.F. and detector coils in Fig. 2 correspond in price to the

H.F. and oscillator coils in Fig. 3. So also do the valves (four in each circuit). The two-gang condenser and trimmers are common to both circuits. Approximately the same number of fixed condensers and resistors are used in either set. Both receivers have one volume control. In fact, everything cancels out save that the straight set has an H.F. choke and reaction condenser not needed in the superhet, and that the superhet has a pair of I.F. transformers and a set of padding condensers that do not appear in the straight circuit. It can be seen that the additional cost of building the superhet is only that of a pair of I.F. transformers!

Conclusion

In conclusion, I should like to state that I hope that the arguments set out in this article will encourage those constructors who have previously fought shy of superhet construction to make an attempt at building a set of this type. They certainly won't regret it after they have completed the receiver and found out its possibilities.

Practical P.A. Working-2

This Month R. SELBY Deals With the Design of a 15 Watt Amplifier

FOR a high-fidelity 15 watts amplifier for operation from A.C. mains, the writer's preference is for an output stage consisting of a pair of KT66, 6L6 or 807 beam tetrodes connected as triodes. PX25's also give similar results but are now obsolescent. The output stage is driven by a phase-splitting triode (or preferably an R.F. pentode connected as a triode), which is preceded by a direct coupled R.F. pentode. Heavy negative feedback is provided from the secondary of the output transformer to the cathode circuit of this valve. The number and character of stages prior to this will depend on the amount of gain required by the particular microphone and pickup in use. Fig. 1 shows a circuit diagram of a high-gain amplifier designed on this basis. This is suitable for use with a modern lightweight pickup of the moving-iron or moving-coil type, and a crystal microphone. Where accessories having a greater output are used, the number of preliminary amplifying stages may be reduced.

Layout

As with all high-gain amplifiers, great care must be taken with layout and wiring to avoid hum. Most readers will, no doubt, be familiar with the points to watch, but perhaps one or two things may be mentioned. An excessively compact design should be avoided, since it is desirable to space the first amplifying stages as far as possible from the mains transformer and choke. Good screening of the early stages is necessary. The writer has found it very successful and convenient to make screening divisions above and below the chassis to enclose valves, coupling condensers, gain controls, etc., thus avoiding the extensive use of screened

wire. Wiring to components should, as far as possible, be arranged so that go and return leads run close together, and indiscriminate return circuits through the chassis must be avoided. Earth leads in the early stages should be short and wired solidly, then connected to chassis at one point only, the best point for minimum hum being found by trial and error. It is also advisable to find in the same way the best point for connecting the heater wiring to chassis.

Where a phase-splitting valve is used, its heater should be fed from a separate winding on the mains transformer and this should be connected to a voltage divider across the H.T. supply, so that the heater is at approximately the same potential as the cathode.

In some situations it will be difficult to pick up an earth connection, so an artificial earth should be provided by means of a condenser of about .05 or .1 μ F connected between chassis and one side of the mains.

The circuit shown in Fig. 1 is very stable, and no trouble is likely to be encountered with parasitic oscillation, providing the output transformer is a reasonably well designed component. The range of output impedances provided will depend on the impedance of the speakers in use, and will be discussed later. But it should be mentioned here that it is not advisable to attempt an unduly wide range, otherwise the performance may suffer. Any tapped output transformer involves a compromise between quality and matching requirements, and the wider the range of tapings the more difficult it becomes to reconcile these requirements.

As regards components, it can only be repeated that these should be of the highest quality. The

writer personally never uses electrolytic condensers in any circumstances except for grid bias decoupling.

Turning now to amplifiers of higher power suitable for outdoor functions, the actual output required will depend on the size of the jobs undertaken, and the type of speaker to be used.

If we assume that A.C. supply will always be available, there is little difficulty in attaining almost any desired power.

If cost, size and weight are secondary considera-

Another disadvantage is that the grid swing required by the output valves is so large that transformer coupling is necessary, so that it becomes almost impossible to apply any worth-while degree of feedback.

This method is very commonly employed in large, permanently-installed amplifiers, such as are used in radio relay stations, large factories, etc., but as these are invariably rack built, ample space is available, and trouble from hum does not arise. Outputs of upwards of 200 watts are usual.

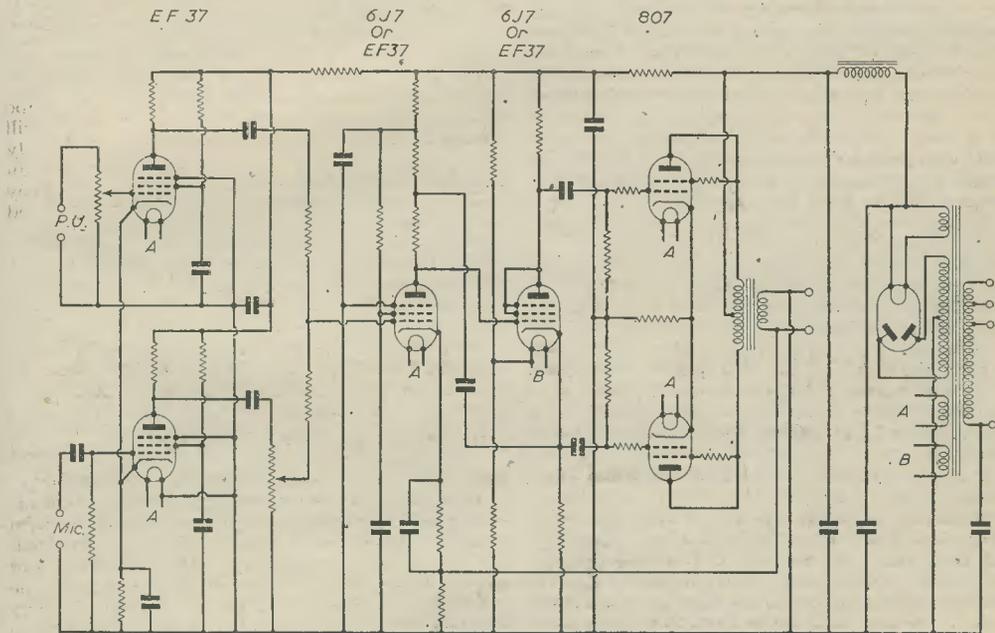


Fig. 1.—One suggested P.A. amplifier circuit.

tions, there is no doubt that a bank of push-pull triodes (or triode-connected tetrodes) operating in class A are unbeatable for quality, stability, reliability and freedom from hum. Unfortunately the H.T. power requirements become heavy, with a consequent increase in size and cost of mains transformer, choke, etc. If this can be tolerated, an amplifier generally similar to that of Fig. 1, but having a bank of output valves appropriate to the power required, with corresponding alterations to the power supply, will prove ideal.

Triodes such as the DA30 operating in class AB1 provide a more economical method of obtaining high powers, but suffer from several disadvantages. The anode consumption fluctuates so much with varying signal strength that a swinging choke input filter is essential to maintain reasonable voltage regulation. The field radiated by this choke, even if screened in a heavy iron box, is so strong that it is impossible to fit it anywhere near the early amplifying stages without inducing severe hum. Consequently, the equipment must be made in two sections, one consisting of the power supply and output stages, and the other of the preceding stages. These units will generally have to be operated with a space of a couple of yards between them.

A third method of obtaining fairly high powers which has become increasingly popular during the last few years is by the use of beam tetrodes or pentodes operating as such. The valves most often used are the 6L6, KT66, 807, EL35 and EL37. Although class AB2 operation is possible, with outputs up to 60 or 80 watts per pair, the practical difficulties are such that it is more usual to employ class AB1, giving 30 to 40 watts. These valves are very efficient, both as regards ratio of output power to anode consumption, and as to the moderate grid swing required, thus making it possible to design a 30 to 40 watt amplifier which is relatively light and cheap.

(To be continued.)

MASTERING MORSE

By the Editor of "Practical Wireless"

3rd Edition.

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Tower House, Southampton Street, Strand, W.C.2.

Underneath the Dipole

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

YET another month passes with television sales practically halted by the effects of the 66½ per cent. purchase tax on radio receiving sets and components. Manufacturers have been forced to reduce their staffs and a great deal of plant stands idle, including, of course, recently planned extensions for coping with huge increases in the output of television receivers. One firm alone had completed arrangements for a possible output of not less than 9,000 moderately priced sets per month by the autumn, but is unable to market even one-tenth of this figure. A radio retailer who used to install two or three dozen sets a month told me that he hadn't sold a single television receiver for over two months.

It is difficult for the layman to fathom the inner workings of the mind of the Chancellor of the Exchequer or his colleagues, or to discover any alleged national benefit which might result from the increased tax. I should imagine that far less tax is actually collected than when this purchase tax was at a lower level, quite apart from the effect it has had of making personnel and plant redundant. However, national posters urge us to buy less, travel less and use less of this or that, and one can only assume that the move is another phase of some masterly scheme of "planned scarcity." Those who are now thrown out of work may have some other name for it. Possibly the "master planners" are considering the establishment of some vast new Ministry to absorb unemployed radio workers, in which their time will be fully occupied in issuing forms in triplicate, controlling, frustrating and generally snooping upon those who remain in the industry. I can only hope that, ere these lines appear, good sense and wisdom will prevail and the purchase tax will have been removed altogether.

Production Progress

Meanwhile, those who already own sets are enjoying the steadily improving television programmes. Plays still seem to head the list in popularity, and several producers at the Alexandra Palace are now challenging the leading position held for so long by George More O'Ferrall, whose smooth technique hides (let it be whispered) certain fundamental shortcomings of the television medium, including the small-sized receiving screen. Incidentally, one effect of the purchase tax has been to reduce the "standard" size of television receiving screens from the pre-war dimensions of 10in. x 8in., to that of about 8in. x 6in., or less. The cost and tax upon the sets giving a larger sized picture now take them right out of the range of the majority of pockets, and, as with high horse-power cars, the world market for large-tube television receivers will be presented on a platter to the American industry. Nevertheless, B.B.C. producers are using great ingenuity in presenting their plays in a manner acceptable on a "Cripps' Size" screen, especially Michael Miles, Douglas Allen, Henry Caldwell and Royston Morley. Having seen the play, "Happy as Larry," I enjoyed George More O'Ferrall's version of it, though I felt that this

producer is now acquiring a kind of Arts Theatre Club style, holding his players down until some of the characters lose force through underplaying. The villainous doctor in "Happy as Larry" was tame and colourless, whereas, played broadly in the manner of the old-time stage "heavy," he would have raised many a hearty chuckle. I sincerely trust that our brilliant O'Ferrall isn't going all "Comargo" and precious, filling our screens with sub-standard heroines and utility crooks, mouthing couplets which should be strictly reserved for the Third Programme!

Television Photography

Television photography, by which I mean the general technique of handling the Emitron camera, lighting, camera tracking and dissolving effects, is also making steady progress. It is now possible to detect decided differences in the photographic style on various productions, a clear indication that the men at the Alexandra Palace are mastering their tools. The most objectionable faults occur during individual shots in plays, when artistes' faces are marred by heavy shadows or haloes to their heads, the latter being caused by back-lighting which is too strong. If a receiver is adjusted with the "contrast" knob set too high, the effect is most objectionable and trying to the eyes. Back-lighting is necessary in order to throw the figures of the actors into relief against the backgrounds of the sets, and is usually obtained by mounting incandescent spot-lamps high up on rails which are attached behind the "flats," as the pieces of scenery are called. Once a sequence in a television play has started, it is difficult to arrange for lighting to be changed. In the film studios, the shortness of each shot (averaging twenty seconds) render such changes in light intensity during a scene rarely necessary, though on occasions special arrangements are made with variable resistances or by placing venetian blind devices in front of the lamps. The latter method is used in conjunction with carbon arcs or mercury-cadmium compact light source lamps, both of which are unsuitable for controlling by resistances. The most advanced type of lighting equipment provides for the remote control of large numbers of venetian blind attachments from a kind of Wurlitzer-like console, operated by the lighting cameraman. This arrangement has been very successfully used on technical productions, and is probably ideal for use on television—expense apart.

Simple Lighting

Generally speaking, the most pleasing effects are still obtained when the lighting of television scenes is simple and straightforward. The simplicity of settings is also an important factor, and much detail or pattern frequently becomes objectionable. The effect of a chandelier or high wall ornament growing out of the head of an actor is inclined to be distracting, while the flash of high-lights upon parts of the scenery or furniture is likely to upset the balance of the picture in a manner which

cannot be corrected by manipulation of the controls by the A.P. engineers. It would seem that provision for stage lighting control of certain key lights by means of shutters or resistances would be a great asset, whatever power lights are used, and I would be inclined to favour the venetian blind device, arranged for fitting in front of any type of light, remote controlled by a selsyn motor.

Sonny Hale's Return

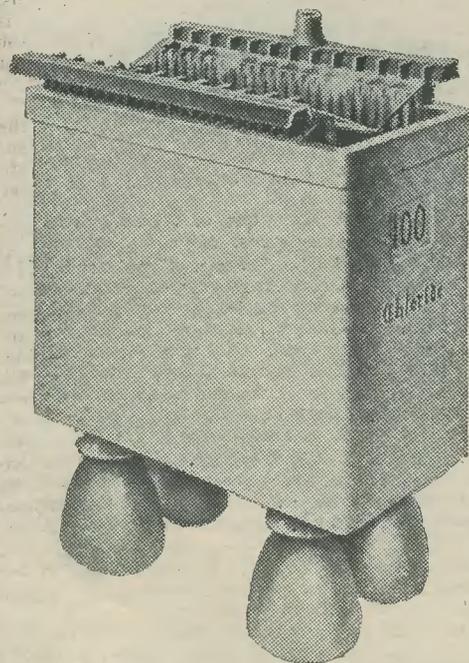
I cannot close my notes this month without reference to the welcome return of Sonny Hale to television after his illness. Henry Caldwell's production of "Halesapoppin" was a fast-moving crazy revue of the type which come over so well, and Sonny was at his best. All kinds of amusing

tricks and stunts were used by the producer, but not all of them were entirely successful, possibly due to under-rehearsal. The pace was terrific and must have been a nightmare for the producer to control, with its ghost sequences, mixtures of film and live television, voices off and the snappiest of cross-cutting from shot to shot. The dialogue was witty as well as crazy, and my favourite scene was the one in which two charladies (Sonny Hale and Doris Hare) sat on the steps of No. 11 Downing Street and discussed the activities of their masters—the Prime Minister and the Chancellor of the Exchequer. I was awaiting for an appropriate line about the purchase tax on radio sets—but perhaps that'll turn up in the next edition of this crazy revue.

Trade Notes

Stoneware Container for Stationary Cells

SOME new containers, developed by the Chloride Electrical Storage Co., Ltd., Exide Works, near Manchester, are made of a chemical grade of vitreous, acid-proof and extremely durable stoneware. From every point of view they represent a very practical alternative to the conventional wood lead-lined boxes for stationary cells—and,



The new Chloride Stoneware Container referred to above.

incidentally, relieve the temporary lead and timber shortage.

Cells assembled in these containers have, moreover, an attractive appearance which is enhanced considerably by the practice of mounting them on combined insulator and pedestal supports,

made of the same material, which eliminate the need for wood stillage and provide the highest possible degree of insulation.

Cells in this new type of container will be available for the export market.

"Windsor" Instruments

FUTURE productions of Taylor radio test equipment will be sold under the name of "Windsor," instead of "Taylor." Every instrument will have a plate affixed indicating that it has been manufactured by Taylor Electrical Instruments, Ltd.

This change is being made in order to enable the instruments to enter certain export markets which were hitherto closed to the products because they were conflicting with the Taylor Instrument Company of America, with whom the English company has no connection.

Ekco Scottish Service Depot Continues

IN view of the recent temporary closing of their Scottish factory, E. K. Cole wish to make it clear that their Service Depot at Duchess Road, Rutherglen, is not affected. This remains open for business as usual from 8.30 to 5.30 Monday to Friday (Telephone: Rutherglen 2240).

Truvox Changes

AS the Truvox sales organisation is growing up, responsibilities have been divided a little, on the following lines:

F. J. Addington Hall takes charge of the radio accessory and domestic appliance marketing division, dealing with wholesale, retail and export distribution.

T. W. Spurr takes charge of the contracts division, dealing primarily with manufacturers' requirements.

L. J. Rawling takes over all publicity.

A.F. Measurement Service

THE service referred to on page 280 of last month's issue is now available also to amateurs at the Special Amateur Division. The address is as mentioned, namely: A. E. Cawfell, 7, Victory Arcade, The Broadway, Southall, Middx.

Television Servicing Examinations

Advance Details of the Syllabus of the Radio Trades' Examination Board

THE following details and syllabus have been issued by the Radio Trades Examination Board as a preliminary towards the holding of an examination in television service work in May, 1950, or earlier, if there is a sufficient number of candidates.

Conditions of Eligibility

Success in the Radio Servicing Certificate Examination of the Board is an essential qualification for admission to the Television Servicing Examination. Full details of the Radio Servicing Certificate Examination may be obtained on application to 9, Bedford Square, London, W.C.1.

The next Radio Servicing Certificate Examination will take place in May, 1949, and application to sit must be lodged not later than March 1st, 1949.

Details of the written paper and the practical test in television servicing will be published by the Board not later than September, 1948. In the meantime, as a guide to teachers and students, the Board issues the following syllabus as covering the requirements of both the written and practical tests.

TELEVISION SERVICING COURSE IN PREPARATION FOR THE R.T.E.B. TELEVISION SERVICING EXAMINATION

1. *Basic Principles.* Nature of light. Simple optics, including eye structure. Persistence of vision. Principles of moving picture transmission (films). Picture frequency and flicker. Gamma. Colour films.
2. *Television Principles.* Photo-electric cells. Simple mechanical scanning. Aperture distortion. The raster. Definition. Aspect ratio.
3. *The Cathode-ray Tube.* General principles. Electrostatic and electromagnetic types. Focusing systems. Deflection and modulation of beam. Types of screen. Build-up of simple raster. Trapezium and astigmatic distortion. Precautions in handling.
4. *The Television Camera.* Early scanning system. The iconoscope, orthiconoscope, image iconoscope, image orthicon, image dissector, monoscope, E.M.I., C.P.S. camera. Camera correction circuits, e.g., Keystone, tilt and bend.
5. *Time Bases.* Function of time bases. Electrostatic and electromagnetic deflection. Power requirements. Simple neon discharge circuit. Thyatron. Hard valves in multivibrator and blocking oscillator circuits. Linearity. Synchronisation.
6. *B.B.C. Standard Transmission.* Waveform. Interlacing. Picture elements. Transmitted bandwidth. Carrier frequencies. Range.
7. *Reception of Standard Transmission.* General receiver requirements. Sound channel and intermodulation. Signal/noise ratio. Bandwidth. Gain.
8. *T.R.F. Receiver.* Intervalve couplings. Heater circuit filters. Band-pass and stagger tuning. Single side-band. Alignment and response curves. Phase distortion (ringing). Use of transmitted test cards.
9. *Superhet Receiver.* Consideration of R.F. and I.F. circuit design. Selection of intermediate frequency. Second-channel interference and choice of oscillator frequency. Oscillator frequency stability. Bi-resonant oscillator circuits. Band-pass and stagger tuning. Single side-band.
10. *Demodulation.* Anode-bend, diode and grid demodulators. Diode loads, effect on video response. Filtering of I.F. or R.F. component.
11. *Video-Frequency Amplification.* Extreme frequency requirements. Compensation by shunt and series peaking circuits. Negative feedback. Phase distortion. D.C. couplings and D.C. restoration. Application of signal to C.R. tube. Methods of modulation.
12. *Synchronising Pulse Separation.* Time constant of C-R and L-R circuits. Integration and differentiation circuits. Amplitude separation of pulses from V-F signal, and frequency separation of line and frame pulses. Pulse limiters.
13. *Sound Receiver.* Separation of sound and vision signals. High-fidelity characteristics.
14. *Power Supply Circuits.* Normal high-voltage rectifier systems, smoothing, inverse peak voltages. E.H.T. from radio-frequency oscillators and time-base flyback voltages. Voltage multipliers. Problem of radiation and screening. Safety precautions. Use of vibrators and converters on D.C. supplies.
15. *Aerial and Feeder Systems.* Simple and folded dipoles. Reflectors. Directors. Multi-element arrays. Capacity loaded aerials. Bandwidth and polar diagrams. End fed aerials. Aerial siting. Reflections. Co-axial and balanced twin feeders. Matching feeder to aerial. General properties of feeders. Losses in feeders. Standing waves. Termination of feeders. Attenuators. Field strength contour maps.
16. *Interference.* Chief sources—car ignition, diathermy, transmitter harmonics. Methods of suppression—use of interference limiters and phase inverters. Importance of aerial siting.
17. *Servicing Equipment.* Importance of insulation. Measurement of E.H.T. Supplies. Use of the oscilloscope. Sweep signal generators. Signal generators. Pattern generators.

The Board will also be publishing in September a revised booklet dealing with both the Radio Servicing and Television Servicing examinations, together with a list of schools and colleges offering coaching for the examinations. In the meantime, there are a number of colleges in the London and Midlands area which are offering courses in preparation for the R.T.E.B. examinations, as well as various courses in television service work. Further information and assistance to any candidate will be provided on application to the Board.

Modulation-1

In This Article H. REES, A.M.I.E.E., Discusses Some Further Technical Topics

WHAT do we really mean by *amplitude modulation*?

In case this should be thought too easy a question, look at Fig. 1(a) and (b). One is a true amplitude-modulated wave. So is the other, in a sense. How would you explain the difference?

What would be the result of extracting the modulation in the two cases and listening in on a pair of telephones or loudspeaker?

We learn that an H.F. carrier is modulated by speech or music at transmitters; that the resultant complex wave is picked up and amplified in a distant receiver; that a rectifying device is

heterodyne (=beat) principle. It must embody an effect *equivalent to detection* to give us a current at beat frequency. It has a certain inherent non-linear characteristic, whereby "beating" and "detecting" take place at the same time.

In older circuits the incoming and local oscillations were heterodyned in a tuned circuit and afterwards rectified. For example, though adjustments would be difficult, the oscillator-detector of Fig. 3 might be modified for superheterodyne purposes.

But it seems we must not now speak of "detecting." The modern mixer, it is suggested, is a unique non-linear device, which produces the beat-difference by *modulation*; we learn the beat frequency is a "sideband" of the same kind as generated at transmitters when audio and radio frequencies are combined.

Established heterodyne principles, with the necessity for rectifying, or its equivalent, are not mentioned. The B.S. Glossary deprecates the use of the word "detection."

True, there is no particular virtue about this word, whilst the modern mixer is not a "rectifier" in the accepted sense. But it has non-linear properties, and whether or not it is being used as a form of detector or modulator, I will leave technical readers to decide.

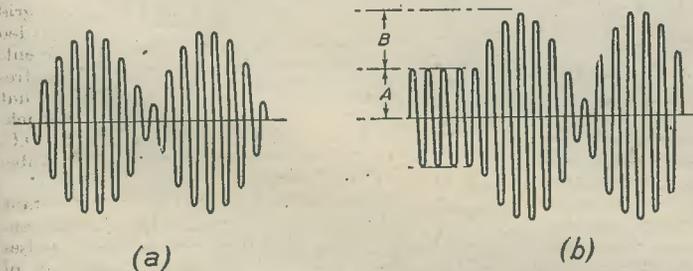


Fig. 1.—Two different kinds of "amplitude modulation," in one of which there is a 180 deg. phase-reversal of the envelope, with consequent severe distortion and frequency-doubling (if the wave were rectified as it stands).

essential to give rise to currents at modulation frequencies.

Which is all fairly straightforward. A rectifier (or "non-linear device") generates an average D.C. when an alternating voltage of constant amplitude is applied, Fig. 2(a). If modulated, the rectified current component will be varying sinusoidally as in 2(b). A rectifier develops the "A.F. component," since it gives a current which is proportional to the amplitude of each R.F. cycle.

Modulation or Detection?

But to show the uncertainties in using the word "modulation" consider next the frequency-changer of a modern superheterodyne.

Two frequencies are "mixed" to give a beat resultant. One time we kept to well-established principles by saying a *first detector* was essential to create a separate current at the beat frequency—a "beat" is itself of the nature of a modulated current, Fig. 1(a), needing rectification to extract the envelope.

These fundamental ideas have not changed. A modern mixer still works on the

About Non-linear Devices

A non-linear element may be employed to modulate—if we start with frequencies in the radio, and audio, range. Thus the H.F. generated in an oscillator could be modulated by speech or music, when H.F. sidebands would result.

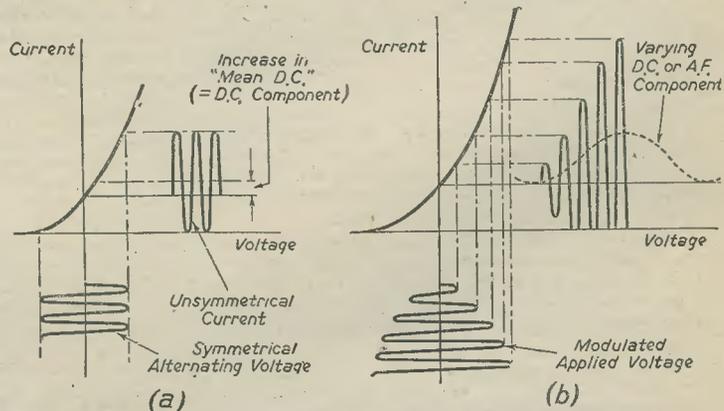


Fig. 2.—Use of a non-linear voltage/current characteristic for rectification, i.e., detection. In modulating, the problem is reversed; a non-linear or asymmetric characteristic is employed to combine H.F. and A.F. components in a manner to develop amplitude modulation.

The same non-linear device may be used to rectify, or detect. That should be its proper function in extracting a beat envelope, whether as orthodox first detector or modern mixer.

Because "non-linear" and "modulation" are taken to denote the same thing we are apt to conclude: "Every non-linear device is a modulator." The generalisation should be: "Every non-linear device may be used for modulating or detecting."

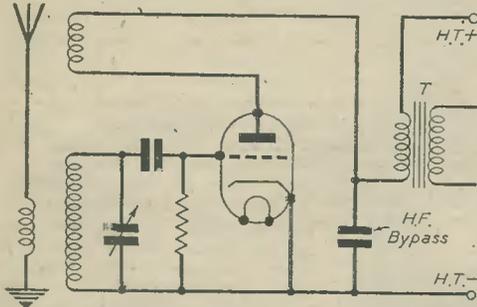


Fig. 3.—A simple self-oscillating detector which may be used to "beat" local and incoming oscillations to produce an audible note in a pair of telephones via an amplifier and A.F. transformer T, if necessary. Though difficult to adjust, the H.F. bypass condenser may be removed, and an I.F. transformer substituted for T, giving the equivalent of early frequency-changers. An improvement would be to separate the "detector" and "oscillator" functions by using separate valves, or multi-electrode types.

If we heterodyne two voltages to give an amplitude variation at their difference frequency, we plainly need the equivalent of a detector to extract the beat difference. The latter is a form of modulation, quite true, but not of a kind which depends upon the action of any non-linear device, whilst the resultant frequencies generated are certainly not "sidebands."

A D.C. "Carrier"

A good starting-point from which to discuss A.M. is to consider a "zero frequency" or D.C. carrier.

A common illustration is a simple telephone circuit, Fig. 4(a). Speech alters the resistance of the carbon microphone, causing the line current to vary as in 4(b), for a single sinusoidal "tone."

We may call this modulation, although there are obvious differences to what we get on modulating an H.F. carrier, Fig. 1(b).

But 4(b) does bear a close resemblance to modulated H.F. in other ways. If this current were passed through a resistance R ohms, the unmodulated D.C. Power = $I_0^2 R$ watts.

When modulated, the total power becomes,
 (D.C. Power + A.C. Power) = $I_0^2 R + \frac{1}{2} I_a^2 R$
 = $(I_0^2 + \frac{1}{2} I_a^2) R$,

where, I_a = the amplitude of the A.C. portion, 4(b).

At "100 per cent. modulation," as in 4(b),

$I_a = I_0$, the current falling to zero for an instant at the peak of the negative half-cycle. At the positive peak the total current becomes, for an instant, $(I_0 + I_a) = 2I_0$, if $I_a = I_0$.

It is then easy to see from the power expressions that the total power when modulating represents a 50 per cent. increase on the D.C. power, or: Total Power = $1.5 \times$ D.C. Power.

If we had an A.C. ammeter in the circuit it would register, first, I_0 . At 100 per cent. modulation the reading would increase to $\sqrt{1.5} \times I_0 = 1.225 I_0$ —a 22.5 per cent. increase on the D.C. reading.

Now, these are precisely the power and current ratios for a 100 per cent. modulated H.F. carrier; 50 per cent. more power must be supplied for modulating, whilst an H.F. ammeter will show a 22.5 per cent. current increase (as long as the modulation is a perfect sine wave).

Thus Fig. 4(b) does provide a useful method of showing how these figures are arrived at. It helps to dispose, too, of a few difficulties, such as why the ammeter registers $1.225 I_0$, and not $(I_0 + 0.707 I_a)$.

R.M.S. readings represent average power. In each case—Fig. 4(b) and modulated H.F.—the peak power goes up four times, but the mean power increases by only 50 per cent.—a current increase of 22.5 per cent.

The "Principle of Superposition"

While 4(b) is a fairly accurate D.C./A.C. analogy

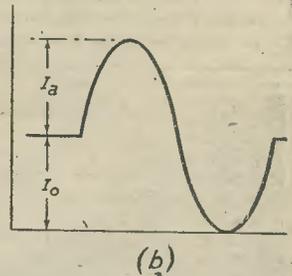
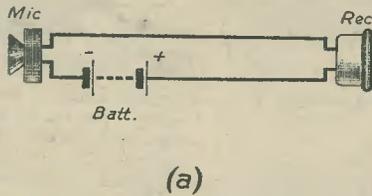


Fig. 4.—Simple "D.C. Modulation," i.e., modulation of a steady D.C., I_0 , by speech currents in an ordinary telephone line. The power ratios and r.m.s. current values in (b) are exactly the same as for a 100 per cent. modulated high-frequency carrier.

of a modulated wave, it is, in another sense, a case of "simple superposition."

We must be quite clear about this term. The Principle of Superposition, in physics, states that a number of frequencies may be superimposed to give a complex resultant waveform, but that each sine wave making up the resultant remains entirely separate. As long as the circuit is "linear," there can be no modulation, though it is possible for frequencies within certain limits to "beat."

(To be continued).

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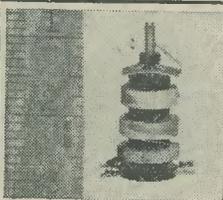
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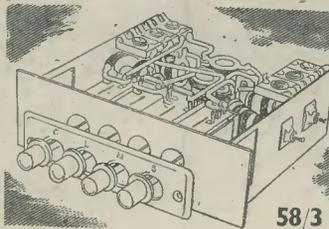
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Programme Pointers

"An Elysian Referendum" is Discussed Here by MAURICE REEVE

SOME time ago, I discussed the practicability, or otherwise, of holding a plebiscite in order to get to the bottom of the public's real wishes concerning their radio listening. So far as the B.B.C. is concerned, it does a wonderfully good job, mainly, I suppose, by deduction based on its mail bags. This leads to results which are, by and large, satisfactory, but can never be wholly satisfactory. Something of the nature of a Gallup Poll, or a referendum based on the widest possible franchise, and at regular intervals, is necessary in order to claim that we are being given exactly what we want. Otherwise, we might as well elect a Government from newspaper editors' postbags and party canvassers. This might, on those occasions when the wishes of the people are obvious to all, produce a representative Government within narrow and circumscribed limits. But nothing more.

I was imagining myself being present the other day at the counting of such a ballot on the most popular in broadcast symphony concert programmes. The result was not only staggering, but cataclysmic. I was completely bowled over. Entirely new vistas and horizons were opened up as the names of the works voted for were recorded, with tens of thousands of votes against each title. Almost the entire classical repertory, as we have known it since broadcasting began and for long before that, was "conspicuous by its absence." Gone were the major portion of the symphonies and concertos that our "Tchaikowsky-soaked population" have saturated in for so long; neither he nor Rachmaninoff gained a single vote. The only Beethoven to collect a few were the sixth and seventh symphonies and the fourth piano concerto. Mozart was fairly well supported, though nothing like so heavily as one would have expected. Schubert had vanished, so had Ravel, though a little Debussy seemed likely to receive a welcome. The rout of the old gang was so complete that even the ranks of Tuscany forbore to cheer.

Many famous musicians were present at the "count." Composers were deeply anxious as to the fate of their works in the public estimation. Executants were apprehensive about their repertoires—the results of lives of technical toil and physical and mental labour. Even impressarios were there, waiting for the news first hand and without trimmings. One eminent pianist and a famous conductor, who arrived together, stood aghast as the results of their life's work, which, incidentally, had brought them a considerable amount of both artistic and material reward, seemed as if it were being thrown into the wastepaper basket. The agents felt that all their contracts with artists, covering more than the two coming years, would have to be scrapped. Everything was chaos, as after the crash of defeated dynasties in a world conflagration.

Elgar's Piano Concerto

But when it was known what the public had voted for in place of their former favourites, surprised wonder, delighted anticipation, and

rapturous exaltation in keeping with a beleaguered garrison about to be relieved, filled the countenances of the true artists present. Only the easy money merchants yet continued to wear their furrowed brows and clenched teeth. For the first work to gain a vote was Elgar's Piano Concerto. It was rumoured that Elgar had written with as great a mastery and insight for that instrument as he had for the violin in his incomparable violin concerto. The solo part was not only as rich in harmonic and contrapuntal devices as any other master concerto—or as Elgar at his best anywhere—but it was extremely brilliant, dazzlingly difficult, and altogether "grateful" for the vainest of pianists.

Then came votes for concertos by Dvorak and Sibelius, also for the piano. Tchaikowsky beaten at his own game! The new look in concertos. "They'll never want to hear the B flat minor again," audibly commented the popular pianist, to which his conductor friend was heard to reply: "It should suit you down to the ground; you'll tear its passion to tatters."

Wagner Symphony

Next was a symphony in C major by Wagner, shortly followed by a second in E major. The slow movement of the latter was stated to be even longer and more beautiful than the "Siegfried Idyl." Other works which the public had been pleased to smile its favours on were a violin concerto by Berlioz—as diabolic as Paganini but much more brilliant musically—an Elgar arrangement for orchestra of Bach's St. Anne's Organ Prelude and Fugue, a piano concerto by Cesar Franck and one by Granados, symphonies by Richard Strauss, Fauré and Rimsky-Korsakov, as well as numerous concert pieces by this one and that.

And so the revolution was over. The great question now was, would the concert-going public get what it had voted for in such an overwhelming manner? Votes of thanks were passed, and suitable speeches made, to those who had so ably conducted the proceedings, the captains and the kings departed and heads were bent over future plans. How long would the mastering and perfecting of all these great works take—that is, if the pianists fulfilled their contracts to play the B flat minor forty-seven times in the next six months and the conductors their Pathétiques, etc., an equally colossal number? One artist, whose famous performance of the former work in recent seasons was known to run well into three figures, said he would be quite willing—and thought he would be quite able—to fulfil his commitments to that work in the immediate future without rehearsal, so as to give some time daily to "learning up" the new Dvorak. He was tickled to death at the prospect of regaling Promenade audiences with new lush melodies and exotic rhythms comparable if not superior to those in the "New World" and other Dvorak symphonies.

Meanwhile the agents went frantically to work booking up their artists to play these new or, about

to become old favourites, and substituting, wherever possible, Sibelius for Rachmaninoff, Cesar Franck for Beethoven and Wagner for Tschaiowsky. Everything now seemed set for another concert boom comparable to the Tschaiowsky and neo-Tschaiowsky boom of the war and immediate post-war years. At last the public would be given what it wanted, and not what was surmised as its wants. It would soon be seen how it had been enduring what had been foisted on it.

But, alas! it was only a dream—or, rather, wishful thinking. On my way home my No. 9

bus halted at the Albert Hall, and an amusingly facetious conductor called out "Albert All. Anyone want a nice bit o' music. Don't think much on it meself." As I looked out of the window at the concert poster immediately in front of me the first item on it that hit me in the eye was: "Concerto No. 1 in B flat minor for Piano and Orchestra. Tschaiowsky."

I didn't trouble to look for the pianist's name. Moral: the only works that can ever take the places of those now considered hackneyed and overdone have not yet been written!

News from the Clubs

THE WEST MIDDLESEX AMATEUR RADIO CLUB

Hon. Sec.: C. Alabaster, 34, Lothian Avenue, Hayes, Middlesex. THE above club continues to be extremely active and progressive in all spheres, and membership increases steadily. Recent meetings have been devoted to a junk sale, and a very timely lecture and discussion conducted by Mr. Bostock (G3BWC) on battery portable equipment.

The club is still seeking a suitable club room where a workshop and permanent equipment can be set up. Plans for the club transmitter are well in hand, and the transmitting licence is awaited.

Meetings continue to be held on the second and fourth Wednesdays of every month at 7.30 p.m., at the Labour Club Rooms, Uxbridge Road, Southall, Middlesex.

SOUTHAMPTON RADIO CLUB

Hon. Sec.: John H. Silence, 80, The Drive, Coxford, Southampton.

At a meeting of the above club held recently, at the "Anchor Stores," East Street, Southampton, Mr. Robert Emmett offered the use of his own workshop and shack for future meetings of the club.

It was decided at the meeting to accept Mr. Emmett's offer, and Mr. Silence (secretary), in thanking him on behalf of the members of the club, said that it would allow the club to expand its activities, as the present accommodation, although suitable for talks, lectures, etc., did not allow for any practical or experimental work to be carried out.

It was decided to hold meetings at the new club room weekly until further notice. All meetings will be held at 7.30 p.m., with Morse practice until 8 p.m. Prospective members are invited to attend meetings, or write for particulars of the club's activities to the secretary of the club.

BASINGSTOKE-DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: L. S. Adams (BSW1565), "Roslen," 16, Brambles Drive, Basingstoke, Hants.

A SERIES of lectures, one per month, will be given by member J. A. Lowe on the "Oscilloscope and its Applications," at the Cricketer's Inn Hall, May Street, A.C. being available.

ROMFORD AND DISTRICT AMATEUR RADIO SOCIETY
Chairman: D. Coppendale, c/o 9, Morden Road, Chadwell Heath, Essex.

THE club transmitter is nearly ready to go on the "air" and will be operated from the H.Q. on 160 metres, although it will be able to operate on the 80 and 40 metre bands. Any reports from listeners will be welcomed and will be replied to with a QSL card.

The following are forthcoming fixtures:

- July 13th. Workshop evening.
- July 20th. "Pop" band portable TX and RX field evening.
- July 27th. Workshop evening and discussion on above field evening.
- August 3rd. Sale of members' surplus gear.
- August 10th. Workshop evening.
- August 17th. Five-metre field evening.
- August 24th. Lecture.
- August 31st. Field exercise to be arranged later.
- September 7th. Sale of members' surplus gear.
- September 14th. Lecture and Demonstration—"Television," by Mr. J. Erskin.
- September 21st. Workshop evening.
- September 28th. Lecture—"Transformer Design," by Mr. J. Erskin.
- October 5th. Sale of members' surplus gear.

October 12th. Workshop evening.

October 19th. Lecture—"Noise Suppression," by Mr. J. Erskin.

October 26th. Workshop evening.

KINGSTON AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: A. W. Knight (G2LP), 132, Elgar Avenue, Surbiton, Surrey. (Telephone: ELM 6931)

THE society endeavours to cater for all classes of radio enthusiasts. A series of interesting lectures has been arranged for Fridays—started in June. The club meets alternate Thursdays, at 7.30 p.m., at the Kingston Hotel. Visitors and new members are cordially invited.

STOKE-ON-TRENT AMATEUR RADIO SOCIETY

Hon. Sec.: D. Poole (G3AQW), 13, Oldfield Avenue, Norton-le-Moors, Stoke-on-Trent, Staffs.

WEEKLY meetings are still in progress for the members of the Stoke-on-Trent Amateur Radio Society, at their H.Q. in the Tabernacle Hall, High Street, Hanley.

There has been much activity recently, lectures by the Chairman (G3UD) on Speech Amplifiers; Converters, by Mr. J. Roberts (Treasurer), who has just had the "pleasure" of sitting for the R.A.E., and "Radio Receivers through the Ages," by a real old timer, G2WN, Mr. Wilson, whose "ticket" dates back to 1910. 2WN told the story of the time when he purchased a hand-driven generator and employed his XYI and four daughters to turn the handle in relays, for a consideration.

READING AND DISTRICT AMATEUR RADIO SOCIETY

Hon. Sec.: Alex Mercer, 23, Oakley Road, Caversham, Reading.

At a recent meeting of the above society, the subject of the demonstration was specially for those new to transmission, and also the "hopefuls." Mr. G. Guy (G8TH), using a small 5 metre Tx., demonstrated methods of matching aerial input impedance to that of the feeder line. At the same time the importance of correctly loading the output of the transmitter to obtain good power efficiency was shown. It is hoped to have a similar demonstration on neutralising from Mr. Guy later in the year.

Later, Mr. F. Ruddle talked on the problem of obtaining adequate selectivity, without losing completely the intelligibility of the signals. A double superhet of about 1935 vintage, giving single side-band reception of either sideband, with a band width of about 4 kc/s was described. Finally, "A Lazy Man's Qser" a method of obtaining the necessary selectivity by inserting the BC453 between the I.F. and detector stages of a communications receiver, was demonstrated.

Meetings are held at Palmer Hall, West Street, Reading, on the second and last Saturday of the month.

WALWORTH MEN'S INSTITUTE RADIO CLUB

Hon. Sec.: B. E. Symons, 100, East Dulwich Grove, Dulwich, S.E.22.

A MEETING of the club took place recently in order to finalise the rules and constitution of the club.

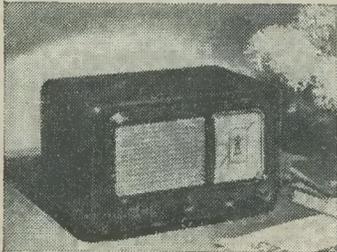
Owing to pressure of business the Secretary (Mr. P. Senelach) regretfully tendered his resignation, and in his stead Mr. B. E. Symons was elected.

Membership has increased considerably since the club was inaugurated and it is hoped that good progress will be made. Arrangements are being made with industrial concerns for the purpose of visits and lecture-demonstrations.

New members are still heartily invited and particulars may be obtained from the secretary.

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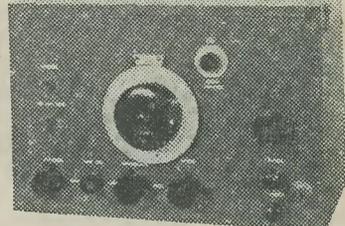
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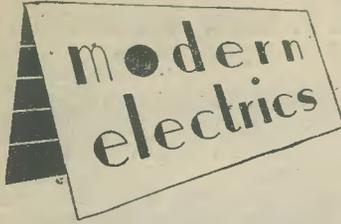
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Impressions on the Wax

Review of the Latest Gramophone Records

STRAVINSKY'S Concerto in D for String Orchestra was composed in 1946 and, in common with much of Stravinsky's music, the brilliance of the concerto is in its masterly orchestration. This month it has been recorded on *H.M.V. C3733-4* by John Barbirolli, conducting the Hallé Orchestra. Barbirolli considers this concerto the best thing the composer has done, and he is playing it at all his concerts. It was given in one of his Albert Hall concerts early in April, and it will be included in his programmes at this year's Edinburgh Festival.

Tchaikowsky's Serenade for Strings in C Major was a great favourite with the composer himself, and soon after its completion he felt it to be one of his best works. There are four movements, the first of which is cast in abbreviated sonata form. Then comes the famous waltz, one of the most telling of all Tchaikowsky's waltzes. An elegy occupies the third movement, and for the finale, the composer uses a Russian folk song. On the whole it is one of Tchaikowsky's happiest scores played on *H.M.V. C3751-4* by the Philharmonia String Orchestra with splendid tone and technique under Issay Dobrowen.

Brigg Fair is a Lincolnshire folk song, collected by Percy Grainger, to whom Delius owed his knowledge of the tune and also to whom he dedicated this work. It has been recorded under the auspices of the Delius Trust by the Royal Philharmonic Orchestra, conducted by Sir Thomas Beecham, on *H.M.V. DB6452-3*. The tune is a model one, very simple, with a haunting melancholy about it that is often tinged with hope. Delius has taken the tune and, with the full resources of the modern orchestra, he has painted the pastoral scene in glowing colours. The music is in the form of variations, with a free middle section and an introduction. Sir Thomas Beecham's performance is of the kind we expect from this grand interpreter of Frederick Delius.

Vocal

Following his moving interpretations of two sacred songs issued in December, Josef Locke, the popular tenor, this month offers fine versions of well-known ballads. "When You Were Sweet Sixteen" was written some fifty years ago, but has lately been enjoying renewed popularity following its revival in the film "The Jolson Story." "Count Your Blessings" was composed by Edith Temple and Reginald Morgan, and is currently one of the publisher's biggest-selling ballads. The sentiments of both songs are warmly conveyed by the soloist on *Columbia DB 2409*.

Verdi's splendid Requiem Mass vibrates with the feelings of an intensely sincere man. The work was inspired by the death of Alessandro Manzoni, poet and supreme patriot of Risorgimento which culminated in the union of Italy. Alberto Erede, celebrated conductor of the Cambridge Theatre operas, partners Luigi Infantino, tenor, in this

latest recording of *Ingemisco* from the Requiem Mass. On the reverse side is Georges Bizet's "Agnus Dei," which is a delightful example of his more serious style. Both of these recordings on *Columbia LX1080* are sung in Latin.

The duet, "Heav'n! My Father" from Verdi's "Aida," Act III, has now been recorded by Joan Hammond, soprano, and Redvers Llewellyn, baritone, on *H.M.V. C3735*. The duet is an extraordinarily dramatic one, with Verdi exulting in the opportunities provided by the story for his own special kind of insight into human hearts.

Light Music

There is an apt contrast between the pieces Andre Kostelanetz gives us this month. Nothing could be more different, nationally and aesthetically, than Falla's "L'Amour Sorcier" and Dvorak's gentle "Humoreske." The latter is the seventh of the group of Humoresques written for the piano, and it has far outstripped its companions in popularity. Kostelanetz's version on *Columbia DX1488* preserves the charm that has endeared this piece to millions. In the Falla, Kostelanetz's musicians let themselves go in a splendid exhibition of *brio* that admirably interprets the "Ritual Fire Dance."

Although criticism has been levelled at the British film "No Orchids for Miss Blandish," there can be no question of the high standard of George Melachrino's orchestral score. In his many assignments for the screen, composer George Melachrino has demonstrated convincingly that he is master of this highly specialised musical idiom. His "Song of the Orchid" and "Danse d'Extase," while being an integral part of the film itself, stand on their own as compositions of considerable worth. Both these compositions are featured on *H.M.V. C3736* by the Melachrino Orchestra, conducted by George Melachrino.

Dance Music

The latest titles by Geraldo and his Orchestra are the current American hit "Teresa," scored by Reg Briggs and sung by Anne Stuart and Denny Vaughan, and "Once upon a Winter Time," which marks the debut of a new Geraldo vocalist, Amru Sani—*Parlophone F2296*.

Other recordings have been made by Oscar Rabin and his Band playing "Lonesome Lane" and "Oh, my Achin' Heart" on *Parlophone F2297*; Joe Loss and His Orchestra playing "Teresa" and "Laroo Laroo Lilli Bolero" on *H.M.V. BD6008* and the Skyrockets Orchestra playing "After All" and "I'd Give a Million Tomorrows" on *H.M.V. BD 6010*.

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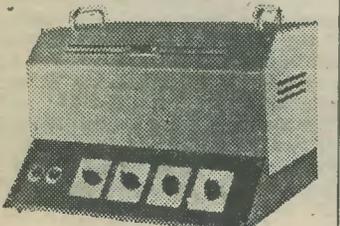
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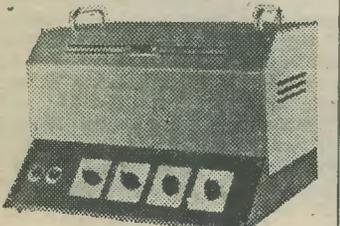
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Open to Discussion

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

Vibrator Switch Unit

SIR,—With reference to my article "Vibrator Switch Unit," appearing in the June issue, I would point out that there is an error in the wiring diagram. In the diagram socket No. 3 is connected to No. 5. This connection would result in a "dead short" of the H.T. supply. There should be no connection at all to socket No. 3. Also, in my diagram I omitted to indicate that socket No. 9 is G.B.—9 v., or to whatever voltage the G.B.— is connected.—A. H. OLIVER (Hitchin).

V.C.R. 97

SIR,—The information supplied by W. G. Wood (Bristol) in his letter published in your April issue can be very misleading. Evidently there are some unpredictable variations in the base connections and screen types of the ex-Service C.R.Ts.

I recently purchased an indicator type 62 (GEE) containing a V.C.R. 97 tube, and, having no published data available at the time, traced out the tube connections myself. Removal of two countersunk screws from the base of the tube releases the bakelite cover plate and exposes the connections to view. In this particular V.C.R. 97 (10E/222) the fifth and seventh contacts are definitely *not* connected; the third anode and coating being connected internally to the first anode and externally to contact No. 10.

Subsequent tests show that with applied anode voltages greater than about 1,500 volts there is some yellowish afterglow; but this is generally an advantage when double beam electronic switching is used at the lower audio frequencies.

I would be very pleased if one of your readers could tell me where I can obtain a copy of the instruction manual for the above equipment.—C. R. TALBOT (Huddersfield).

Automatic Two-valver

SIR,—I read with interest your article on the automatic two-valver.

While I agree with the writer that the simple detector-output type is unsatisfactory for both sensitivity and selectivity, I have constructed one which is free from Continental interference both day and night, and which gives good selectivity and volume for the two main stations.

The circuit embodies a simpler method of automatic station changing and the set also can be used for good quality gramophone reproduction. The components can be found in most constructors kits and with some improvisation comparatively little expense is involved.

Firstly, an aerial coil with a reaction winding can be used or wound to cover medium-wave band, and paralleled to this via a switch, another coil

approximately 60 turns of 24 s.w.g. wire. With the switch open the set should be tuned to the Light Programme and the tuning condenser then fixed. By switching the extra coil into circuit the inductance of the grid coil is altered sufficiently to change the frequency of the tuned grid circuit to that of the Home Service.

No complicated arrangement of pre-set condensers and switching is needed and the remainder of the circuit follows the orthodox R.C. coupled output.—B. A. CHAPMAN (London, N.16).

Contact Wanted

SIR,—I am a constant reader of PRACTICAL WIRELESS, and I wonder if, through your magazine, I could contact some other reader (Barnton and Blackhall, Midlothian) who is interested in amateur transmitting and reception on medium or short waves. I wish to qualify for the G.P.O. and Postmaster General's amateur transmitting licence, therefore I would like the assistance of some reader about my own age (18 years) to enable me to do so.—JAMES NOBLE (Police Station, Burnshot, South Queensferry, West Lothian, Scotland).

Television Interference

SIR,—With reference to Mr. Cox's letter, published in the July issue, concerning television interference from overhead aircraft, this source of interference is by no means uncommon and is caused by the television wave being reflected from the aircraft downwards to the receiving aerial, where it arrives a fraction of a second after the direct ground wave. This results in the formation on the screen of a second image slightly displaced to the right of the true image; furthermore this "ghost" image, as it is usually called, may be either positive or negative, depending upon the time delay between the waves, or, as is probably happening in Mr. Cox's case, the ghost image may fluctuate between positive and negative, due to the changing position of the aircraft and the consequent change in the time delay and relative phases of the waves.

Obviously, the farther away the aircraft the longer the delay; so far as aircraft are concerned the delay is normally short and as this time delay changes from a minimum to maximum and to minimum again in a fairly short time it may not be possible actually to distinguish on the screen between the true image and the ghost, which may just appear as a blurring to the right of the picture detail.

This reflection of the wave is, of course, not confined to aircraft. The wavelength of the vision transmission is 6.66 metres or 22ft., approximately, therefore there are many objects—hills, large buildings, especially steel-framed ones, and even clouds—that may cause reflection. Gasometers also

appear to make excellent reflectors. In the case of interference due to reflection from fixed objects the ghost image will, of course, appear on the screen at a fixed and steady distance from the true image, and it is possible to make a positive ghost change to a negative by shifting the aerial a half wavelength forwards or back.

In the case of a steady ghost image it is possible to estimate the distance the interfering reflected wave has travelled. This may be done by measuring the displacement of the ghost image from the true image on the screen. The ratio of the displacement to the picture width multiplied by the time taken for one horizontal scan gives the time delay. The velocity of the wave is 186,000 miles per second, or 0.186 miles per micro-second. If we let D equal the distance the reflected wave has travelled farther than the direct wave in miles, d equal the displacement of the ghost from the true image, w equal the picture width and f equal the time taken for one horizontal scan of the visible portion of the picture in μ secs., then $D = 0.186 \frac{d}{w} \times f$, and as $f = 84.5 \mu$ secs. this can be reduced to $D = 15.7 \frac{d}{w}$.

For example, with a 10in. wide picture and a 2in. displacement, $D = 3.14$ miles, and if the distance from Tx to Rx is, say, 10 miles, the reflected wave has travelled a total of 13.14 miles.

If D is large compared with the distance from Tx to Rx, then only the use of a directional aerial is likely to effect an improvement. If, however, D is by comparison small, indicating that the cause of reflection is near to the direct-line path, a directional aerial is unlikely to improve matters and a change in the position of the aerial should be tried.

Obviously, nothing can be done to the receiver itself to cure the trouble. In the majority of cases a change in the position and/or direction of the aerial works wonders, and I suggest to Mr. Cox that he determines experimentally the best position and direction of his aerial to minimise the interference. —J. DODDS (Penge).

"What Is a Classic?"

SIR,—I must express my appreciation of the humorous column, "Programme Pointers," but in case some musically inexperienced readers should take the statements on "What is a Classic?" too seriously, I think it only fair to warn them that the works of Liszt, Tchaikowsky and many others are chock-full of folk-tunes presented in a manner quite different from that intended by the original (anonymous) composers. Also, many of the older classics written for harpsichord, spinet, etc., are played nowadays on the piano, which gives an unbelievably different effect.

These and many other considerations lead to the conclusion that only one dogmatic statement can be made about music—that each work be judged by its effect, and not pre-judged by its context or manner of presentation.

... which is why I'm so amused by Maurice Reeve's forthright laying-down of the law!—STEVEN LANE (London, W.14).

"A Wireless Widow's Plea"

SIR,—Please may I, the mere wife of a "short-wave maniac," crave a small space on your "Open to Discussion" page in PRACTICAL WIRELESS.

For the past two years my husband has completely neglected me. He refuses to go out anywhere and is so tied to his chair by his short-wave set that sometimes I have almost to drag him away even for his meals. Believe me, I'm fed up to the teeth with "wireless." On the very few occasions that he manages to tear himself away from listening to have a little conversation with me he talks "wireless." I can't ask friends in to the house to keep me company because we haven't a spare room for him to do his listening, etc., in and I get so ashamed of him sitting there and ignoring people. If I want to go out I have to go alone and I can't go out much because we have a young child.

At times of late I've got so miserable I've thought of starting a "Wireless Widows' Club." —(Mrs.) MAY MCCARTNEY (Accrington, Lanes.).

Anti-static Aerial

SIR,—With regard to the query by Mr. Knight in your July issue as to why, when the screening of his down lead is earthed interference is not suppressed, could this not be due to the screening acting as a reflector when it is not earthed? This would result in interference being reflected away from the core of the lead.

If the screening were earthed the waves or currents of interference would run to earth and in doing so set up similar impulses in the core of the lead which is connected to his set.—A. MELVILL ELLIOTT (Harrow).

Ex-Service Equipment

- THE co-operation of readers is sought in helping others out of difficulties regarding items of surplus gear as follows:
- J. Miller, of 204, Colchester Road, Ipswich, Suffolk, requires a source of supply for Telefunken valve RV.12.P.2000.
 - J. L. Jones, 12, Dunster Gardens, N.W.6, is unable to identify the coloured leads and voltages required for a Mark 2, No. 158 Transceiver.
 - H. D. Everett, of 32, Lofin Way, Beehive Lane, Chelmsford, requires circuit data for a R.3168 and Type 6E indicator.
 - W. A. Sampford, 87, Ascension Road, Collier Row, Romford, Essex, wishes to convert to mains working a Type R.A. 10F.A. Beadix receiver.
 - L. Legge, "Pyrland Acre," Cheddin Road, Taunton, wishes to contact a reader who has had experience with the German Nora GW.69 receiver.
 - J. G. Coward, 31, Ash Grove, Charny Down, Bath, Somerset, requires technical data for receiver TCS.10 and transmitter TCS.5.
 - J. M. Stirling, Home House, Duddington, Edinburgh, requires details of receiver No. 18, Mk. III.
 - T. S. W. Stevens, 70, Thirlmere Avenue, Reading, needs details of the power supply, type of phones or speaker and circuit of receiver R.1082.
 - P. J. Suvarna Raju, Government Carrier Office, Berhampur, Ganjam District, Orissa Province, India, would like to contact a reader who can assist him in supplying details of Wireless Set No. X'tal, ZA23774, P.C. Ref. No. 92120, Serial 18424.
 - G. V. Goodlow, 15, Crocus Avenue, Birkenhead, would like circuit and details of R.1355.
 - N. C. Biggs, 14A, Odeon Parade, Greenford, Middx., wishes to use a VCR.528 or VCR.1528 in a television receiver and requires suitable data.
 - T. N. Menzies, 10, Almond Grove, Old Trafford, Manchester, 16, has an Indicator Unit 184 and would like details, circuit, etc.
 - G. Richards, 3, Chaffinch Road, Beckenham, Kent, cannot trace connections for mikes, phones and batteries in a 38 transceiver.
 - P. B. Jones, 4, Gilvach Cottages, Six Bells, Abertillery, Mon., would like to get into touch with someone who has details of the parachute radio Ref. No. T.113/CRT-1.

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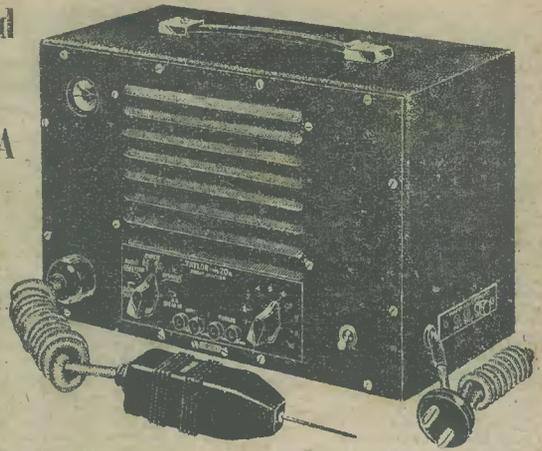
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