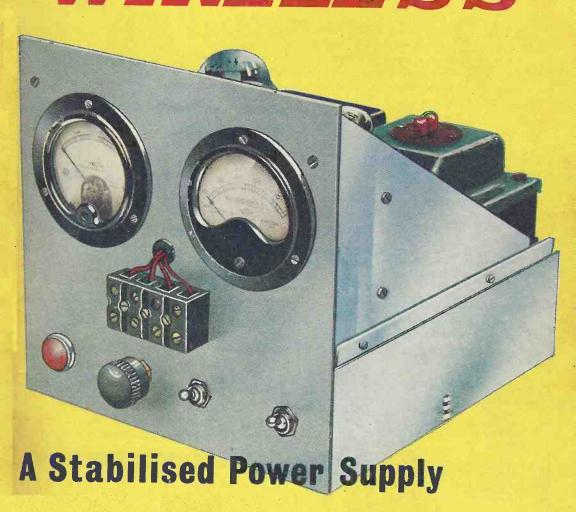
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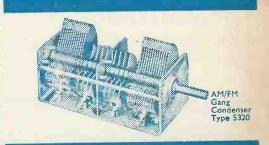
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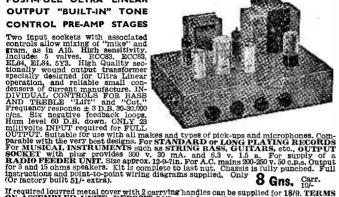
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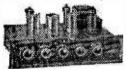
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Junior 5 watts High Quality output.
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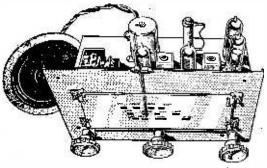
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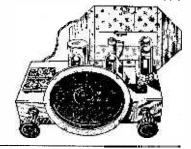
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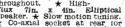
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CRYSTAI MICROPHONE (Hius). Sensitive Miniature Lapel-type, Complete with clip and screened lead. Brand new 17/8, Post 8d, MINIATURE 2P, 2 WAY SLIDER SWITCH as used in P.W. pocket superhet and "Road-tarer". 2/8 each, plus 8d, P. & P. LIGHTWEIGHT HIGH RESISTANCE HEADPHONES. 4,000 chms, adjustable headband, brand new. Limited quantity at 13/8 per pair, plus 11- P. & P. SMALL SOLDERING IROV. Complete with vinyl carrying case, mains lead and 2-pin blus A.C. 230 v. Handle unscrews and becomes protective cover for the bit. Only 18/9, plus 11- P. & P. Spares available. Bit 1/3. Element 4/6.





NEW! 10.000 O.P.V. MULTI-TESTER ON BOTH AC & DC

HODEL EP-10K OUTPERFORMS INSTRUMENTS MANY TIMES ITS SIZE AND PRICE!

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UNRELIEVABLE RARGAIN!

A revolutionary new Multi-Tester. A complete wired and tested instrument (not a kit) incorporating extra large 3kin, meter face and unique slide range switch. Can be conveniently carried in the pocket and features unusually sensitive 10,000 diper voit AC-DC meter. 1 per cent precision resistors, and largest meter voit AC-DC meter, 1 per cent precision resistors, and largest meter placed on an instrument this size. Single, easy to use range sector switch, can be appreciated by the novice and engineer alike Complete with colour coded test leads and battery.

Size: 44 x 32 x lin. Model EP-10K ONLY 25.19.6

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Precision engineered
Crystal Microphone
-for lapel or nand
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RH-20 RADIO HEADPHONES
Hi-impedance2,000 ohms-general
use headset, Black
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Incorporates TX/RX covering 2-8 Mc/s (37.5-150 metres), and inter-com. amplifier. 500 microamp com. amplifier. 500 microamp check and tuning meter, circuit and instruction book. ONLY 65/-, Carr. 10/-

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Size only 4 x 2½ x 1½in. £6.6.0 P. & P

Two-tone plastic case. Trouble-free case. Trouble-free printed circuit, fully tunable, built-in ferrite rod aerial, genuine full tone speaker, earphone for personal tuning the company of the case. Company of the case carphone and telescopic aerial.

MINIATURE PANEL METERS

Precision built featuring d'arsonval movements, jewelled bearing, silvered dials with black numerals and pointers. Accuracy 2% of full scale. 1,21/32in. square fronts, 14in. overall front to back. Require 14in. dia. round hole in panel. All have clear plastic ironts with zero adjustment screws.



**S'* METER MODEL SR. 2P. Standard 'Ham'' Signal strength indicator. Calibrated in 'S'* un 'its from 0-9 with scale terminating in +10 to +30 db calibrations. Additional full scale calibrations of 0-5 +0-10 in linear scale divisions. A 'must' 'for radio amateurs for conversion of any Communication Receivers with A.V.C. action to give calibrated signal strength action. 35'-.

*VU METER MODEL VR. 1P. Calibrated and damped in accordance with standard VU Meter Practice. Upper scale reads -20 to 43'U. Lower scale reads 0-100% modulation. Uses precision carbon film multiplier resistor and full wave rectifier. 42/6.

DC MICROAMMETER Model MR.25 0 to 50 uA. 39/6.

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**Model MR.21 0 to 1 mA. 27/6.

**Model MR.22 0 to 50 to 50 uA. 39/6.

**Model MR.21 0 to 1 mA. 27/6.

**Model MR.22 0 to 50 uA. 39/6.

**Model MR.21 0 to 1 mA. 27/6.

**Model MR.22 0 to 50 uA. 39/6.

**Model MR.22 0 to 1 mA. 27/6.

**Model MR.22 0 to 50 uA. 39/6.

**Model MR.22 0 to 1 mA. 27/6.

**Model MR.22 0 to 1 mA. 27/6.

**Model MR.22 0 to 50 uA. 39/6.

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MINIATURE EARPHONE

A really sensitive dynamic earphone of exceptionally fine quality. Provides clear reproduction of music as well as speech. Fully Guaranteed and complete with transparent ear insert, 3 feet cord, sub-miniature plug and socket.

socket. CR-5 High imp. crystal R/- Each MR-4 Low imp. magnetic 8/- Post 1/-

FULL SCALE RANGES: D.C. VOLTAGE: 0-6-30-120-600-1200 v. (10,000 o.p.v.), A.C. VOLTAGE: 0-6-30-120-600-1200 v. (10,000 o.p.v.).

A.C. VOLTACH: 0-0-0-120-000-1200-(1000-100). D.C. CURRENT: 0-120 uA, 0-12-300 mA.
RESISTANCE: 0-20K. 0-2 Meg. (150 ohm, 15K at centre scale). CAPACITANCE: 0.005 to 0.15 uF.

CAPACTIANCE: 0.005 to 0.15 uF. (64 AC.6 v.).
DECIRELS: -20 to +63db. (600 ohm, 1mW.0dbm-0.755 v.
ACCURACY: D.C. Voltage and Current +2% f.s. A.C. Voltage ± 4% f.s. Resistance ± 3% of total scale length.

MAINS PORTABLE SOLDERING

> Model SPI. Precision Built. 30 Watts. Only 18/9. P. & P. 1/3. HI-FI HEADPHONES

Uses high-quality per-manent magnetic speakers with regular voice coil.
The padded chamoisearmuffs give

muis give correct spacing for optimum acoustic machinest musicand voice early with the spacing for optimum acoustic machinest musicand voice early with the space of the space

AERIAL Variometers

These magnificent These magnificent instruments will enable you to receive maximum signal strength on all S.W. receivers. Precision caliprated control 12/6. P. & P. 2/6.



MINIATURE DUBILIER CONDENSER SPECIAL! Minimum lots of one dozen from these essen-

these assor-ted values: .002; .04; .01; .005; .001;



.005; .001; all at 100 volts A.C. and 300 volts D.C. Recent Manufacture ONLY 5- per dozen. P. & P. 6d (Please state values required)

Relda Breaks the Tape Recorder Price Barrier!

NEWY MODEL RA-11 TRANSISTORISED PORTABLE TAPE RECORDER Size only 6 x 8 t x 3 tin, and weights a mere 2t lbs. Fully transistorised, complete with mike, earphone, built-in spaces are applifier. Powered by three inexpensive batteries. Twin track recording it 3 P. A matrix meconomy. Records and plays for over one hour on standard sin, reel. (3d matrix meconomy. Records and plays for over one hour on standard sin, reel. (3d matrix meconomy. Records and plays for over one hour on standard sin, reel. (3d matrix meconomy. Records and plays for over one hour on standard sin, reel. (3d matrix meconomy. Records and plays for over one hour on standard sin, reel. (3d matrix meconomy. Records and plays for over one hour on standard sin, reel. (3d matrix meconomy.)

The RA-11 is a precision miniature tape recorder into one seasily into a brief case or handbag, utilise advanced transistor circuitry and built-in 2 x sin. P.M. speaker and amplifier. Engineered for ease of operation, all controls are accessible on front panel. The magnificent two-tone plastic and metal case features a carrying handle and snap open top for fast, easy tape loading. Complete with batteries, tape and accessories.

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SUMMER SALE!

STOCK OFFERED AT SENSATIONAL REDUCTIONS THIS MONTH

- Brayhead TV Turret Tuner, for 33/38 Mc/s. I.F., normally 79/6. With valves 39/6. Less valves 19/6, plus 3/6 post and ins.
- 14in. TV Mask, grey plastic, normally 10/-. Sale price 5/-, plus 1/6 post and ins.
- 17in. TV Mask, grey plastic, normally 12i-. Sale price 9i-, plus 1/6 post and ine
- TV Rectifier, R.M.5., equivalent, normally 25/-. Saje price 12/6.
- 14in. TV Cabinet, modern design. Cost &4 to make. Sale price 9/6, plus 3/6 carriage.
- Set of Four TV Parts, scan coils, line E.H.T. frame output and width control, Normally 57/6. Sale price 39/6, plus 2/6.
- Output Transformer, fixed ratio for pentode, normally 6/6. Sale price 3/6.
- 259-0-250 60/80 mA. Mains Transformer, with 6.3 v. filament windins, half-shrouded dropthrough, standard replacement in many receivers, made vo sell at 19/6. Sale price 12/6, plus 2/6 post and ins.

Ditto, but with additional 5 v. winding for separate rectifiers, made to sell at 21/-. Sale price 13/6, plus 2/6.

- Auto Transformer, totally enclosed primary 200-250, secondary 110-120 v 200 w. normally 27/6. Sale price 19/6, plus 3/6.
- I.F. Colls, standard size by Weymouth 465 Kc/s. dust cores, normally 12/6.
 Sale price 6/6 per pair.
- P.M. Speaker, 6lin., with outransformer, normally 30/-.
- Miniature Microphones.
 American, beautifully n
 price 2/-.
 s. Dynamic made. Sale
- Pilot Bulbs. 3-5 volt, 0.3 amp. 3/6 a box of 25.
- Stick Microphone, Cosmocord 39/1, normally \$3.3.0. Sale price 35/*.
- Windsor Cabinet and Chassis, comprises a veneered and polished cabinet, size 14 x 17 x 8 im, and prepared metal chassis with glass dial to fit, normally £3,15.0. Sale price 29/6, plus 5/-.
- Push-Puil Transformers, input and output, midget, potted. Sale price 5/-pair, plus 1/6.
- B78 Holder, with skirt for screening can. Normally 10d. Sale price 6d. or can. No
- Metal Rectifiers, 250 v. 60-80 mA, ideal for mains set or instrument, or to replace that expensive valve. Sale-price 3/6.
- FilamentTransformer, 6.3 v. 11 amps., normally 8/6. Sale price 6/6, plus 1/-post.
- Filament Transformer, 6.3 v. 2 amps., normally 10/6. Sale price 6/6, plus 1/-
- Charging Switchboard, offered at about 1/20th of original cost. Ex government, contains three reverse current relays, one voltmeter, one mains ammeter, two secondary ammeters and three variable resistors. In original cases. Sale price \$2,15.0, 1,250 watt, \$22,15.0, 550 watt, carriage 10/-.
- Cine Camera, 16 mm. motorised 24 v. for 15 frames per second. Sale price \$3.19.6, plus 3/6 carriage.
- Dinghy Mast, tubular aluminium, extends from 15in. to 9ft. Sale price 4/6, plus 1/6 postage.
- Magneto Generator (hand), as used in telephones. Sale price 7/6, plus 1/6 postage.

- P.O. Type 3000 Relays, 2,000 ohm coil, 6 contacts 7/6, 4 contacts 6/6, 2 contacts 5/6, plus postage 1/-.
- Variable Rheostats, heavy duty slider resistor rated at 25 amps. Ideal for dimmer circuits, etc. Sale price 7/6, plus 6d, postase.
- Versatile Wire, single strand 18 gauge, with p.v.c. covering, New i-mile on drum. Sale price 6/6, plus 3/6
- Wire jointer (welder for 28 gauge or thinner), in bakelite case with trigger switch, works off step-down trans-former. Sale price 2/6, plus 9d. postage.
- Rectifier Bargain, selenium rectifier 25 v. 25 amp., easil rebuilt into 6. full-wave charger rectifiers, suitable 6 or 12 v. battery at 3 amps. Sale price 15/-, plus 3/6 Post.
- 80 ohm Coax, low loss expanded polythene, normally 9d. per yard. Sale price 6d. yd.
- Connecting Wire, 24 gauge. Tuned copper, P.V.C. insulated. Four 100ft. coils, different colours. Sale price 8/-.
- Superhet 7 v. 5 Waveband Chassis. Unused. Less valves and power pack. Soiled 75/-. Coll pack with twice as much. Carriage and insurance 7/6.
- Geiger Counter Tube, 20th Century. No. G25 with circuit of selger counter. Sale price 27/6.
- Twin-twisted Lighting Flex equiva-lent 1436, 12/6 per 100 yd, coil. Carriage 1/6.
- 3029 Twin T.R.S. 37/6 per 100yd. coil, carriage 8/6.
- 3029 Single T.R.S. 20/- per 100 yd. coil, carriage 2/6.
- Transistor A.F. equivalent to red spot. Sale price 2/6.
- Bakelite Wall Switch household type 6/- doz. one way, 8/- doz. two way.
- Wall Switch by Crabtree two way and off. Sale price 1/- each.
- Double pole, double through toggle switch heavy duty, 10 amp. 250 volts. Suitable for controlling photo flood lamps. Sale price 1/2. 18/- doz.
- Multi-speed Motor with gearbox, works on A.C. 3 D.C. mains, gives any speed from 1 r.p.m. Sale price 17/6, plus 2/6 postage.
- Low Resistance Single Headphones, good British make. Sale price 4/6. good 5 plus 1/6.
- Chest Microphone, excellent American make with adjustable mouthpiece, 6/6, plus 1/6.
- Throat Microphone, 2/6, plus 1/6 post.
- American Lightweight Headphones, type HS30. Sale price 17/6, plus 1/6 post.
- Regulator Resistors, slider type, 11 ohm, 15/-, 3 ohm, 12/6, 1 ohm, 2/6, plus 2/- post.
- E.H.T. Transformer, standard mains input, 3 secondaries, heavy duty potted transformer in cast case, cormal price 20/-. Sale price 15/-, plus
- Suppressor Condenser, stops drill, etc., interfering with radio or television. Simple instructions included, normal price 1/6 each. Sale price 1/-
- Bi-Metal Contact Strip for making thermostat, 1/9.
- Rectifier Unit, for working D.C. instruments, motorised equipment, etc., from A.C. mains. Input 200-240 v. Outbut 200-240 v. 300m amp. 35/-, carriage 7/6.

- Sniperscope, "Cat's Eye" for seeing in the dark. Will work burglar alarms. circuits, etc. Sale price 4/-, plus 1/- post.
- Telephone Handset, sound powered, just join two together with a pair of wires and you have telephonic communication. Sale price 25/-, plus 3/-
- 12-24 v. D.C. Converter. Sale price 32/6.
- R.F. 25 Tuner Unit, complete, new condition. Sale price 8/6, plus 2/6 post.
- Stud Switch, heavy duty. 30 amp. contacts, for dimmer, charger, regulator, etc. Sale price 7/6.
- Powerful Blower, with motor, 24 v. D.C., but can be operated off mains with rectifier, 15/-, post and packing 2/-.
- with rectifier, 15%, post and packing 24. Canadian Telephone Sets, although originally intended for use with transphones to the make excellent telephones to the make excellent telephones to the set of the set
- Ardente Hearing Aid, normally bargain at \$7.10.0. Sale price 49/6, plus 3/6 post and insurance. Need attention, ditto transistorised \$3.10.0.
- Switch for Electric Blanket, double pole three position, 5/-.
- Packard Bell Pre-Amp, complete with 65L7 and 28D7 valves, relay, leads, acks, input and output trans-formers, etc., etc., 7/6, plus 24- post, less case.
- Centre Zero meter 3in. movement, flush mounting, 500-0-500 micro Amp. Sale price 30/-, plus 1/6 post.
- Moving Coil Meter, 21in. movement, 0-750 micro amp. Sale price 19/6, 0-30 mA., 15/-, plus 2/-, ditto 2,500 micro amp. 15/-.
- Unbreakable mains leads, as fitted to electric razors etc. Makes ideal lead for test meters. Twin 6ft. long 6d. per lead. 5/- doz.
- Cold Cathode Valve CV413 voltage regulator or trigger tube. Unused, but ex equipment. 2/- each.
- Electric brake disc type for stopping lathe and coil winders etc. 25/-.
- VCR517 Cathode Ray Tube is a plug in replacement for the VCR97. 8/8, carriage and insurance 4/6.
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- Rotary Switch by Santon, suitable 30 amp. A.C. single pole on/off. 3/6. • Silicon crystal diodes, 6/- per doz.
- Sapphire gramophone needles miniature or standard 78 r.p.m. type. 12/- doz. 1/6 each.

Please include enough for postage and request "Summer sale list", for details of many other items. <mark>ଦ୍ୱିଷ୍ଟର ଜଣି ବର୍ଷ ପ୍ରତ୍ୟର ପ୍ରତ୍ୟର ପ୍ରତ୍ୟର ପ୍ରତ୍ୟର ପ୍ରତ୍ର ପ୍ରତ୍ମର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ମର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ମ ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ମ ପ୍ରତ୍ର ପ୍ରତ୍ମ ପ୍ରତ୍ର ପର୍ବ ପ୍ରତ୍ର ପ୍ରତ୍ମ ପର୍ବ ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପର୍ବ ପ୍ରତ୍ର ପ୍ରତ୍ୟ ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ୍ର ପ୍ରତ</mark>



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2 x CX7l's direct coupled cascade drive to 2 precision matched 0C74's in Class B push-pull provide up to 1 W undistorted output from 5 mV. in at 1.5 K-ohm Frequency response, 60-16,000 c/s ± dB. Overall size 3 x 2.2 x 1.2in, 92/6. Post and ins. 2/6. 750 MWATT AMPLIFIER. Similar specification, £2.2.6.



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Very modern cream cabinet, size 51 x 8 x 14 in. with chrome handle, tuning knob and scale. Price 7/6, plus 1/6 postage and packing.

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Trace signal right through: Radio, T.V., Tape amplifier, Hi-Fi, etc.—simplest way to fault-find—carry it like a fountain pen—all parts including transistor barreit cluding transistor barreit crystal, everything except crystal, everything except ancluded 10% by 16, data included 10% of complete with deaf aid type earphone, 200-,



This Docket receiver has alremarkable performance comparable in fact with portables being sold at £12 and over. It uses the 3in, moving coil speaker to give reality good quality tone and the circuit is reflex R.F. with push-pull output. It completely tunes the medium and long wave bands. Price for all parts and pocket sized cabinet £4.15.0. Post and insurance 2/6.

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Features include American Philoo
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years old".

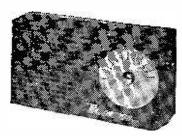
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4 stages. Permanent germanium diode and high gain AF output stage, fitted with miniature speaker, proper tuning condenser, volume control and in case with handless sillustrated dies monogram). completely postable realists of carth required. Pocket 4 and insurance Focket 10de price 4286, plus 266 post and insurance Focket 10de price 4286, plus 266 post and insurance. Focket 10de price 4286, plus 266 post and insurance. Prices are processor, plus 266 post and insurance. Prices are processor and plus 266 plus 266

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GARRARD 4-SPEED HIGH FIDELITY UNITS Autochanger RC210 £9.19.6 Price inc. plug-in normal Transcription 4HF £1.19.6 heads. Stereo hds. £2.ex.

Matth	eo speakers, s	on., ogin., om., 17 e ea. 10m.	. 25/*. 12In. 30/*. 1ra	anscription 4FIF £10.19.0	
BRA	ND NEW	VALVES	Matched pairs 1/-		Tape
OZ4	6/- 6BA6	7'- 6SJ7M 6'- DF96	8/- EL4 9/- PCL82	8 5 5 4006 1214 MYLAR DITEO	
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3V4	7/6 615 6/- 616	5/6 12AX7 6/- ECC84		3'6 "Instant" Bulk Tape Eraser and Head	d De-
5U4 5Y3G	6/- 616 6/- 617G	5/6 12K7GT 6/6 ECH42 6/6 12O7GT 6/6 ECL80		0'0 fluxer, 200/250 v. A.C., 27/6, Leaflet, 9	
5Z4G	9/6 6K6GT	6/6 12Q7GT 6/6 ECL80 5/- 25YG5 9/6 ECL82	10/- 12/- UL41	8/6	
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4		5/-	EBC41	7/9	ESU208		PY83	7/3	VX3138		6D6	4/6	7H7	7/3	21 0 LF	_
1		2′-	EBC90	5/-	EYSI	8/-	PY80	6/9	W31	7/-	6E5	5/-	7Q7	7/-	210VP	
1		3/-	EBC91	3/9	EY86	8/-			Y63	5/-	6F6	7!-	777	5/-	7 pir	n
ı		3/6	EC52	3/-	EY9	3/6	PY8I	7/-	Y66	8/-	6F6G	4/-	7Y4	61-	274B	
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ı		1/6	ECC82	6/6	EZ80	6/6	QS 7 5/2		IA5GT	5/-	6F17	7/6	9D2	3/-	705A	
1		76	ECC83	7/-	EZ8I	6/9	QS95/1		IC5GT	7/6	6G6G	3/-	12A6	5/-	715B	•
ı		7/-	ECC84	71-	FW4/50		QS108/		ID8GT	6/-	6H6M	2/-	12AH 7	7/-	717A	
ı		2/9	ECC85	7/9	GL450	10/-	Q3100/	6/9	IE7GT IG6GT	7/6	6.15	3/6	12AT7	5/6	801	
1		16	ECC91	4/-	GZ32	9/-	QS150/			12/-	6J5G	3/-	12AU6	9/-	803	- 2
ı		5/-	ECF82	8/6	HL23	6/-	Q3130/	6/9	ILD5 ILN5	3/6 4/9	616	4/3	12AU7	6/-	804	
ı		5/- :	ECH42	7/6	HL23DI		QV04/		IR5	61-	6J7G	5/-	I2AX7	7/-	805	
ł		4/-	ECH81	7/9	HL41D		المحمدة ا	12/6	IS5	5/9	6K6GT	6/6	12C8	3/-	807AM	IEF
1		B/-	ECL80	8/-	HVR2	12/6	R3	8/-	133 1T4	4/-	6K7G	2/3	12E1	22/6		
Į		6/-	ECL82	9/-	KF35	5/-	RIO	12/6	2A3	8/-	6K7GT	4/9	12H6	2/-	807BR	
ı		16	EF22	7/3	KRN2A		REL21	25/-	2A5	8/-	6K8G 6K8GT	5/9	12J5GT	3/6	808	
ı	BT45 40	0/-	EF32	5/-	KT2	4/-	RK34	2/6	2A6	7/-	6K8M	8/3 8/6	12K7GT		810	- 3
ı	BT83 22		EF36	3'6	KT31	8/-	RX235	10/-	2034	2/6	6L5G	6/-	12K8M	9/-	813	٠
ı		5/-	EF37A	8/-	KT32	8/-	SP2	41-	2D4A	4/-	6L6	9/-	12SA7 12SC7	716 416	815	-
ı	CY3I 7	16	EF39	4/3	KT33C	419	SP13C	4/6	2X2	4/-	6L6G	6/6		6/6	816	
ı	D41 3	/3	EF50	2/6	KT44	6/3	SP41	2/6	3A4	5/-	6L34	4/6	12SG7 12SH7	3/-	826	
1	D77 4	/3	EF54	3/3	KT76	10/-	SP61	2:-	3B7	5/-	6N7G	5/9	12SH7	61-	829A	-
ı	DA30 12	/6	EF55	6/-	KTW62		SU2150		3B24	8/-	6N7GT	61-	12SK7	4/-	832 832 A	
ı		3/-	EF70	4/-	KTW63	6/6	T41	7/-	3E29	U/-	607G	6/-	12SL7	7/-	832 A 843	-
l		5/-	EF73	61-	MH4	3/6	TP25	15/-	(829B)	60/-	6R7G	6/-	12SN7	8/-	866A	
ı		i/-	EF80	5/6	MH4I	5/-	TTII	3/-	305GT	9/-	6R7GT	8/-	1207GT		872A	٠,
I		76	EF85	6/10	ML4	4/-	TZ20	16/-	354	5/-	6SA7	6/-	12SR7	6/-	930	•
ı		/3	EF86	9/-	MS/PEN	6/-	U17	5/-	3V4	7/3	6SC7G	5/6	15D2	6/-	954	
ł		/3	EF89	7/9	NT37		UI8	6/6	5T4	9/-	6SC7GT	6/-	15R	5/-	956	
ı		3'-	EF91	3/6	(4033A)	10/-	U27	8/-	5U4G	5/-	6SG7	5/-	20A2	7/6	958A	
ı		/3	EF92	4/6	OD3	5/-	U52	5/-	5Y3GT	6/-	6SH	5/-	21B6	91-	1616	
ı		5/-	EF95	7/6	OZ4	5/-	UBC41	7/6	5Z3	8/6	6SH7	4/6	30	5/-	1619	
ı		-/-	EK32	7′-	PCC84	71-	UCH42		5Z4G	8/-	6SJ7G	5/9	35L6GT	8/-	1625	
ı		/-	EL32	3/9	PCC85	8/3	UL41	7/-	6AB7	4/-	6SK7	5/3	35T	30/-	1626	
ŧ		/-	EL33	8'-	PCF80	7/-	UL84	7/6	6AC7	3/-	6SL7GT	616	35Z4GT	7/-	1629	
I		/6	EL35	8/3	PCF82	8/-	UL85	7/-	6AG5	3/6	6SN7GT	4/6	37	4/-	4120	
ı	E!323 25		EL4I	8/3	PCL82	8/6	UU9	5/6	6AG7	6/-	6SQ7	6/-	38	41-	7193	
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£15. Carriage 15/-.

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(e)

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Provides complete tape recording facilities and designed to operate through the pick-up sockets of the standard type of RADIO RECEIVER, or an AMPLIFIER, from which really first class reproduction is obtained. It, con-

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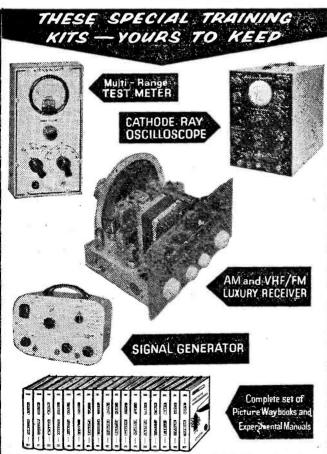
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Zamataman programma mataman manana ka

Retail or Home-Constructed Equipment

OR much of the time the amateur radio enthusiast is content with making easily constructed equipment and so long as it does the job it was made for, the finish is not important. Even if it does not work well, the constructor is not so disappointed, as the pleasure is in making it, and tracing and correcting any faults is often as enjoyable. But now and again the need arises for a piece of equipment that looks attractive, works well and is reliable. Now the constructor is faced with the problem of whether to buy a ready-made instrument retail, or of building a home-constructed unit.

The piece of equipment needed will, in many cases, be a receiver, but even if it is a signal generator, a multimeter, an oscilloscope, or any of the multitude of instruments the amateur constructor could find a use for, the electronics industry gives him a wide range from which to choose. The competition between different firms provides a large selection of designs and circuits, and it would be understandable if, just for once, the radio constructor forsook his soldering iron, and purchased a

commercial unit.

If he decides upon such a course, there are many advantages at once obvious. First of all, whichever instrument he buys will almost certainly make an attractive addition to the house or work-bench. Another advantage is that the constructor can be sure that the unit works well, as he will almost certainly see it in operation before he decides definitely to purchase it. If the equipment is needed quickly, building one is obviously out of the question, and the local radio supplier offers the solution. An added inducement which might persuade the enthusiast to buy a commercial instrument is the fact that new components are always used, which helps to ensure a long and reliable life for the unit.

If on the other hand, the amateur feels that a home constructed instrument would amply fulfil the requirements and would probably be cheaper, then he may look forward to practising the most popular part of his hobby; that of construction. Here home-constructed equipment has an advantage over commercial products as the constructor will be familiar with every part of the circuit employed and will thus be capable of repairing it himself should a fault arise; whereas if a fault develops in a ready-made set it must be returned to the makers to be serviced.

There is a third possible course open to the radio amateur, and that is to buy one of the numerous kits on the market, which, when built to the exact instructions of the makers, provides a useful instrument in a suitable cabinet usually supplied with the kit.

The firms belonging to the R.E.C.M.F. produce more than seven million components a day. This places before the equipment manufacturing firms and the amateur constructor a wealth of components which should enable anyone faced with this problem of whether retail or home-constructed equipment would serve his purpose best, to decide with complete confidence, that whichever he chooses, the materials will be of the highest standard and the wide selection will undoubtedly provide for the most stringent requirements.

Our next issue, dated September, will be published on August 4th.

Round the World of Wireless

POTENTIAL AND CURRENT NEWS

Broadcast Receiving Licences

THE following statement shows the approximate number of Broadcast Receiving Licences in force at the end of April, 1961, in respect of wireless receiving stations situated within the various Postal Regions of England, Wales, Scotland and Northern Ireland. The numbers include Licences issued to blind persons without payment.

Region				Totai
London Postal	• •			686,093
Home Counties	••	••		652.402
Midland	••	• •		470,131
North Eastern	• •	••	• •	512,903
North Western South Western	••	••	• •	441,417 389,319
Wales and Border	Counti	es	• • • • • • • • • • • • • • • • • • • •	228,497
Total England and	Wales			3,380,737
Scotland	••	••		378,535
Northern Ireland	••	••		117,678
Grand Total	••	••	••	3,876,950

A long-range high-cover radar of the type being supplied by Marconi Ltd. to the Admiralty.

Medium Range Radar for R.A.F.

THE Ministry of Aviation recently ordered the new Cossor CR787 medium range radar equipment for airfield surveillance duties. An English Electric travelling wave tube, used as a microwave pre-amplifier ahead of the signal mixer, does much towards achieving the overall receiver noise figure of only 8dB. This is claimed to increase the range by approximately 25per cent, over that otherwise attainable with the same transmitter power and aerial gain.

An important feature, which the travelling wave tube affords, is that the noise figure is consistently maintained at this low level for many thousands of hours, which means that the results obtained at maximum search range will be consistent. Another advantageous factor in the performance of this tube, is that it is normally impossible to damage it by input overload.

Radar for the Royal Naval Air Service

THE Admiralty has ordered the supply of a Marconi high-power (500kW) 50cm radar Type S 264A/H to the Royal Naval Air Station Ycovilton, where it will be installed. The

geographical situation of RNAS Yeovilton, places it near to two important air-lanes which makes it essential for the airfield to have a complete knowledge of all airliner movements in the air spaces through which the Navy's fast-climbing fighters have to pass, to reach the upper atmosphere, where they fly without the risk of colliding with any civil aircraft.

Because it operates at long range and has high altitude cover, and is impervious to weather conditions, the Marconi S 264A/H is considered to be well suited to effect this radar control.

Cable Installation at Kincardine

132kV cables will be supplied and installed by AEI Ltd. under a £40,000 contract at the Kincardine generating station. Two 132kV circuits of six single-core oil-filled cables will connect supergrid interbus transformers in a new 275kV sub-station with an adjacent 132kV sub-station, and one circuit of three 132kV cables will connect the 132kV sub-station with the termination of a 275kV overhead line.

Radiotelephones for Ambulances

DEVON County Ambulances will soon be installed with radiotelephones of the type

already used by many ambulance services in Great Britain. Pye Telecommunications Ltd. have been awarded the contract, and will complete the installation in four stages, the first being to establish one fixed station. The complete scheme will comprise four fixed stations and approximately 60 mobile units.

Mr. Krushchev at British Trade Fair in Moscow

AT the British Trade Fair, recently held in Moscow, Mr. Krushchev spent some time examining the exhibits at the Ultra Electronics stand. He seemed particularly interested in the engine control equipment and in SARAH (search, rescue and homing equipment).

homing equipment).

Mr. Krushchev stated that
Russia may well have requirements for SARAH equipment.

Technical Lecture in Moscow

J. SHARPE, B.Sc., A.M.I.E.E., of EMI Electronics Ltd., has been chosen by the Russian authorities as the sole representative of the Scientific Instrument Manufacturers' Association at the British Trade Fair, Moscow, to give a technical lecture to a Russian audience. The subject of Mr. Sharpe's paper will be "Photomultipliers and their Applications".

The lecture will cover such points as design and characteristics of photomultiplier tubes, and their specialised modification for particular applications.

Scottish Radio and Electronics Exhibition

THE Scottish Council recently held, in London, a one-week exhibition of equipment produced by Scottish radio and electronic manufacturers.

This is the second exhibition in this field to be organised by the

Council in London.

Altogether there are now fifteen companies in Scotland directly concerned with the production of electronic equipment. This industry employs 8,000 people, which may appear to be a small number, but it must be remembered that this was an industry which was practically unknown in Scotland before the war.

Of particular importance to Scotland is the fact that this development in their electronic involustry will provide more opportunities for electronic engineers and applied physicists, chemists,

New Printed Circuits Factory

and metallurgists.

A LARGE modern factory, specifically designed and built for the production of all types of printed circuits, instrument panels, etc., has recently been opened by Printed Circuits Ltd., an AEI company, at Boreham Wood. The factory is equipped with two completely automatic machines for etching and anodising.

The equipment provides for automatic selection of any one of a number of dyes which are constantly available to their correct specification, together with the fixing and sealing processes to ensure continuity of colours throughout a long production run. Designed primarily for the rapid etching of printed circuits, the etching unit is capable of handling single and double sided boards of various laminates and thicknesses.

Computer Development

IN 1956 International Computers and Tabulators Ltd. and the General Electric Co. Ltd. agreed to associate and develop their specialist knowledge in their respective fields in regard to computers, through the medium of a jointly owned subsidiary—Computer Developments Ltd.

in order to derive further mutual advantage from this association. I.C.T. is forming a subsidiary to be known as I.C.T. (Engineering) Ltd., whose nominal capital will be held as to 90per cent by I.C.T. and 10per cent by G.E.C. This company will assume responsibilities now undertaken by I.C.T.'s Research and Design Division and by the G.E.C. Computer Development Department at Coventry. G.E.C. will continue to supply I.C.T. with a substantial proportion of its steadily increasing requirements for electronic equipment.

Servicing Examinations 1961

THE Intermediate Radio and Television Servicing Certificate Examination this year has attracted 2,678 entries; an increase of 640 on the number who entered for the Radio Servicing Examination in 1960. Entries for the Final Radio and Television Servicing Certificate Examination total 707, an increase of 43.

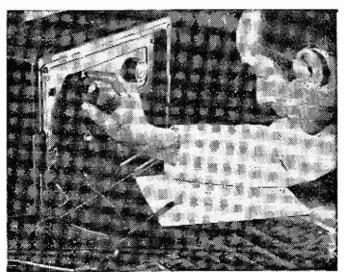
The written papers of these examinations were held on 8th and 10th May. The practical test of the Final Examination was held on 3rd and 17th June. The Intermediate practical test will take place during October, limited to those candidates who have passed the written papers.

In the light of experience, and British Standard for Fixed Wireorder to derive further mutual wound Resistors

IN a series dealing with components intended primarily for use in telecommunication and allied electronic equipment, this British Standard is divided into two parts, the first specifying requirements and tests, and the second comprising a list of standard sizes and ratings, for fixed wire-wound resistors.

The specification applies to insulated and non-insulated fixed resistors consisting of a winding of resistance wire on a heatresisting former, and having a dissipation of 70°C not exceeding 200W and a rated resistance value not greater than 200k. Precision wire-wound resistors are excluded from the standard.

Part I of the standard requires reference to B.S.2011, climatic and durability tests for components for radio and allied electronic equipment." The object of the tests is to establish, as far as is possible in laboratory conditions, the components' suitability for use over stated ranges of temperature and humidity, their ability to withstand specified conditions of mechanical shock expected in transit or under operational conditions, and their ability to withstand normal assembly processes, such soldering.



This operator is testing the ohmic resistance of strain gauges at the Boreham Wood factory of Printed Circuits Ltd.

THIS UNIT MAY BE USED WITH A RECEIVER TO ELIMINATE ALL SIGNALS ABOVE A CERTAIN LEVEL. IT CAN ALSO BE USED TO PREVENT OVER-MODULATION IN A PHONE-TRANSMITTER.

HIS unit may be added to either a receiver or a transmitter. With a receiver, it cuts off all signals above a certain level, and thus reduces static or bursts of noise. When used with a phone transmitter, it prevents over-modulation, and allows an increase in effective audio power.

Effect of Clipping

Fig. 1 is a representation of the result of using the clipper in a transmitter. At "A", the trans-mitter is modulated to such an extent that the greatest signal peaks fall within the 100per cent modulation limits. The general modulation level, apart from these peaks, is perhaps 30 to 50per cent. Owing to the characteristics of the usual voice, this is about the general effect achieved. At "B", audio gain has been increased. This

gives much more power on the general modulation level, but peaks now extend beyond the 100per cent limits. Positive modulation peaks beyond this limit need not be important, if the transmitter can

handle them. But, with negative peaks, the P.A. anode voltage is driven below zero, and this breaks the carrier and causes splatter, which can give rise to interference. It is for this reason that more than 100per cent. modulation must never be permitted.

The waveform after the clipper has removed the peaks is represented in Fig. 1A. No over-modulation is present, but if "C" is compared with "A" it will be seen that the general level of audio is much higher. With slight clipping, such as represented by "C there is almost no sacrifice in communications voice quality.

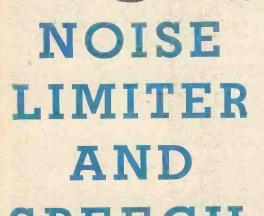
For receiving purposes, the clipper acts as a limiter, in a similar way to that represented by C" in Fig. 1. Pulses of high static noise, or loud

bursts of reception, are eliminated. This is par-ticularly useful for headphone reception with a powerful receiver, but is also helpful in removing all high amplitude noise pulses.

Clipper Circuit

The circuit is shown in Fig. 2. The valve type and component values are not critical, but the two 220k cathode resistors should be matched fairly closely. While the anodes are positive, the audio signal can pass from the input to the output circuit. But when the input exceeds the anode voltage the output cathode cannot follow this swing, so peaks are cut off as at "C" in Fig. 1.

The level at which clipping takes place is set by means of the clipper control. Circuit values are such that the clipper can be inserted where



SPEECH CLIPPER

By D. West-Henry

there is an audio swing of some 5V to 10V or so. This means that it can usually be placed before the driver, in a transmitter, or before the output stage, in a receiver.

Current is drawn from the existing power pack. The 8µF condenser and 47k resistor merely serve to decouple and smooth the supply to the clipper.

When the clipper is used with a receiver, the output to the following valve grid may be taken directly from the 0.01 µF condenser. The receiver volume control should be earlier in the circuit than the clipper. With all ordinary circuits, this will be so if the clipper precedes the output stage.

When the clipper is used in a transmitter, the clipping action produces square waves and high frequency transients which could cause over-modulation or splatter. The filter thus becomes necessary, and is intended to cut off frequencies beyond approximately 3,000c/s. This does not make 3,000c/s. This does not make much difference to voice quality.

Wiring

A wiring plan of the unit is shown in Fig. 3. The unit can be Fig. 1.—This represents the way in which the clipper is used in a transmitter.

constructed entirely on one side of a 2in. x 7in. or similar aluminium box. The simplest method of construction is to wire the unit on a metal plate with flanges, then add the sides, etc., to complete the box. Complete screening was not found necessary if the unit were suitably placed, but is necessary if the location of the unit might result in hum, instability, or pick up of R.F.

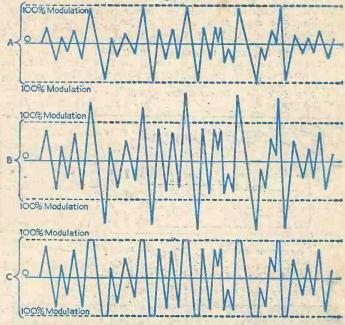
Reasonably short screened leads are provided for input and output connections. It is then only necessary to open the grid circuit of the driver or output valve to include the clipper in circuit. As the unit is in the grid circuit, the screening is necessary to avoid hum or instability. The choke should also be clear of the field near mains transformers or output transformers.

Any normal H.T. voltage is itable. The 6H6 will require suitable. 0.3A at 6.3V for its heater.

Receiver Adjustment

Initially, set the 100k potentiometer so that adequate positive voltage reaches the 6H6 anodes. Adjust the receiver volume control for the usual head-

phone or loudspeaker output which is required. The clipper potentiometer control knob is then slowly rotated in a clockwise direction, until volume just begins to fall. It should then be found that turning up the receiver volume control causes no further increase in output from the headphones or speaker.



Results will be best if the clipper is so adjusted as to allow a normal degree of volume, and the receiver volume control is set for average volume from the station tuned in. If the clipper is adjusted to clip at a low level, and an attempt made to boost volume by turning up the receiver volume control, quality of reproduction will fall. The clipper is not a form of automatic volume control, or automatic noise suppression, but is a

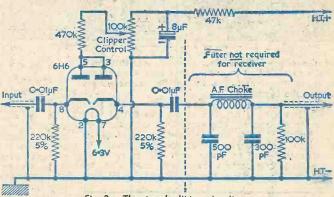


Fig. 2.—The speech clipper circuit.

means of always maintaining output between set limits.

With a Transmitter

In a 60W modulator, the best circuit position was found to be in the grid circuit of the driver. Using a crystal microphone, followed by a highgain twin triode, pentode driver, and pentodes in Class AB2, sufficient modulation power was available, with more than average clipping, if wanted.

Bass response in the modulator should be as good as possible, after the clipper. Poor bass response tends to cause sloping of the square tops

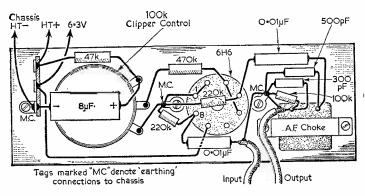
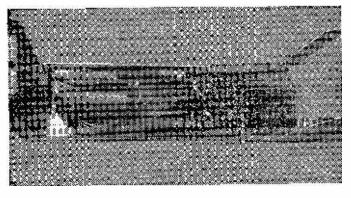


Fig. 3 (above).—This, and the illustration below, show the wiring details of the unit.



of the clipped waveform, thereby re-introducing peaks to a limited extent. Some bass suppression is quite usual, and this should be in the stages before the clipper.

A small surplus audio transformer of the type used for coupling between stages was found suitable for the choke. The inductance required is in the region of 20H, but the winding is not called upon to carry any direct current. If necessary, experiments may be made with chokes or other iron-cored components to hand, and also by changing the values of the 500pF and 300pF con-

COMPONENTS LIST

Resistors: 470k, 100k, 47k, two 220k, 5per cent Capacitors: 500pF, 300pF, two $0.01~\mu\text{F}$, $8~\mu\text{F}$ electrolytic.

6H6 valve 100k potentiometer A.F. Choke densers, or the 100k fixed resistor. If the filter cuts too severely, speech will sound very low-pitched.

Installation

If an oscilloscope is available, this can be coupled to the transmitter in any of the usual

ways which are used to check modulation. Using an artificial aerial load, set the clipper initially as described for receiving, then increase the audio gain until the 'scope shows overmodulation on voice peaks. Slowly turn the clipper control knob until these peaks cease. Increasing the audio gain, or voice level, will then give fuller modulation, without danger of over-modulation. A two-fold increase in average modulation should cause no deterioration in speech quality, and there is the added advantage that carelessly raising the voice or speaking too near the microphone cannot cause over-modulation.

If a 'scope is not available, a temporary circuit may be arranged to show when the P.A. anode is driven below zero voltage. This can be carried out by connecting a valve rectifier from the P.A. side of the modulation transformer, to a limiting resistor and sensitive meter, the latter being connected to chassis. The rectifier should have an inverse voltage rating at least equal to twice the P.A. H.T. voltage, and its cathode or heater is taken to the modulation transformer. Heater current is drawn from an adequately insulated heater transformer, or from an insulated and protected dry battery. When modulation exceeds 100per cent. in the negative direction, the valve rectifier will con-

duct, giving a momentary indication on the meter. The clipper is adjusted until these indications cease.

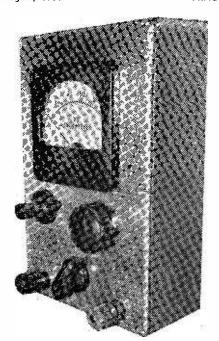
Splatter

It is also possible to listen for splatter, each side of the carrier frequency. The station receiver can be used for this, with its aerial and earth terminals shorted to prevent overloading.

Once the clipper is set so that it operates at just under 100per cent modulation, it will not need further adjustment in the normal course of events, when used with a transmitter or receiver. It is necessary to have some extra audio gain available, compared with that which would give 100per cent modulation without the clipper in circuit

clipper in circuit.

The layout of components in this unit is not critical, but if that shown in Fig. 3 is followed the unit will function free from adverse effects which might otherwise be encountered.



A Sensitive Multimeter

A 10,000Ω/V INSTRUMENT By R. Murray-Shelley

MULTI-RANGE test meter is an instrument which is almost essential when servicing electronic equipment, or when carrying out experimental work. The unit to be described is very suitable for both these applications. The meter has a total of sixteen ranges, and a basic sensitivity of $10,000\Omega/V$ —sufficiently versatile and sensitive for general use, yet at the same time being sufficiently robust to withstand a certain amount of rough handling.

The Basic Movement

The accuracy and reliability of any instrument of this kind depends to a large extent on the basic meter movement. This instrument is designed around a moving coil meter having a full-scale deflection of $100\mu A$, and an internal resistance of 1000Ω . The values of the shunts and multipliers given are based on a movement having these characteristics; however, the formulae required to calculate these resistor values are to be provided, and therefore almost any movement, of which the full scale deflection and internal resistance are known, could be used.

The larger the scale of the meter, the more accurate the finished instrument will be. A meter having a 2½in. scale was used in the prototype, and such units are readily obtainable from government surplus suppliers. A mirror scale is a very useful addition, since this will prevent errors due to parallax when taking readings. The scale of the meter should be calibrated from 0 to 100. Meters with scales having unusual calibrations will have to be recalibrated, though these should be obtainable more cheaply than the former types.

Ranges

The meter as it stands will only measure current to a maximum of $100\mu\text{A}$ (or 0.0001A) and volts to 0.1. (This follows from Ohm's Law—V=I x R—the resistance in this case being $1,000\Omega$.) To enable the meter to measure larger currents and voltages resistors known as multipliers (for voltage) and shunts (for current) are placed in series and parallel respectively with the meter, as required. In this instrument they are selected by means of a rotary switch. The ranges so obtained are: D.C. volts—0-3, 0-10, 0-100, 0-300, 0-1,000. A.C. volts—0-10, 0-100, 0-300, 0-1,000. Current—0-100 μ A, 0-1mA, 0-10mA, 0-100mA, 0-1A. Resistance—0-10k, 0-1M.

Voltage Ranges

This instrument is intended to measure both direct and alternating supplies. However, since a moving coil meter which will only respond to direct current is being used, then the alternating current must be rectified before being applied to the meter. Another point which must be considered is that an alternating supply can be measured in two ways. Either the mean, or average, voltage may be measured, or the root mean square (r.m.s) voltage may be obtained. This latter differs from the first by a factor of 1.11.

COMPONENT LIST Meter 100μ A full scale deflection, 1,000 Ω internal resistance MR 4 Westectors, type WX3, connected in bridge circuit or meter rectifier 29k (31k in parallel with 470k) 99k (90k in series with 9k) R2 R3 R4 3M (2·7M in series with 300k) R5 IOM R6 81.1k (75k in series with 6.1k) R7 890k (820k in series with 68k) R8 R9 9.0M (5.6M, 2.2M and 1.2M in series) R₁₀ III II Ω (100 Ω in series with II II Ω – see text) 10·101 Ω (wire-wound—see text) 1·001 Ω (wire-wound—see text) RII RI2 RI3 0.10001Ω (wire-wound-see text) RI4 150 Ω (see text) **R15** l Ok VRI 5k linear carbon Cell 1.5V (e.g. U10 cell) Terminals, knobs, box, connecting wire, etc. 3-pole, 2-way rotary switch **S2** 3-pole, 12-way rotary switch.

This quantity is known as the form factor, or, more properly, the waveform factor. The average value is, however, little used today, and most references in A.C. terminology are made to the root mean square form of measurement. For this reason the instrument is designed to measure r.m.s. volts directly.

TABLE I Eureka Copper 40s.w.g. Resistance 22s.w.g. 26s.w.g. 28s.w.g. $\Pi \cap \Omega$ 30ft 3in. 9ft 43in. 8ft I 1 in. 10-101 Ω 1·001 Ω 2ft Ilin. 0·10001 Ω 2ft lin.

The formula for obtaining the multiplier values for the direct voltage ranges is:

 $R = \frac{V}{Im} - Rm$

where V is the maximum voltage to which the meter is required to measure, Im is the meter full-scale deflection in amps, and Rm is the internal resistance of the meter.

For alternating voltage ranges, the formula

 $R = \frac{E - 1}{Im \times 1.11}$

where E is the required full scale alternating r.m.s voltage.

A voltage drop occurs across the rectifier, and allowance must be made for this when calculating the multiplier values. This drop is considered as being IV, which is found to be quite satisfactory in practice. The rectifier itself consists of four Westectors (type WX3) connected in a bridge circuit. These rectifiers are of the copper oxide type and are very suitable, having a maximum output current of 100μ A. They are small, and connection is made to them through their wire terminals. Alternatively, a miniature bridge rectifier, sold as a meter rectifier, may be used. They can thus be wired directly into the circuit and are self-supporting. Changing from direct to alternating voltage ranges is accomplished by means of a 3-pole, 2-way switch connected as shown in the circuit diagram (Fig. 1).

Current Ranges

The instrument will measure up to 1A in five ranges. This is more than adequate for normal servicing of radio and television equipment. The shunts are of a much lower resistance than the multipliers used for the voltage ranges, and therefore they may be conveniently wound by hand. The values and the lengths of resistance wire or insulated copper wire required are given in Table 1.

(To be continued)

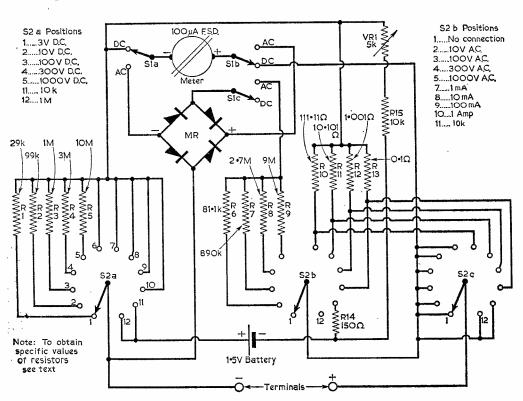


Fig. 1.—The complete circuit of the meter.

HIS unit is a two-stage receiver of simple design and construction, with a performance which may surprise those who are not familiar with the capabilities of the super-regenerative circuit at high and very high frequencies. Two acorn valves are used, and these together with the remainder of the components, may be obtained for a few shillings. The heater rating of each valve is 150mA at 6.3V (though they operate satisfactorily at a lower voltage) and the total H.T. consumption is less than 2mA at about 100V, so that few constructors will find it necessary to provide a separate power pack, though details of a suitable unit will be given. In spite of its simplicity of construction, the receiver is capable of giving an A.F. output equal to that of the usual type of tuner. When fed from a reasonable aerial, and carefully adjusted, the output, from a good amplifier has a very satisfactory quality, and the background is quiet. Further simplification of the circuit and adjustment is possible, though at the expense of some gain; details will be given below. Little or no drift occurs on warming up.

AN ACORN F.M. TUNER

A BAND II PRE-AMP AND F.M. TUNER

The receiver consists of a conventional pre-amplifier (Fig. 1a) designed round a 954 valve, followed by a 955 acorn triode in a super-regénerative circuit (Fig. 1b). In the prototype the two stages were con-structed separately, the first having been used originally as pre-amplifier and, occasions, as a 90Mc/s signal generator. This stage is recom-mended to those in fringe areas whose conventional tuners, in spite of being provided with a good aerial, require some preamplification of the signal. modified form, having less gain, has given excellent results in Oxford—a fringe area—when followed by a converted R.F. 26, the aerial being a 2ft vertical rod attached directly to L1 (since it was not possible to use even an indoor dipole). In these conditions a commercial tuner gave no result at all, and the output of the converted R.F. 26 alone was almost inaudible. audible. Although it might have been expected that the pre-amplifier would introduce

noise, none could be detected in the output, and the quiet background and freedom from interference which are associated with reception of the F.M. transmissions were obtained.

Construction of the Pre-amplifier

First, the coils are wound, each consisting of 7 turns of 28s.w.g. enamelled wire close wound on a ½in. former, with a $1\frac{1}{2}$ turn coupling coil of thin, PVC-covered, wire over the larger winding. The turns are cemented in place with polystyrene cement, Balsa cement, or Durofix. The coil formers and cans, size ¾in. diameter by 1in. tall, were recovered from a disused TV chassis, and iron dust cores are used for tuning. The can size is not important, but the number of turns must be

By C. J. Lloyd HT.+ Ct 1500pF 90-100V VRI 100k 1.5-2mA C7 ○•○∫µF \$100k V1 Note All resistors are 1/2 watt 000 rating Output See Č6 1500p**F** C2 1000 R4 Aerial S 22k **R3** Chassis [a] [b]

Fig. 1.—The complete circuit of the tuner.

suitably adjusted if the diameter of the former differs from ¼in. Those used in the prototype have the merit of small size, which facilitates compact construction and short wiring. Further, the coil formers were fitted with six tags instead of the usual four, so that two tags were available for use as anchor points for the H.T. supply lead and decoupling capacitor. In their absence it would have been necessary to provide a tag strip, and to increase the size of chassis to accommodate it.

The prototype chassis is of heavy gauge tinplate, 2in. square, whilst both stages can be accommodated on a chassis 5in. × 2in. It is suggested that a suitable piece of metal be cut and bent as shown in Fig. 2, which also gives dimensions for drilling; the upturned edges give rigidity and yet

permit ease of soldering, and sides may be sweated on to complete the box form when wiring is complete. The dimensions may be altered to suit different sizes of coil can and other components, but the constructor must aim at rigidity, compactness and short wiring if instability is to be avoided. If aluminium is used, earthed soldering tags must be provided and the sections will have to be bolted together where tinplate would be

- 5"--±1<u>4″</u> Bend up-Screen Bend down 3/8 Bend 11/3 Bend up down

Fig. 2.—The drilling dimensions for the chassis.

sweated. A slight rearrangement of components

would allow a 20z tobacco tin to be used.

The 954 valve, supported by its wiring, projects through a $\frac{3}{16}$ in hole in a screen sweated to the main chassis as shown in Fig. 3. For this operation, a large hot iron is recommended. Before inserting the valve, an insulating 'washer' of thin paxolin or waxed paper is fitted to prevent the valve pins, or their wiring, from accidentally touching the screen.

The coil formers should be mounted so that the positions of the tags permit the wiring to be kept short; resistors and capacitors should be of small dimensions for the same reason. The wiring of earthy end of L1 being taken to the earth point on the screen shown in Fig. 3. This diagram will enable the wiring of the 954 to be completed; it shows only the relative positions of the components, and it will be found that the wiring is more compact than Fig. 3 suggests. Soldering to the valve pins is simple, but it must be done with care. Fairly thin wire, well tinned, must be used, and a loop made to fit the pin of the valve. The loop should be held in position at

the end of the pin, when very brief contact with a really hot iron carrying a little solder will make the joint without cracking the glass seal.

The Super-Regenerator

In the opinion of the writer, this circuit has been undeservedly neglected in recent years. older generation of experimenters will remember it for its performance on the short waves before the superhet become popular, but some comment on it may be appreciated by others. Referring to Fig. 1b, the valve is connected as an oscillator at signal

frequency, the H.F. choke taking the place of the usual anode load. The values of R4 and C5 are so chosen, however, that rectification of the oscillation at the grid charges C5, blocking the grid and quenching the oscillations until the charge leaks away through R4, when the valve again oscillates. This cycle of operations is

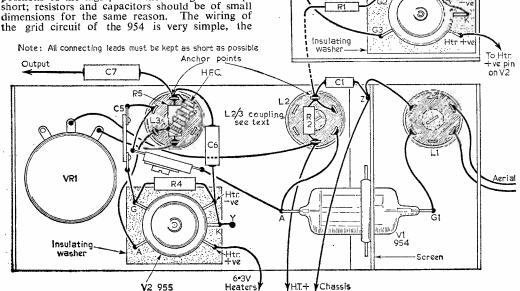


Fig. 3.—The component layout and wiring diagram.

repeated, maintaining the valve in its most sensitive state. An A.M. signal fed to the gridanode coil is demodulated and, the impedance of the choke to A.F. being virtually zero, the A.F. content of the signal appears across R5/VR1. and is taken from C7. C6 bypasses the quench frequency, and its value will affect the operation of the circuit to some extent, but its value is not critical; if made too large there will be some loss of 'top'. The frequency of quenching is determined largely by the time-constant of R4/C5 and it is, of course, supersonic, but it must not be greater (and preferably much less) than 1/100 of the signal frequency. It is for this reason that the super-regenerator is not suited to reception on the medium and long waves. The circuit is very sensitive to changes in the period in each cycle during which quenching is in operation, and VR1,

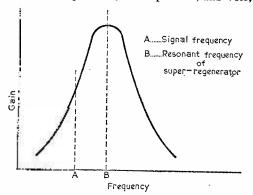


Fig. 4.—This shows the gain of the 954 valve plotted against the frequency.

which varies the anode voltage of the valve, is included to adjust the working conditions to the optimum. It will be found that VR1 must be carefully adjusted for best results, and after the preliminary setting up it might be advantageous to replace it with a variable resistor of lower value, together with a fixed resistor, to cover the range of resistance required.

Quality

Since the operation of the circuit maintains the valve in its most sensitive state, its amplification is much greater than in any other configuration. It is, however, incapable of giving good quality from A.M. signals (though speech is satisfactory), and it has at times been accused of being temperamental. This reputation is not deserved; if construction and adjustment are carefully carried out, the circuit is perfectly stable. The tuning is relatively broad, but this is offset by the fact that the valve tends to respond only to the strongest of the several signals which may simultaneously reach it owing to lack of selectivity in the preceding stages. Tuning is comparatively easy, since a loud hiss, which indicates that super-regeneration is taking place, disappears when a carrier is tuned.

It must be emphasised that on no account must this circuit be used without an R.F. stage to isolate it from the aerial, as its quenched oscillations will cause interference over a wide area, not merely to BBC transmissions but to those of essential services. Interference from an unscreened coil or H.F. choke can be troublesome, but tests have been made with the prototype, using a standard type of FM tuner to detect radiation, and the constructor may rest assured that no trouble will be caused in this respect.

f.M. Reception

Fig. 4 shows diagrammatically the gain of the valve plotted against frequency. If the F.M. carrier frequency is at point A, changes in frequency owing to modulation will cause corresponding changes in gain, and the A.F. signal will appear at the anode of the valve. Further, if the straight line portion of the graph about A will accommodate the full frequency variation, distortion will be absent; thus the broad tuning of the superregenerator is an advantage. It will be seen that the transmission may be tuned at two points, one on either side of the peak. The setting of the carrier at an off-peak position means that the maximum gain of the valve cannot quite be realised, but the amplification at VHF is so great that the small loss is of little consequence.

Construction of the Super-Regenerator Stage

The 955 envelope projects through a noin hole in the chassis (Fig. 3), and again the pins are prevented from shorting to earth by an insulating washer. Coil L3 is identical with L1 and L2. Several small R.F. chokes from surplus VHF equipment have been used successfully, but a suitable choke may be made by winding 60-100 turns of 32s.w.g. enamelled wire on a 1/2 in. former. Fig. 3 shows the disposition of under-chassis components, and also the valve wiring.

Resisto		PONENTS LIST			
(All ½W)					
RI	100k	R4 22k			
R2	4·7k	R5 47k			
R3	lk	R (Fig. 5)25—120 k IW			
Capaci	tors	(3)			
ĊI	500þF	C2 1000pF			
C3	1000₽F	C4 trimmer, see text			
C5	I00pF	C6 1500⊅F			
C7	0•0ĺ μF				
Smooth	Smoothing capacitors 8—8µF				
VRI	IÕOK	, , ,			
VI	954	V2 955			
H.F.	Choke	Mains transformer			

Power Supplies

If power is drawn from an existing source, e.g. an A.C. mains amplifier, it will be necessary to include a ½W or 1W resistor in the H.T. supply line, and, since the current required is only 1½-2mA, the resistor will have to be of a high value — not less than 100k — depending on the voltage available at the amplifier. The H.T. line voltage of the tuner is not critical, and the 954 will take 250, but the anode voltage of the 955 at its optimum working point is of the order of 50 and too high an H.T. voltage will create difficulty in the operation of VR1, which may

have to be increased in value. A decoupling condenser of, say 1 or $2\mu F$, should be connected from the slider of VR1 to chassis.

A suitable power pack is shown in Fig. 5, where the value of R must be chosen by experiment to give the necessary low H.T. voltage; smoothing is adequate. Suitable transformers are sold for use in struments and pre-amplifiers—the writer uses one taken from a very old battery eliminator.

Coupling the Two Stages

Several methods of coupling the two stages have been tried, and the constructor is recommended to experiment for himself. In general, the closer the coupling the better the signal but the more critical the tuning and the greater the influence of the tuning of L2 on L3, and vice The 1½ turn windings on L2 and L3 may be connected together, either directly or with a small capacitor, preferably variable, included in the loop. Direct connection is recommended for preliminary experiments — in the prototype this method produces an output equal to that of the usual type of tuner. The writer uses a 3-12pF trimmer between the anode of V1 and the junction of L3/C5, adjusting the capacity (which is not critical) to give the best compromise between output and ease of adjustment. Alternatively, this capacitor may join the anodes of V1 and V2.

Adjustment of the Pre-amplifier

A pre-amplifier is a poor substitute for a good aerial. Articles on the construction of VHF aerials have appeared in this magazine, and the best that conditions permit should be used. The H.T. voltage should be raised to 230-250, and the aerial twin feeder connected to the coupling coil of L1, a short length of twin feeder being used

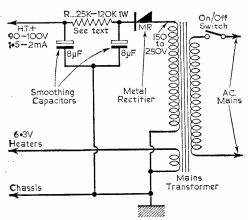


Fig. 5.—The circuit of a suitable power pack.

to connect the 1½ turn coil of L2 to the aerial input of the set. If V2 has been included in the unit it must not be permitted to oscillate, and the H.T. supply to it should be disconnected. L1 and L2 are then tuned, using a 'screwdriver' made from a plastic knitting needle (or even a matchstick) until they peak on the Network Three (Third Programme) frequency. Resonance may be judged by ear, but better by connecting a volt-

meter (10V range, $500\Omega/V$ or better) across the electrolytic capacitor in the discriminator stage and tuning for maximum reading. There will be no sign of instability, indicated by a sudden large increase in the meter reading, when L1 and L2 are brought to resonance, if screening is adequate, the wiring is short and a common earthing point is used. The coils may then be slightly staggered in tuning, screwing one core in and the other out until the meter (or the ear) indicates that amplification of the Home, Light and Third Programme frequencies is the same. Alternatively, if required, resistors may be soldered in parallel with the main windings of L1 and L2 to broaden the tuning-5 or 10k may be tried—but some loss of gain will follow. The cores should finally be sealed in position with wax. If maximum amplification is necessary, a worth-while increase in gain is obtained by tuning the coils to each station as required, a procedure less tedious than it sounds if the core is provided with a suitable extension, e.g. a short length of plastic rod or tube.

By coupling output to input, using an inch or two of flex, L1 and L2 being in resonance, a Band II oscillator is obtained which may be found useful in aligning an F.M. receiver. If the valve refuses to oscillate the connections to one of the coils should be reversed. Care must be exercised in its use—it can cause interference—and the H.T. voltage should be kept as low as possible consistent with oscillation. A loop of wire, connected to the aerial input of the receiver by a length of twin flex and placed near the oscillator will pick up the signal, and movement of the loop will vary the input to the set over a

wide range.

Adjustment and Operation of the Tuner

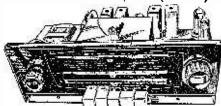
VR1 is set to minimum and the 955 tested for oscillation by shorting its grid to earth when the anode current will rise and the anode voltage fall (note that a high resistance voltmeter must be used owing to the high resistances in the circuit; also note that if the H.T. voltage is too low for oscillation to occur, the same effects are noticed on shorting the grid to earth).

Connecting to an Amplifier

The output is fed to an amplifier, or to high resistance phones, through C7, coaxial cable being used for the amplifier connection. hiss will indicate that super-regeneration If the pre-amplifier stage has place. been aligned as described above, tuning should bring in the transmission, when L3 the three cores are trimmed, and VR1 adjusted, for best results The prototype can be aligned, however, in a few minutes by connecting the aerial to L1, searching for a signal and making a final adjustment of the cores. If difficulty is experienced, it is useful to remember that a brass nut stuck on to the bottom of the core will give a wider range of tuning and will correct a coil with too high an inductance. If a signal generator is available, a modulated signal should be injected into L3 when the resonant frequency of L3 may be found and adjusted: the signal is then transferred to L1 and the first stage aligned.

(Continued on page 319)

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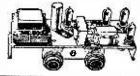
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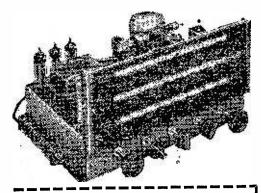
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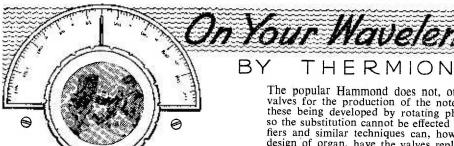
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The Radio Show

S I write these lines information is beginning to trickle through from the various manufacturers concerning the wonders which they will be revealing to the public at this year's Radio Show. As usual, much secrecy surrounds some of the proposed exhibits and I do hope that some of the suggested ideas materialise this year. Previously I have heard rumours about items which were going to be revealed at curtain up, but which had, in fact, not got beyond the laboratory-and in some cases not even progressed beyond the drawing board. I have not yet, however, heard much which will interest the home constructor. Suppliers for this band of enthusiasts now seem to be dwindling to infinitesimal proportions, and the amount of apparatus seen at the show, to interest him, becomes smaller and smaller. One old faithful is still there, however, although his sights now seem to be laid on the manufacturer, with the poor home constructor waiting to pick up the odd items which fall from the table. This seems a great pity, and I well remember the day when the late Mr. Camm suggested that future exhibitions should have a separate components or home-constructor's section—there was so much available and it was included with complete receivers and other apparatus on the stands and many complaints were received by us concerning the difficulty of seeing these particular items. The Component Makers Exhibition is now a twoyearly affair and is more for the trade, so the amateur is more or less forced to rely upon the surplus market, but I must admit that this does provide a most interesting field—especially for those who are young in heart and have plenty of spare time. Some of the surplus equipment, which can now be obtained, provide a most interesting source of items when one is able to settle down and dismantle them, whilst others, wrapped in mystery, and in the absence of circuits and service manuals, provide many interesting hours of investigation to find out firstly what they are and how they function, and secondly to find a circuit or arrangement in which they can be used.

Those Transistors

I still receive much correspondence on the subject of transistors, and recently heard from an enthusiast who wants to build an electronic organ of the standard type, but using transistors. I am afraid this is rather a problem and I do not think it has been successfully tackled yet—even in America.

The popular Hammond does not, of course, use valves for the production of the notes and tones, these being developed by rotating phonic wheels, so the substitution cannot be effected here. Amplifiers and similar techniques can, however, in any design of organ, have the valves replaced in most cases by transistors, but I have not yet heard of a transistorised oscillator which will develop sufficient harmonics to provide a six or seven octave keyboard. It should be quite a saving from the power and space point of view, but I wonder if the enclosed circuitry in an organ body would be subject to too much heat. It seems that stability would suffer, even if one could find a satisfactory circuit, and I am afraid I must leave this type of development to the expert in this field. I should, of course, as always, be glad to hear of any successful experiments which readers have carried out in this particular connection.

The Printed Circuit

I recently had an opportunity of going over a factory which concerned itself solely with the production of printed circuits, and I found this a most fascinating subject. The old methods have disappeared, and the accuracy now employed in the making of these circuits is almost astounding. The depositing of the metallic layer, for instance, is controlled to such a high accuracy that two or more layers may be deposited on such an item as a small circular spring to provide exactly the right degree of tension, and when one considers that the overall diameter of this spring is less than half an inch and it consists of spiral slots removing nearly half of the total, one has to admit that this is indeed a "printed circuit par excellence" the other extreme, of course, there were the large computer panels which could be made up to about 10ft square. One would think that the manufacture of this type of apparatus was not controlled to the same degree as some of the more delicate components parts used in modern electronic equipment. I was very surprised, therefore, to find that in the manufacture of the printed units there is one section which is of the modern dust-free, aircontrolled type almost on the same lines as those employed in a modern transistor manufacturing building. All the operators wear special dust-free overall equipment, and the air is washed and controlled in a most remarkable manner. I wonder how far this printed technique will progress as techniques are developed in this ever widening field of radio and associated practices?

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COMPLETING CHASSIS No. 3 - THE VARIABLE FREQUENCY AUDIO **OSCILLATOR**

By E. V. King

THE P.W. SIGNAL **GENERATOR**

(Continued from page 257 of the July issue)

EFER to Fig. 21; July issue. Wire in R22 between pin 1 (V4) and pin 6. Make sure it does not touch the centre spigot.

Wire in R23 between pin 3 and earth. Join

wire in R23 between pin 3 and earth. John R25 and R24 together, using short leads, and solder R24 to pin 2 and R25 to chassis.

From the junction of R24 and R25 take C18 to the last unearthed tag of the tag strip, and from there a lead straight across the unit to the centre tag of VR1. Remove C17 from the position shown in Fig. 19 and solder it between pin 1 and the pert tag but one of the strip, and continue and the next tag but one of the strip, and continue with a lead across the unit to the output socket (C16 has already been removed).

Testing the Oscillator, Cathode Follower and Amplifier

Connect phones to the output socket and switch on. With the output control on full, the volume should be such that it can be heard a yard or two away from the phones. On switching S5, the note will change somewhat. It should be possible to control the volume with VR1.

If an A.C. valve voltmeter is available, the output from this unit should be in excess of 100V with VR1 full on. The prototypes (three were built) all gave between 150 and 180V peak-to-peak output on the middle range.

Adding the Variable Potentiometer

In order that the frequency may be altered, the values of the resistances R17 and 18 must be made variable by a series arrangement of a pair of ganged potentiometers. (The circuit is given in Fig. 22.) These should, if possible, be of the "log" type to avoid undue cramping of the frequency scale at the top (high frequency) end of the scale. A "log"-scaled potentiometer connected wrongly will make matters even worse!

The potentiometer is fixed on a metal bracket which is soldered to the top of the chassis, Fig. 23. It must go on the right side looking from the front to allow room for the main R.F. frequency dial to come later. When finally fixed, make sure the Fig. 23 shows the tags do not short to earth. potentiometer with the tags facing upwards; this is done for clarity—finally it is rotated so that the tags are underneath and the wires short.

Underchassis Wiring (Fig. 23)

R18 (see Fig. 17 last month) is removed completely, R17 (Fig. 17) is unsoldered from pin 7 of V3a and the wire shortened. Note that it is left connected to the tag strip. Make sure C12 is still connected to pin 7 of the valve (V3a).

Above-chassis Wiring

The centre tags of both potentiometers are connected together (see Fig. 23) and a lead is

taken from the junction, through a grommeted hole, to pin 7 of V3. The remaining two tags to be used are connected as shown in Fig. 23 -one via R18 to chassis and the other to the end of R17 (the end which was disconnected from pin 7 of V3a).

Testing

Plug into the mains and connect phones to the output socket. With VR2/3 turned fully clockwise, the frequency of the note heard should be exactly as it was before. As VR2/3 is moved anti-clockwise the frequency will become lower, going down to about 150c/s. If any trouble is found in testing, it can only be due to a fault in the wiring or in the components just added. These should be thoroughly checked.

Adding the Variable Range Switch and Condensers

Readers who wish to do so may experiment by replacing C11 and C12 by other condensers of any similar values. They will find that the frequency range is altered and that VR2/3 still operates.

In order to make the instrument cover the range given, condensers will have to be switched in as

required (see Fig. 24). The ranges of the prototype were as follows:-15c/s to 330c/s (by

the addition of C19/ 20 and S6/7).

3.3kc/s 15c/s to (this range is now working).

1.5kc/s to 33kc/s (by addition of C21/ 22 and S6/7).

There will be no difficulty if beginners follow the instructions carefully.

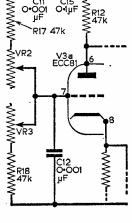


Fig. 22 (left).—To make the frequency of the audio note produced variable, two ganged potentiometers must be added.

Fig. 23 (right).—The wiring of the two ganged potentiometers.

Wiring CII and CI2 via S6/7

Temporarily remove C12 (see Fig. 23). Make sure there is now only one lead on to pin 7 of V3 (see Fig. 25). Examine the wiring of V3 again as it will be difficult to reach later. Solder a lead on to pin 7 (V3a), making two leads in all on this pin. One goes to the sliders of the potentiometers and the other, just fitted, is taken to contact "a" of S6.

The Switch (S6/7)

If a switch similar to that in Fig. 25 is used, the beginner will find the wiring easy. In Fig. 25 the switch is shown to the left

as it looks when viewed from the rear, and the wires are lettered to correspond to the switch

contacts (see also Fig. 24).

If any other switch is used, great care is necesary other swhen is used, great care is necessary to distinguish the connections before fitting:
"a" must make contact with "d" at the same time as "b" makes contact with "h"; "a" must make contact with "e" when "b" makes contact with "j"; "a" must make contact with "t" when "b" makes contact with "k". This will ensure that two similar condensers are always in the circuit two similar condensers are always in the circuit at the same time. Do not proceed until you are quite sure about these switch connections (check with Fig. 24).

Refer to Fig. 25. The lead from pin 7 (V3a) to "a" has been connected. Remove R17 from the internal tag strip (see Fig. 23) and solder it to "b" on the switch. Adjust the length of the wire as necessary. R17 will be held "in the air" about in. from switch. (The other end is left as already

wired.)

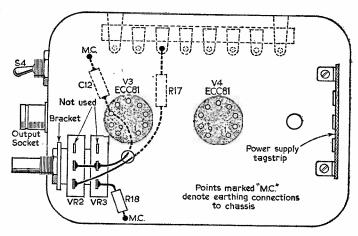
Earth two tags on the tag strip as shown in Fig. 25. Connect the three condensers C12, C22 and C20 to these earthed tags and connect the others ends to switch contacts "e", "d" and "f" respectively.

Remove C11 from the tag strip (see Fig. 17 last month), and unsolder C15 from the tag strip. The end of C15 just unsoldered is now soldered to a new tag strip similar to the one on the other side of the chassis. On this tag strip, all tags except the end ones are insulated from

the chassis.

C11 (previously removed) is now fixed to this new tag strip; a lead continues to "j" of the switch (see Fig. 25). Solder C19 as shown, and continue a lead to "k" on the switch. Fix C21 as shown and continue a lead to "h" on the switch.

Fig. 25 (right).--The wiring for the modifications included in Fig. 24.



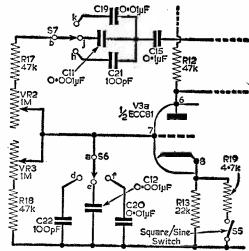
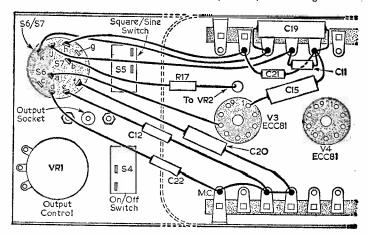


Fig. 24 (above).—The circuit of V3a modified to include switched capacitors for three ranges.



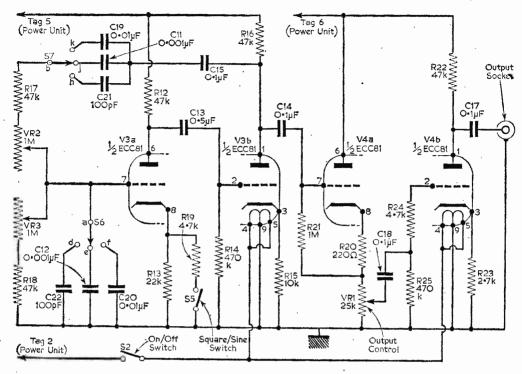


Fig. 26.—The complete circuit of the Variable Frequency Audio Oscillator—Chassis Number 3. This circuit is given only for reference and only experienced constructors should attempt to build this unit without employing the progressive constructional details given in this and previous issues.

Testing the Unit

Turn the switch S6/7 fully anti-clockwise, then one click clockwise. Test as before. The unit should now work as it did after fitting the potentiometer, but before fitting the range switch. If it does not, either some wiring has been moved (to cause a short circuit) or a mistake has been made in the wiring.

COMPONENTS LIST For Figs. 22 to 25 0.01 µF 1000 or 750VW 0.01 µF 1000 or 750VW CI9 **C20** C2I 100pF mica or ceramic C22 100pF mica or ceramic The higher the tolerance of CII, 12, 19, 20, 21, and 22, the better the instrument will be. Optional wave shaper For this RI3 is changed to a 4.7k component and a variable resistor of 25k is put in series

with it. This will have to be mounted on the back of the cabinet. It may prove valuable when used in conjunction with an oscilloscope. If this is incorporated, R19 and S5 are not required

S6 and S7 Two pole, three way single wafer switch

VR2, 3 IM potentiometers

Turn the switch fully anti-clockwise. The note will now be very low when the potentiometer is turned anti-clockwise, each pulse being heard clearly in the phones. Probably the unit will tune down to about 10c/s. When the sine/square switch is placed at "square" the pulses will be very sharp—rather like the "cracks" of a geiger counter.

Turn the range switch fully clockwise, and then back one click. This will give the high pitched, whistle-like range. (Some older people will not be able to hear the extreme high frequency range. say, from 16kc/s to 35kc/s.)

Current Consumption

H.T. lead to tag 5 on power unit: 0.5 to 0.8mA according to the frequency setting.

H.T. lead to tag 6 on power unit: Between 5

These values should be checked and the exact value noted in case a fault develops later.

Circuit

The complete circuit of the oscillator is given in Fig. 26. No beginner should attempt to make this in one go; the chances of his success would be poor. The circuit is given, so that, having built the unit, the beginner will be able to see the whole circuit at a glance. This is valuable if any trouble should arise.

(To be continued)

VOICE-OPERATED SWITCH

A DELAY MECHANISM FOR USE WITH A TAPE RECORDER

N order to widen the range of any taperecorder, a simple voice-operated switch may be employed. In a unit of this type, the audio signals are employed to actuate a relay which opens ore closes the capstan motor circuit, and also that of the bias oscillator. By virtue of this switch, the tape is only running when it is desired to record, and a saving in tape can be realised, especially if recordings are of an intermittent nature. Incorporated in the voice switch is a delay circuit to stop the switch turning off the recorder during slight pauses, or even between words. The period of this delay can be altered as explained later.

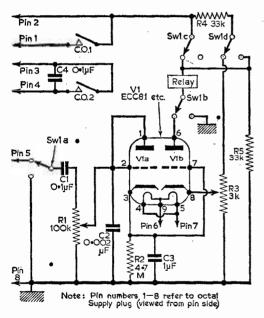


Fig. 1.—The circuit of the switch.

Power Supply

Before starting on the construction the reader would be advised to check that the tape-recorder can supply the necessary current to work the voice switch. A supply of about 200/250V at 7mA and 6.3V at 0.4A is required for the H.T. and valve heater respectively. If this cannot be accomplished, a small power supply can be made up. It is assumed that the reader has sufficient knowledge for this as no power supply details are given; circuits have appeared in these pages in previous issues.

By D. P. Francis

Operation

When normal operation of the recorder is desired, the unit is simply switched off by means of SW1. This will be so when playing back a previous recording or recording direct from a radio-jack. When switched off, the audio input is disconnected and the relay is held energised by a simple resistance network, R3, R4 and R5.

The input to the switch is taken from the output valve of the recorder at a point where it enters the recording head network, so that any audio signals present in the microphone are thus also fed into the unit via C1, R1. C1 is the H.T. blocking capacitor, R1 being the sensitivity control. R1 controls the amplitude of the signals fed into the unit, and therefore the point at which R1 operates. It should be noted that if R1 is turned towards maximum sensitivity, random noise will cause the relay to energise; needless to say, this is undesirable.

Valve V1 is a double triode, ECC81, the anode and grid of the first section being strapped together to form a diode. An ECC35 or ECC83 would also be suitable. The diode rectifies any signals presented to the anode, and a positive D.C. voltage appears across C3 and R2. These two components constitute the delay circuit. The time delay with the specified values of C3 and R2 is approximately 5 seconds. The reader can increase the value of one of them to increase the delay. Decreasing the value will bring about a decrease in the time law

lag.

This positive voltage is coupled to the grid of V1b, and if sufficient to overcome the positive bias applied to the cathode by R3, the valve will conduct and amplify the signal. This increase in the anode current causes the relay to energise, and thus switch on the recorder.

When, after recording, no more signals are fed into the unit, capacitor C2 will discharge through R2 at a rate dependent upon the C/R time constant. When the voltage charged in C2 falls below that applied to the cathode of V1a, the valve will cease to conduct and the relay will de-energise, so switching off the recorder.

COMPONENTS LIST

100k &W pot. CI 0.1 µF 350VW 4.7M 12W C2 0.002 µF 350VW R2 3k w.w. pot. C3 I µF 350VW R3 C4 0·1 µF 350VW R4 33k 2W R5 33k ½W ECC81, ECC35, ECC83 6,500 Ω relay, 2 make/break contacts 4-pole, 2-way, wafer switch Length of 8-core lead. Connecting wire Suitable aluminium chassis, size about 6in. x

4in. $\times 2\frac{1}{2}$ in.; aluminium for bottom cover and

Valveholder, solder, nuts and bolts, etc.

brackets.

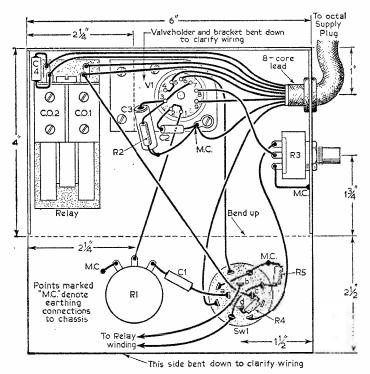


Fig. 2.—The component layout and wiring diagram of the switch.

Construction

The unit can be built within a chassis 6in. x 4in. x 2 1in. A smaller chassis could be used if a smaller relay is used, as long as the coil has a resistance of about 6.500Ω . If an ECC35 valve is used, the unit will be slightly larger than when made with an ECC81 or ECC83.

The recorder can be adapted by fitting a supply socket for the unit, such as an octal valveholder.

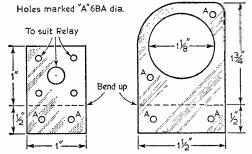
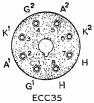


Fig. 3.—The relay support bracket (left) and the bracket to support VI (right)

A suitable hole is made at the rear of the tapercoorder for the socket, and eight leads soldered to the pins, making certain that the length of the leads is sufficient to reach the various points in the recorder circuitry.



Base connections when used as alternative to ECC81

Fig. 4 (above).—The base connections for the ECC35 valve; an eight pin plug which may be used as an alternative to the ECC81.

The H.T. supply lead to the bias oscillator is disconnected, the valve being connected to pin 1 and the supply lead to pin 2 of the socket. One of the leads to the capstan driving motor is similarly treated, and is connected to pins 3 and 4 Pin 5 of the socket is soldered to the recording head network at the junction with the output valve. This lead is for the audio input. Pins 6 and 7 are connected in parallel with one of the valve heaters. Pin 8 is the earth lead and is connected to the chassis.

The next step is to cut out suitable brackets for V1 and

relay and drill and bend them as shown in Fig. 3. Before the valveholder is mounted in position, it would be wise, and also far easier, if the holder were wired.

The positions of the various components can be seen from Fig. 2. Complete the remainder of the wiring, using a grommet for the hole through which the 8-core lead passes through the chassis. Check all wiring, ensuring that the leads are not cross-connected, e.g. heaters connected to the H.T. supply.

Adjustment

The setting up of the switch can best be accomplished with the aid of an audio signal generator or a morse code oscillator. If the reader has not access to either, a receiver fitted with a BFO may be used (beat frequency oscillator). This is carried out by tuning the receiver to a station (not a morse transmission, as this might cause the relay to chatter) and switching on the BFO. The microphone is placed adjacent to the loudspeaker or headphones. A low-range A.C. voltmeter is also required.

Using the meter, measure the voltage at the junction of C1 and R1, adjusting the recorder input control until a reading of 3V is obtained. R1 is now turned to maximum sensitivity, i.e. maximum resistance to earth. R3 is now adjusted until the relay just closes. Check that the voltage at R1 is still 3. R3 can now be sealed against movement.

(Continued on page 329)

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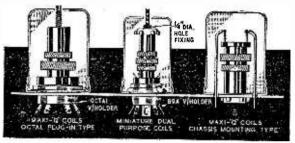
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An Amateur Communications

WIRING AND ALIGNMENT

Receiver

By P. Hayes

(Continued from page 230 of the July issue)

In last month's issue, the circuit was described and explained.

Components

There is considerable latitude in the value of the components except for the padders, grid components of the oscillators, and the tuning capacitors. Other valves may be used instead of the EF91's (for example 6AM6, Z77, 8D3, 6F12, etc.). Octal based valves can be used instead, but gain may be less, and the size of the receiver will have to be increased. An EA50 is used as the detector, but any other valve detector may be used, but most probably another valveholder will have to be drilled. A crystal diode can, of course, be used but it might be damaged if a very strong local signal is tuned in with the gain up. None of the other components is critical and they must be of 20per cent

tolerance. However, the decoupling capacitors should not be reduced below $0.05\mu F$.

Construction

The chassis can be made from a sheet of aluminium, or can be bought ready made.

The coils can be placed roughly in the positions indicated in Fig. 3. This procedure is carried out if a coil-pack is not to be used. The strip of metal nearest to the I.F. amplifier should be either of copper or another material which will take solder, or be of aluminium and have numerous soldering tags bolted on it (Fig. 5).

Wiring

The heaters and the power pack should be wired first and tested. The R.F. stage is wired next, the "earthy" ends of the components being soldered to the end of the screens between the coils. When this stage has been completed, the mixer stage is wired. The oscillator stage has to be carefully

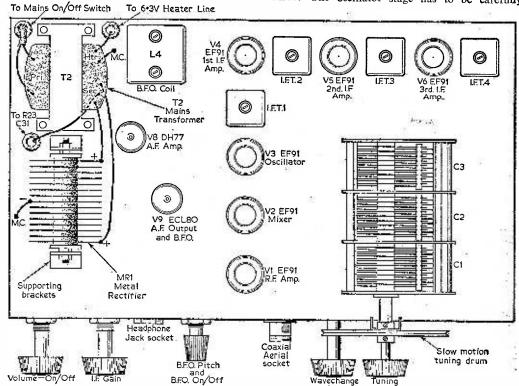
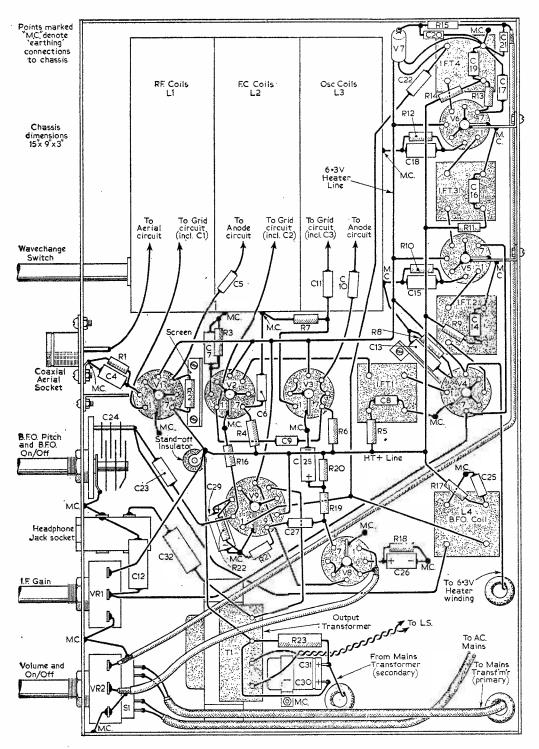
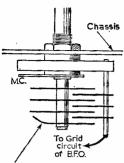


Fig. 2 (above).—The above-chassis layout of components.

Fig. 3 (on page 312).—The complete underchassis wiring diagram.





Moving vane bent to meet fixed vane when rotated to maximum capacity

Fig. 4.—A modified airspaced capacitor (C24) which is included in the BFO circuit.

constructed to avoid drift. None of the components connected to either the grid or the anode should be placed near any of the heatgenerating resistors such as the smoothing resistor, R23.

The first I.F. stage is wired quite simply, but untidy wiring should be avoided as instability

can easily occur. The lead from the first I.F.T. marked or coded AVC should be taken directly to earth. The other stages, also, should be connected as neatly as possible. No wires, especially those to grid or anode connections, should be any longer than is absolutely necessary. Even with the neatest possible wiring, instability may be experienced at high levels of gain, and the bias resistors should be accordingly increased. The reader can experiment profitably with the value of these resistors if no instability is experienced. A good way of obtaining added selectivity is to choose such a value for the cathode bias resistors that the set is on the verge of oscillation, thus giving an effect similar to the use of "reaction" in TRF receivers. A useful increase in gain is also obtainable, but valve noise is also increased.

The detector must be placed at one end of the "trough" formed by the sides of the chassis and the screens of the coil-pack. This is to avoid instability caused by the capacity between the valve and its wires and the grid connection of the last I.F. valve. It should be noted that incurable instability will almost certainly occur if the I.F.T.s are not firmly bolted down on the chassis.

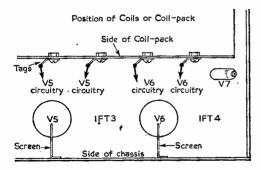


Fig. 5.—The strip of metal nearest to the I.F. amplifier should be of either copper or another material which will take solder, or be of aluminium and numerous solder tags attached to it, as indicated.

It will be noticed that screened cable has been specified for the connection from V7 to the volume control. The author has not found this necessary but it is advisable to screen this lead, and that from the volume control to V8.

	COMPONEN	ITS L	IST .
All res			therwise stated
RI	180 Ω	R13	10k
R2	4·7k	RI4	lk l
R3	180 Ω	RI5	47k
R4	4·7k	RI6	47k
R5	lk	RI7	100k
R6	4·7k	RI8	Ik
R7	47k	RI9	220k
R8	lk	R20	47k
R9	lk	R2I	100k
RIO	lk	R22	390 Ω
RII	<u>Ik</u>	R23	ik, 5W
RI2	lk		
	acitors 20per cent;	300V	W unless other-
	stated 3 x 0·0005 μF	CI7	0·1 μF
CI	S x σ·σσσσσσσσσσσσσσσσσσσσσσσσσσσσσσσσσσ	CIB	0·1 μF 0·1 μF
C3	Three gang tuning capacitor	CIP	0·1 μF
C4	0·I μF	C20	100pF
C5	0·001 μF	C21	100pF
C6	0·1 μF	C22	2ρF
C7	0-1 μF	C23	0.0001 aF
C8	0·1 µF	C24	0-25hF
C9	2pF	C25	0.1F
CIO	0.001 μF	C26	25 uF. 25VW
CH	47pF	C27	<i>0-1 u</i> F
CI2	0·5 μ F	C28	8μF
CI3	0·1 μF	C29	50 μF, 25VW
CI4	0·1 μF	C30	16 μF
CI5	0·1 μF	C31	8μF
C16	0-1 μF	C32	0·1 μF, 750VW
Vaives	E COL	V6	EF9I
VI V2	EF9I	V 6 V 7	EA50
V2 V3	EF91 EF91	V8	DH77
V3 V4	EF91	V9	ECL80
V4 V5	EF91	• /	
LIT		L4	Any I.F. coil,
L2	See text		465kc/s
13 ∫	1471		
I.F.T.	.1)		
J.F.T	2 Miniature I.F.	VRI	100k
I.F.T	.3 transformers	VR2	IM
I.F.T	.4		
TI	Output transform	er	
T2	Mains transforme		
	Primary 250V		
	Secondaries 250	-0-250	V, 100mA,
	6.3V, 3A (5V	, 2A	for heaters of
	rectifier, if u	sed)	EAV 100 A
MRI		20-0-2	250V, 100mA,
<i>C</i> .	full-wave		· .
Chas	sis 15in. x 9in.		*
Loug	speaker 3 Ω plug and socket (for he	adohones
7 R7	G valveholders wit	h skir	ts and screening
Ca			
	A valveholder		•

The audio amplifier construction is of no special importance except for the need for neat wiring to cut down on hum and to reduce instability. Apart from these necessities, the construction of the A.F. amplifier is straightforward.

(Continued on page 337)

SIGNAL GENERATOR OUTPUTS

By R. Brown

HE instruction handbook on a communications receiver usually has a long and detailed section on testing. The sensitivity, we are told, for example, should be $6\mu V$ for a 20dB signal-to-noise ratio—a figure which can be easily checked, it says, with the aid of a signal generator.

It is at this stage that difficulties first appear. The signal generator has an output attenuator calibrated in microvolts; should this attenuator be set to $6\mu V$? Will this give the correct input into the receiver, and will the signal generator effectively simulate the aerial? It all depends upon which convention the manufacturer of the instrument used.

mstrument useu.

Signal Generator Output Circuits

Connected across the output valve of the signal generator there is usually a simple valve voltmeter, which is mounted on the front panel of the instrument. It has only one calibration mark, a line which is usually marked "set carrier level". When setting up the instrument, the gain

one realises that zero internal impedance simply means that the value of E is not affected by the amount of current drawn from the generator. This condition will be met, for if a load is connected to the output terminals and the value of E falls, E is simply restored to its original value by adjusting the carrier level control.

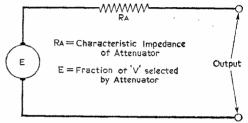


Fig. 1b.—This is the equiva'ent circuit of Fig. 1a as seen from the output terminals. The generator "E" has zero internal imbedance.

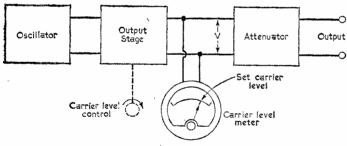


Fig. Ia.—The carrier level control (output stage gain) is adjusted until the carrier level meter deflects to the set carrier level mark. This gives an accurately known fixed input, "V" to the attenuator.

of the output stage is increased until the meter is at the "set carrier level" mark. The output stage is then giving a standard, known voltage output (V). This output is then taken, via the output attenuator (which allows accurately known fractions of this voltage to be selected), to the output socket.

Inside the signal generator is a resistance (RA), which is equal (and should have the same value at all settings of the attenuator) to the characteristic impedance of the attenuator in series with a voltage E. The value of this voltage will depend upon the setting of the attenuator, being equal to V when the attenuator is introducing no attenuation (Fig. 1a).

The generator E is shown as having zero internal impedance. This is not difficult to see if

Attenuator Calibration

With an accurately known variable voltage output, at a known and constant source impedance, the next problem is to mark the various attenuator positions. There are three methods commonly used. The first two are of value when the signal generator is to be used normally with loads having an input impedance equal to the signal generator output impedance (RA). The third method is more versatile and allows the voltage developed across the load to be found quickly and easily whatever value of load is used.

The First Method

Using the first method, the attenuator markings give the voltage developed across a certain value of load resistance—a value normally equal to the signal generator output impedance (Fig. 2a). This is very convenient because, if, for example, 100μ V is to be applied across a load, and the load has the correct impedance, then the attenuator is simply set to the 100μ V setting.

The shortcomings of this method become apparent when attempting to make measurements applied with impedence other than the setting the

The shortcomings of this method become apparent when attempting to make measurements on loads with impedances other than that of the signal generator — e.g. medium frequency receivers, which work from non-resonant aerials. The value of the voltage across the load has to be calculated each time. While this is not difficult.

it is certainly an inconvenience, particularly when a number of measurements at different voltages have to be made

ages have to be made.

The value of E has first to be found. This will usually be equal to twice the figure given on the attenuator. The fraction of E which is developed across the load has then to be calculated using the equivalent series circuit of E, Ra and the load Fig. 2b. But the value of Ra may not accurately be known, since the manufacturer sometimes guarantees that the stated voltage will appear only across the matched load. If, for example, the carrier level meter were in error over a small part of the range, the value of Ra could be altered over this portion of the range to correct this error. And this could give rise to errors when working into unmatched loads.

The Second Method

The second method of marking the attenuator has much the same type of advantages and disadvantages as has the first.

The attenuator is marked in terms of the power delivered to a matched load. This is given by $E^2/4R$.

This will, since the generator is working into a matched load, be the maximum power obtainable from the signal generator (Fig. 3a).

The Third Method

With the third method, the attenuator readings give the value of E directly. The manufacturer states the value of RA with some accuracy, and thus no particular value of load is presupposed. A calculation sometimes has to be made, but this is simple, and since RA and E are guaranteed, within reasonable limits, there is no chance of error (Fig. 3b).

The latter method is the one most suited to

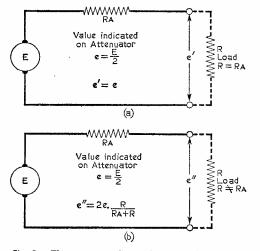


Fig. 2.—The output conditions for a signal generator in which the attenuator markings give the output voltage developed across a load having a value equal to Ra; 2a shows this condition, while 2b shows the condition when the load has a value different from Ra.

receiver measurements. The receiver manufacturer is normally referring to the source, EMF (E), when he states that the sensitivity should be $6\mu V$ for a 20dB signal-to-noise ratio.

Connecting the Signal Generator to the Receiver H.F. and VHF

As with all electronic measurements, receiver sensitivity is best checked under conditions which are as close as possible to normal working conditions. To achieve this the signal generator, when connected to the receiver input, should present the same impedance as the normal aerial.

Aerial Radiating Resistance

In the H.F. and VHF bands, a resonant aerial, such as the half-wave dipole, is normally used. The feed is taken from a current antinode, so that the impedance presented to the receiver can be considered to be purely resistive, being equal to the radiation resistance of the aerial. Aerials usually have a radiating resistance of either 50 or 75Ω , and signal generators are normally designed with either 50 or 75Ω outputs. Thus, provided that the signal generator has the right output impedance it will effectively simulate the aerial.

Changing the Output Impedance

It may well be that a signal generator having the correct output impedance is not available. Occasionally receivers are designed to work from aerials having radiating resistances other than 50 or 75Ω . This does not present any great problem, for the output impedance can be changed with the aid of external impedances,

(To be continued)

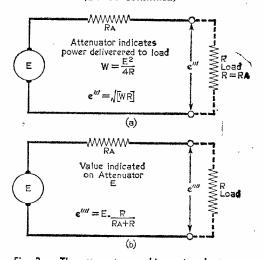


Fig. 3a.—The attenuator markings give the power delivered into a matched load, R.—Ra.
Fig. 3b.—The attenuator indicates directly the value of E.Ra is reasonably constant over the whole range of the instrument.

A STABILISED

By J. W. Adams

OONER or later the serious experimenter requires a source of H.T. which is stabilised against variations of the mains supply and output current. The unit described will conform to these requirements, providing an H.T. voltage adjustable between 150 and 300 D.C. at a maximum current of 100mA.

Construction of the unit is straightforward, and can follow Figs. 2, 3 and 4. The layout of the components is not critical, but the wiring to the control grid of V3 should be kept short to avoid introducing hum into the circuit. Note the fact that 47Ω grid stopper resistors are fitted close up to the grid pins of V2.

Voltage Control

If desired, the meters can be omitted, the voltage

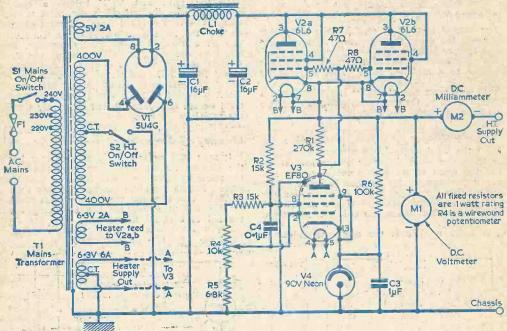


Fig. 1 .- The circuit of the unit.

Operation

The theoretical circuit is shown in Fig. 1. Briefly the circuit operates as follows: the H.T. voltage from a conventional full-wave rectifier circuit is applied to the anodes of two triodeconnected 6L6 in parallel; the stabilised output is taken from the cathodes, which are connected to one side of a separate heater winding on TI so as to prevent the rated heater-cathode voltage being exceeded.

Regulation of the bias on the grid of V2, and hence of the output voltage, is achieved by V3, an EF80, acting as a D.C. amplifier. Variations in the output voltage affect V3 through the potentiometer network R2, R3, R4 and R5, causing an alteration of the bias voltage on the grid of V2 which restores the output voltage to that selected by R4. The neon V4 holds the cathode potential of V3 at some 90V.

adjustment control R4 being directly calibrated. The smoothing choke L1 should be rated at around 120mA with an inductance of 10H.

Fig. 2b shows the major details of the chassis,

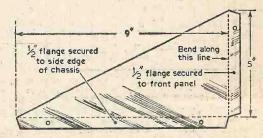
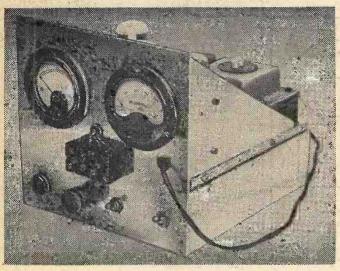


Fig. 2a.—The dimensions of the front-panel support.

POWER SUPPLY



A UNIT THAT
WILL GIVE AN
ADJUSTABLE H.T.
VOLTAGE, STABILISED
AGAINST THE
VARIATIONS OF THE
MAINS SUPPLY

The completed unit

which is made from 16s.w.g. a luminium should be cut to size and the holes for the valveholders should be cut to the correct size with a punch, or with the aid of a hand-drill and cold chisel, the resultant hole being cleaned with a half-round file. The same technique can be applied to cutting the rectangular hole for the mains transformer, the hole being omitted in the case of a transformer of the upright mounting variety. The chassis can then be bent, and the corner strengthening flanges bolted to the corresponding chassis wall.

Chassis

The panel (Fig. 3), and the two strengthening brackets (Fig. 2a), are made of 18s.w.g. aluminium to the dimensions shown and care should be taken to ensure that the various holes line up with the corresponding holes in the front wall of the chassis. Holes to suit M1 and M2 should be cut only if the metering facilities are to be incorporated. The panel can be fixed in position and the brackets bolted to the rear edge of the panel and to the chassis.

The various components are fitted in the positions shown in the diagrams. To keep the

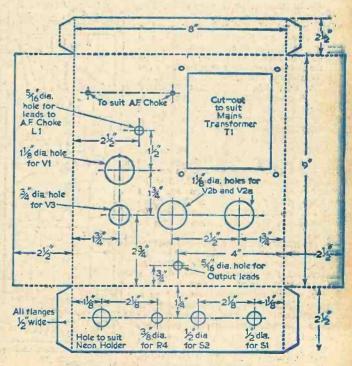


Fig. 2b.—Constructional details of the main chassis.

Right-An underchassis view.

wiring convenient, the valveholders should be orientated as shown in Fig. 4. Difficulty may be experienced in obtaining a suitable mains transformer, and one may be salvaged from an old

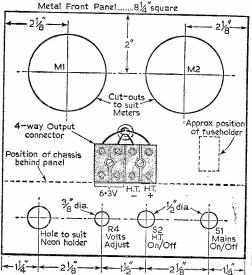


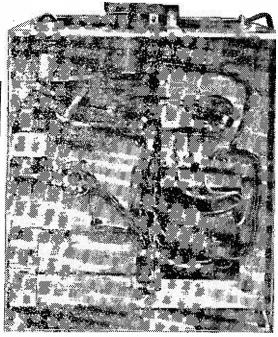
Fig. 3. (above).—The position of the controls and meters, etc., on the front panel.

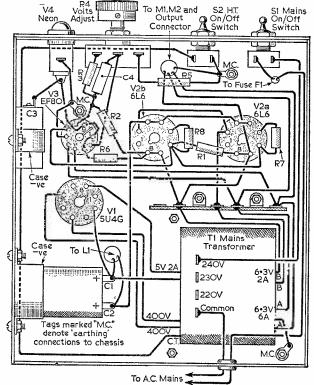
television set of the type that used a transformer to supply both the H.T. and heater voltages. The various windings should be identified before the transformer is removed. The requirements for the secondary windings are as follows: 5V 2A, 6·3V 2A, 6·3V 6A, 400-0-400V 150A. A component with similar ratings can be used, but it should be noted that the separate heater winding for V2 is essential because the cathode of V2 is directly connected to it.

All resistors are of at least 1W rating, the layout of the wiring is suggested in Fig. 4; the A.C. wiring should be carried out first using a heavy gauge flex for the heater wiring. The tag-strips are only required if the transformer has flying leads. The resistors, condensers, and the remainder of the circuit should then be wired.

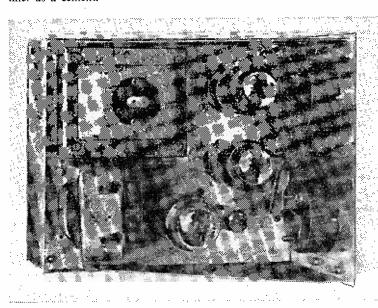
If the meters are not used—for reasons of economy or otherwise — the 10k potentiometer can be directly calibrated to indicate the output voltage, using a D.C. voltmeter and a load of some nature, as the off-load output voltage is slightly higher than that on load. Some trouble may be experienced in making the neon strike, and this will probably be due to the presence of a series resistor

Fig. 4. (right).—The underchassis wiring diagram.





in the neon-holder or in the base of the neon. The latter can be removed by soaking the neon in methylated spirit, unsoldering the base and removing the resistor. The base can then be resoldered and fixed in position using a cellulose filler as a cement.



A top view of the unit.

Housing

A case can be fitted to the unit if desired, and it should provide adequate ventilation above and below the chassis. An alternative arrangement would be to construct the stabilisation section of

the circuit as a separate unit for use in conjunction with an existing power supply. The prototype holds the output at 250V ±2V, at a current of 50mA, for a variation in the mains input voltage of ±30V.

Greater Current

The unit will provide a greater output current if an adequate mains transformer and smoothing choke are employed, together with an extra 6L6 in parallel with "V2". If less power is required, one 6L6 may be omitted.

Testing

After checking all the wiring the valves can be inserted in their respective holders and the unit tested.

COMPONENTS LIST

Resistors: all IW

RI 270k R5 6.8k R2 15k R6 100k R3 15k R7 47 Ω R4 10k w.w. potentiometer R8 47 Ω

Capacitors:

C1. 2 16 uF 500 VW electrolytic

V2a 6L6 V4 90V neon
V2b 6L6 with a red panel
holder.

Ti see text

MI suitable D.C. voltmeter

M2 suitable D.C. milliameter

Three International Octal valveholders

One B9A valveholder

SI SPST toggle switch

S2 SPST toggle switch

3A cartridge fuse and holder

4 way output connecter

AN ACORN F.M. TUNER

(Continued from page 300)

L2 and L3 are not independent, and there will thus be several core positions at which a station may be received. With a little patience, L1 and L2 can be so tuned that all three services may be received by adjusting L3 only. If capacity coupling is used between the two stages, L2 can be replaced by a resistor of, say, 22k. There are then only two coils to tune, but there is some loss in gain. If this modification is used, it would be as well to raise the H.T. voltage to V1.

Modifications

The basic circuit has been used in several modified forms, and the constructor may like to experiment for himself. Several super-regenerators have been tried, but the Flewelling circuit described is simpler than any and as efficient as most. Air-cored coils have been tuned with trimmers, but there is some sharpening of tuning which is undesirable in the 955 stage, though it may be an advantage in the pre-amplifier. It is essential to avoid the use of unscreened components if radiation and instability are to be countered, for there are three tuned circuits virtually in resonance.

Phase Splitters and Phase Reversers By J. B. Dance

CIRCUITS FOR AUDIO AMPLIFIERS AND OSCILLOSCOPES

(Continued from page 246 of the July issue)

N last month's issue the article concluded with the fact that feedback must be introduced to remove the disadvantages of the simple phase reverser.

This feedback is conveniently applied in the "see-saw" circuits which have all of the advantages and none of the disadvantages of the simple phase reverser. The latter is not therefore used very often nowadays.

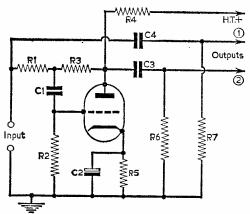


Fig. 6.—The phase reverser of a see-saw circuit.

The See-saw Circuit

The see-saw circuit is widely used in modern high fidelity audio amplifiers. There are a number of different forms of this circuit which derives its name from the way in which the input and output voltages of the phase reversing stage "see-saw" at the audio frequency about a mid-point; the grid voltage is taken from near this midpoint. The circuit is also known as the "floating paraphase" circuit and as the "anode follower".

The simplest form of the circuit is shown in Fig. 6. The main difference between this circuit and the simple phase reverser is that a feedback resistor (R3) is connected between the grid and anode of the valve (the condenser C1 passes audio easily and is used merely to prevent the D.C. anode voltage from reaching the grid). The outputs are taken from the two points shown, one of them being directly from the input.

Ideally, R1 and R3 should not be exactly equal in value if perfect balance is to be obtained. In practice, however, they are normally made equal and, providing that the phase reversing stage has a fairly high gain from grid to anode, reasonably good balance is obtained owing to the feedback from the anode to the grid.

Practical Circuits

Four different see-saw circuits are shown in Fig. 7 (a-d) with some typical component values, the main differences being the position of the D.C. blocking condensers and the grid leak. The first valve of each circuit is merely an ordinary amplifying stage and the second valve the phase reverser. The performance of the circuits (a) and (b) is very similar, but circuit (c) is not used so often, as the coupling condensers would have to be several times larger than in the other circuits if an equivalent low frequency performance were to be obtained. In the circuit of Fig. 7(c) both output valve grids (not shown in the circuit) and the V1(b) grid are returned to earth through R1; thus the circuit is economical in components. The circuit of Fig. 7(d) is very good, as the unbalance caused by the loading effects of the grid resistor used in the other three circuits is eliminated.

The cathode resistor used in the circuits need not be bypassed with a condenser if the valves used are of similar types (for the same reason as in the phase reverser circuit). Valves of the same type are normally used for this reason and also because the H.T. decoupling is simplified.

Output Voltage

The maximum output voltage from any of the

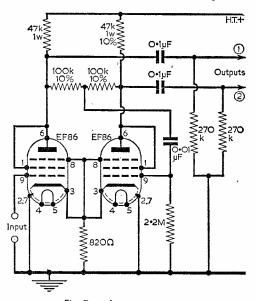


Fig. 7a.—A see-saw circuit.

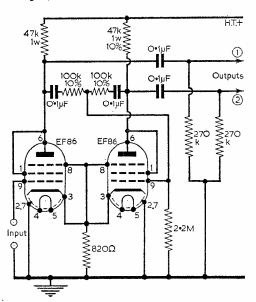
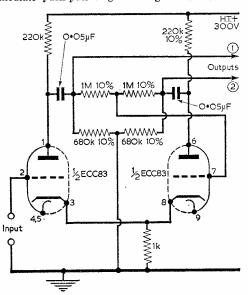


Fig. 7 circuits is about twice that of the same valve used as a concertina phase splitter. The circuit of Fig. 7(d) will provide an audio output of nearly 60V peak at 4per cent distortion when

Fig. 7c.—A see-saw circuit which is not often used on account of the larger condensers which are required. The grids of the two output valves are returned to earth through RI.

the H.T. supply is 300V D.C., with less distortion at lower output voltages. The circuit can therefore feed output valves directly without any intermediate push-pull stage. The gain of the circuit



of Fig. 7(d) is about 60. The balance is quite good, but usually not quite so good as that given by the cathode follower phase splitter.

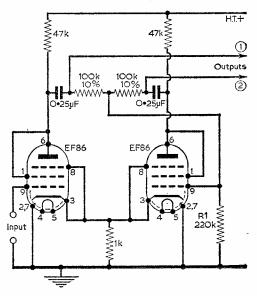
Common Anode Impedance

A slightly different circuit is shown in Fig. 8. The principle of operation is the same as that of the four circuits of Fig. 7, but the common impedance is in the anode circuit instead of the grid



Fig. 7b.—A see-saw circuit with isolating condensers in series with each 100k resistor.

circuit. The H.T. supply in the circuit of Fig. 8 should be well smoothed, as hum or any other variations in the H.T. voltage are fed to the grid of VI(b) but not to the other grid. Each of the two audio output voltages in this circuit is equal to about sixteen times the input voltage.



Cathode Coupled Circuit

A rather different type of phase splitter is shown in Fig. 9. The first valve is similar to a cathode follower phase splitter but is cathode coupled to the second stage. No signal reaches the grid of V1(b) and it may therefore be considered as a



Fig. 7d.—In this circuit, the unbalance due to the loading effects of the grid resistor used in the other three circuits is eliminated.

grounded grid amplifier. The outputs are taken from the two anodes via D.C. blocking condensers as shown.

The cathode and anode voltages of V1(b) are of the same phase as the input, but V1(a) reverses the phase of the signal in the ordinary way. The circuit is known as the "cathode coupled phase splitter", the "Schmitt phase splitter" or the "long tailed pair" (although the latter name is

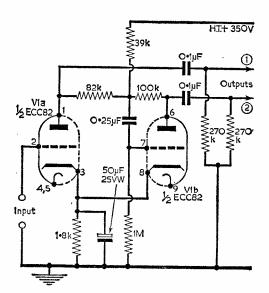


Fig. 8.—A self-balancing phase splitter with a common anode impedance.

also used for cathode coupled push-pull amplifiers). R1, R6, C4 and R4 are necessary to provide a suitable bias.

If the two output voltages are to be equal, R2 cannot equal R3, or the A.C. signal currents would cancel at the cathode and V1(b) would receive no input. If R2 is nearly equal to R3, R5 must be large, so that a small out of balance current passing through it will provide enough voltage to operate V1(b).

Disadvantages

When the stage is very nearly balanced and the two anode resistors have equal values, the signal voltage from the cathodes to earth will be approximately half the input voltage because the grid-cathode signal voltages of the two valves will be equal but 180° out of phase. Thus, the gain of the stage is only one half of that of a conventional amplifier circuit using a single valve of the same type.

Both anode currents are passing through a fairly large cathode resistor and this results in the cathodes being at a fairly high positive potential above earth. If the heaters are earthed, a valve must be chosen which has a suitably high heater-cathode voltage rating. The high cathode potential also necessitates a higher H.T. voltage in order to maintain a reasonable anode-cathode voltage and low distortion.

Unbalance

If a reasonable value of cathode resistor is used, cay 22k, the unbalance is likely to be over 10per cent. This is too large for a circuit which will be used in a high fidelity audio amplifier. The unbalance can be reduced by substituting a pentode for the cathode resistor, the grid of the pentode being fed with the unbalance voltage.

(Continued on page 346)

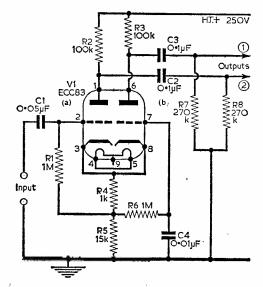


Fig. 9 (above).—A Schmitt cathode-coupled phase splitter.

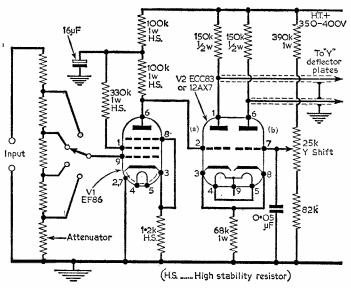


Fig. 10 .—A simple oscilloscope amplifier for D.C. and audio frequencies.

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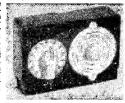
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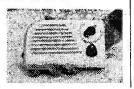
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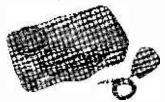
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THE BILET, IS THE LEADING ORGANISATION OF ITS

N last month's issue, all the circuitry was explained and a few constructional details of the main and pre-amplifiers were given.

Am

Inexpensive Amplifier

(Continued from page 207 of the July issue)

The power supplies for the pre-amplifier are taken from the B7G socket on the main amplifier and as the gain from this point onwards is not high, the signal from the pre-amplifier can be passed into the same socket in a screened cable without fear of hum pick-up. If it is more convenient, there is no reason why the pre-amplifier should not be built on the main c'assis and in this case, the B7G socket will do for V1. The volume and tone controls can be fitted along the front runner, the chassis being made about $1\frac{1}{2}$ in, wider to accommodate them. No other alteration to the layout is necessary.

Pre-amp Construction

A plan of the separate chassis on which the pre-amplifier is built, together with the controls, is shown in Fig. 4 (July issue). It is also of 16s.w.g. aluminium and is designed to be screwed to the inside of the cabinet behind the control panel. The valve is mounted on an inch wide bracket fitted across the chassis at a point $2\frac{3}{4}$ in. from the end adjacent to VR1. The valve and its immediately associated components can conveniently be made up as a sub-assembly and fitted to the chassis with self-tapping screws after the controls have been fitted and wired. The control panel carries also the mains switch and pilot light for all the equipment in the cabinet. If single chassis construction is adopted, it is recommended that the mains switch should be either a separate control or incorporated with Vk2, where it is not likely to introduce hum. The prototype was required only for radio reproduction. If other inputs are to be used regularly, it is suggested that the control panel be enlarged to accommodate a co-axial socket and change-over switch, the wiring for which should be thoroughly screened.

Wiring

The wiring diagrams are given in Figs. 5 (page 207. last month) and 6. It will be seen that the double electrolytic C8/C10 is mounted in the vacant space beneath the mains transformer. If a drop-through type of trans-former is used, it must be

By V. E. Holley

fitted elsewhere but there are several alternative positions and the choice is entirely one of convenience. Tinned copper wire of 22s.w.g. is suitable for wiring up, and lengths of more than an inch or so should be covered with sleeving. An

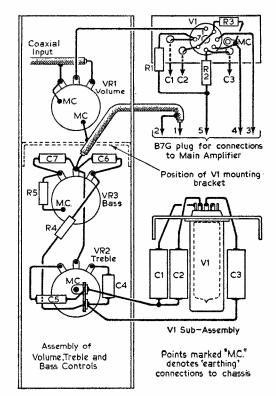


Fig. 6.—The wiring diagram of the pre-amplifier.

octal socket is used for connecting the loud speaker, the spare tags being used for anchoring one or two small components.

Components

All the resistors may be $\frac{1}{2}$ W except R18 (10W) and R17 (1W). The two 47k load resistors in the invertor stage and the grid resistors in the output stage, must be matched fairly accurately and if this cannot be done, 5per cent components or better should be used. It is advisable that all the capacitors except C2, should be 500VW, so that in an emergency they will be able to withstand the peak output from the rectifier. Of the valves, V1 may be almost any voltage amplifying pentode and V2 any double triode, though a low μ type is to be preferred.

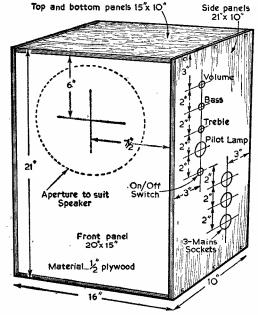


Fig. 7.—Details of a suitable cabinet for this amplifier

Testing

When construction is complete, make a check with a meter between the chassis and the rectifier cathode (pin 8) to see that there are no shorts in the H.T. circuits. If all is well, the power can be connected and a measurement made of the voltage between C13 and chassis. It should be about 265V which, allowing for bias, gives about 250V between the anodes of the output valves and their cathodes.

Instability

If there is instability or the reproduction sounds distorted, it will probably be caused by incorrect connection of the feedback circuit. Either the primary or secondary connections to the output transformer should be reversed.

Installation

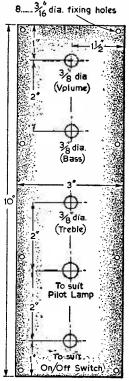
Lack of space precluded any serious attempt at a high fidelity speaker enclosure and so it was

Fig. 8.—Dimensions of the control panel.

decided to rely on a simple standing boxbaffle, on top of which the tuner could be stood in its own smaller cab-The baffle inet. suitable for an 8in. or 10in. speaker and houses, in addition the preamplifier, the amplifier and control panel.

Making a Cabinet

The dimensions of the cabinet are given Fig. 7. Suitable material is plywood not less than 1/2 in. thick and much time and hard labour will be saved if the supplier can be persuaded to cut the pieces accurately to size on a power-saw bench. Assembly is by simple butt joints, glued and screwed with 11 in. wood screws. These should be inserted about three or four inches apart along each joint in holes drilled previously to receive them. The holes should be countersunk so that the screw heads finish



Material.....tinted Perspex. laminated plastic etc.

up just below the surface. The first operation is to cut a hole in the front for the speaker. This is best done by making a 1in. hole with a brace and bit on the circumference and cutting away the unwanted material with a coarse hack saw blade in a pad handle. The aperture need not be trimmed off—a rough sanding to remove splinters is enough.

Assembly

The top, bottom and sides should be assembled around the front for trial, using a couple of screws at each corner; the front should be a good push fit into the rectangle thus formed. When all is well, dismantle and make holes in the right hand side for the controls as shown in Fig. 7, after which the top, bottom and sides can be assembled permanently with glue and screws. Push the front into position and set aside for the glue to harden. Do not secure the front yet. When the glue is hard, remove the front and cover it with a piece of speaker material. This is best secured to the wood with an impact adhesive at the edges. Stick one edge first and allow it to dry thoroughly; the material can then be stretched tightly over the board and the remaining edges secured, after which the front can be fitted permanently to the cabinet. Apply glue to the mating surfaces and push it into position. Place the assembly face down on a flat surface and adjust the position of the front so

(Continued on page 329)

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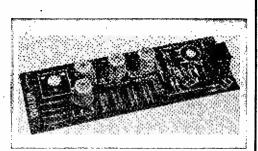
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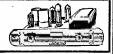
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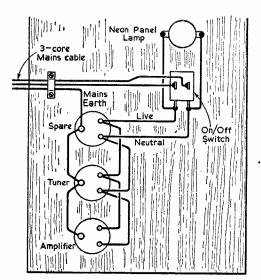


Fig. 9.—The mains wiring inside the cabinet.

(Continued from page 326)

that the outer surface of the speaker material is flush with the sides of the cabinet; secure with screws.

Finishing

The outer surface of the cabinet must be sanded off to remove any projections and covered with some sort of material which can be stained and polished. Veneer should be avoided unless the constructor has experience in its application but the same result can be achieved with 2mm hardwood ply, having an oak, walnut, etc., facing. This should be cut to size and secured with an impact adhesive to the outside of the cabinet. Care is necessary to ensure that the surfaces are brought together in exactly the right position at the first attempt

Cut first a sheet for the front, 15¼in. x 20½in. and make in it an aperture of the desired shape and size. If this is a rectangle as in the prototype, the cut out portion can be used for the top of the cabinet. Apply the remaining "frame" to the cabinet in such position that it is flush at the top, projects ¼in. each side and leaves ¼in. of uncovered cabinet at the bottom. Cut and fix plywood to the sides in the same way, remembering to make holes in the right-hand side for the controls. The ply for the top should measure 15in. x 10in. so as to fit flush at the rear and leave a 2mm rebate at the front and sides when the job is finished.

Polishing

The outer ply surface must now be prepared for final polishing. Remove any projections at the corners with No. 2 glass paper and then thoroughly sand the whole surface with No. 0 paper. Wood dye of the desired colour may now be rubbed in with a rag wad. The best final treatment is french polish, using one of the

polishes sold for amateur use but if the constructor does not feel inclined to tackle this, a very reasonable finish can be produced by rubbing in a floor sealing compound of self-drying oils marketed by a well known polish manufacturer. Two or three coats will be required, with 24 hours between each. When polishing is done, the ½in. uncovered strip round the bottom can be enamelled black and the appearance can be further enhanced by adding to the bottom two wood battens about 7½in. x lin. x ½in. as "feet" so that the cabinet will stand ½in. above floor level.

Control Panel

This may be of tined Perspex, etc., to blend with the cabinet or a contrast can be produced by using black or white material. Laminated plastic sheet as used for covering kitchen surfaces is very suitable but must be cut and drilled rather carefully to avoid chipping the polished surface. Cut to the dimensions given in Fig. 8 and secure to the cabinet with chromium plated screws.

Loudspeaker

The performance of the amplifier merits a good quality speaker. The prototype uses an 8in. cambric cone type having a wide frequency response. It should be mounted first upon a piece of ½in. or ¾in. fibre board (about 10in. square for an 8in. speaker), which should then be secured to the inside of the cabinet over the aperture provided. To avoid resonances, it is advisable to line the inside of the cabinet with sound absorbent material; ordinary carpet felt secured with adhesive is satisfactory.

Connections

The mains supply to the cabinet should be taken first to the switch and then distributed to sockets inside the cabinet in the position shown in Fig. 7, into which the amplifier and tuner can be plugged. A spare socket is useful for additional apparatus. The wiring is shown in Fig. 9. The amplifier can be secured to the floor of the cabinet in any desired position by wood screws through the chassis flanges.

Voice-operated Switch

(Continued from page 308)

Care must be taken to ensure that the H.T. supply for the switch unit is taken direct from the recorder's H.T. and not via contacts of C.O.2.

Other uses for this switch will become apparent to the user after experience is gained in its use. Two of such possible uses are as a "baby alarm", when the switch is used to switch on an amplifier so that the infant's cries may be heard. Instead of an amplifier, an audio oscillator can be employed or even a warning light. The second use is for the transmitting amateur. Here the unit can be readily employed to turn the station over from "transmitting" to "receive" merely by speaking into the microphone. This is, of course, when the transmitter is modulated and not when using C.W.

Short-wave Listeners'

UITE a number of enthusiastic short wave Listeners collect QSL cards. These are cards which are sent by transmitting stations, and are an acknowledgement or confirmation of a contact having been made. In the case of the S.W. listener, they are confirmation of the receipt of a report from the listener.

Procedure

Such cards bear the station call sign, and other details, and their collection, from stations all over the world, is an interesting side activity for the S.W. listener. Rare cards, from distant stations, are often used to decorate a corner near the receiver. As some S.W. listeners may have started collecting QSL cards, or may have found that expected cards do not arrive, a few details of the best methods of obtaining such cards should prove useful.

First, it may be stated that some stations almost always acknowledge listeners' reports, while others seldom, or never, send any acknowledgement. It is thus inevitable that some reports do not bring the expected QSL card. Apart from this, it is the usefulness of the report which will often decide whether it obtains a card acknowledgement or

A listener report is not of much use if very brief, and from a locality which an amateur is contacting. During the contact, he will already have obtained an up-to-the-minute report over the air. In the same way, it is not much use sending reports to stations which are very near. The listener who wants to obtain a good return of cards, for reports sent out, thus needs to choose conditions where he thinks his report will be of real use or interest to the transmitting station. Sometimes this depends on the transmitting equipment. For example, it could be useful to know that a very low power transmitter was received well at a locality fifty miles or so away, whereas if the station was using greater power, this report would not mean much.

Information

The report should always contain information such as the type of receiver and aerial, and should give readability and signal strength in accordance with the usual code. If the listener remembers that the real purpose of his report should be to convey useful information to the station heard, this may help.

Reports, when forwarded direct, should be correctly addressed. This is most important with all stations and particularly those overseas. possible, the inclusion of a stamped and addressed envelope will be very helpful in getting a reply. With overseas stations, an international reply coupon will usually be required for the reply, unless the listener makes use of one of the various schemes which exist for the collection and forwarding of cards. It is possible for reports and ackknowledgements to travel at the lower unsealed rates.

Some listening experience, and a good short wave receiver and aerial will go a long way towards obtaining a good return in QSL cards. The DX bands, such as 20m and 15m are of course much more likely to provide distant stations. Local bands, such as 80m, will provide dozens of local stations in an hour or so, and there is very little point in sending reports to them.

Reports should always be accurate. A mistake in copying the call sign, for example, might result in the report being forwarded to the wrong station. The report is then useless. Some S.W. listeners have cards printed with spaces for the required information (such as date, time, receiver, conditions, signal strength, etc.) and use these for reports. The SWL cards themselves resemble QSL cards, but have no call sign. They are a good investment for a listener who is going to collect QSL cards regularly.

Weaker Signals

When an interest is taken in regular longdistance reception, it is a good plan to give some attention to the weaker signals. Several bands can furnish very loud reception of American, African, European, and Asian stations, but the really notable DX signal will usually be at a rather lower level. As various countries move into the dark hemisphere, they may become audible, and this accounts in some measure for the hour by hour change in conditions.

A notebook, with pages ruled for GMT, frequency or wavelength, station, and receiver dial readings, will prove extremely helpful. It is convenient to devote one page to each band, rather than mixing up reception notes of several bands all on the same page. It is quite possible to maintain regular day to day reception from countries very many thousands of miles away. Previous notes on reception conditions, or stations

heard, will also be a very useful guide.

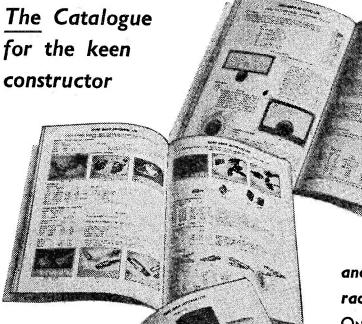
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POCKET VOLTMETERS. Read 0-15 volts and 0-300 volts A.C or D.C. BRAND NEW and UNUSED. ONLY 18/6.

B.C. 221 FREQUENCY METERS. The famous American crystal controlled, portable frequency measuring standard. Coverage 125 kc/s-20 Mc/s. With original numbered calibration book. Perfect order. Illustrated details on request. ONLY £16.

UNIVERSAL VOLT-OHM-MILLIAMMETER. Reads A.C. and D.C. Volts up to 1,000 in 5 ranges, at 1,000 ohms per volt. D.C. current (3 ranges) to 500 mA. Resistance readings to 200 K ohms in 2 ranges. Basic movement 300 A sensitivity. Easily read open scale, beautifully made and fully guaranteed. Limited number available under import quota. Complete with leads, prods. and internal battery. ONLY 59/6.

ACOS TYPE 39-1 STICK MICROPHONE. With screened lead and stand 39/6, plus $1/6~\rm p.~\&~p.$

CRYSTAL DESK MICROPHONE. With screened lead and built-in stand, 16/6, plus 1/6 p. & p.

ELECTRONICS HARRIS

(LONDON) LTD.

138 Gray's Inn Road, London, W.C.I. (Phone: TERminus 7937

Please include carriage costs on All items.

(Open until 1 p.m. Saturdays). We are 2 mins. from High Holborn (Chancery Lane Station) and 5 mins. by bus from King's Cross.

-RETURN-OF-POST SERVICE

We offer a reany efficient Mail Order Service on all items stocked. All cash orders are dealt with on the day of receipt. Hire purchase orders are subject to slight delay but this is kept to the absolute minimum.

GRAMOPHONE EQUIPMENT

GRAMOPHONE EQUIPMENT

ALL LATEST MODELS

ALL POST FREE RECORD CHANGERS

GARRARD RESIGNED : \$9.19.6 12 of 15/B.S.R. UA14 (TCS PU) . 27.15.0 21.11.0 12 of 12/B.S.R. UA14 (TCS PU) . 27.15.0 21.11.0 12 of 12/B.S.R. UA14 (MODEL) . 27.50.0 21.11.0 12 of 11/B.S.R. UA14 MODEL . 27.50.0 21.11.0 12 of 11/B.S.R. UA14 MODEL . 27.50.0 21.11.0 12 of 11/B.S.R. UA14 MODEL RECORD PLAYERS

GARRARD TA (GCS PU) . 28.10.0 21.40 12 of 21.50
E.M.I. (ACOS Stereo/Mono PU) 24.10.0 21.50 3 of 21.50
E.M.I. (ACOS Stereo/Mono PU) 26.15.0 11.70 12 of 10/8

GARRARD 4HF (GCS PU) . 218. 9.9 23.15.9 12 of 15/8
Many of the above can be supplied for stereo working. See our Gramophone Equipment List for details.

LOUDSPEAKERS

GOODMANS: Axiom 110 10in. 25,0,0; Axiom H2 10in. 28.10,0; Axiette 8in. 26,12.1; Axiom 300 12in. 211.5.9; Axiom 400 12in. 216,1.0; Axiot 60 Bass, 12in. 29,12.9; Trebax Tweeter 28,4.0; CX500 Cross-over unit £1,19.0. WHITELEY: HF 1016 10in. 28,0.0; HF 1012 10in. 25,0.0; HF816 3in. 26,17.3; T816 8in. 26,10.0; T10 Tweeter 24,8.3; T359 Tweeter £1,15.0; CX3000 Cross-over unit £1,11.6; CX1500 Cross-over unit £2,0.0. H.P. Terms available.

LATEST TEST METERS

Hire Purchase Cash Price Deposit Mthly/Pmts. .. £24. 0.0 £4.16.0 12 of £1.15. 2

AVO Model 8 ... AVO Model 8 with AVO Model 8 with leather carrying case AVO Model 7 with leather carrying case AVO Multiminor AVO Multiminor with leather carrying case TAYLOR Model 127A CABY A-10 (CABY R20) .. £27.18.0 £5.12.0 12 of £2. 0.11 .. £21. 0.0 £4. 4.0 12 of £1.10.10 .. £24.18.0 £5. 0.0 12 of £1.16. .. £9.10.0 £1.18.0 12 of 14

AMPLIFIER KITS

We have full stocks of all components for the Mullard 510, Mullard 3-3, Mullard 2 and 3 Vaive Pre-amp, Mullard Stereo. Mullard Mixer, GFC 912 Plus. Fully detailed list on any of these sent upon request. Instruction Manuals: All Mullard Audio Circuits in "Circuits or Audio Amplifiers". 9/5. GEC 912, 4/6. All post free.

"BRAND FIVE" RECORDING TAPE

Long Play: 900ft (5"), 18/6; 1200ft (5"), 23/6; 1800ft (7"), 35/-, Double Play: 1200ft (5"), 37/6; 2400ft (7"), 60/-, (All Post Free!)

TAPE DECKS Hire Purchase
Cash Price Deposit Mthly/Pmts.
. £8.19.6 £1.16.6 12 of 13/7
. £12.19.6 £2.12.6 12 of 19/-All carriage free Cash Price Deposit Mhilyl Pmts.

B.S.R. TD2

COLLARO STUDIO : £8.19.6 £1.16.6 12 of 19/
ARMSTRONG PAR03 : £1.21.86 £2.12.6 12 of 19/
ARMSTRONG PAR03 : £16.16.0 £3.8.0 12 of £1.4.7

All components in stock for the Mullard Tape "C" Pre-Amplifer Kit. Fully detailed list available.

OUTPUT TRANSFORMERS

GILSON: W0696A. W0696B, 50/6, post 2/-. W0710, W0710/8K, 55/6, post 2/-. W0892,62/3, post free; W0767, 27/-. post 1/6. PARTRIDGE: P9667. 52/6, post 2/-. P9014, 98/6, post free; P4131, 60/-, post free; P3591A, 99/-, post free; P5202, P5208, 95/-, PARMEKO: P2641, 28/-, post 1/6.

Complete with JASON FM TUNER KITS

JASUN FM TUNER KITS Complete with valves. Standard Tuners: FMT1, £6,19,6: Power Pack, £2,12,6: FMT2, less power supply, £8,9-6: with power supply, £10,9-6. Fringe Tuner: FMT2. less power supply, £10,9-6: with power supply, £12,7-6. (Important. When ordering JTV2 and Mercury 2 kits it is essential to give TV Channel required). Hire Purchase terms available. Instruction manuals available separately if required. Data Booklets for FMT1, FMT2 and FMT3. 2/10. JTV2 3/10. Mercury 2, 3/10. All post free.

• HLUSTRATED LISTS are available on LOUDSPEAKERS.

TAPE DECKS. TEST GEAR. RECORDING TAPES. GRAMOPHONE EQUIPMENT AMPLIFIED RITS. MULLARD CATHODE
RAY TUBES. Any will be sent free upon request.

• TERMS OF BUSINESS
Cash with order or C.O.D. We charge C.O.D. orders as follows.
Up to 23, minimum or 218. Over 23 and under 25, 1/6. Over 25
and under 210, 1/8. Over 410, no charge. Postage extra on
CASH orders under 23 except where stated. Postage extra
on Overseas orders irrespective of price.

WATTS RADIO (MAIL ORDER) LTD.

54 CHURCH STREET, WEYBRIDGE, SURREY
Telephone: Weybridge 4556

Please note: Postal business only from this address. CLOSED FOR ANNUAL HOLIDAY AUGUST 11th-26th



rade

HI-FIDELITY RECORD CHANGERS

SEVERAL hi-fidelity record changers were on view at the Radio and Electronic Components Exhibition, as part of the Collaro stand. The C.60 Studio Model record changer, a four-speed machine, gives a performance within very close wow, flutter, rumble and speed tolerances. A new model, the A-700, was also shown.

model, the A-700, was also shown.

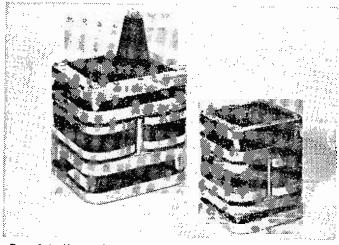
The "Studio" Tape Transcriptor was once again on view. This is a three-speed deck with either half or quarter track magnetic heads.

either half or quarter track magnetic heads.

All these pieces of equipment are made by Collaro Ltd., Ripple Works, By-pass Road, Barking, Essex.

VALVES AT THE R.E.C.M.F. EXHIBITION

A SPECIAL feature of the Standard Telephones and Cables Ltd. stand at the Component show was a range of valves for industrial and communications applications.



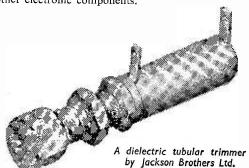
Two of the Vanguard series of transformers manufactured by Gresham Transformers Ltd.

A new compact, forced-air-cooled oscillator triode which develops 5kW at up to 120Mc/s was on show.

Among the many STC transistors on view, were a number of silicon diffused mesa types, and a range suitable for switching applications in computers. Standard Telephones and Cables Ltd., Connaught House, Aldwych, London, W.C.2.

NEW CONDENSERS AND TERMINAL STRIPS

A MONG the new components shown at the R.E.C.M.F. Exhibition on the Jackson Brothers Ltd. stand were gang condensers—Type P. These were designed for A.M./F.M. and A.M. use. Also on show were dielectric tubular P.T.F.E. trimmers which incorporate low loss and wide temperature range features, and have a special locking device. Jackson Brothers (London) Ltd., Kingsway, Waddon, Surrey, manufacture these and many other electronic components.



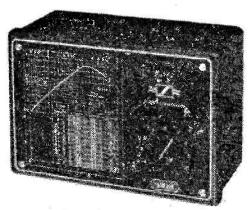
SPEAKER CABINET FOR A POCKET TRANSISTOR RECEIVER

RECENTLY introduced by the Zenith Radio Corporation, is an auxiliary speaker cabinet which converts a pocket transistor set into a fulsize radio. The "Converta", as it is called, is now available in this country and consists of the Zenith

Royal 50c transistor set—obtainable separately—which plugs into a cabinet containing a larger speaker. The price of the Royal 50c and the speaker cabinet is 27 guineas. The Zenith Radio Corporation, Sovereign House, Queen Street, Mayfair, London, W.I.

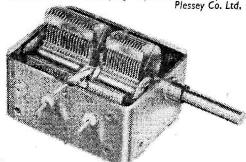
NEW SERIES OF TRANSFORMERS

A NEW series of transformers—the Vanguard range—was on show on the Gresham Transformers stand at the recent Radio and Electronic Components Exhibition. The Vanguard range is the latest development in the design of resin cast transformers by Gresham. The range fulfils all the requirements of RCS.214, yet the transformers are lighter and sometimes smaller than similar counterparts. This new range is made by Gresham Transformers Ltd.. Twickenham Road, Hanworth, Middlesex.



Above.—A Grundig Inductance Decade distributed in this country, by Wolsey Electronics Ltd.

Below .- A new two gang capacitor made by the



A BIT CLEANER

THIS bit cleaner was designed to be attached to the standard soldering iron rest for A.N.T.E.X. Precision miniature irons. It comprises a specially prepared brush to ensure speedy and efficient cleaning. The new attachment costs 3s. 3d, and can be obtained complete with the iron rest for 15s. 9d. This new product is manufactured by A:N.T.E.X. Ltd., 7/8 Idol Lane, London, E.C.3.

LIGHTWEIGHT SOLDERING

INTRODUCED this year by Remploy is this lightweight 25W soldering iron (MH 1/7). It was designed primarily for radio, television and instrument work. It incorporates a light in the front of the plastic handle which lights when the iron is live. It is available in three voltage ranges; 100/110, 200/220, 230/250. The soldering iron costs 23s. 6d, and is made by Remploy Ltd., 25/28 Buckingham Gate, London, S.W.I.

INDUCTANCE DECADES

SOME additions to the range of Grundig Measuring Instruments have been announced by Wolsey Electronics Ltd., the sole distributors of this make of instruments in the country. The additions are three inductance decades (Types LD.1, 2 and 3) which are intended for quickly constructing filter circuits, electro-acoustic equivalent circuits, equalisers, etc. By using large ferrite shell-type cores the quality factors for medium audio frequencies are maintained above 100 with good level stability and temperature independence. The three instruments cover from ImH to 1·1H overall. The inductance decades cost £23 10s. 0d. each and are distributed by Wolsey Electronics Ltd., Cray Avenue, St. Mary Cray, Orpington, Kent.

NEW GANGED CAPACITOR

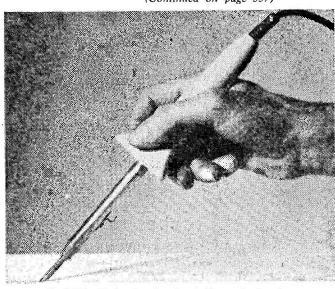
A NEW two gang capacitor has recently been put on the market by the Plessey Co. Ltd., intended for radio receivers demanding a high per-

formance tuning unit.

The rigid style of frame ensures freedom from low-frequency microphony and the robust assembly and widely-spaced vanes in the oscillator section give freedom from vane microphony. A high order of capacitance matching accuracy between the two sections enables the receiver designer to provide tuned circuits with a negligible loss caused by any mis-matching between R.F. and oscillator sections. This capacitor is made by The Plessey Co. Ltd., Ilford, Essex.

TRANSISTOR PORTABLE

A NEW transistor portable receiver is now available from Philips Electrical Ltd. at $16\frac{1}{2}$ guineas. The model 303T covers long and medium wave bands and has provision for use with a car aerial. It weighs only $5\frac{3}{4}$ lb and measures $10\frac{3}{4}$ in. x $3\frac{1}{2}$ in. x $7\frac{3}{4}$ in. The receiver operates on two 9V batteries (Continued on page 337)



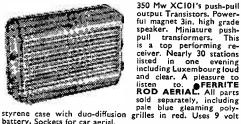
The 25W soldering iron introduced this year by Remploy.

PORTABLE RADIO OR CAR RADIO

PUSH-PULL SIX

(6 Ediswan Transistors plus 2 Diodes)

MEDIUM, LONG WAYE AND TRAWLER BAND EXTEND-ING TO 80 METRES WITHOUT COIL CHANGING COIL CHANGING



350 Mw XCI0I's push-pull output Transistors, Powerful magnet 3in, high grade speaker. Miniature pushpull transformers. This is a top performing re-This ceiver. Nearly 30 stations listed in one evening including Luxembourg loud

battery. Sockets for car aerial.

Total building cost **£6.19.6** P.P. 2/6. Size 6½ x 4½ x 1¼in. "Agreeably surprised with Trawler Band reception. Luxembourg as 'oud as local. Your easy build diagrams helped a lot . . . my first attempt."—H.S., Penzance, Cornwall (poor reception area). "Super car radio."—L.B.V., Liverpool.

ALL PARTS SOLD SEPARATELY

TRANSONA-4

(4 Ediswan Transistors, plus 2 Diodes)

Miniature speaker. FERRITE ROD AERIAL. MW/LW and Trawler Band coverage down to 80 metres On test tuned in many stations. This sensational new radio is simple to build with our easy-build plans. Handsome pocket



May be built for 65 /- P.P. 2/6

NEW! POCKET RADIO

(5 Ediswan Transistors and 2 Diodes)



MEDIUM, LONG WAVE AND TRAWLER BAND TO 80 METRES. TRAWLER BAND 10 op The nacio-besigned round super sensitive ferrite rod aerial and 3in. speaker. Home and Continental stations at your finger tips. Attractive 2-tone pocket size case in gleaming Colectories. No aerial required. polystyrene. No aerial required. receiver. Easy-build plans for

Many stations listed test receiver, beginners. Powered by $4\frac{1}{2}$ volt battery. Total cost of parts required. £4.19.6 P.P. 2/6

ALL PARTS SOLD SEPARATELY

PUSH-PULL FIVE NEW

(MW/LW and TRAWLER BAND) (5 Ediswan Transistors)



Now greatly improved. Sensitive FERRITE ROD AERIAL. Pale blue polystyrene case with speaker grilles in red. Volume/sensitivity control, Miniature push-pull transformers. 350 Mw XCI0I's in push-pull. Sensitivity R.F. stage for station selection.

Total building cost £5.7.6 P.P. 2/6 ALL PARTS SOLD SEPARATELY

Push-Pull Pocket Six

MEDIUM AND LONG WAVES AND 400 TO 750 METRES WITHOUT COIL CHANGING.

Sensitivity of a superhet, tonal quality of a TRF. Volume control. Tuning condenser. Latest type switches. Handsome two-tone pocket case. Ferrite rod aerial. 3in. quality speaker. Easy build diagrams. 6 Transistors (including Ediswan and Semiconductors) plus 2 diodes.



All parts cost £5.19.6 P.P. 2/6 ALL PARTS SOLD SEPARATELY

New! Easy Build Three Radio

(3 Ediswan Transistors plus 2 Diodes)

Easy to build, easy to operate. This transistor radio operates over the M.W. and L.W. extending down to 80 metres without coil changing. Ferrite rod aerial, volume-sensitivity control. Sonotone high fidelity miniature earpiece or miniature speaker.



May be built for 49/6 P.P. 2/6

1	Ferrite Rod Aerial, M/L wave (7in.)	.8/6
	Ferrite Rod Aerial, M/W (4in.)	5/-
	Transformers: 300 ohms primary, 5 ohms secondary Brand new boxed	3
	High Fidelity Headphones with miniature earpieces and transformer with lead and jack plug for high or low impedance, matching. Brand new. Boxed	25/-
	Sensitive balanced Armature Headphones. Boxed. brand newpair	
i	Sensitive 2½in. Speakers. Only 7/8in. deep, 3 ohm	16/6

DATA SHEETS AND PARTS PRICE LIST FOR THE ABOVE 1/3 EACH

ALL PARTS SOLD SEPARATELY
AFTER SALES SERVICE

RADIO EXCHANGE COMPANY

27 HARPUR STREET, BEDFORD

PHONE 2367

(Opposite Co-op)

CLOSE I p.m. SAT.

CODAR "CLIPPER" ALL BAND RECEIVERS 10-2000 METRES

LISTEN TO AMATEURS, AIRCRAFT, SHIPPING, SHORT, MEDIUM, LONG WAVE BROADCAST STATIONS THROUGHOUT THE WORLD

THE MINI-CLIPPER

The miniature valve radio with the BIG SET features! Covers all Short, Medium, Long waves 10-2000 metres (5 coils), Smart all satin silver all, front panel with engraved dials, etc. Ball bearing, air spaced variables. Size only $6\frac{3}{4} \times 3\frac{1}{2} \times 4$ in. Battery lasts months. No drilling. Total building cost including punched chassis, valve, front panel. One coil for 20-60 metres, nuts,

bolts, wire, Step-by-step pic-torial plans, 39/6. P. & P. 2/-. Additional coils and electrical bandspread optional extras. Parts sold separately. Full plans, parts list, 21-.

39/6



THE SUPER CLIPPER 88/6

This world-famous hybrid receiver has achieved remarkable success. Tremendous performance with Hi-gain valve detector PLUS two Ediswan transistor amplifiers which are supplied assembled, ampliners which are supplied assembled, only 3 wires to connect! Large precision dial, 7 x 4in., with 2 pointers, bandset and bandspread, dua! slow-motion drives, air spaced variables. Punched chassis 8 x 5½in. Batteries last months. Covers 10-2000 metres (5 coils). Total building cost including chassis, valve,

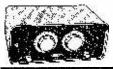
2 transistor stages, 2 coils 20-60 and 55-190 metres. Step-by-step pictorial plans, nuts, bolts, wire, 88'6. P. & P. 2'6.

THE CLIPPER. As above but one transistor stage, 79'6. P.&P. 2'6 Optional Front Panel, Silver Hammer finish, all holes, 6'9.



THE CLIPPER CR 45

£6.17.6



This A.C. Mains receiver is the latest model in the famous CLIPPER Series and combines really top Ints A.C. Plains receiver is the latest model in the lamous CLIPPER Series and combines really top performance with superb processional finish, te is the finest ALL BAND receiver at the price with a new high gain circuit using ECC81 double triode, EL84 output, EZ80 full wave rectifier. Power output $3\frac{1}{2}$ watts for 2/3 ohm speaker. Covers 10-2000 metres (5 coils). World-wide reception. Outstanding features include 3 planetary slow motion drives, separate electrical bandspread, air spaced low loss variables, satin silver dials, silver hammer front panel. Total building cost, including $10 \times 5\frac{1}{2}$ in punched chassis, valves, front panel, 2 coils 20-60 and 55-190 metres, nuts, bolts, wire, etc., 10 pages pictorial plans, £6.17.6. P. & P. 3/6. Optional extra. Modern styled Cabinet, rear panel, silver hammer finish, 27/6. Parts sold separately. Full plans, parts list, 10 pages, 3/6 post free.

No technical knowledge is required to build these fine receivers. Only new guaranteed components are supplied. Send 3d. stamp for illustrated leaflets, testimonials. Suppliers to Educational Authorities, Government Departments, etc.

CODAR RADIO COMPANY, COLEBROOK ROAD, SOUTHWICK, SUSSEX



BUILD YOUR OWN • RADIO EQUIPMENT • TEST GEAR HI-FI INSTALLATION - AND LEARN AS YOU DO IT



To: RADIOSTRUCTOR (Dept. G107). Reading, Berks.

BLOCK

(821) We do not employ representatives 8-61

(Continued from page 334) and may be obtained in two different colour schemes. The portable is produced by Philips Elec-trical Ltd., Century House Century House, Shaftesbury Avenue, London, W.C.2.

CABLE CONNECTOR

THIS year Marconi's Wireless Telegraph Co. Ltd. exhibited at the Components Exhibition for the first time.

Among the many pieces of equipment on show was a connector which has been designed to provide a rigid and reliable interconnection of 4000Mc/s microwave equipment. Alternative connectors for flexible cable or panelmounting requirements are available. The design incorporates a sealing ring for waterproofing the connecting joint and a specially designed tool is available for assembling the connectors. The impedance is 50Ω and the voltage standing wave ratio is less than 0.2dB between 3600Mc/s and 5000Mc/s per pair of connectors. the connectors is from £2 2s. 0d., depending on the type. They are manufactured by Marconi's

The type F1200 coaxial connector made by Marconi's Wireless Telegraph Co. Ltd.

The price of Wireless Telegraph Co. Ltd., Chelmsford, Essex.

SOLID STATE MICROWAVE SWITCHES

A NEW range of silicon p-n junction type microwave switches has been announced by the Electronic Apparatus Division of Associated Electrical Industries Ltd. They employ variable resistance diodes which enable them to handle higher powers than the type employing variable capacitance diodes and they are operated from 1.5V D.C.

The diodes will operate at any frequency from the S-band to X-band and are offered in tunable mounts to achieve maximum efficiency at any particular frequency in the wide band for which each mount is designed. Associated Electrical Industries Ltd., Crown House, Aldwych, W.C.2.

RADIO REMOTE CONTROL

A DEVICE that will enable a car radio to be remotely controlled from any seat or a single radio installation in the house to be tuned in from every room, was on view on the stand of Hughes International (U.K.) Ltd. at the Radio and Electronic Components Manufacturers Exhibition.

With this device, a silicon capacitor, radios can be tuned electrically at the end of a long wire rather than mechanically with a rigid shaft. Also these capacitors make "signal seeking" possible in tuned circuits. At the push of a button the capacitors sweep the band to the next station.

These "signal seeking" circuits also have

These "signal seeking" circuits also have inherent automatic frequency control characteristics: i.e. the receiver will automatically follow the station whenever the transmitted frequency varies.

The silicon capacitors are manufactured by Hughes International (U.K.) Ltd., Kershaw House, Great West Road, Hounslow, Middlesex.

An Amateur Communications Receiver

(Continued from page 313)

Alignment

The wiring should be checked prior to switching on the set. The local station should be tuned in. If no signal is receivable, the wiring should be checked. If all seems right, the only fault may be misalignment of the I.F. stages.

If suitable instruments are available, the alignment is considerably simplified. A signal generator should be set to 465kc/s using modulation, and the cores of the I.F.T.'s are adjusted for maximum volume, starting with I.F.T.4 and ending with I.F.T.1. The generator should then be set to a frequency in the medium waveband, say, about 1.25Mc/s, and the tuning condenser adjusted to this frequency on the dial. A signal should be audible. If not, turn the oscillator core (or trimmer) until the signal is heard. The procedure is repeated over all the wavebands until the best volume from all receivable stations is obtained.

If a signal generator is not available, the core (or trimmer) of the oscillator coil should be adjusted to obtain the local station. When it is receivable, it can be used to "home" on. The cores of the IFTs are adjusted for optimum signal strength, followed by adjustment of the R.F. and mixer coils. The I.F. frequency is not necessarily 465kc/s, but it will not affect the performance of the receiver. In fact, the author aligned his receiver by ear, and experienced no difficulty.

Performance

Using the receiver, the author has heard, in the last three months, amateur stations from over sixty countries, some as far away as New Zealand and Argentina. A 132ft long wire about 30ft high was used as the aerial.

Club News

REPORTS OF CURRENT ACTIVITIES

AMATEUR RADIO MOBILE SOCIETY
Hon. See: G3FPK, 79 Murchison Road, London, E.10.
The second International Mobile Rally was held on Sunday,
June 18th, on the USAF base at the RAF Station, Barford St.
John, near Banbury. Talk-in stations G3NMS/A on 1980kc/s and
G3HGE/A on 2 metres, were in operation from the early morning. The star attraction this year was the performance by the U.S. 3rd Air Force Band. At this Rally, the Annual General Meeting was also held. The election of the 1961/2 Committee followed the reports of the Committee and the Treasurer.

BRIDLINGTON AND DISTRICT RADIO SOCIETY Hon. Sec: H. H. Mills, G3AJB, 28 East Road, Bridlington, East Yorkshire.

During April, the Society held its first Annual General Meeting, at which, the Chairman, H. Jones, G3GBH, Treasurer, J. Wilson, G3MCF, and Secretary, H. Mills, were all re-elected. Also during April it was decided to run an "A" station at the National Field Day. On April 24th, J. Hargreaves, G5VO, gave a lecture on "Basic Radio Theory", and on May 1st, members enjoyed three Mullard films. three Mullard films.

Recently the meeting place has been changed and now members will meet at "S.T. Contest", Applegarth Lane, Bridlington, at 7.30 p.m. on Wednesday evenings.

BRITISH TWO-CALL CLUB

Hon. Sec: G. V. Haylock, G2DHV, 28 Longlands Road, Sidcup. Kent

Major D, W. J. Haylock, G3ADZ, has been elected to the post of president this year, and the vice-president is Air Commodore E. C. Poole. Membership is open to all British subjects with at least one overseas call sign.

CLIFTON AMATEUR RADIO SOCIETY Hon. Sec: E. Godsmark, G31WL, 211 Manwood Road, Crofton Park, London, S.E.S. On April 21st members heard a lecture by C. Hatfull, G3HZ1

"Direction Finding"

No lectures or demonstrations have been arranged for the summer, but there will be two portable transmitting field days and two direction finding field days. The club will be active as G3GHN/P during N.F.D.

DERBY AND DISTRICT AMATEUR RADIO SOCIETY Hon. Sec: F. C. Ward, G2CVV, 5 Uplands Avenue, Littleover,

As part of the Golden Jubilee Year celebrations, 120 members, friends and guests attended the Founder Members' Dinner at the Derbyshire Yeoman, on Saturday, April 22nd. These celebrations are being held to commemorate the foundation of the Derby Wireless Club in 1911. The Club has the distinction of being the first of its kind in the Country.

GUILDFORD AND DISTRICT RADIO SOCIETY Hon. Sec: J. R. Barker, 35 Banders Rise, Merrow, Guildford,

Surrey At the Annual General Meeting John Barker was elected the new Secretary, and D. Tillier was elected as Treasurer. On May 11th Maurice Child gave a talk on "The Early Days of Radio", and on the 26th of the same month, G8VH gave a short lecture. The club meets on the 1st, 3rd, and 4th Thursday of every month at 41 Egley Road, Woking.

A modulator, suitable for use with the club transmitter, is in

the course of construction.

HARLOW AND DISTRICT RADIO CLUB Hon. Sec: B. H. Wynn.

On Sunday, June 11th the Club held a mobile rally near Harlow.

NORTHERN HEIGHTS AMATEUR RADIO SOCIETY Hon. Sec: A. Robinson, G3MDW, Candy Cabin, Ogden, Halifax, Yorkshire

G3FOH gave a lecture on May 3rd; his subject being SSB. All meetings are at the Sportsman Inn, Ogden, Halifax.

Future Events:
July 12th—Spares sale.
July 26th—An informal evening.
August 9th—A discussion on the "Scout-Jamboree-on-the-Air".

PLYMOUTH RADIO CLUB Hon. Sec: R. Hooper, 2 Chestnut Road, Peverell, Plymouth, Devon. At the AGM, held during May, H. Jones, G5ZT was elected President, E. Fallou was elected Chairman, and J. Fallon, Treasurer.

The Ernie Hillyard trophy was once again presented to John Fallon, as was the G5ZT trophy.

READING AMATEUR RADIO CLUB

Hon. Sec: R. G. Nash, G3EJA 9 Holybrook Road, Reading.

At the April meeting the clubroom was filled with students and candidates for the 1961 R.A.E., to hear Mr. Kirkpatrick, Chief of the Radio Section of the G.P.O. London, and Mr. Horsnell, telephone manager of the Reading G.P.O., give a talk about, and answer questions on, licensing conditions for the radio amateur.

G3NNF gave a talk at the June meeting on L.F. aerials for confined spaces.

confined spaces.

RHONDDA RADIO SOCIETY Hon. Sec: A. Chapman, 23 John Street, Porth, Rhondda, South Wales.

Wales.
The Society has now been established at its headquarters,
"The Royal" Hotel, Trealaw, Rhondda.
The following officers have recently been elected; Chairman—
S. Weaver, G31TQ; Vice-chairman G. Williams, GW2F0F;
Treasurer—G. Tuckwood; and joint Secretaries—A. Chapman
and W. Smale, GW3DRK.
Future film-strip lectures include "Modulation and Modulators" and "R.F. Amplification".

SOUTH SHIELDS AND DISTRICT AMATEUR RADIO CLUB Hon. Sec: D. Forster, G3KZZ, 41 Marlborough Street, South

Hon. Sec: D. Forster, G3RZZ, 41 Mariburough Sheet, Some Shields, Durham.

The Club holds meetings in Trinity House, Social Centre Laygate, on Friday evenings for theory and morse classes; and on the last Wednesday in each month at 7.30 p.m.

A mobile rally will be held on Sunday, July 9th, at Bents Park Recreation Ground, Coast Road, South Shields. The talk-in stations will be G3KZZ/A on 1980kc/s, and G3DD1 on 3600kc/s. Light refreshments will be available on the site. Light refreshments will be available on the site.

COURSES OF INSTRUCTION
BRENTFORD EVENING INSTITUTE.
Clifden Road, Brentford, Middlesex.
During the session 1961-62 the Institute is arranging classes in

During the session 1961-62 the Institute is arranging classes in the following subjects:
Radio Amateurs: course in preparation for the London City and Guilds Examination; which will be held on Wednesdays from 7 to 9 p.m.

Morse Code for amateurs: Tuesdays 7 to 9 p.m.
Mathematics for Radio Amateurs; Thursdays 7 to 9 p.m.
Radio Servicing; Tuesdays 7 to 9 p.m.
All classes open the week beginning Monday, 18th of September.
WESLEY EVENING INSTITUTE
Wesley Road, London, N.W.10.
Due prominence will be given to television topics in the classes for session 1961-62. The classes will be held on Mondays and Wednesdays from 7—9 p.m. They will commence on September 18th.
The course, which is mainly intended for amateurs, covers theory and some practical work.
There is a mid-evening canteen and ample parking space.

eory and some practical work.

There is a mid-evening canteen and ample parking space.

Applications for eprolyment should be made to: "Jeanville",

Applications for enrolment should be made to: Brighton Road, Addleston, Weybridge, Surrey.

TRAINING IN ELECTRONICS

A school for training engineers in the use of electronic equipment has been established by Associated Electrical Industries Ltd. at New Parks, Leicester, headquarters of the Electronic Apparatus Division. Trainees include not only members of the Company's Construction Department but also customers' engineers.

The courses will enable AEI Construction Department electronic specialists to keep up to date with the rapid and advanced developments taking place within the electronics industry; to extend the knowledge of engineers specialising in heavy current electronic engineering; and to train newly qualified engineers in current techniques in industrial electronics.

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ADDING COMMUNICATION

PDATIOR

By F. G. Rayer

C1 and C2 are two sections of the tuning condenser, and a 3-gang component will now be wanted, the remaining section being used for the oscillator, as in Fig. 7 (July issue).

C3 is a panel operated aerial trimmer. It allows slight changes caused by the aerial to be corrected, and allows accurate trimming on all parts of each band. It also avoids the need for trimmers across each coil in the aerial circuit, though these can still be fitted, if preferred. To trim such a circuit, set C3 at about half value, and adjust the pre-sets C4 and C5, and those connected to the oscillator coils, for best results. Subsequently, when listening to very weak stations, or after any changes to the aerial circuit, C3 may be adjusted by means of its control knob, for best reception. Many expensive communications sets have such a panel aerial trimmer. A capacity of about 50pF will usually suffice.

Fig. 9 incorporates a potentiometer or variable resistor for R.F. gain control. This is practically essential for some purposes — as when receiving C.W. with the AVC switched out of action. It is, of course, panel mounted, with a control knob.

Assuming that unit coils are fitted, three coils will be wanted for each waveband. To avoid ganging difficulties, it is wise to obtain aerial frequencychanger and oscillator coils in matched sets, from a single maker. The oscillator coils must be for the I.F. which will be employed—usually about 465kc/s, unless a double superhet is in view. TUNING AND BAND CALIBRATION

(Continued from page 217 of the July issue)

For the R.F. and F.C. circuits shown, the wavechange switch will need six poles. A long switch with individual wafers will allow ample separation between R.F. and F.C. circuits and wiring. When all coils and trimmers are connected, any error in switch connections, or coils, may be difficult to reach. It is thus quite a good plan to connect the coils for one band only, and then to test the receiver. Errors can then easily be corrected, and other sets of coils added.

Tuning Arrangements

A high quality tuning drive, or bandspread tuning, is desirable. The latter has attractive features, and can be provided by wiring a low capacity condenser in parallel with the main tuning condenser, as in Fig. 10. For general purposes, the bandspread condenser can be of about 15pF to 30pF maximum capacity.

If the usual gang condenser is 500pF per section, and the bandspread condenser is 25pF per section, 180° rotation of the latter will equal about 9° of rotation with the 500pF condenser. This greatly simplifies tuning any narrow band of frequencies, and also makes a high-ratio reduction drive

unnecessary.

Connections between the two condensers should be short and direct, and small ball drives can be fitted to both. Bands can be accurately calibrated as described later.

Some wide coverage communications receivers employ gang condensers of 500pF each section. But if most interest is in the S.W. bands, a lower

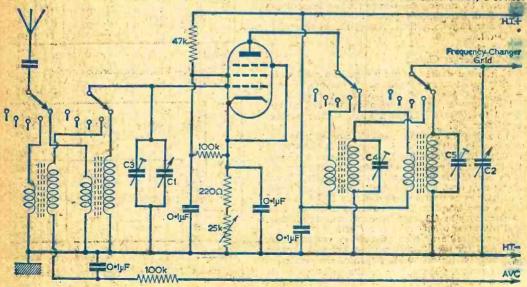


Fig. 9.—An R.F. stage with panel trimmer.

capacity, such as about 300pF each section, will be slightly better. An extra set or so of coils will be needed, but the L/C ratio will be more favourable.

Various high quality drives which give a form of mechanical bandspreading are also available. One of these will be very useful when much listening is done on various narrow frequency bands, and when an arrangement like that in Fig. 10 is not provided.

Band Calibration

Accurate band calibration is an extremely useful feature, and is most easily achieved by using a calibration marker. A 100kc/s crystal controlled oscillator for this purpose is shown in Fig. 11. This can easily be constructed as a separate unit, and power can be drawn from the receiver. Some very high-grade communications sets already have such an oscillator.

The 100kc/s oscillator will provide marker signals at 100kc/s (0·1Mc/s) intervals. These signals will be audible up to 15Mc/s to 30Mc/s or so, according to receiver sensitivity. It is thus only necessary to tune slowly down through the bands, and mark the dial each time the signal is heard. Identification of the particular harmonics can easily be made by counting from any known station frequency, such as the National Physical Laboratory transmissions on 2·5Mc/s, 5Mc/s and 10Mc/s.

To permit an extremely high degree of accuracy, the marker can be tuned to zero beat with the BBC Light Programme (200kc/s) or with one of the NPL signals. The 100pF trimmer is for this purpose. Output is taken to the receiver aerial terminal. For accurate tuning of the receiver to the marker harmonics, the BFO should be working.

With a separate bandspreading condenser, an extremely high accuracy in logging can be achieved by turning the bandspreading control to zero, setting the large condenser to zero beat with a marker harmonic, then turning the marker and BFO off.

Another Marker Circuit

If it is not desired to use a crystal, a somewhat similar result can be achieved by making up the oscillator in Fig. 12. Spares can be used for this. C1 is a pre-set, and should allow the coil to be tuned to 200kc/s. C2 is a small vernier tuning condenser, with knob.

To adjust the oscillator, switch it on at least ten minutes in advance, and tune in the 200kc/s (1500m) Light Programme. Reduce signal strength by removing the aerial, or using a short piece of wire. Set C2 at half capacity, and adjust C1 to about zero beat. C2 can then be adjusted until the oscillator is as nearly as possible on 200kc/s. The audio tone heard in the receiver speaker will fall in frequency as C2 approaches its correct setting, and will cease when tuning is correct.

Harmonics are then tuned in exactly as described for the 100kc/s marker, but will appear at 200kc/s (0·2Mc/s) throughout the receiver tuning ranges. The oscillator should be checked against the Light Programme signal at frequent intervals, and C2 adjusted as necessary.

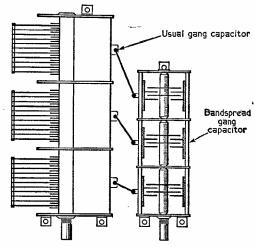


Fig. 10.—A low capacity condenser for bandspread tuning.

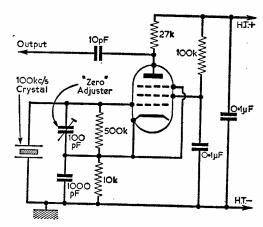


Fig. 11.—A 100kc/s calibration marker.

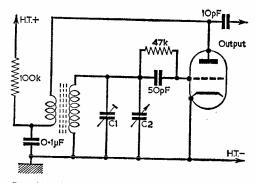
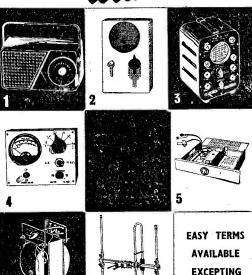


Fig. 12.—A 200kc/s secondary standard marker.

(To be continued)

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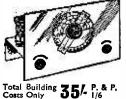


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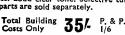
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The Editor does not necessarily agree with the opinions expressed by his correspondents

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

PHONETIC ALPHABET

SIR,—I am a keen short wave listener and have spent many happy hours on the 40m amateur band. Lately, however, I find it increasingly difficult to recognise the call-signs, given both before and after the QSO. This is, I believe, the result of the amateur using a code known only to himself.

The task of the operator and the listener would surely be simplified if the current phonetic alphabet was made standard and included in the R.A.E. examination.—P. A. ELLIS (Windsor).

DAMAGE TO TRANSISTORS

SIR,—Whilst considering the damage caused to transistors through reversed polarity, I recalled the function of a diode—to allow a current to flow in one direction only—and look forward to the time when we shall see germanium, or perhaps silicon diodes which have an extremely low forward resistance, but a sufficiently high resistance to prevent reverse current from damaging the transistors. The diode could be incorporated into the positive line, acting as a fuse. — B. FORHEAD (Cobham).

TRANSISTOR SET RECEPTION

SIR,—May I add to the remarks of Mr. James (June issue) about the small portables on sale for a few pounds. I maintain that locality is all important and, in fact, have proved this to myself.

At the moment I am experimenting with a three transistor set. It uses only four components (including the tuning system) and is capable of good reproduction over a small dynamic speaker. Last year I had a similar model in use on the Norfolk Broads when many stations were received, including some European broadcasts; but when used in the North West of England its performance was much worse.

I am, I think, one of your oldest readers and I have, like Thermion, used mangle rollers and bellwire to read, in morse, the weather report from Poldhu.—G. W. Phillimore (Cheshire).

SIR,—I thoroughly agree with what Mr. James said about portable radios working well in some parts of England and not in other districts. I constructed a transistor portable radio and

received Home, Light, Luxembourg, Third and foreign stations in Birmingham; but when I made a visit to Nottingham, only 50 miles away, no

signals at all were picked up.

I wonder if any reader could explain the following query? I recently bought an amplifier that had a built-in loudspeaker. I plugged it into the mains, and by accident the aerial lead-in touched one of the input wires of the amplifier. Then, quite suddenly, the Light Programme came through the loudspeaker as a strong signal. This amplifier now serves as an excellent Light Programme receiver.—B. N. JOYCE (Birmingham 31).

FRENCH TELEVISION RECEPTION

SIR,—With reference to Mr. Forsyth's query (June issue) on the reception of French TV sound on 355m; it is most unlikely that the sound could be heard on medium waves. What I think this reader heard was the medium wave station at Nancy on 358m, which carries the France II network. It is very probable that this service was relaying the sound from the TV programme at that period.—R. PATRICK (Derby).

BBC TELEVISION RECEPTION

SIR,—In reply to Mr. Shucksmith's letter, in the June edition, who receives BBC television on 3.5Mc/s in the 80m band; I receive ITV television on the same frequency.

The reason is that a signal is being emitted from the I.F. stage of a television receiver. It is impossible for these to be the actual signals from the television transmitters, as BBC TV is about 6Mc/s and ITV is about 1090Mc/s. — W. B. BICKHAM (Trull, Somerset).

SIR,—Like Mr. Shucksmith (June issue) I have also received BBC television on the 80m band. I believe that the signal is being emitted from a nearby TV receiver, for when the television is on in my own home, the signal is fairly strong, but when switched off it is very weak. Furthermore, this set has an external ITV converter, and when this is turned to ITV, this signal can be heard.—R. J. Bowser (Luton).

YOUNG ENTHUSIASTS

SIR,—I read in the June issue that you would like to hear from young enthusiasts. I made my first set when I was eight years old. This was the simplest crystal set, but soon I added a two valve amplifier to it, using HL2 and KT2 valves. I followed this with a five-watt amplifier, based on a Roding circuit using two 6C4 and one 6V6 valves. to use with an A.M. tuncr. I next made another of these amplifiers and built them both into a

stereo radiogram, which used a home-made pickup arm. I have since constructed many pieces of equipment, including several P.W. designs. I am fourteen years old.—J. FISHER (Finchley).

CORRESPONDENTS WANTED

SIR,—I am 18 years old and am very interested in radio as a hobby. I hope to become an amateur transmitter in the near future and would like to correspond with any other amateurs. I will answer all letters received. — V. N. SURENDRAN (Karithala -X., Ernakulam, Kerala State, India).

SIR,—I am 16 years old and am very interested in radio construction and amateur radio. I would like to correspond with radio enthusiasts of my own age.—C. F. HILLON (18 William Road, Haydock, St. Helens, Lancashire).

UNMARKED COMPONENTS

SIR,—I have recently decided to take up home construction again, and am annoyed to find that the hobby still seems to be back in the 20's. In those days I seem to remember there were continual notes in your pages about manufacturers marking components with the maker's name and value. This particularly applied to variable condensers and such items, but to-day I find that these parts are still without any indication as to value. It seems to me that it is more important to-day that these markings should be conspicuous as the components are so much smaller and are available

in various types. The spacing and the size controls the capacity and one cannot therefore look at it and say that's a two-gang 0.0003μ F, for instance, and as some two-gang units have the two sections of different capacities one is in the dark when the box in which it is bought is thrown away. The colour-code is all right so far as it goes, but I have found so many components which carry no identification — transistors included. — R. W. Entwistle (York).

POWER SUPPLY

SIR,—The present tendency to use "A.C./D.C." techniques in all mains apparatus seems to me very bad, not only from the point of view of efficiency but also from the safety angle. How can a manufacturer justify a "live" chassis when the slight extra expense of a mains transformer will make the set safe? I believe the reason this is now being done is because there have been several cases of fire arising from the use of a main transformer with wire of too low a current-carrying capacity. To me this is as bad as using the live chassis arrangement, and I would have thought that the I.E.E. or some other body would have introduced a regulation making it illegal to use this type of construction in domestic equipment. The service engineer may know how to handle this type of equipment but in these days of "do it yourself" too many householders are likely to try and put a fault right, with disastrous results.-R. E. BENNETT (Wolverhampton).

Phase Splitters and Phase Reversers

(Continued from page 322)

The unbalance mentioned above is not normally too large if the circuit is to be used in an oscilloscope amplifier. The supreme advantage of the cathode coupled phase splitter for use in oscilloscope amplifiers is that the circuit can easily be modified to function without any coupling condensers or transformers whatsoever. Such a circuit can be used to amplify the very low frequencies—or even D.C. itself—which are sometimes involved in oscilloscope work. The circuit is not very susceptible to jitter or hum owing to any H.T. fluctuations; the distortion is fairly low and there is practically no tendency to oscillate. For oscilloscope work involving no frequencies below about 50c/s, however, one of the circuits shown in Fig. 7 may be found more convenient, as they give about twice the gain. The cathode follower phase splitter is not normally used in oscilloscope work unless it is followed by a pushpull stage, as the maximum output voltage is too small.

A typical oscilloscope amplifier which will function from D.C. to above the highest audio frequencies is shown in Fig. 10 (page 322). The potential divider resistors between the input and the EF86 valve (V1) attenuate the input voltage to a suitable value for feeding into the amplifier. These resistor values can be chosen to meet individual requirements. There is some negative feedback across the cathode resistor of V1, but in any case the use of a cathode bias condenser is not advisable if the amplifier is to be used for low frequency work.

The valve capacities reduce the high frequency

response of the circuit. The high frequency response could be improved by the use of smaller anode resistors, negative feedback and compensating condensers or chokes. Arrangements must, of course, be made to ensure that the final anode of the cathode ray tube is at approximately the same voltage as the mean deflector plate potential.

Gain

If a signal voltage of amplitude 10 to 20mV is applied to the input of the Fig. 10 circuit, the gain is sufficient to give a reasonable deflection on a 3in. cathode ray tube. Care must therefore be taken during the construction of the amplifier to ensure that unwanted pick-up is avoided.

A further advantage of the cathode coupled phase splitter in the output of an oscilloscope amplifier is that the grid of V2(b) in Fig. 10 can be supplied with a D.C. voltage from a potentiometer for the Y-shift. Cathode coupled circuits can be used in cascade without condenser coupling.

Summary

High fidelity audio amplifiers normally use one of the circuits in Fig. 7, especially if economy is important. The circuits of Figs. 2 and 3 (July issue) give rather better balance, but an extra stage is normally required. The circuit of Fig. 4 (last month) gives high gain. Oscilloscope amplifiers for use at D.C. or low frequencies use the cathode coupled phase splitter; otherwise they normally use one of the see-saw circuits.



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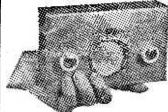
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Practical Wireless

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The index letters which precede the Blueprint Number indicate the periodical in which the description appeared. Thus PW refers to PRACTICAL WIRELESS; AW to Amateur Wireless and WM to Wireless Magazine.

Send (preferably) a postal order to cover the cost of the Blueprint (stamps over 6d. unacceptable) to PRACTICAL WIRELESS, Blueprint Dept., George Newnes, Ltd., Tower House, Southampton Street, London, W.C.2.

SPECIAL NOTE

THE following blueprints include some pre-war designs and are kept in circulation for those constructors who wish to make use of old components which they may have in their spares box. The majority of the components for these receivers are no longer stocked by retailers.

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The PW 3-speed Autogram ... — 8/The PW Monophonic Electronic OUERY COUPON

Organ ... — 8/(No constructional details are available with this blueprint)

This coupon is available until 4th August, 1961, and must accompany all queries in accordance with the notice on our "Letters to the Editor"

PRACTICAL WIRELESS, AUGUST, 1961.

TELEVISION

The PT band III converter .. — 1/6

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