

PRACTICAL WIRELESS

APRIL
1969

310

Cir-kit

**FREE
INSIDE**

Presented FREE with
**PRACTICAL
WIRELESS**

INSTRUCTIONS
Remove paper backing and, place adhesive side downwards in the chassis. Press down firmly. Drill 1/16" holes in board through side. Pass through and glue and cut to size. Punch holes in board through holes, and the leads and length and thickness. Alternatively, using a hand and using a hole required.



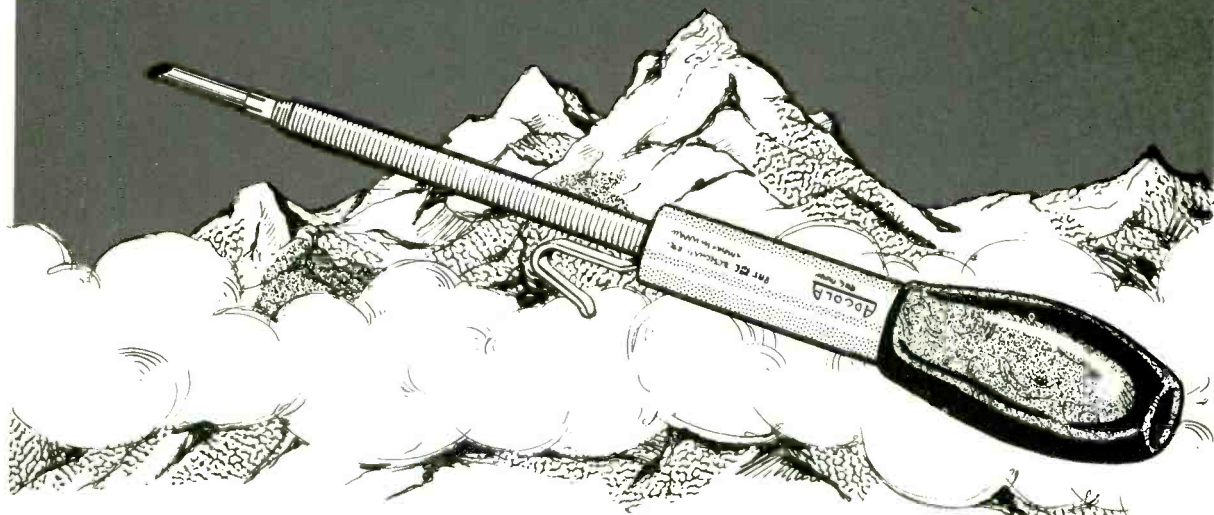
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AMPLIFIER**

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PRICE**

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5/-

TRIO COMMUNICATIONS EQUIPMENT

JR-500SE

This high performance receiver is made especially to cover the amateur bands and utilises a crystal controlled double heterodyne circuit for extra sensitivity and stability. Brief spec: Covers all the amateur bands in 7 separate ranges between 3.5 and 29.7 Mc/s. Circuit uses 7 valves, 2 transistors and 5 diodes plus 8 crystals; output 8 and 500 ohm and 500 ohm phone jack. Special features: Crystal controlled oscillator • Variable BFO • VFO • AVC • ANL • 8 meter • 88B-CW • Stand-by switch • Special double gear dial drive with direct reading down to 1 kHz • Remote control socket for connection to a transmitter. Audio output 1 watt. For use on 110/250V A.C. Mains. Superb modern styling and control layout—finished in dark grey. Cabinet size 7 x 13 x 10in. Weight 18 lbs. Fully guaranteed, complete with instruction manual and service data.



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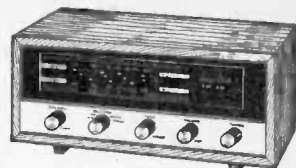
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**LASKY'S
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PRICE**

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LASKY'S "Compact" STEREO A M P



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Cabinet size 12 x 8 x 5in. attractive grey lizard skin finish. Fitted high flux 6in. 5w. 3 ohm speaker.

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Mono **59/9** Stereo **69/9**

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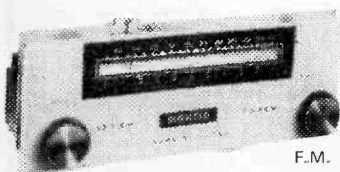
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Circuit diagram, construction details and parts list (free with kit) 1/6. (S.A.E.).

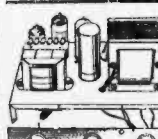


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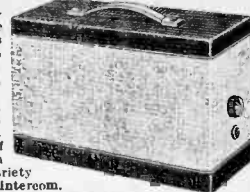
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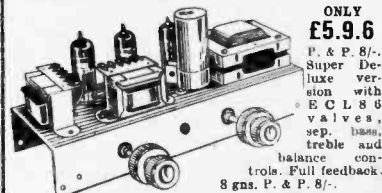
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● Transistors (GET114 or 81 Mullard AC128D) and patched pair of AC128 o/p). ● 9 volt operation.
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SPECIAL PRICE 45/- P. & P. 3/- Also ready built and tested, 52/6. P. & P. 3/-.

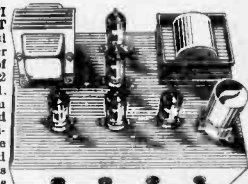
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23. P. & P. 5/-.

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SPEAKERS: Elac Heavy duty Ceramic Magnets 11,000 line, 10 in. round, 10 x 6 in. 3 ohm, or 15 ohm, 45/6. P. & P. 3/6. 8 in. round 16 or 3 ohm, 42/6. P. & P. 3/6. E.M.I. 13½ x 8 in. 15 or 3 ohm 45/-. P. & P. 3/6. E.M.I. 3 in. square, 15/-. P. & P. 1/6. E.M.I. 13½ x 8 in. fitted two 2½ in. tweeters. 15 ohms. 77/6. P. & P. 4/6. E.M.I. 13½ x 8 in. (15 ohm) Hi-Fi Quality, 25.19.6. P. & P. 4/6. E.M.I. 1. Woofers, 6½ x 6½ in. square. 3 ohm. 59/6. P. & P. 4/6. E.M.I. Crossover, 16/6. P. & P. 1/-. EAGLE Crossover units, 3 or 16 ohms, 14/6. P. & P. 1/-. Bakers 12 in., 25 watt, 15 ohm, 26.6.0. P. & P. 3/6. All other speakers supplied—Goodmans, Bakers, W.B., Wharfedale, Eagle, Tripletone.

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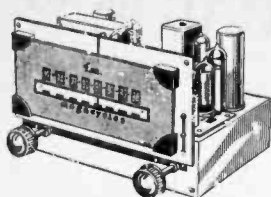
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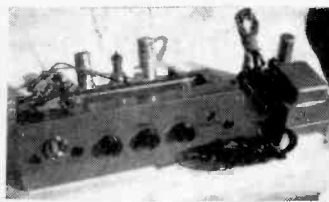
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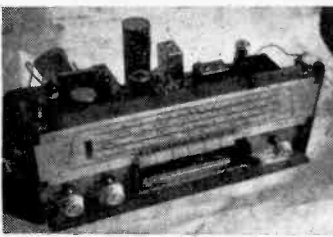
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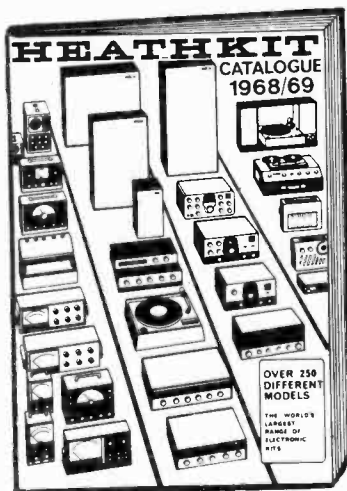
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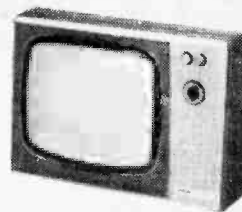
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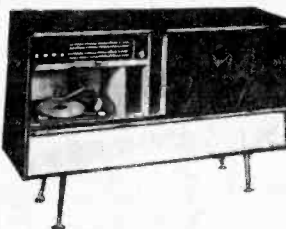
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1R5	5/6	25U4GT11/6	DY87	5/8	EM84	6/3	PL81	7/8	UCH81	6/6
1R5	4/3	30C1 6/9	EAB8C80 6/6	EM87	7/6	PL82	6/6	UCL82	7/-	
1T4	2/9	30C15 13/-	EAF42 8/9	EY61	7/-	PL83	6/6	UCL83	11/6	
384	5/9	30C18 9/-	EB91 2/3	EY86	6/3	PL84	6/3	UP41	9/9	
3V4	5/9	30F5 13/6	EB93 3/6	EZ40	7/6	PL500 12/6	UF80	7/-		
5U4G	4/6	30FL1 12/6	EB041 8/3	EZ41	7/6	PL504 12/6	UF85	9/6		
5Y3GT	5/9	30FL12 14/6	EBF80 6/-	EZ80	4/6	PL508 15/-	UF89	9/6		
5ZAG	7/6	30FL14 10/6	EBF89 6/3	EZ81	4/6	PL602 14/6	UL41	6/6		
6J30L2	12/6	30L1 6/-	ECC81 3/9	GZ32	8/9	PM84	7/9	UL44	20/-	
6AL5	2/3	30L15 14/-	ECC82 4/9	KT32	5/-	PX25 10/6	UL84	6/6		
6AM6	3/6	30L17 13/-	ECC83 7/-	KT61	8/9	PY31	5/6	UM84	7/6	
6AQ5	4/9	30P4 12/-	ECC84 5/6	KT66 18/-	PY32	10/-	UY41	7/-		
6AT6	4/-	30P12 11/9	ECC85 5/-	ME140015/-	PY33	10/-	UY85	5/9		
6AU6	4/9	30P19 12/-	ECX80412/6	N78 14/9	PY81	5/3	VP48	10/6		
6BA6	4/6	30P11 12/6	ECF80 7/-	PABC80 7/-	PY82	5/3	VP1321 21/-			
6BE6	4/3	30PL13 14/6	ECF82 6/9	PC86 9/6	PY83	5/9	Z77	3/6		
6BT6	7/-	30PL14 15/-	ECH35 6/-	PC88 9/6	PY88	6/3	Transistors			
6BW6	13/-	35L6GT 8/-	ECH42 10/6	PC96 8/6	PY800	6/9	AC107	3/6		
6F13	3/6	35W4 4/6	ECH81 5/9	PC97 8/6	PY801	6/6	AC127	2/6		
6F14	9/-	35Z4GT 5/-	ECH84 6/9	PC900 8/3	R19	6/6	AD140	7/6		
6F23	13/6	6063 12/6	ECL80 6/9	PCC84 8/-	R20	12/6	AF102	18/-		
6K7G	2/6	A231 8/-	ECL82 6/9	PCC85 6/6	TH21C	9/9	AF116	3/6		
6K9G	4/6	BT29 13/6	ECL83 9/-	PCC88 9/9	U28	13/-	AF116	3/3		
6L18	6/-	COH35 10/-	ECL86 8/3	PCC89 10/6	U26	12/-	AF117	3/6		
6V8G	5/-	CL33 18/6	EF39 3/9	PCF189 9/9	U47	13/6	AF124	7/6		
6V6GT	6/6	CY31 6/9	EF41 9/6	PCF80 6/9	U49	13/6	AF125	3/6		
6X4	3/6	DAC32 7/3	EF80 4/9	PCF82 6/-	U52	4/6	AF126	2/6		
6X5GT	5/9	DAF91 4/3	EF85 5/6	PCF86 9/3	U78	3/6	AF127	8/6		
7B6	10/9	DAF96 6/-	EF86 6/6	PCF80013/6	U911	12/6	OC26	5/9		
7B7	7/-	DF33 7/9	EF89 5/3	PCF801 7/-	U301	13/6	OC44	2/3		
7C6	6/9	DF91 2/9	EF91 3/6	PCF802 9/6	U801	18/-	OC45	2/3		
7Y4	6/6	DF96 6/-	EF94 4/9	PCF805 9/-	UABC80 6/3	OC71	2/6			
10F1	15/-	DH77 4/-	EF183 6/-	PCF80611/6	UAF42	9/6	OC72	2/6		
10F13	15/6	DH81 10/8	EF184 5/9	PCF80810/6	UB41	6/6	OC75	2/6		
12AT7	3/6	DK32 7/6	EH90 6/6	PCL82 7/-	UBC41	7/9	OC81	2/3		
12AU6	4/9	DK91 5/6	EL33 8/9	PCL83 9/-	UBC81	7/-	OC81D	2/3		
12AU7	4/9	DK92 9/3	EL34 9/6	PCL84 7/6	UBF80	6/-	OC82	2/3		
12AX7	4/9	DK96 7/-	EL41 9/6	PCL85 8/3	UBF89	6/9	OC82D	2/6		
12K8GT	7/-	DL35 5/-	EL84 4/9	PCL86 8/6	UC92	5/-	OC170	2/6		

READERS RADIO

85 TORQUAY GARDENS, REDBRIDGE, ILFORD,
ESSEX. Tel. 01-550 7441

Postage on 1 valve 9d. extra. On 2 valves or more, postage 6d. per valve extra. Any Parcel Insured against Damage in Transit 6d. extra.

DOOR INTERCOM

Know who is calling and speak to them without leaving bed, or chair. Outfit complete microphone with call push button, connectors and master inter-com. Simply plugs together. Originally sold at £10. Special snip price 49/6, plus 3/6 postage.



MINIATURE WAFER SWITCHES

4 pole, 2 way—3 pole, 3 way—4 pole, 3 way—2 pole, 4 way—3 pole, 4 way—2 pole, 6 way—1 pole, 12 way. All at 8/6 each. 36/- dozen, your assortment.

WATERPROOF HEATING ELEMENT
26 yards length 70W. Self-regulating temperature control. 10/- post free.

BLANKET SWITCH
Double pole with neon light into side so luminous in dark, ideal for dark room light or for use with waterproof element—new plastic case. 5/6 each. 3 heat model 7/6.

MAINS TRANSFORMER SNIP
Making a power pack for amplifier or other equipment? These transformers have normal mains primaries (230/40 v.) and isolated secondaries two types (1) 12 v. 500 mA. at 8/6; (2) 15 v. 500 mA. at 8/6.

PP3 ELIMINATOR. Play your pocket radio from the mains save £8. Complete component kit comprises 4 rectifiers—mains dropper resistances, smoothing condenser and instructions. only 6/6 plus 1/- post.

BECKASTAT
This is an instant thermostat, simply plug your appliance into it and its lead into wall plug. Adjustable setting for normal air temperatures. 13A loading. Will save its cost in a season 19/6. Post and ins. 2/9.

KETTLE ELEMENT
230/240V 1500 watt. Made by Best for kettles with 1 1/2 in. dia. including: Best, Besco, Chalfont, Davidson, Dimplex, Grafton, Hawkins, Jurymaid, Microwave, Monogram, Pico, Revco, Town, Swan. Normally 32/6. Our price 15/- plus 2/6 post.

QUICK CUPPA
Mini Immersion Heater, 350v. 200/240v. Boils full cup in about two minutes. Use any socket or lamp holder. Has at bedside for tea, baby's food, etc. 19/6, post and insurance 1/6. 12v. car model also available.

MAINS TRANSISTOR POWER PACK
Designed to operate transistor sets and amplifiers. Adjustable output 6v., 9v., 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1, PP2, PP4, PP6, PP7, PP8, and others. Kit comprises: mains transformer rectifier, smoothing and load resistor, condenser and instructions. Real snip at only 16/6, plus 3/6 postage.

THERMOSTATS
Type "A" 15 amp. for controlling room heaters, greenhouses, airing cupboard. Has spindle for pointer knobs. Quickly adjustable from 30-80°F. 9/4 plus 1/- post. Suitable box for wall mounting. 5/-, P. & P. 1/-.
Type "B" 15 amp. This is a 17in. long rod type made by the famous Sunvic Co. Spindle adjusts this from 50-550°F. Internal screw alters the setting so this could be adjustable over 30° to 1000°F. Suitable for controlling furnaces, oven, kln immersion heater or to make flame-start or fire alarm. 8/6 plus 2/6 post and insurance.
Type "D". We call this the Ice-stat as it cuts in and out at around freezing point, 2/3 amps. Has many uses one of which would be to keep the 10A. pipes from freezing, if a length of our blanket wire (18 yds. 10/-) is wound round the pipes. 7/6. P. & P. 1/-.
Type "E". This is standard refrigerator thermostat. Spindle adjustments cover normal refrigerator temperature. 7/6, plus 1/- post.
Type "F". Glass enclosed for controlling the temp. of liquid—particularly those in glass tanks, vats or sinks—thermostat is held (half submerged) by rubber sucker or wire clip—ideal for fish tanks—developers and chemical baths of all types. Adjustable over range 50° to 150°F. Price 15/-, plus 2/- post and insurance.

ELECTRIC CLOCK WITH 25 AMP. SWITCH

Made by Smith's these units are as fitted to many top quality cookers to control the oven. The clock is mains driven and frequency controlled so it is extremely accurate. The two small dials enable switch on and off times to be accurately set. Ideal for switching on tape recorders. Offered at only a fraction of the regular price—new and unused only 39/6, less than the value of the clock alone—post and insurance 2/9.

INFRA-RED HEATERS

Make up one of these latest type heaters. Ideal for bathroom, etc. They are simple to make from our easy-to-follow instruction—uses silica enclosed elements designed for the correct infra-red wavelength (3 microns). Price for 750 watts element, all parts, metal casing, as illustrated. 19/6, plus 4/- post and insurance. Full switch 3/- extra.

ELECTRIC BARGAIN

5A, 3 pin switch sockets
An excellent opportunity to make that bench dis board you have needed or to stock up for future jobs. This month we offer 6 British made (Hicraft) bakelite flush mounting shuttered 5A switch sockets for only 10/- plus 3/6 post and insurance. (20 boxes post free).

CONTROL DRILL SPEEDS

DRILL CONTROLLER
Electronically changes speed from approximately 10 revs. to maximum. Full power at all speeds by finger-tip control. Kit includes all parts, case, everything and full instructions. 19/6 plus 2/6 post and insurance. Or available made up 29/6, plus 2/6 post.

THIS MONTH'S SNIP

CASSETTE LOADED DISCATING MACHINE
battery operated and with all accessories. Really fantastic offer a British made £31 outfit for only £4.19.6, brilliantly designed for speed and efficiency—cassette takes normal spools, drops in and out for easy loading—all normal functions—accessories include: stethoscopic earpiece—crystal microphone has on/off switch—SEND TODAY £4.19.6 plus 7/6 post and insurance. Post switch 18/6 extra Spare Cassette at 4/6 each, three for 10/-.

THERMOSTAT WITH PROBE
This has a sensor attached to a 15A switch by a 14in. length of flexible capillary tubing—control range is 20°F to 150°F so it is suitable to control soil heating and liquid heating especially when in buckets or portable vessels as the sensor can be fished out and lowered into the vessel. This thermostat could also be used to sound a bell or other alarm when critical temp. is reached in stack or heap subject to spontaneous combustion or if liquid is being heated by gas or other means not controllable by the switch. Made by the famous Teddington Co., we offer these at 12/6 each. Postage and insurance 2/9.

ELECTRIC CLOCK WITH 3A SWITCH
Electric Clock with 3 amp switch made by Smiths for Dreamland. These are mains driven and frequency controlled so are extremely accurate. The dial enables "switch-on" time to be accurately set. Switch off is 3 hours later or by manual control. Intended for switching electric blankets this needs only one setting for the season. Suitable also to control tape recorder, radio and lamp etc. up to 600W. In neat plastic case with mains lead and two outlet plugs. New and unused, 39/6, post and insurance 3/6.

HI FI BARGAIN

FULL FI 12 INCH LOUDSPEAKER. This is undoubtedly one of the finest loudspeakers that we have ever offered, produced by one of the country's most famous makers. It has a die-cast metal frame and is strongly recommended for Hi-Fi load and Rhythm Guitar and public address.
Flux Density 11,000 gauss—Total Flux 44,000 Maxwells—Power Handling 15 watts R.M.S. Cone moulded fibre—Freq. response 30-10,000 c.p.s.—specify 3 or 15 ohms—Main resonance 60 c.p.s.—Chassis Diam. 12in.—12in. over mounting lugs—Baffle hole 11in. diam.—Mounting holes 4, holes—1in. diam. on pitch circle 11 1/2in. diam.—Overall height 5 1/2in. A £6 speaker offered for only £3.9.6 plus 7/6 p. & p. Don't miss this offer. 15in. 30/6 plus £7.19.6.

INDICATOR LAMP

Panel mounting, consists of neon lamp in red plastic lens with resistor in leads for mains operation 2/6 each 24/- dozen.

12V BLOWER

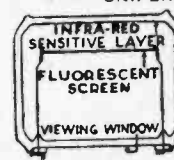
Heavy duty motor with centrifugal blower coupled to one end. Ideal for car heater. 12/6, plus 4/6 post.



2kW FAN HEATER

Three position switching to suit changes in the weather. Switch up for full heater (2kW), switch down for half heat (1kW), switch central blows cold for summer cooling—adjustable thermostat acts as auto control and safety cut-out. Complete kit £3.15.0. Post and ins. 7/6.

SNIPSCOPE



Famous war-time "cat's eye" used for seeing in the dark. This is an infra-red image converter cell with a silver caesium screen which lights up (like a cathode ray tube) when the electrons released by the infra-red strike it. A golden opportunity for some interesting experiments. 7/6 each, post 2/6. Data will be supplied with cells, if requested.

AC FAN

Small but very powerful mains motor with 6in. blades. Ideal for cooling equipment or as extractor. Silent but very efficient. 17/6, post 4/6. Mounts from back or front with 4BA screws.

FLUORESCENT CONTROL KITS

Each kit comprises seven items—Choke, 2 tube ends, starter, starter holder and 2 tube clips, with wiring instructions. Suitable for normal fluorescent tubes or the new "Grolux" tubes for fish tanks and indoor plants. Chokes are super-silent, mostly resin filled. Kit A—15-20 w. 19/6. Kit B—30-40 w. 19/6. Kit C—50 w. 19/6. Kit D—65 w. 19/6. Kit E for 6in., 9in., and 12in. miniature tubes, 19/6. Postage on Kits A and B 4/6 for one or two kits then 4/6 for each two kits ordered. Kits C, D and E 4/6 on first kit then 3/6 for each kit ordered. Kit E 3/6 on first kit then 3/6 on each two kits ordered.

TELESCOPIC AERIAL

for portable, car radio or transmitter. Chrome plated—six sections, extends from 7 1/2 to 47in. Hole in bottom for 6BA screw. 7/6.

Be first this year! SEED AND PLANT RAISING
Soil heating wire and transformer. Suitable for standard size garden frame. 19/6 Post and ins. 3/6.

MOVING COIL METER BARGAIN

Panel meters are always being needed and they are jolly costly when you have to buy them in a hurry—so you should take advantage of this offer: 2in. moving coil flush mounting meters only 9/6. These are actually R.F. meters and cost about £3 each but if you don't want them for R.F. then all you have to do is to remove the thermopile and you will have a 2.3 ma. meter which you can make into almost anything by adding shunts or series resistor. New and unused.

16 RPM GEARED MOTOR

Made by Smith's Electric, these are almost silent running, but are very powerful. They operate from normal to 240V, mains and the final shaft speed is 16 r.p.m. 15/-, Post & ins. 2/9.

REED SWITCH

Suitable for dozens of different applications, such as burglar alarms, conveyor belt switching. These are simply glass enclosed switches which can be operated by a passing permanent magnet coil. A special buy enables us to offer these at 2/6 each, or 24/- a dozen. Suitable magnets are 1/- each.

MINIATURE RELAY

American make—530 ohm coil 20-30 volt. operation—2 pole change over 4/6 each, 48/- doz.

SPRING COIL LEADS

as fitted to telephones, 4 core 2/6 each, 3 core 2/- each.

ELECTRONICS (CROYDON) LTD
Dept PW 266 London Road, Croydon CRO-2TH
Also 102/3 Tamworth Road, Croydon

SEW PANEL METERS

Send S.A.E. for full lists. Other ranges available. Please include postage.
Special quotations for quantities.



CLEAR PLASTIC METERS

Type MR.38P. 1 21/32in. square fronts.

50μA	37/-	750mA	25/-
50-0-50μA	35/-	1 amp.	25/-
100μA	35/-	2 amp.	25/-
100-0-100μA	32/6	3V D.C.	25/-
500μA	32/6	10V D.C.	25/-
500-0-500μA	25/-	250V D.C.	25/-
1mA	25/-	500V D.C.	25/-
1-0-1mA	25/-	100V D.C.	25/-
2mA	25/-	150V D.C.	25/-
5mA	25/-	300V D.C.	25/-
10mA	25/-	500V D.C.	25/-
20mA	25/-	15V A.C.	25/-
50mA	25/-	50V A.C.	25/-
100mA	25/-	150V A.C.	25/-
150mA	25/-	300V A.C.	25/-
200mA	25/-	500V A.C.	25/-
300mA	25/-	8 meter IMA.	29/6
500mA	25/-	VU meter	39/6

Type MR.45P. 2in. square fronts.

50μA	42/6	10V D.C.	27/6
50-0-50μA	39/6	20V D.C.	27/6
100μA	39/6	50V D.C.	27/6
100-0-100μA	38/6	100V D.C.	27/6
500μA	29/6	15V A.C.	27/6
1mA	27/6	300V A.C.	27/6
5mA	27/6	8 meter IMA.	35/-
10mA	27/6	VU meter	42/6
50mA	27/6	1 amp A.C.*	27/6
100mA	27/6	5 amp A.C.*	27/6
500mA	27/6	10 amp A.C.*	27/6
1 amp.	27/6	20 amp A.C.*	27/6
5 amp.	27/6	30 amp A.C.*	27/6

Type MR.52P. 2 1/2in. square fronts.

50μA	59/6	100-0-100μA	45/-
50-0-50μA	49/6	500μA	42/6
100μA	49/6	1mA	37/6

BAKELITE PANEL METERS

Type MR.65. 3 1/4in. square fronts.

25μA	67/6	500mA	32/6
50μA	45/-	1 amp.	32/6
50-0-50μA	42/6	5 amp.	32/6
100μA	42/6	15 amp.	32/6
100-0-100μA	42/6	30 amp.	32/6
500μA	39/6	50 amp.	32/6
1mA	32/6	100mA	32/6
1-0-1mA	32/6	20V D.C.	32/6
5mA	32/6	50V D.C.	32/6
10mA	32/6	150V D.C.	32/6
50mA	32/6	300V D.C.	32/6
100mA	32/6		

*Moving iron, all other moving coil.



"SEW" EDGEWISE METERS

MODEL PE 70. Dimensions 3 1/2 x 1 11/32 x 2 1/2in. deep overall. Available as follows:

50 microamp.	57/6	500 microamp.	49/6
50-0-50 microamp.	55/-	1 milliamp.	45/-
100 microamp.	55/-	300 volt A.C.	45/-
100-0-100 microamp.	52/6	VU meter.	62/6
200 microamp.	52/6		

Post extra.

ECHO HS-606 STEREO HEADPHONES

Wonderfully comfortable. Light-weight adjustable vinyl headband. 6ft. cable and stereo jack plug. 25-17,000 cps. 8 ohm imp. 7/6 P. & P. 2/6.

TRANSISTORISED TWO-WAY TELEPHONE INTERCOM

Operative over amazingly long distances. Separate call and press to talk buttons. 2-wire connection. 1000's of applications. Beautifully finished in ebony. Supplied complete with batteries and wall brackets. £6.10.6. P. & P. 3/6.

INTERCOM/BABY SITTER

Transistorised Intercoms, ideal for home/office/workshop etc. 2-way buzzer call system. For desk or wall mounting. Supplied complete with connecting wire, batteries, instructions. 2 station 59/6. P. & P. 2/6. 4 station £8.12.6. P. & P. 5/-.

SINCLAIR EQUIPMENT

Z12 12 watt amplifier, 99/6
P24 Power Supply Unit 89/6
Stereo 25 Preamp. £9.10.6
Q14 Speakers £29.19.6
Micromatic Radio Kit, 49/6. Built 59/6.
ALL POST PAID

SPECIAL OFFER
Two Z12 Amps, P24 Power Supply, Stereo 25 Preampifier, £22, or with two Q14 speakers, £37.

NEW SINCLAIR 2000 SYSTEM

35 watt Integrated Amplifier, £29, Carr. 5/-.
Self-powered FM Tuner, £25, Carr. 5/-.

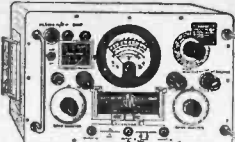
GARRARD TAPE MOTORS

Brand new stock as used by famous manufacturer. 200/250V. A.C. Capstan motor 15/-, Post For-ward 10/6. Fast rewind 10/6. P. & P. 5/-.
Set of three motors 32/6. P. & P. 5/-.

FIELD TELEPHONES TYPE L

Generator ringing, metal cases. Operates from two 1.5V batteries (not supplied). Excellent condition. £4.10.0 per pair. Carr. 10/-.

AVO CT.38 ELECTRONIC MULTIMETERS



High quality 97 range instrument which measures A.C. and D.C. Voltage, Current, Resistance and Power Output Ranges D.C. volts 250mV-10,000V. (10 megΩ-110 megΩ input). D.C. current 10μA-25 amps. Ohms 0-1,000 megΩ. A.C. volt 100mV-250V (with R.F. measuring head up to 250 Mc/s). A.C. current 10μA-25 amps. Power output 50 micro-watts-5 watts. Operation 0/110/200/250V. A.C. Supplied in perfect condition complete with circuit lead and R.F. probe. £25. Carr. 15/-.

TYPE 13A DOUBLE BEAM OSCILLOSCOPES



An excellent general purpose D/B oscilloscope. T.B. 2cps-750 Kc/s. Bandwidth 5/3 Mc/s. Sensitivity 33mV/CM. Operating voltage 0/110/200/250V. A.C. Supplied in excellent working condition. £22.10.0. Or complete with all accessories, probe, leads, lid, etc. £25. Carriage 30/-.

ADMRALTY B.40 RECEIVERS

Just released by the Ministry. High quality 10 valve receiver manufactured by Murphy. Coverage in 5 bands 650 Kc/s-50 Mc/s. I.F. 500 Kc/s. Incorporates 2 R.F. and 3 I.F. stages, band-pass filter, noise limiter, crystal controlled B.F.O., calibrator. O/F output, etc. Built-in speaker, output for phones. Operation 150/230 volt A.C. Size 19 1/2 x 13 1/2 x 16in. Weight 114 lbs.

Offered in good working condition. £29.10.0. Carr. 30/-.
A few Brand New £35. Carr. 30/-.
Also available B.41 L.F. version of above. 15 Kc/s-700 Kc/s. £17.10.0. Carr. 30/-.

CLASS D WAVEMETERS

A crystal controlled heterodyne frequency meter covering 1.7-8 Mc/s. Operation on 6 volts D.C. Ideal for amateur use. Available in good used condition. £5.18.6. Carr. 7/6. Or brand new with accessories. £7.18.6. Carr. 7/6.

AUTO TRANSFORMERS

0/115/230V. Step up or step down. Fully shrouded.
150 W. £12.6. P. & P. 3/6.
300 W. £2.7.6. P. & P. 3/6.
500 W. £3.10.0. P. & P. 6/6.
1,000 W. £5.10.0. P. & P. 7/6.
1,500 W. £6.10.0. P. & P. 8/6.
3,000 W. £7.10.0. P. & P. 12/6.
7,500 W. £15.10.0. P. & P. 20/-.

MARCONI TEST EQUIPMENT

EX-MILITARY RECONITIONED. TF.1440 STANDARD SIGNAL GENERATORS. 85 Kc/s-25 Mc/s. £25 Carr. 30/-.
T.885 VIDEO OSCILLATOR 0-5 Mc/s. £45 Carr. 30/-.
T.F.195M BEAT FREQUENCY OSCILLATOR 0-40 Kc/s. 200/250V. A.C. £20 Carr. 30/-.
T.F.142P Distortion Factor Meter. £20 Carr. 30/-.
All above offered in excellent condition, fully tested and checked. T.F.1100 VALVE VOLTMETER, Brand New, £50 T.F.1267 TRANSMISSION TEST SET, Brand New, £75 T.F.1371 Wide Band Millivolt Meter. Brand New, £50.

Variable Voltage TRANSFORMERS

Brand new, guaranteed and carriage paid. High quality construction. Input 230V. 50-60 cycles. Output fully variable from 0-250 volts. Bulk quantities available.
1 amp. £5.10.0; 2.5 amp. £8.15.0; 5 amp. £9.15.0; 8 amp. £11.10.0; 10 amp. £18.10.0; 12 amp. £21.0.0; 20 amp. £27.0.0.

AMERICAN TAPE

First grade quality American tapes. Brand new. Discount on quantities.
3in. 225ft. L.P. acetate 3/6
3in. 600ft. T.P. mylar 10/-
5in. 600ft. std. plastic 5/6
5in. 900ft. L.P. acetate 10/-
5in. 1,200ft. L.P. mylar 15/-
5in. 1,800ft. T.P. mylar 22/6
5in. 1,200ft. L.P. acetate 12/6
5in. 1,800ft. L.P. mylar 19/-
5in. 1,800ft. D.P. mylar 2/6
5in. 2,400ft. T.P. mylar 39/6
7in. 1,200ft. std. acetate 12/6
7in. 1,800ft. L.P. acetate 15/-
7in. 1,800ft. L.P. mylar 20/-
7in. 2,400ft. D.P. mylar 25/-
7in. 3,600ft. T.P. mylar 45/-
Postage 2/- Over £3 post paid.

TAPE CASSETTES

C90-60 minutes 10/3
C90-90 minutes 14/3
Over £2 post paid

G. W. SMITH & CO (RADIO) LTD.
3-34 Lisle St., W.C.2
Also see oppo. page

MULTIMETERS for EVERY purpose!

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MODEL TE-70. 30,000 O.P.V. 0/3/15/60/300/600/1,200V. D.C. 0/6/30/120/600/1,200V. A.C. 0/30/1A/3/30/300mA. 0/16K/160K/1.6M/16 Meg. ohm. \$5.10.0. P. & P. 3/-

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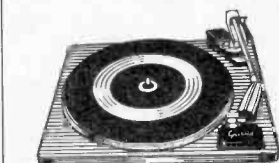
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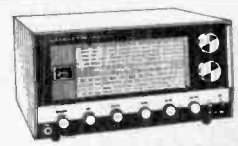
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An exciting new receiver covering 6 amateur bands 160/80/40/20/15/10 metres. Illuminated slide rule dial • 8 meter • Crystal calibrator • Product detector • Automatic noise limiter • RF tuning and gain controls. • Speaker or phone output • 6 valves, 2 transistors, 2 diodes 220/240V. A.C. Supplied brand new and guaranteed. \$40.0.0. Carr. 10/-



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CODAR CR.70A

Communications Receiver 540-10 metres



The Codar CR.70A is an excellent general coverage communications receiver for the keen short wave listener. Very reasonably priced at just £19.10.0 the CR.70A is outstanding value for money. In four stable ranges, the receiver covers from 540 metres medium wave, right through the shipping and coastguard frequencies all the short wave and international amateur bands up to and including 10 metres, where the rapidly improving conditions that now prevail allow the regular reception of world-wide call-signs!

The CR.70A has a high 'Q' aerial input stage giving extremely high gain with low noise level. Double tuned, iron cored I.F. transformers produce high selectivity. Ready to plug into 200-250 volt A.C. mains, the CR.70A needs only your aerial and a 2-3 ohm loudspeaker. The cabinet measures only 13" x 5 1/2" x 7 1/2" and the control panel is finished in black and white with chrome trim knobs. Fully guaranteed for 12 months!

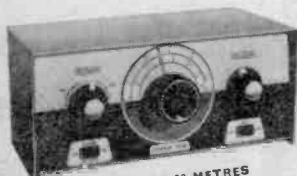
Buy your Codar equipment from your radio hobby store or direct from Codar. The order form will also bring fully descriptive leaflets (8d stamps appreciated).

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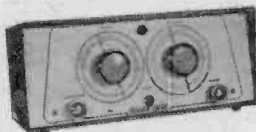
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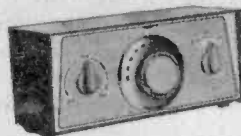
- *Ideal for SWLs *5 valves (inc. two twin triodes) giving 7 valve line-up
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5 transistors, bandspread 1.8-2Mc/s and 3.5-4Mc/s 12 volts, only 8" x 4" x 3 1/2". Ideal portable, mobile or home receiver. Efficient BFO, printed circuits. ONLY £15.17.6. Carr. 4/6.



CR45 MAINS T.R.F. SHORT-WAVE RECEIVER
World wide reception. *Separate electrical bandspread. *3 slow motion drives. *Output 3 watts spread. *3 valves ECC81, EL84, EZ80. for 2/3 ohm speaker. *Valves ECC85K with 3 coils Size 12" x 5 1/2" x 7". CODAR-KIT CR45K with 3 coils (10-28, 25-75, 60-176 metres). £9.15.0. Carr. 6/-, or ready built CR.45 £11.19.6. Carr. 6/-. Extra coils 5/4 each.



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1.5-30Mc/s. Provides up to 20dB gain plus substantial image rejection. Improved signal/noise ratio and selectivity. Power requirements 180-250 volts 12mA H.T. 6.3 volts, .3 amp L.T. Size 8 1/2" x 5" x 4". Ready built complete with cables, plugs and instructions. £5.19.6. Carr. 4/6. Self-powered P.R.30K £7.19.6. Carr. 4/6.



MINI-CLIPPER—OUR FAMOUS SHORT-WAVE RECEIVER
*Can be built in one evening. *Complete with valve, one coil 25-75 metres and 4 page instruction manual. Price £2.4.6. Carr. 3/-. Extra coils 5/4.

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PRACTICAL WIRELESS

VOL 44 No 12

Issue 746

APRIL 1969

TOPIC OF THE MONTH

Time for review

THE Monopolies Commission has its ever vigilant eye on matters of take-overs and lack of competition, yet it has never looked at radio broadcasting—the attitude seems to be that monopoly by semi-state organisations is no evil.

Before readers draw the conclusion that we are about to change our policy and jump on the bandwagon of the "pirate station lobby" we say straightaway that we will never support anarchy of the airwaves (or anywhere else for that matter). All we are suggesting is that it is time to review the situation on sound broadcasting, to see whether there isn't a good case for the licensing of radio stations independent of the BBC, their revenue obtained by advertising.

We know the arguments against this; that the programme material would descend to the lowest common denominator, that there aren't the available frequencies, that local papers would suffer from the competition for advertisers and that the BBC is doing a grand job anyway. We have said that we are suggesting ideas, not acting as a pressure group, but let us take these arguments one by one, taking the last one first.

There is no need to commit Auntie to euthanasia, she *is* doing a grand job, and independent stations *could* be complementary to the existing four services. There *could* be room for them, on v.h.f., (125 channels are available). Most American cities of any size have at least fifteen f.m. stations, so we could presumably do the same without interference to or from European stations. As for the argument that commercial radio would rob local papers of advertising, this has not been borne out abroad where this has happened, nor were national newspapers hit by the introduction of Independent Television.

We are very lucky in having a body such as the BBC to control our broadcasting services as they stand at the moment, but Auntie can stand competition—she has done it in the past and can do it again. The Conservative Party has pledged to review the situation if they are returned at the next election and the big debate on this subject is likely to grow.

Let's start talking about it now; we welcome readers' comments.

W. N. STEVENS—*Editor*

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MAY ISSUE WILL BE PUBLISHED
ON APRIL 8th

All correspondence intended for the Editor should be addressed to: The Editor, "Practical Wireless", IPC Magazines Ltd., Tower House, Southampton Street, London, W.C.2. Phone: 01 836 4363. Subscription rates, including postage: 42s. per year to any part of the world. © IPC Magazines Ltd., 1969. Copyright in all drawings, photographs and articles published in "Practical Wireless" is specifically reserved throughout the countries signatory to the Berne Convention and the U.S.A. Reproductions or imitations of any of these are therefore expressly forbidden.

NEWS AND COMMENT...

TRANSISTOR TESTER TT 1



The model TT 1 transistor tester is a portable, battery operated instrument for checking the leakage current and current gain of bi-polar transistors. Its main feature is that current gain may be measured anywhere within the range of 5 microamps to 100 milliamps, ensuring that circuit operating conditions may be reproduced. An expanded scale is provided for indicating leakage current, covering the range 0 to 100 milliamps, mid-scale 100 microamps. All measurements are made with a collector voltage of 9V.

Specification: Measurement facilities—d.c. current gain, Collector-base leakage current, Diode leakage current, Internal battery check. d.c. current gain ranges—10-1000. Collector current ranges—0-100 microamps, 0-1 milliamp, 0-10 milliamps, 0-100 milliamps. Indication—On 3in. moving coil meter and calibrated dial. Polarity—n-p-n and p-n-p. Collector voltage—9V. Power supply—From internal 9V PP7 battery, duration 6 months. Case—Hammer-grey finish with screened front panel, "lay flat" carrying handle and rubber feet. Weight—3 lb. Size—9 x 6 x 3in.

The price is £32. R.M.S. Instruments Limited, 24 Guildford Street, Chertsey, Surrey.

THE RAVENSBROOK STEREO AMPLIFIER



The Ravensbrook is based in many respects on the Ravensbourne design with a nominal output of 10+10 watts.

The whole amplifier is constructed on a single printed circuit board made from high grade fibreglass.

A four-way push-button Input Selector provides selection of disc, tuner and tape inputs. The fourth button provides for mono/stereo operation. In the mono position the left-hand input channel is fed to both speakers. The

output from a compatible stereo pickup is connected in parallel for playing mono records.

Total harmonic distortion is less than 0.1% at 10 watts into 15 ohms. 1kHz; and less than 0.25% at 10 watts into 15 ohms. 100Hz-10kHz. Output impedance matching is 8-16Ω.

A low noise pickup input stage using a special low noise p-n-p transistor, in conjunction with a high output second stage, achieves a very wide dynamic range. This avoids distortion on peak recorded passages. Two special quadrifilar wound transformers are used to drive two pairs of high current gain output transistors giving very low distortion. The technique of winding quadrifilar transformers, where all four windings are wound simultaneously, results in maximum coupling and perfectly balanced windings. These transformers are smaller versions of those to be found in the Ravensbourne amplifier. Silicon transistors are used throughout apart from one germanium device which forms part of the regulated power supply.

Recommended UK retail prices: Chassis model £42 10s. Case model £47 10s. Teak case alone £5. Purchase tax 10s. 1d.

Rogers Developments (Electronics) Limited, 4-14 Barmston Road, Catford, London, S.E.6.

COURSE FOR BEGINNERS AND ADVANCED

Readers might be interested to know that the Leyton Senior Evening Institute, Essex Road, E.10 runs a radio and TV maintenance class on Wednesday and Thursday evenings dealing with the principles and practice of our hobby. This caters for beginners and the more advanced.

Enrolment is through the normal evening institute channels, and, although the course started in September, new faces are always welcome.

MOTOROLA DATA BOOK OF ICs

Motorola Semiconductors Limited, York House, Wembley, Middlesex, has announced publication of the first edition of *The Integrated Circuits Data Book*. It contains complete data sheet specifications and other applications and test data for all standard Motorola integrated circuits (both digital and linear) manufactured at the time of publication.

A valuable interchangeability guide to all major manufacturers of digital and linear integrated circuits is included. Manufacturer type numbers are listed in alphanumeric order by product family and cross-referenced to the Motorola direct replacement. A description of the circuit function is also included for each manufacturer's part number.

Other items in the 960-page reference include a digital applications selection guide, arranged by function, for Motorola's eleven logic families, and an alphanumeric index to all Motorola type numbers. Separate sections are devoted to MECL, MHTL, MTTL, MDTL, MRTL, MOS and linear integrated circuit data sheets, plus a 12-gate complex array.

Supplements to *The Integrated Circuits Data Book* will be available, and an updating service subscription coupon printed in each copy gives the subscriber the opportunity of receiving complete data sheet information for all new Motorola IC introductions.

The book can be obtained from The Modern Book Company, 19-21 Praed Street, London, W.2, at a cost of £2 10s. plus 5s. postage and packing.

NEWS AND COMMENT...

WORLD RADIO CLUB AWARD



For nearly 50 years listeners have been reporting to broadcasters on reception of transmissions. In return, the BBC and other broadcasters have sent cards to verify correct reporting, the card issued by BBC External Services being known throughout the world as the "Big Ben" card.

Now, for the first time, the BBC is offering an award to listeners who correctly report on a number of BBC transmissions received from different transmitting sites. The reports will be analysed by BBC engineering staff and the certificates will be issued by the programme, World Radio Club. This award scheme applies to the one frequency schedule period only—2nd March to 3rd May, though there's a possibility that the scheme will be repeated.

To qualify for the award, listeners must give evidence of reception of three BBC transmissions from each of the following: Great Britain and the Atlantic, East Mediterranean and Far Eastern relay stations. These twelve reports (which must be received in one envelope before the end of May) should contain the following information: location, date, time, frequency and a few words about programme content. In return, the award will contain the

four verifications required by the serious DXer.

To be eligible for the award, a DXer must be a member of World Radio Club, the programme for DXers and short-wave enthusiasts which is broadcast in BBC World Service on Sundays at 0930 GMT, Thursdays 1245 GMT, Fridays 2345 GMT and on the North American Service on Mondays at 1515 GMT. To become a member you need simply write to World Radio Club, BBC, Bush House, London, W.C.2.

The picture shows Doug. Crawford, the World Radio Club compère.

CONFERENCE

DIGITAL SATELLITE COMMUNICATION

A major impact on all aspects of satellite communication over the next five years is expected to result from the introduction of digital techniques, especially pulse code modulation. In recognition of the economic and technical implications of this, Intelsat, the international consortium of over 60 nations is to sponsor a conference entitled "Digital satellite communication". The IEE is to co-sponsor the conference which will be held at Savoy Place, London, W.C.2, from the 25th to 27th November 1969.

The aim of the conference is to provide a forum for the presentation and exchange of information on digital-communication techniques, and the programme will embrace: systems aspects including performance targets and comparisons with analogue systems, coding and modulation, signalling and switching including interface with terrestrial networks, demand assignment and multiple access techniques, error control, interference aspects.

The programme will also include some invited papers from international authorities in this field.

The technical programme committee invite contributions from all nations, and intending authors should submit synopses written in English (preferably) or French of 500 to 1000 words in length by the 1st April 1969.

Further details of the conference and registration forms will be available in due course from the Intelsat-IEE Joint Conference Secretariat, Savoy Place, London, W.C.2, England.

CASSETTES FROM LONDON TO SYDNEY

Fifteen of the cars which completed the London to Sydney Marathon carried the Cassette Car Radio and other Philips car entertaining equipment. They included one of the six official Ford Cortinas, driven by Britain's Roger Clark with Ove Andersson as co-driver, which was all-set to win the marathon before mechanical trouble on the last lap put it into 10th place.

THE LECTURE:

About colour TV, covering the setting-up procedure and dealing in detail with degaussing, purity, convergence and grey scale tracking.

THE FILM:

Entitled "It's the Tube that makes the Colour" and describing the

manufacture of Mullard "Colour-Screen" TV picture tubes.

THE NOSH:

Free refreshments will be served during the interval.

THE VENUE:

Caxton Hall, Caxton Street, Westminster, London, S.W.1.

THE DATE:

Friday, March 28th at 7.15 p.m.

THE TICKETS:

They're free too! send a s.a.e. now to: FILM SHOW, Practical Television, Tower House, Southampton Street, London, W.C.2.



CIR-KIT

HOW TO USE YOUR FREE GIFT TO BEST ADVANTAGE

Like all good inventions, *Cir-Kit* is the kind of product which makes you wonder why it was not invented years ago. It is remarkably simple, cheap and efficient and in this article ways will be described of using your free length of *Cir-Kit* to its best advantage.

CIR-KIT, which is the invention of Mike Wheals, is produced by his company "Peak Sound (Harrow) Ltd.". As you will see from your free sample, it comprises 99.5% pure copper strip one-sixteenth inch wide. This copper strip, which is only two-thousandths of an inch thick, is backed by a layer of special adhesive

protected by easily removed silicon release paper. The surface of the copper is covered by a flux assist lacquer making soldering easy.

Being inexpensive and easy to apply, either to plain or matrixed paxolin board, alterations and modifications are quickly carried out.

APPLYING CIR-KIT

If there is not a circuit layout to follow, refer to the theoretical circuit diagram and if necessary decide how you wish the components to be arranged on the board. The overwhelming number of semiconductor circuits are low impedance operated and the layout is therefore relatively unimportant. Normally articles in *PRACTICAL WIRELESS* give details of whether layout is important and this may be taken as a reliable guide.

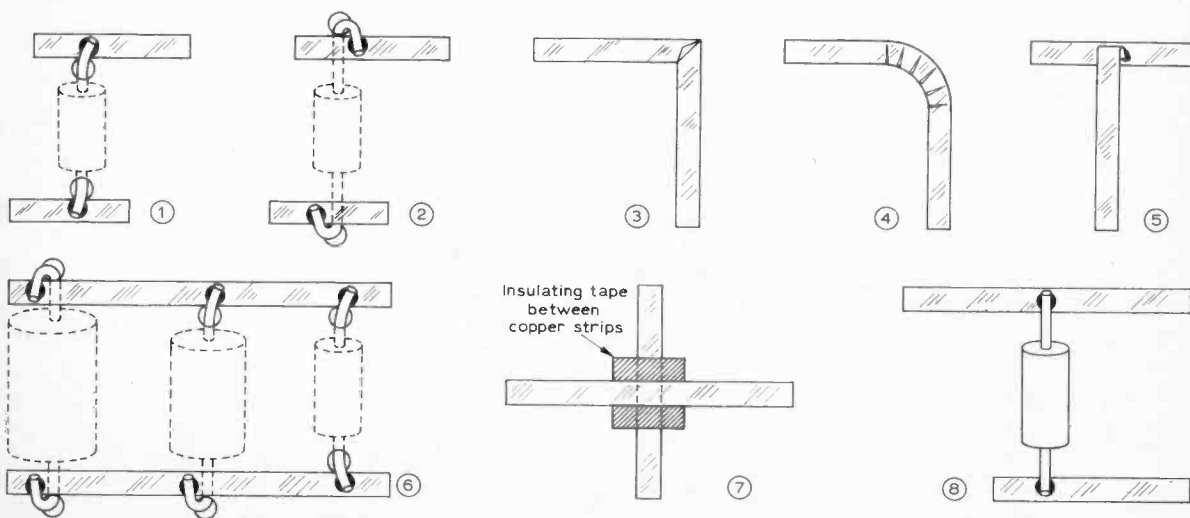
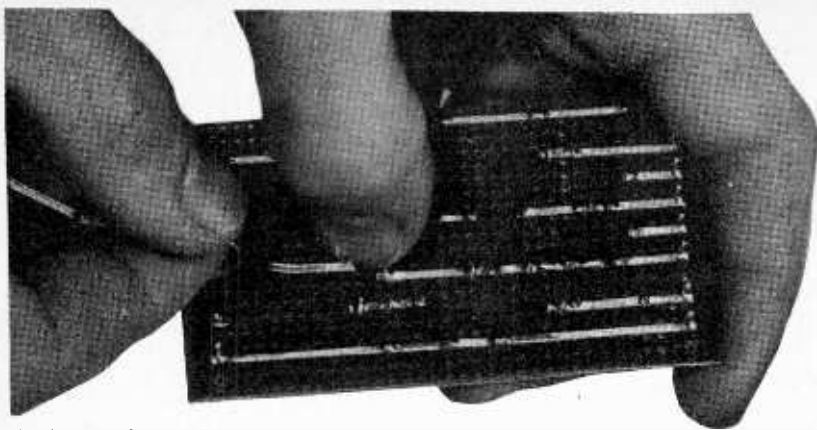


Fig. 1: The component leads should be passed through holes adjacent to the strip; Fig. 2: Leads may be doubled back if convenient; Fig. 3 and 4: Bends or curves are easily incorporated; Fig. 5: T-junctions are made by joining the strips and soldering afterwards; Fig. 6: Components of different sizes may be mounted on two parallel strips by using holes on alternative sides; Fig. 7: Crossovers may be used; Fig. 8: For quick "bread-boarding" components may be mounted on the same side as the copper strips.



Laying the Cir-Kit strip is a simple matter of peeling back the protective backing and pressing it onto the matrix board.

A very easy and convenient way to work out the layout is to draw the proposed positions on one-tenth inch graph paper and, using the same pitched matrix board, transfer the final layout to the board. Using one-tenth inch matrix board, the one-sixteenth Cir-Kit strip will fit exactly between the holes.

Cir-Kit may of course be used with plain board such as paxolin, but here it will be necessary to drill the required holes with a No. 60 drill, these holes may be either adjacent or through the strip.

ADVANTAGES OF CIR-KIT

One distinct advantage of Cir-Kit is that cross-overs can be incorporated in the design; it is only necessary to lay clear adhesive or insulating tape over the strip nearest the board and lay the cross-over strip on top of that. Right-angles and curves are readily made by gently bending the Cir-Kit as it is laid.

SOLDERING

Soldering presents no more difficulties than with any other form of wiring. It will however be necessary to bear in mind the rules that apply to good transistor soldering techniques. These are:

1. You should have a hot soldering iron to start with.
2. Low melting point solder should be used.
3. Apply the solder and iron together leaving them there just as long as necessary (one or two seconds is about right as long as the solder has begun to flow).
4. Once the joint has been made ensure that the component is not moved whilst the solder is setting.
5. Too long an application caused by using an iron which is too cool will cause the copper strip to expand and possibly lift off the board.

QUICK BREADBOARDING

When quick experimental circuits are required the Cir-Kit strip and the components may be applied to the same side of the board, making alterations and modifications very quick.

POINTS TO REMEMBER

Cir-Kit, exactly as supplied as the free gift, is widely used by industry, research organisations and educational authorities for experimental and development work.

Because of its economical rate of use and its long life the lengths of Cir-Kit sold on cards should last the experimenter a considerable time. Another advantage is that the adhesive will be found to strengthen with age making it suitable for both permanent and experimental work.

The length presented is sufficient to enable you to build either the Hi-Fi preamp or the tone control for the P.W. Double-12 project described on page 910. ■

Watch out for the NEW LARGE-PAGE PRACTICAL TELEVISION

April issue on sale March 21

Contents include

★ The Videoscope MV3

A new P.T.V. oscilloscope design with wide bandwidth to meet the requirements of colour receiver and videotape equipment servicing.

★ Understanding Colour Faults

The first requirement in trouble-shooting in the chroma and tube-drive sections of a colour receiver is an understanding of colour faults: are you faced with a case of distortion, phase error, low gain in one channel or the complete absence of one or more of the colour signals? The diagnosis of colour faults and how to quickly pinpoint their causes is simply explained.

★ Aerial Design

Constructional details of a Band I/III aerial for loft or outdoor use with a combined downlead. Also how to make a simple balun.

★ Flywheel Sync Circuits

Commonly-used circuits are examined with an outline of fault-finding and adjustment procedures and off-screen illustrations of fault effects.

PLUS ALL THE REGULAR FEATURES



THE P.W. DOUBLE-12 HI-FI AMPLIFIER

HAL MOORSHEAD

PART 1

THE term "High Fidelity" has been grossly misused for a considerable time in some quarters and the amateur constructor may have been very disappointed at some of the results achieved after building amplifiers claiming to fall into this category.

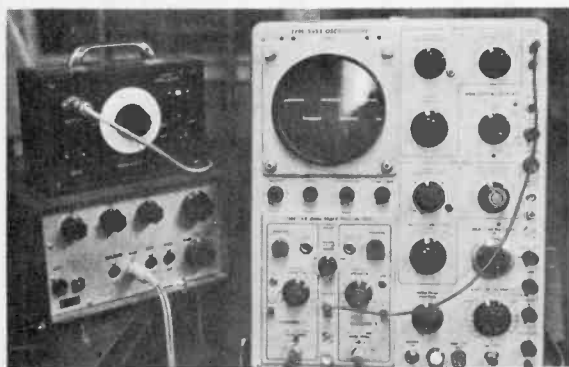
The PRACTICAL WIRELESS "Double-12" was designed as a true hi-fi project, that is its performance had to fall within certain specifications for frequency response, distortion etc. If the electrically measured characteristics are good on an amplifier it follows that the final results when listening to records, tape or f.m. radio will also be good. In addition to being excellent in performance the "Double-12" is easily made from reasonably priced components, all readily available and the associated metalwork and cabinet are as simple as possible, compatible with rigid construction and pleasing appearance.

metalwork for the complete preamplifier. The following issue will deal with the main amplifiers and power supply and details of a suggested cabinet.

Although this short series will be dealing with a stereo project, there is no reason why it cannot be used for mono and here, of course, only one preamp. and one main amplifier are needed.

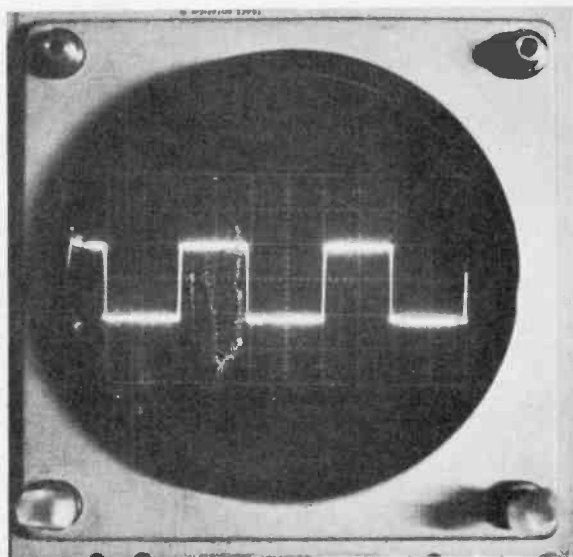
Specification

To be considered as hi-fi an amplifier must have sufficient output, and for this reason an output of 12 watts (r.m.s.) was considered necessary. Obviously it is no good having plenty of power if it is distorted and the total distortion at 10 watts is about 0.06% and at 1 watt a tenth of that figure. To provide a wide range of tone control separate bass and treble controls give a 12dB boost or cut at 100c/s and 10kc/s with reference to 1kc/s. With no fre-

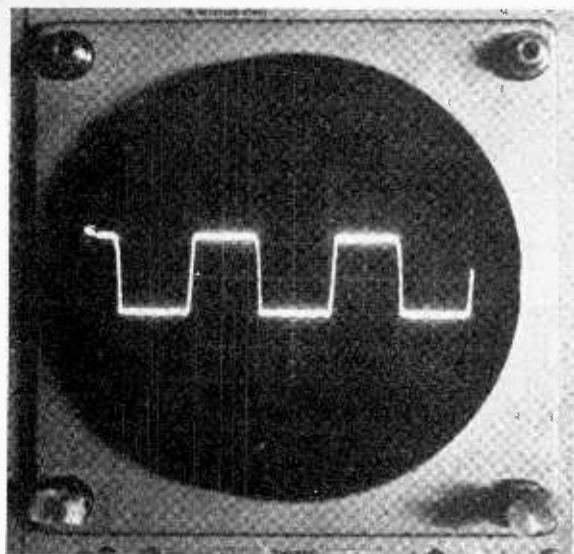


The equipment used for testing the P.W. Double-12.

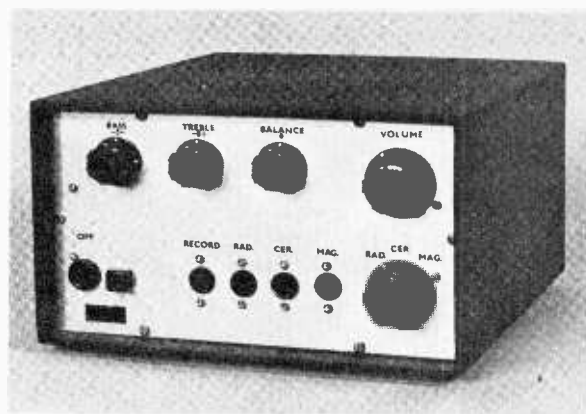
This month's article deals with the building of the panels for the preamplifier and tone control using the free gift of Cir-Kit presented in this issue. The length supplied is sufficient to build either of these units. Next month we will be describing the connecting of these panels to the controls and the



A 1kc square wave after having been passed through the entire amplifier.



The very slight slope on the square wave at 10kc/s shows that response at this frequency is also very good.



The front panel of the completed unit.

quency correction applied the response is within $\pm 3\text{dB}$ between 30c/s and 45kc/s.

An amplifier of this sort needs switched equalisation for magnetic or ceramic cartridges. The output from an f.m. tuner should already be equalised as should the low level output from a tape-recorder and in these cases frequency correction is not needed.

An attractive feature incorporated in the pre-amplifier is the overload factor, that is the factor by which the input may be overloaded without incurring unacceptable distortion. The following figures give the input sensitivities for full output and the overload figures in parentheses: Magnetic pick-up -2.5mV (45mV), Ceramic pickup -25mV (250mV), Radio or auxiliary -60mV (1 volt).

The most severe test that may be applied to an amplifier is to observe on an oscilloscope the reproduction of a square wave. Any deficiencies in the system will show up clearly: photographs of the response at two frequencies show how well the "Double-12" performed.

Preamplifier circuit design

In the preamplifier low-noise silicon transistors were chosen and the plastic encapsulated versions were used, BC169C, these are available for about 2s. 6d. each. The actual types used are not critical and if slightly less gain can be tolerated the following types may be used BC109, BC149, BC172, BC184L, BC151, BC154, 2N930 and 2N3391A. Some of these types are exact equivalents but, as mentioned, others have less gain.

Transistors Tr1 and Tr2 form a directly coupled pair, the base voltage of Tr1 is derived from the emitter of Tr2 through R7, 220k Ω . By using this arrangement a high impedance input can be obtained making matching a simple matter by selecting suitable resistors on the input switch; another advantage of this arrangement is the stabilisation achieved and an improvement in the signal-to-noise ratio.

To obtain the necessary equalisation for the various inputs, negative feedback is taken from the collector of Tr2 through a switched RC network to the emitter of Tr1. In switch position A (magnetic cartridge) the equalisation is within $\pm 1\text{dB}$ over the complete audio range for the RIAA replay curve.

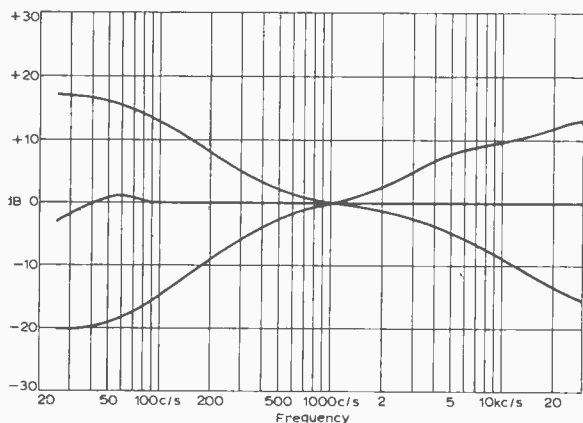


Fig. 1: Graph showing the control of the tone controls. The horizontal line is with both treble and bass controls in the centre position.

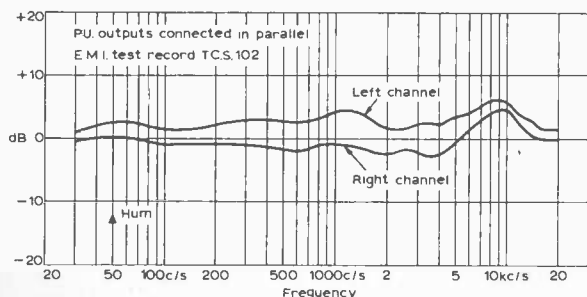


Fig. 2: The equalisation of the unit for a Deram pickup.

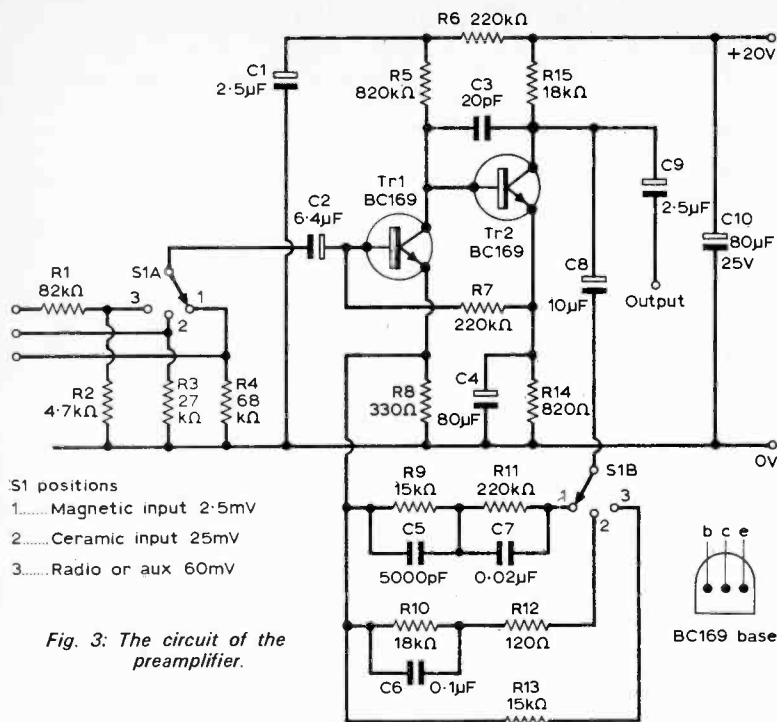


Fig. 3: The circuit of the preamplifier.

For ceramic cartridges the low and high turnover points can be adjusted by altering the input resistor R3. The value shown gives a good response for the Sonotone 9TAHC, while the graph shows the curve for a Deram pickup.

Careful selection of the components in the feedback circuit will give a good signal-to-noise ratio on all inputs (60dB down) and a high overload point (26dB on magnetic pickups).

Tone control circuit design

The tone control is built on a separate board and, in addition to giving wide control over the tone, gives a voltage gain of four times. Linear rather than reverse logarithmic controls are used because of the difficulty of matching such controls. If the tone control is to be used on a monaural system reverse logarithmic controls may of course be used.

The operating point of Tr3 is controlled by R4, R5 and R6, while a.c. feedback is removed by C7. Tone control is achieved by means

★ components list

PRE-AMP

Resistors:

R1 82kΩ	R9 15kΩ
R2 4.7kΩ	R10 18kΩ
R3 27kΩ	R11 220kΩ
R4 82kΩ	R12 120Ω
R5 820kΩ	R13 15kΩ
R6 220kΩ	R14 820Ω
R7 220kΩ	R15 18kΩ
R8 330Ω	
VR1 10kΩ log—Double ganged	

Capacitors:

C1 2.5µF 64V Mullard
C2 6.4µF 25V Mullard
C3 20 or 22pF
C4 80µF 2.5V Mullard
C5 5000pF Mylar film
C6 0.1µF Mylar film
C7 0.02µF Mylar film
C8 10µF 16V Mullard
C9 2.5µF 64V Mullard
C10 80µF 25V Mullard

Transistors:

Two of any of the following silicon types—BC169, BC184, BC149, BC109 in gain groups—high gain are recommended.

Miscellaneous:

Board—0.1in. matrix or plain paxolin 2 x 3½in. Four-pole Three-way selector switch. Cir-Kit 17in.

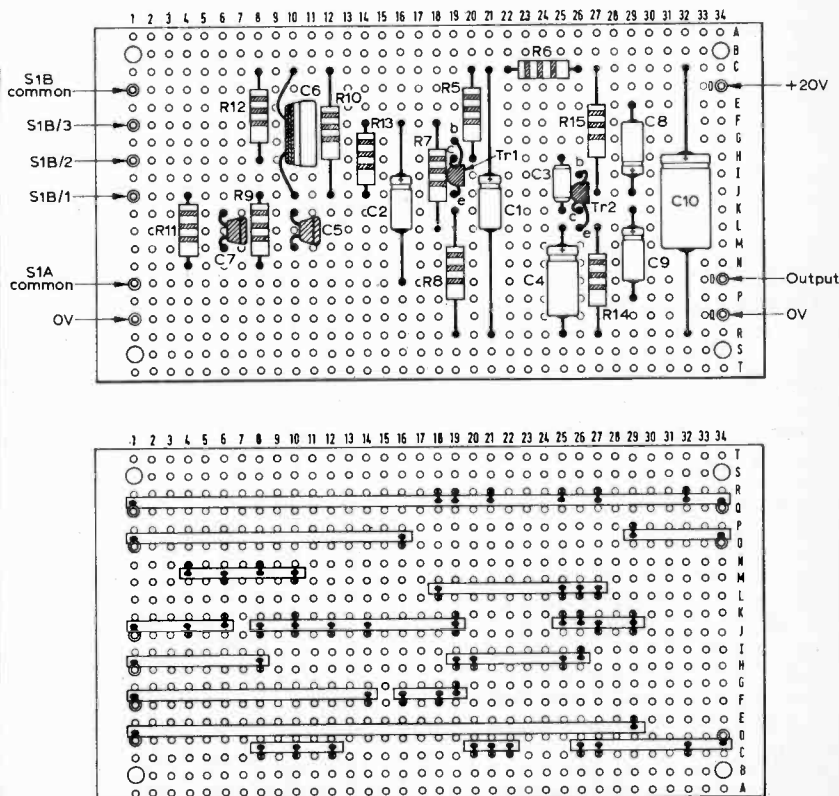


Fig. 4: The component layout of the preamplifier showing the positioning of the Cir-Kit strip.

★ components list

TONE CONTROL CIRCUIT

Resistors:

R1	220k Ω	R5	15k Ω
R2	22k Ω	R6	47k Ω
R3	22k Ω	R7	3.3k Ω
R4	47k Ω	R8	6.8k Ω
VR1	Treble 100k Ω	VR2	Bass 250k Ω

linear linear
[VR1 and VR2 should be double ganged types for stereo].

Capacitors:

C1	3300pF	C5	10 μ F 16V
C2	3300pF	C6	10 μ F 16V
C3	0.01 μ F	C7	10 μ F 16V
C4	0.01 μ F	C8	10 μ F 16V

Transistor:

BC169C or any of series quoted for preamp.

Miscellaneous:

Baseboard 0.1in. matrix board or plain paxolin 2 x 3 $\frac{1}{2}$ in. Cir-Kit 17in.

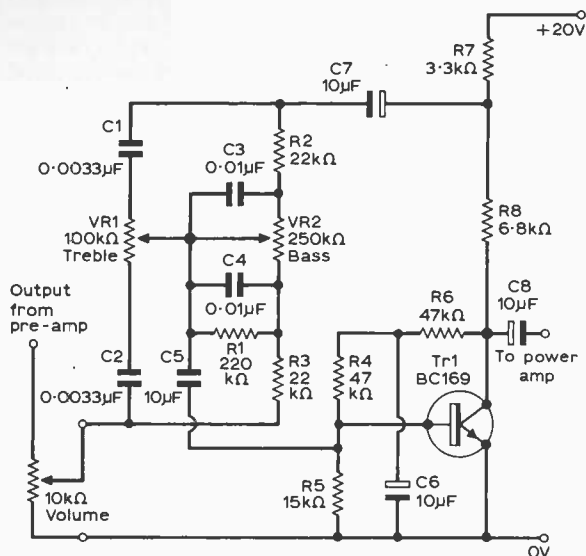


Fig. 5: The circuit of the tone control.

of frequency selective feedback one network giving treble boost and cut, the other providing bass boost and cut. The output from the unit is taken via C8 to the input of the power amplifier, the volume having been controlled at the input to the tone control unit.

Layout considerations

As mentioned in the article dealing with Cir-Kit, layout is uncritical and the one suggested may be altered if desired. No attempt has been made at miniaturisation and the layout roughly follows the circuit diagram. For those wishing to make the units smaller it is perfectly possible to have the preamp and the tone control on one panel for each channel.

The actual assembly of the units should be as described in the introductory article on Cir-Kit, the points made on soldering being observed in construction.

Next month details will be given on the physical layout of the units and the construction of the pre-amplifier as a complete unit.

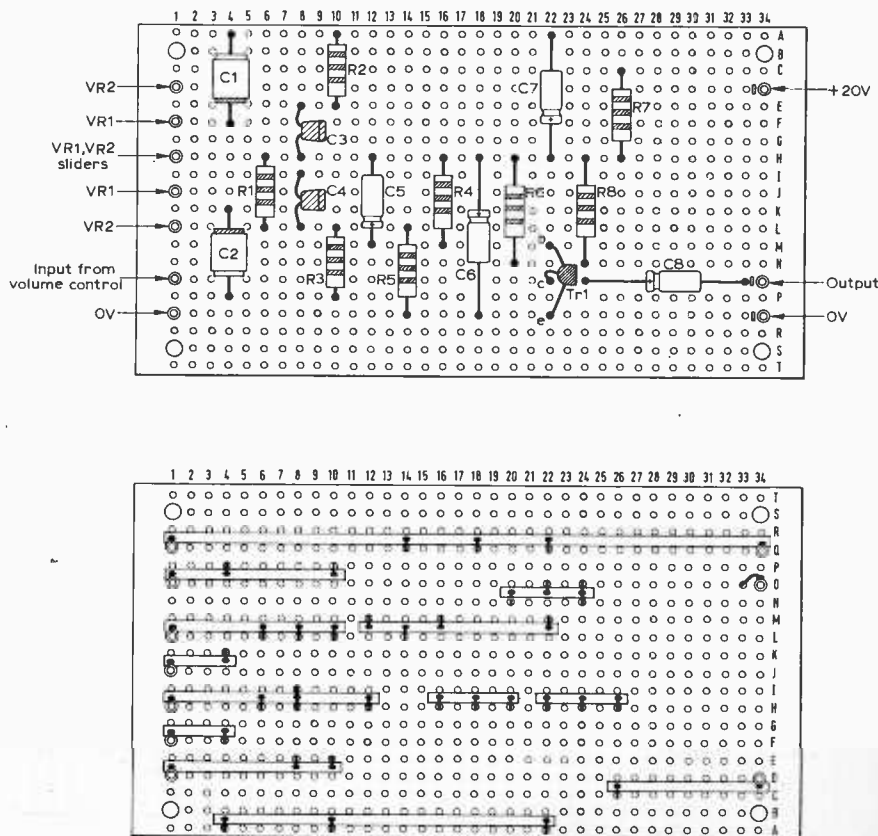


Fig. 6: The arrangement of the components for the tone control panel.

AERIALS

A. J. WHITTAKER

PART 1—TRANSMITTER AERIALS

THE basic principles of radiation of wireless waves were first investigated by Clerk Maxwell in 1864, and from the general laws of magnetism, he deduced that: "A detachment of electromagnetic energy must occur whenever the current in a circuit changes, i.e., whenever an electron has its velocity altered by the action of an accelerating force."

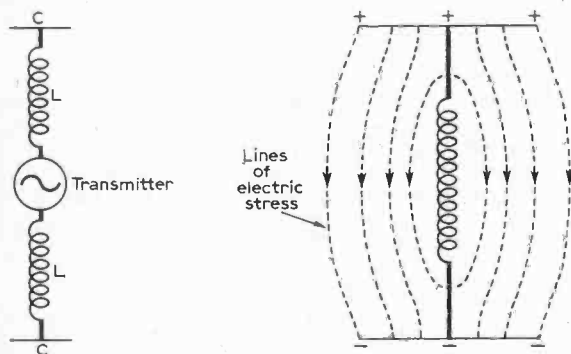


Fig. 1: The electric field with no aerial current.

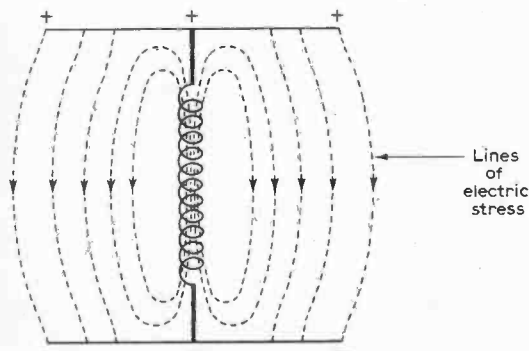


Fig. 2: The start of aerial current coincides with the electrostatic field collapsing.

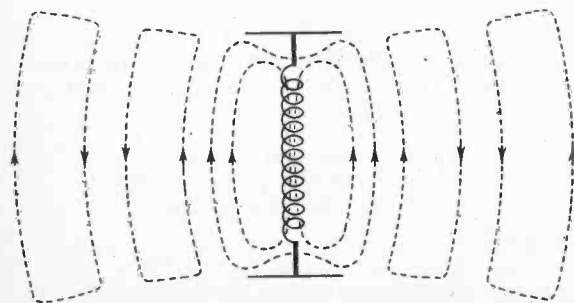


Fig. 3: Energy being radiated from the aerial in cycles. See text for explanation.

This article sets out to give the near-beginner an insight into the design and functioning of aerials, and in particular shows how to juggle the formulae associated with them. Before embarking on the study of theory, however, there are a couple of terms which will crop up frequently that should be explained.

The *polarisation* of the wave is the plane of the electrostatic field of the radio wave which corresponds to the voltage of the wave. Therefore, waves radiated from a vertical aerial have their electrostatic field in a vertical plane, and are said to be vertically polarised. The electromagnetic field, of which the wave is also composed, is at right angles to the electrostatic field, and corresponds to the current of the wave.

Field strength is a measure of intensity and is the voltage developed between the ends of a length of wire, one metre in length, placed with its axis parallel to the axis of polarisation. This voltage is produced partly by the electrostatic field which, in cutting the wire at right angles, induces a voltage in it. As both the electrostatic and electromagnetic fields are in time phase with each other, the induced voltages will add.

Dipole or Hertzian Oscillator

Professor Hertz, in 1880, in a series of classical experiments succeeded in producing waves of the type predicted by Clerk Maxwell. He developed a form of dipole aerial for detecting and radiating electromagnetic oscillations and showed that the waves produced obey the same laws as light waves.

A dipole is a symmetrical aerial, the two ends of which are at opposite potential, with respect to a central earth point. Figure 1 shows the distribution of the electric field when the current in the aerial is zero.

When the moment of maximum potential has passed the electrons will start to flow upwards, constituting an electric current, and giving rise to the electromagnetic field. At this point in time the electrostatic field starts to collapse. Figure 2 illustrates this condition.

Due to the property of electric inertia, summarised by Lenz's and Faraday's Laws "the current in a circuit continues to flow after the potential across the condenser is reduced to zero" and in so doing starts to charge up the capacitor in the opposite direction giving rise to new lines of force in a reverse direction to the previous field. If we regard the collapse of the initial field as lagging a little on the changes in potential which caused it to take place, then it is clear that the new electric field starts to build up before the first one has disappeared. The first disturbance is then forced outwards in the form of closed loops, by the build-up of a new electric field. Figure 3 shows the detachment of radiated energy. The direction of the lines in the inner surface of the first loop, and the outer surface of the second are the same and accordingly mutual repulsion takes place.

In addition to the electric fields, we must regard the circuit as being surrounded by rings of magnetic stress, the intensity of which, at any point, will vary with the current strength and whose direction alternates.

In the immediate neighbourhood of the current carrying wire (aerial) the magnetic lines of force are in the horizontal plane and at right angles in space to the electric flux. This essential space quadrature is maintained in the radiated field. The electric and magnetic inductive fields are in time and space quadrature i.e., 90° out of phase in time and in space at right angles. Figure 4 illustrates.

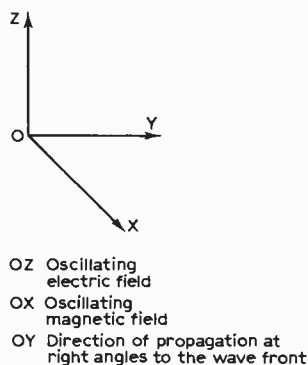


Fig. 4.

When a wave arrives at the surface of another medium and the direction of propagation is perpendicular to the surface, it is then completely reversed and the wave travels back along its original path, but it suffers a 180° phase change. The direction of the magnetic or electric fields will be reversed, but not both. Usually it is the electric field which reverses in direction.

Velocity of Propagation

The amplitude of the electric field "X" measured in electrostatic units is numerically equal to the amplitude of the magnetic field "H" measured in electromagnetic

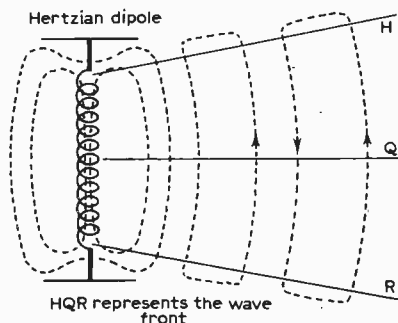


Fig. 5: The wavefront HQR moves out from the source of radiation.

units. When "X" and "H" are expressed in the same fundamental units the relation connecting them is

$$\frac{X}{H} = C \text{ Where } "C" = 3 \cdot 10^{10} \text{ cm/sec}$$

The general formulae in r.m.s. values is "X" = 300H.

Polarisation and Wave Front

With reference to Figure 5, all points along the surface, HQR experience the same moving flux at the same time. HQR represents the wave front which is the surface joining together all points that experience the same flux at the same time. The direction of propagation is always at right angles to the wave front. Detached loops move outwards with ever increasing heights, but preserving a constant width.

The frequency with which successive maxima will follow each other is given by,

$$f = c/\lambda$$

or $c = f\lambda$ where λ is the wavelength.

When the electrostatic flux lines are vertical the wave is said to be vertically polarised. This occurs when the transmitting aerial is vertical in space. Conversely when the electric field is horizontal the wave is said to be horizontally polarised. The amplitude of the radiated wave varies inversely as the square of the distance from the transmitter aerial.

Total Power Radiated

Radiation from a dipole may be summed up by assuming it to be placed at the centre of a large sphere, the surface of which will be continually penetrated by outgoing moving fields. The electric and magnetic fields represent a storage of energy evaluated from $\frac{1}{2}CV^2$ (energy in capacitive component) and $\frac{1}{2}LI^2$ (energy in inductive component). Both of these may be put in a form more useful and reduced to

$$\text{Energy in electric field} = \frac{KX^2}{8\pi} \text{ per unit volume}$$

$$\text{Energy in magnetic field} = \frac{\mu H^2}{8\pi} \text{ per unit volume}$$

Since these two energy densities are equal and complementary the total energy density may be written as

$$\frac{KX^2}{8\pi} (1 + 1) \text{ per unit volume}$$

Having arrived at an expression for "X" at such a distance from the transmitter that the inductive field may be neglected we can add up mathematically the energy flowing through the whole sphere, which gives,

$$\text{Total power radiated} = 320\pi I^2 l^2 / \lambda^2$$

where l and λ are in the same units and I is in amps.

Radiation Resistance

As the power radiated is proportional to the current squared (I^2) it may be considered that the power is expended in heating a fictitious resistance R such that,

$$I^2 R = \frac{I^2 (320\pi^2 l^2)}{\lambda^2}$$

$$\text{Whence } R_r = \frac{320\pi^2 l^2}{\lambda^2}$$

This is defined as that fictitious resistance which when multiplied by the square of the aerial current (I^2) measures the power radiated.

Where

R_r . . . Radiation resistance
 l . . . half length of dipole
 λ . . . wavelength (lambda).

References

Short Wave Radio (Ladner and Stoner)
 Admiralty Handbook, Wireless Telegraphy
 RSGB Handbook

TO BE CONTINUED

PART 2

LAST MONTH THE BASIC RECEIVER WAS DISCUSSED. THIS MONTH THE ADDITIONAL FEATURES ARE DESCRIBED.

Aligning I.F. Circuits

The i.f. cores will usually need slight adjustment for best results. Each i.f.t. has two cores, one reached from below the other from above. The correct tool should be used or a No. 10 plastic knitting needle, carefully filed to engage the cores. Any of several



F.G. RAYER G30GR

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methods can be used. If a modulated signal of 460kc/s is available from a generator, cores can be adjusted for maximum audio output.

Satisfactory alignment is easily possible without these instruments. Tune in a station and adjust the cores for maximum S-meter reading, or if the S-meter is not fitted, clip voltmeter leads from the i.f. stage cathode to chassis, and put the meter on a 2-5V range. Then adjust for minimum cathode voltage, which corresponds to minimum anode current and maximum a.v.c. voltage. Repeat with a weak signal.

As a.v.c. is derived from the last i.f. anode, the final i.f.t. diode winding is peaked for maximum audible output, which will be seen to correspond to a slight dip in a.v.c. voltage or slight rise in cathode current. The i.f.t. cores may be peaked in two positions. With one, the cores are outwards, and separated from each other. With the other, one core is nearer the other, the latter position gives less selectivity and should not be used. This position will not be encountered unless the cores have been rotated considerably or moved unnecessarily.

Coil Trimming and Alignment

Since each waveband is separate from the others, only adjustment of one band will be described in detail.

Switch to Band 2 (medium waves), with the ganged capacitor open, rotate the oscillator trimmer to set the h.f. band end to 1,500kc/s and adjust the grid trimmer for best results. Close the tuning capacitor and rotate the oscillator coil core to set the i.f. band end to 525kc/s. Roughly adjust the grid core for best results.

Repeat these adjustments to make sure coverage will be suitable. The grid circuit is then trimmed at a point a little removed from the h.f. band end, and the grid circuit core similarly adjusted a little clear of the l.f. band end. Signals may be from a generator or stations, with indication of best output by the S-meter or cathode meter.

When the r.f. stage is fitted, note that the panel trimmer peaks for best results near the h.f. end of the band. Leave the trimmer in this position, tune to the l.f. end of the band, and adjust the aerial coil core

for best results, re-adjustment of the panel trimmer should only occasionally be necessary. Trimmers and cores should be touched up as necessary later, after all work is finished, with the cover plate fitted, and with weak signals.

In the case of the higher frequency ranges, if primary interest is in amateur band reception, then range 3 can be trimmed at 3.7Mc/s, and the cores adjusted at 1.9Mc/s. Similarly, range 5 can be trimmed at 28Mc/s, and cores adjusted at 14Mc/s, but satisfactory tracking should in any case be found throughout the bands.

Note that on the higher frequencies, second channel responses will become more apparent as frequency increases, this is always so with a receiver of this kind. Bands 1, 2, 3 and 4 should be significantly clear of such effects, but at the h.f. end of band 5 it is easily possible to tune the oscillator circuit to the wrong side of the signal frequency. The oscillator should be at a higher frequency than that of the signal. If a signal generator is used, tune the generator slowly in the l.f. direction, after alignment. If a second response is found at twice 460kc/s (nearly 1Mc/s) below the frequencies the oscillator has been adjusted below the signal frequency. Correct this by adjusting the oscillator coil trimmer to lower capacity, and re-align this band.

Aerial and Earth

Random aerial lengths for any band can be used. An outdoor wire, high and clear of obstructions if possible, is suitable for any frequency, however indoor and short aerials will generally give good results. For maximum short wave efficiency some improved form of aerial is often employed. If the receiver will be employed exclusively with low impedance feeders, aerial coils with low impedance primaries may be fitted instead, and are for 75 ohms. The specified coils are for about 600 ohms, so give good general results with all aerials, including dipoles. Distant stations should normally be received satisfactorily with any reasonable aerial when conditions allow. For maximum possible results with very weak signals, an aerial matching unit may be connected in the usual way.

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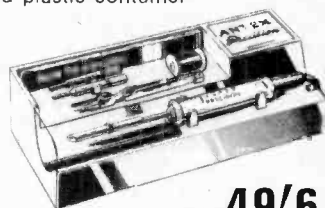
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Fully guaranteed Individually packed VALVES

PERSONAL CALLERS WELCOME

Open 9-12.30, 1.30-5.30 p.m. Thursday 9-1 p.m.

MANY OTHERS IN STOCK include Cathode Ray Tubes and Special Valves. U.K. Orders up to 10/-, 1/-; 10/- to £1, 2/-; over £1, 2/- per £1; over £3 post free. C.O.D. 4/- extra

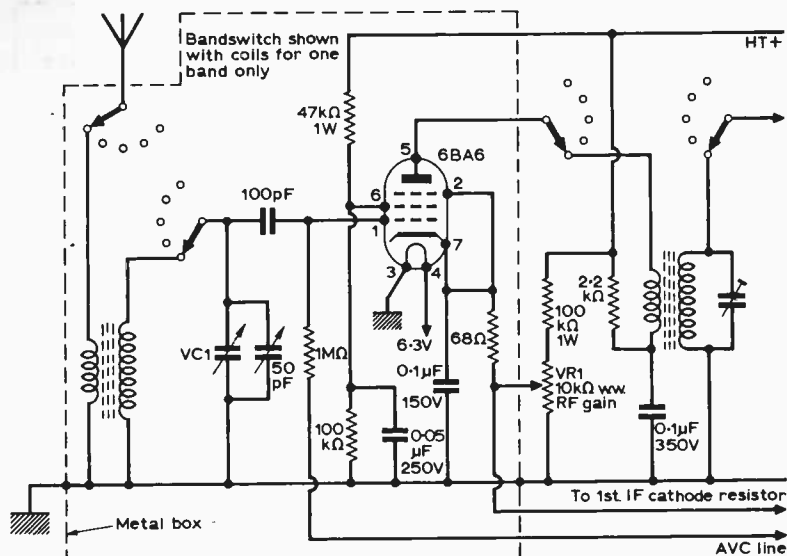
Colomor
brand
ALL valves
guaranteed

A2134 8/-	ECF82 6/6	KT66 18/6	RG1-240A	U55 7/-	X66 7/8	184 5/-	5A174G 5/-	6AC7 3/-	6CW4 13/-	12AT6 4/8	77 6/8
AR3 5/-	ECB35 11/-	KT67 45/-	SP61 3/8	UY21 10/6	X76M 7/-	185 4/6	5B261M40/-	6AG5 2/6	6D6 3/-	12AT7 4/-	78 5/-
ARP3 3/6	ECB42 10/6	KT71 7/6	STV280/40	UY41 7/-	X118 8/6	1T4 3/-	5B252M35/-	6AG7 6/-	6E5 8/-	12AT7WA 80	5/8
ARP12 3/6	ECB81 5/6	KT76 7/6	60/-	UY85 5/6	X145 8/6	2A3 5/-	5B254M40/-	6AH6 11/8	6EA8 9/-	6/8	81 9/-
ATP1 2/3	ECB82 8/6	KT78 27/-	STV280/80	UY85 5/6	Y63 6/6	2D21 4/9	5B255M40/-	6AJ7 3/-	6EU7 7/-	12AU7 4/3	83 14/-
ATZ1 9/6	ECB83 6/6	KT88 27/-	60/-	UY85 5/6	Y65 4/-	3A4 4/-	5B255M40/-	6AK5 12/6	6F23 13/6	12AV6 5/8	84 5/-
BD78 4/6	ECB83 10/6	KT88 27/-	60/-	UY85 5/6	Y65 4/-	3A4 4/-	5B255M40/-	6AK6 12/6	6F23 13/6	12AX 7/8	85A2 7/8
BL63 10/-	ECB86 8/6	KT88 27/-	60/-	UY85 5/6	Y65 4/-	3A4 4/-	5B255M40/-	6AK7 6/6	6F23 13/6	12AX7WA 282A	25
BT35 15/-	ECF36 3/6	MHL1D6 7/6	10/-	VP133 9/-	Z90PT 12/-	3B7 5/-	5U4G 4/6	6AK8 6/-	6F7 6/-	10/-	307A 5/6
BT45 150/-	ECF37A 8/6	ML6 6/-	70/-	VR99 7/8	1B22 30/-	3B24 14/-	5V4G 7/8	6AL5 3/6	6F8G 5/6	12AY7 10/-	313C 25/-
BT33 35/-	EF39 8/6	N34 8/6	70/-	VR105/30	1G5GT 6/-	3D6 3/-	5X4G 8/6	6AL5W 7/8	6F12 4/6	12BA6 6/-	357A 70/-
CV102 3/6	EF40 9/6	N78 15/-	70/-	VR150/30	1G6GT 6/-	3E29 50/-	5Y3GT 6/6	6AM5 2/6	6F13 5/-	12B26 5/8	368A8 30/-
CV103 4/-	EF41 9/6	CA2 6/-	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AM6 3/-	6F17 5/-	12B17 3/8	383A 27/8
CV15 3/6	EF42 13/6	OB2 6/-	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AN5 20/-	6F23 3/6	12C8 3/6	446 8/-
(matched pairs) 120/-	EF50 4/6	OB3 7/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AN8 10/-	6F23 3/6	12E1 17/-	703A 30/-
CV15 3/6	EF80 4/6	OC3 6/-	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5 5/8	6F23 3/6	12E6 3/6	705A 20/-
CV15 3/6	EF85 6/6	OD3 6/-	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	715B 50/-
(Single) 50/-	EF86 6/6	OZ4 6/-	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
CY31 7/8	EF89 5/6	P41 7/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
D41 3/6	EF91 3/6	PAB20 7/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
D77 3/6	EF92 2/6	PAB20 7/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DA100 26	EF95 5/6	PC97 9/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DAF90 7/6	EF183 6/6	PC90 9/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DD41 4/6	EF184 7/6	PC84 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DET20 4/6	EF190 7/6	PC89 9/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DET25 10/6	EF21 5/6	PC189 10/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DF31 3/6	EL32 3/6	PCF80 6/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DF92 2/6	EL34 10/3	PCF82 6/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DF96 7/6	EL35 5/6	PCF84 9/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DK92 9/6	EL38 24/-	PCF86 9/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DK96 8/6	EL41 10/3	PCF89 9/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DL63 8/6	EL42 11/-	PCF89 9/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DL92 4/6	EL50 8/6	PCF85 12/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DL93 4/6	EL51 9/6	PCF86 14/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DL94 8/6	EL54 4/6	PCF88 14/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DL96 8/6	EL55 5/6	PCF89 14/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DL10 12/6	EL51 10/3	PCF89 14/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DY86 6/6	EL56 5/6	PCF89 14/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
DY87 6/6	EL56 5/6	PCF89 14/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EB0F 18/6	EM31 5/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EB0C 8/6	EM50 7/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EB0C 8/6	EM81 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EB1H 7/6	EM84 7/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EB2C 5/6	EN52 11/-	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EB180C 7/6	EN52 5/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EL148 2/6	EL57 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EL148 18/6	EL57 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EA50 1/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EA76 7/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EAB280 6/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EAC91 3/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EAF42 9/3	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EB91 2/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EB93 8/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EB41 9/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EB81 6/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EB80 7/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EBP83 8/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EBP89 8/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC3 5/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC70 4/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC90 4/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC91 8/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC93 12/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC95 15/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC90 10/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC91 4/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC92 4/3	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC93 5/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC94 8/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC95 5/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC96 8/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC97 8/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC98 7/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC99 4/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC189 9/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6
EC90 6/6	EL58 8/6	PCF85 8/6	70/-	VR150/30	1G6GT 6/-	3Q4 8/-	5Y3WGB 15/-	6AQ5W 9/6	6F23 3/6	12E7GT 6/8	717A 3/6

TRANSISTORS, ZENER DIODES etc.

OA5 3/-	OC28 12/6	OC172 7/6	AD149 16/-	CR81/10 5/-	JK11A 12/6	6J5GT 5/6	6J5GT 5/6	6J5GT 5/6	6J5GT 5/6	6J5GT 5/6	6J5GT 5/6
OA7 4/-	OC29 15/-	OC200 7/6	AEY11 15/-	CR81/20 9/-	JK19A 25/6	6J8W 6/-	12BH7 3/-	815 35/-	815 35/-	815 35/-	815 35/-
OA10 3/-	OC35 10/-	OC201 10/-	AEY12 12/6	CR81/3010/-	JK21A 12/6	6J70 5/-	12BH7 3/-	815 35/-	815 35/-	815 35/-	815 35/-
OA47 2/-	OC36 12/6	OC202 12/6	AF114 6/-	CR81/35	JK21A 12/6	6J7M 8/-	12BK7 5/6	828B 50/-	828B 50/-	828B 50/-	828B 50/-
OA70 2/-	OC38 5/-	OC203 10/-	AF115 6/-		11/8	12C101B15/-	8K6GT 8/-	12LGTGT77/-	843 5/-	843 5/-	843 5/-
OA71 2/-	OC41 6/-	OC204 12/6	AF116 6/-	CR81/40	MAT100 12/6	6K7 6/-	12N7GT 6/-	86A 15/-	86A 15/-	86A 15/-	86A 15/-
OA73 2/-	OC42 5/-	OC206 12/6	AF117 5/-	MAT101 8/-	6K8G 2/-	6/-	884 10/-	884 10/-	884 10/-	884 10/-	884 10/-
OA74 2/-	OC44 6/-	IN21 3/6	AF118 10/-	CR83/05 6/-	6K7GT 4/-	12MR7 6/-	954 4/-	954 4/-	954 4/-	954 4/-	954 4/-
OA76 2/6	OC45 3/6	IN21B 1/6	AF124 7/6	CR83/20	MPP101 10/-	6K8G 4/-	13D1 4/-	955 2/6	955 2/6	955 2/6	955 2/6
OA81 2/-	OC70 4/-	IN25 12/-	AF125 6/6	10/-	MPP10410/-	6K8GT 7/3	13D5 5/6	956 2/6	956 2/6	956 2/6	956 2/6
OA90 2/-	OC71 3/-	IN43 4/-	AF126 6/-	CR83/30	MPP1010/-	6K25G 18/-	1487 15/-	957 5/-	957 5/-	957 5/-	957 5/-
OA200 2/6	OC72 5/-	IN70 4/-	AF127 10/-	11/8	RAS50BAF	6L5G 6/-	19A6G 5/9	958A 4/-	958A 4/-	958A 4/-	958A 4/-
OA202 3/6	OC73 6/-	2N456A 7/6	AF139 6/-	CR82525 6/-	12/8	6L6WG 12/-	19B2 15/-	991 12/-	991 12/-	991 12/-	991 12/-
OA210 7/6	OC76 6/-	2N458 7/6	AF139 12/6	CR83/40	16/8	6L7G 4/-	19G6 20/-	1625 6/-	1625 6/-	1625 6/-	1625 6/-
OA211 9/6	OC78 6/-	2N190 7/6	AFY19 22/6		7/8	6L3A 8/-	19H4 70/-	1629 4/6	1629 4/6	1629 4/6	1629 4/6
OA220011/-	OC81 5/-	2N1091 9/6	ASV26 6/6	CR84 25/-	12/8	6N7G 5/6	20A1 35/-	2051 5/-	2051 5/-	2051 5/-	2051 5/-
OA220110/-	OC81D 3/-	2N1306 7/6	ASV28 6/6	GET103 4/6	12/8	6P25 13/-	20P4 20/-	2729 28/-	2729 28/-	2729 28/-	2729 28/-
OA2202 2/6	OC81DM 3/-	2N1307 7/6	AS221 12/8	GET115 9/-	Z Range 5/6	6P25 13/-	20P4 20/-	2729 28/-	2729 28/-	2729 28/-	2729 28/-
OA2206 8/6	OC82 5/-	2B803 10/-	AS233 30/-	GET115 9/-	Z Range 5/6	6P25 13/-	20P4 20/-	2729 28/-	2729 28/-	2729 28/-	2729 28/-
OA2209 9/6	OC82DM 3/-	AS212 4/6	BC071 6/-	GET115 9/-	Z Range 5/6	6P25 13/-	20P4 20/-	2729 28/-	2729 28/-	2729 28/-	2729 28/-
OA2210 9/6	OC83 6/-	AC136 6/6	BCY31 9/6	GET173 6/-	Zener diodes 3/6 c	6A87GT 6/3	25Z3 8/6	5678 10/-	5678 10/-	5678 10/-	5678 10/-
OA2213 6/6	OC83B 3/-	AC127 7/6	BFY51 5/-	GET880 9/-	Z2A Range 7/6 c	68C7 7/-	25Z6GT 6/-	5678 10/-	5678 10/-	5678 10/-	5678 10/-
OA2228 2/6	OC84 5/-	AC128 6/6	BFY52 5/-	GET880 9/-	Z2A Range 7/6 c	68C7 7/-	25Z6GT 6/-	5678 10/-	5678 10/-	5678 10/-	5678 10/-
OA222510/-	OC122 10/-	AC176 7/6	BSY27 6/6	GET880 9/-	Z2B Range 5/-	68C7 7/-	25Z6GT 6/-	5678 10/-	5678 10/-	5678 10/-	5678 10/-
OA2226 15/-	OC139 7/6	ACV17 8/6	BSY28 5/6	GET880 9/-	Z2B Range 5/-	68C7 7/-	25Z6GT 6/-	5678 10/-	5678 10/-	5678 10/-	5678 10/-
OC22 10/-	OC140 9/6	ACV18 5/6	BSY51 7/6	GET108 15/-	ZL range 5/6 c	68C7 7/-	25Z6GT 6/-	5678 10/-	5678 10/-	5678 10/-	5678 10/-
OC23 12/6	OC142 9/6	ACV19 6/-	BYZ13 6/-	GET108 15/-	ZL range 5/6 c	68C7 7/-	25Z6GT 6/-	5678 10/-	5678 10/-	5678 10/-	5678 10/-
OC24 7/6	OC170 5/-	ACV28 4/6	BYZ15 10/-	GET108 15/-	ZL range 5/6 c	68C7 7/-	25Z6GT 6/-	5678 10/-	5678 10/-	5678 10/-	5678 10/-
OC26 6/-	OC171 6/-	AD146 16/-	BYZ16 15/-	GET108 15/-	ZL range 5/6 c	68C7 7/-	25Z6GT 6/-	5678 10/-	5678 10/-	5678 10/-	5678 10/-

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U91 14/6	75μA	2" round panel sealed	27/6	6B8G 2/6	6X5G 5/6	30PL13 16/3	9003 8/6
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R.F. Stage

The circuit for this is shown in Fig. 6 with an aerial coil for one band only. VC1 is that section of the ganged capacitor nearest the panel and the parallel trimmer is a 50pF air-spaced variable capacitor, the spindle being extended by a short length of $\frac{1}{4}$ in. shaft and a flexible coupler. The shaft runs in a bush fixed to the panel. It was found necessary to wire up the valveholder and associated components first, then fit the trimmer, and afterwards the coils. The circuit is checked on the appropriate band, after wiring in one coil to avoid complicated mistakes, finally add the other coils, checking on each band as it is fitted.

VRI provides manual control of r.f. gain as this is necessary for very strong a.m. signals, c.w. and s.s.b., and reduced background noise. R.F. and mixer stages must be fitted with screening cans. When the r.f. stage is not present, the primaries of the mixer grid coils are returned to the chassis. This circuit is now by-passed to chassis by the 0.1 μ F capacitor, and h.t. applied through the primaries from the 2.2k Ω resistor.

The valvholder, with cathode, grid and screen grid components, occupies the first section of the coil box. The valvholder is placed with pin 5 near the runner between this compartment and the central compartment, so that a lead from the anode, pin 5, runs directly through a hole to the band-switch. R.F. stage tuning is satisfactory if the 50pF panel trimmer can be peaked for best results throughout all bands, but aligning the aerial coil cores as explained reduces the need to adjust this.

Additional I.F. Stage

Figure 7 shows the circuit of this stage which is placed between the frequency changer and the existing i.f. amplifier. The primary of i.f.t.1 now supplies the frequency-changer stage with h.t. through the 1.5k Ω resistor by-passed by a 0.1 μ F capacitor. After fitting the new i.f.t., transfer the mixer anode lead to it.

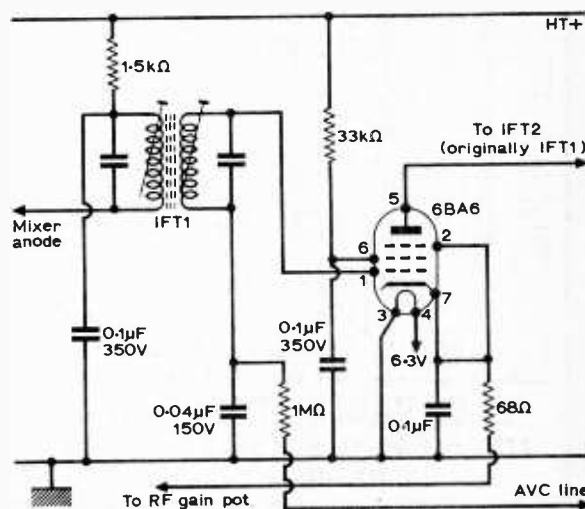
The 6BA6 anode is now connected to the

existing transformer primary and the a.v.c. bias is obtained from the a.v.c. line. The r.f. gain potentiometer controls the cathode voltage of this stage and the r.f. stage. Manual control of the r.f. and first i.f. stages in this way is normally sufficient and the second i.f. stage, to which the S-meter is connected, does not have manual control of cathode bias. When the extra stage has been added, a considerable increase in sensitivity and selectivity should be found; the i.f.t. cores are adjusted for best results, as described previously.

S-Meter

This reads in an upwards direction, employing a cathode bridge circuit shown in Fig. 8. The i.f. valve and 47k Ω resistor are two arms of the bridge, and the cathode resistor and portion of the other arms. With no signal and voltage the zero potentiometer is at no voltage is present across the and consequently reads zero.

When a signal is present, a.v.c. reduces the cathode current. The voltage drop across the cathode resistor



falls, and the meter pointer rises in accordance with the signal level. Changing the resistor in series with the meter allows any degree of sensitivity. The values shown give approximately 6dB per S-point. The S-meter is actually a 1mA movement, and a suitable scale can be made for an ordinary milliammeter.

Changes which improve signal strength will raise the meter reading. These include internal adjustments, such as trimming or peaking the panel aerial trimmer or external causes, such as the efficiency of the aerial-earth system. With many transmissions, readings change continuously due to propagation conditions, and this does not indicate a fault.

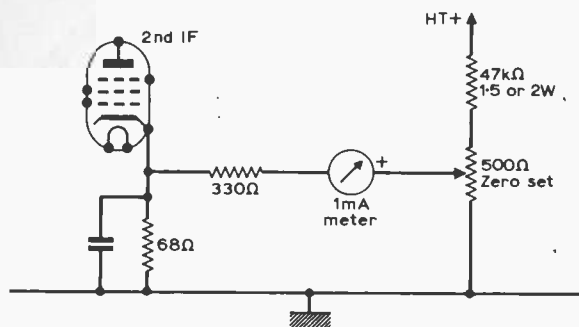


Fig. 8: The S-Meter circuit.

Beat Frequency Oscillator

Figure 9 shows the circuit for the b.f.o. which employs a 6C4 triode with large capacitances from anode and grid circuits to earth. The b.f.o. coil, three capacitors, and resistor are ready included in the HSO-460 b.f.o. unit can. The c.w./a.m./s.s.b. switch brings the b.f.o. into action, and its frequency is adjusted by the panel trimmer VC1.

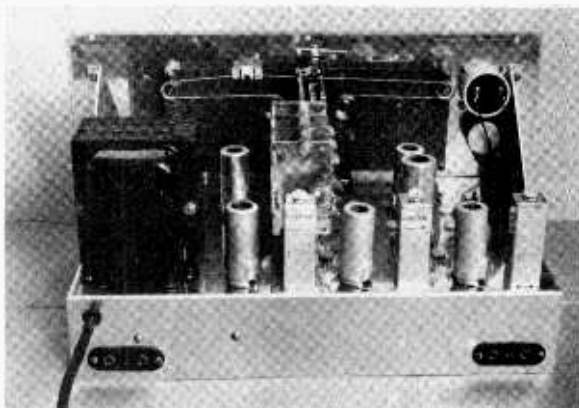
With the 3-position switch in the a.m. position, the b.f.o. is not in use, and a.v.c. operates normally, this is for the reception of voice and other amplitude modulated signals. With the switch in the c.w. position, the automatic volume control circuit is out of use, and the panel r.f./i.f. gain potentiometer must be operated to give the required sensitivity, and especially to reduce the strength of strong signals. The heterodyne control VC1 is rotated above or below the zero beat position, as required for best reception of the code signals.

Reception of S.S.B. Signals

When the switch is placed in the s.s.b. position, the a.v.c. characteristics are changed and the injection level raised to provide carrier insertion. VC1 is adjusted as necessary for upper or lower sideband. For exceedingly weak s.s.b., the c.w. position may be chosen. For strong s.s.b., keep audio gain well up, but reduce r.f. gain with the panel control. The s.s.b. position can be used for very strong c.w.

The valve, b.f.o. coil, and other items occupy space on the chassis near the output stage, Fig. 2. When first testing this stage, tune in a carrier at a.m. for maximum S-meter reading, reduce r.f. gain to give moderate volume only, set VC1 about half

closed, switch to c.w., and rotate the coil core for zero beat. VC1 then allows the b.f.o. to be set either above or below the i.f.



Rear view of the completed receiver.

Other Circuits

When the receiver is used with a transmitter in particular, a "standby" switch is often handy. This leaves heaters on, but the receiver mute. A suitable method is to place an on/off toggle switch in the h.t. positive circuit. In some receivers the standby position leaves the r.f. and i.f. circuits operating at very low sensitivity. For this method, the switch may be placed in series with the r.f./i.f. gain control, and have a 47kΩ to 68kΩ resistor in parallel, when this switch is opened, cathode bias then rises to a high value.

Some constructors may favour separate control of a.v.c. for best results in all circumstances, for this purpose, an on/off switch may be connected from the a.v.c. line to chassis. No a.v.c. voltage is then applied to r.f. and i.f. stages with this switch closed.

A jack for phones is often convenient. A jack with open circuiting contacts will automatically disconnect the speaker, when the jack plug is inserted. It is generally satisfactory to feed medium impedance phones from the output transformer secondary. Another method is to feed the phones via a 0.01μF mica capacitor from the output stage anode. As much more power is available than required, a resistor of between 10kΩ and 33kΩ should be included in series with the capacitor. This method is also satisfactory with high impedance phones.

Additional ventilation is provided for the cabinet by a row of two 1/4 in. diameter holes in the back and bottom, and the cabinet is also raised on four feet. Cut-outs are made opposite speaker, aerial and earth sockets.

P.W. GUIDE TO COMPONENTS
Due to pressure on space, Part 5 in this series is held over until the next issue.

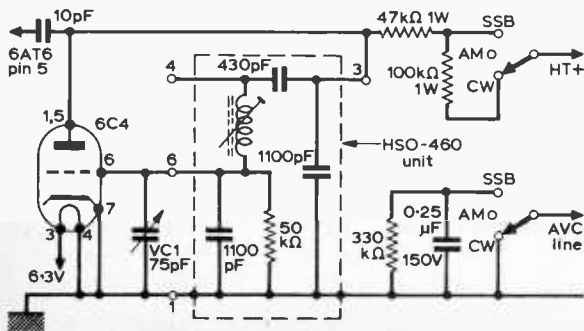
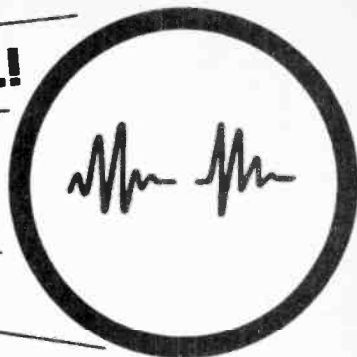


Fig. 9: The beat frequency oscillator.

LOOK!

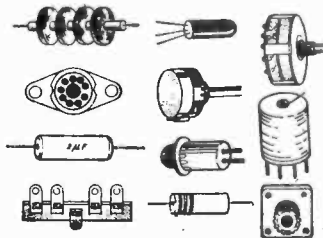
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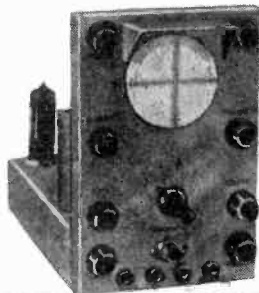
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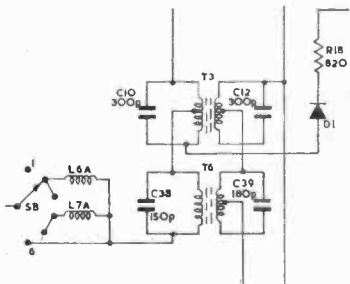
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SATELLITE EARTH STATION

RICHARD COLLINS REPORTS... PART 1

THE Post Office recently brought a new aerial system into service at its Goonhilly 2 Earth Station, which is Britain's latest space communications station. This aerial system will work with the new Intelsat III satellite.

Goonhilly 2 will maintain a role as an earth station in the expanding system of global communications via Intelsat III satellites in synchronous orbit over the Atlantic, Indian and Pacific oceans.

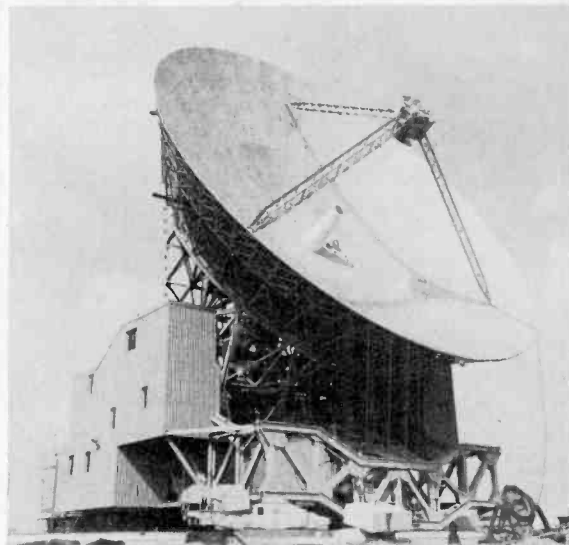
Goonhilly 1 will no longer be required for the service to America. It is being provided with new equipment to enable it to operate with countries to the east of Britain via an Intelsat III satellite (to be launched in the summer) which will be positioned over the Indian Ocean.

400 Phone circuits

The giant 90ft diameter dish aerial will carry up to 400 telephone circuits and a television programme simultaneously. Multiplex equipment has been installed to derive the first group of up to 132 circuits and additional equipment has been installed to bring this up to nearly 400 circuits, eventually providing routes not only to the USA and Canada but also to Africa and the Middle East. As more earth stations become operational the system will expand until by 1971 Goonhilly is expected to be working to 20 countries.

This Goonhilly installation, which meets the technical requirements of the International Telecommunications Satellite Consortium INTELSAT, has been built to a Post Office specification and installed at a total cost, including roads, buildings, etc., of approximately £2m. The Marconi Company of Chelmsford were the main contractors.

The aerial covers a 210° arc in azimuth to enable it to work to either the Atlantic or the Indian Ocean satellites. The entire structure weighs nearly 1,000



The No. 2 aerial.

tons, which includes the transmitters, receivers and ancillary equipment. It is mounted on a central bearing with two massive bogie units carrying the load at the front of the structure.

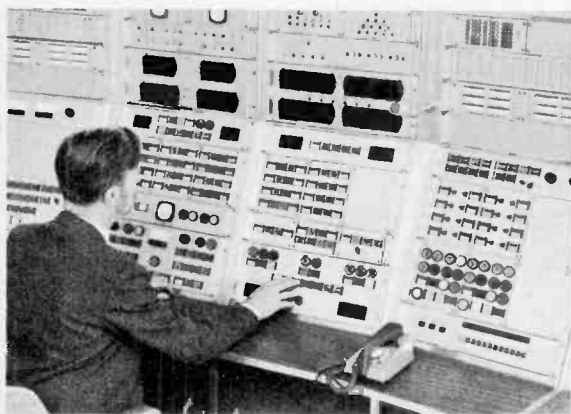
The 90ft reflector surface consists of a 24ft diameter central section surrounded by two rings of stainless-steel panels with a surface accuracy of 0.020in. r.m.s. Maximum distortion in a wind speed of 70 m.p.h. will be 0.200in.

The spinning horn

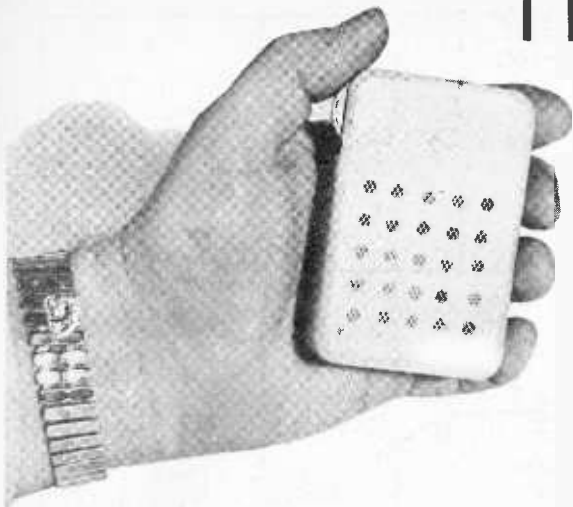
It makes use of a Cassegrain configuration with a spinning horn at the apex of the main reflector. The spinning feed-horn is a feature of Marconi's "mode conversion scanning system" of aerial steering. It introduces a conical scan of the aerial beam only at the frequency of the satellite beacon signal. Thus it avoids unwanted a.m. of the communication carriers or significant degradation of aerial efficiency for either direction of transmission. By this means autotracking can be achieved either by servo-control of the main reflector mounting or, within a range of about ± 20 minutes of arc, by deflection of the sub-reflector. Provision has also been made for control of the aerial manually and for the addition of tape control facilities later if required.

The aerial and telecommunications equipment are controlled and monitored from a suite of consoles in the central building. Each carrier is monitored separately and reserve equipment is switched into use automatically if a disabling fault condition arises. Faults which cause degradation of the service but do not interrupt it can be located and eliminated by manual switching of their component sub-systems without interference with traffic. A separate console enables the television service to be monitored and tested.

TO BE CONTINUED



The control console in the main Goonhilly station building.



A MINIATURE THREE TRANSISTOR RADIO WHICH OPERATES EITHER AN EARPIECE OR LOUDSPEAKER

WITH six transistor radios available for under 40s., there are few financial incentives to build a miniature radio, but for the beginner there are few more satisfying projects. The Mite was designed as an easily built, three transistor radio covering the medium waves, the final result being an extremely small and useful radio. The size of the case is $3\frac{1}{2} \times 2\frac{3}{8} \times 1$ in. outside measurements—which from the photograph can be seen to fit easily into the palm of a hand, yet the Mite drives a loudspeaker almost to its limit and has a separate volume control. With careful setting of the regeneration control it will receive Radios 1, 3, 4 and Radio Luxembourg, together with a number of continental stations after dark.

There is nothing very unusual about the circuit shown in Fig. 1, except that it was chosen to operate well within the tolerances of the components chosen. The disadvantage of many projects of this type is that the circuit is built around the actual transistors used in the prototype without a view to someone else copying the circuit. It will be seen that the Mite uses a reflexed OC44 with regeneration, the most sensitive circuit ever developed, signals from this being fed through a conventional volume control into a directly-coupled high gain amplifier. From the circuit it will be seen that the minimum of components are used.

The circuit

Since the Mite is intended primarily for the beginner, a thorough description of how the radio works will help. The radio waves are picked up by the ferrite rod aerial; this rod greatly increases the signal pickup of the coil around it and increases the inductance of it (fewer turns are needed). VC1 is connected in parallel with the coil and forms the tuned circuit, selecting the appropriate frequency; one side of the coil is connected to chassis. A small overwind on the

THE MITE

JULIAN ANDERSON

coil picks up the output of the tuned circuit and transforms it from the very high impedance of a tuned circuit to a lower one suitable for feeding into a transistor circuit, a transistor being basically a low impedance device. One side of the overwind is connected directly to the base of the first transistor, an OC44, while the other is connected to chassis via C1. This capacitor avoids a d.c. connection to the base and serves another function, described later.

Tr1 is arranged as a common emitter amplifier, and at the collector the signal is divided three ways. A tiny part of the signal is fed back to the top of the coil via VC2, a variable capacitor made from twisting two wires together, this gives a very low value. This passes again through the stages mentioned above, the result of this is known as regeneration. A second part of the signal is taken off by C2 and is rectified by D2. The arrangement of C1, C2, D1 and D2 is known as a voltage doubler and it not only rectifies the amplified signal but it smooths it and doubles it—how's that for economy! The resulting audio signal (a.f.) is passed through the overwind again and fed back into the base of Tr1 to be amplified again. This is known as reflexing and was very popular in the days of expensive valves and expensive transistors but is less popular today. It is only used here to save components and consequently space.

The amplified a.f. signal now appears at the collector of Tr1 (VC2 and C2 are so small in value that no appreciable amount passes through them) and passes through the r.f. choke, this will pass the a.f. but blocks the r.f. on the two previously described functions.

The a.f. signal is developed across R2 and fed via C3 (which stops d.c. passing through the volume control) and in turn is connected to Tr2 via C4, also arranged as a common emitter amplifier. C4 prevents the base of Tr2 from being d.c. connected to chassis. The output from Tr2 is connected directly to the base of Tr3 which in turn amplifies the signal and develops it across the loudspeaker or earphone. R3, R4 and R5 provide the correct voltages for Tr2 and Tr3 whilst C5 smooths the voltage across R5. C6 smooths the negative line and prevents r.f. and a.f. getting where they don't belong.

To the experienced constructor two points will be noticed. First the mismatch between Tr1 and Tr2; in theory coupling in this manner tends to prevent the first stage from working properly, but due to the low value of C3 the arrangement works perfectly well. The second point is connecting the loudspeaker with no method of transforming. Here again in practice the circuit works perfectly well and the current drain is not excessive (below 15mA).

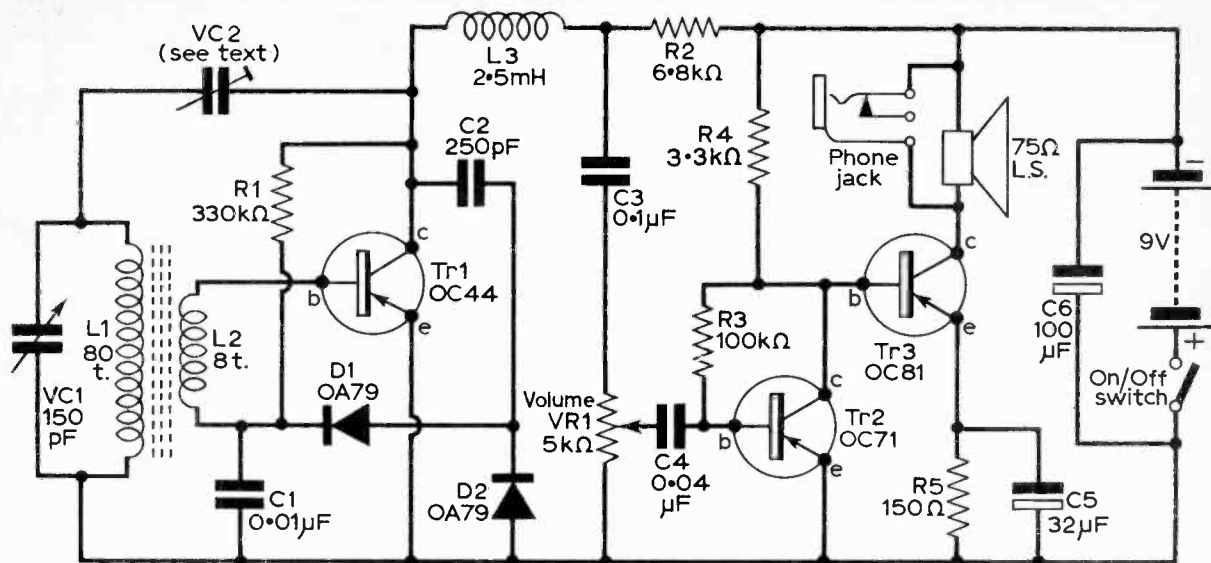


Fig. 1: The circuit of the Mite. All the components except the battery, the loudspeaker and the earphone jack are mounted on a piece of Veroboard. The way in which the circuit is explained in the text.

Component layout

Using transistors, layout is not very important, but for those wishing to use their own arrangement of components two points should be borne in mind. Firstly the ferrite rod should not be near the speaker magnet and secondly the r.f. choke should not be too near the aerial coil or the twisted wires of VC2—other than these two points, layout is not critical.

The ferrite rod

Although the ferrite rod, fitted with aerial and coupling windings can be bought, it is an easy matter to construct one's own. The ferrite slab is $2 \times \frac{3}{4} \times \frac{1}{2}$ in.; normally these are sold only in longer lengths although the section is fairly common. The slab is cut to size by filing a "V" shaped groove across one

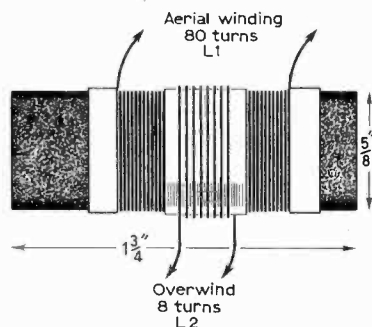


Fig. 2: Details of the ferrite rod aerial.

of the flat surfaces and smartly snapping it at this point, no great care is needed as it will break cleanly.

The windings should be started at one end, a narrow strip of adhesive tape should be bound around this end for about three turns, one end of the wire being trapped in the tape. The wire used should be 34 gauge enamelled copper wire and 80 turns are wound tightly on to the slab, finishing it as mentioned above, trapping the wire in further turns of tape, the details are shown in Fig. 2. The overwind, or coupling wire, should be wound on top of

★ components list

Resistors:

R1 330kΩ	R4 3.3kΩ
R2 6.8kΩ	R5 150Ω
R3 100kΩ	

All 10% tolerance, $\frac{1}{4}$ watt miniature

Capacitors:

C1 0.01 μF	C4 0.04 μF
C2 250 pF	C5 32 μF 10v.
C3 0.1 μF	C6 100 μF 10v.

Transistors:

Tr1 OC44 etc
Tr2 OC71 etc
Tr3 OC81 etc

Miscellaneous:

VC1 150 pF + 65 pF miniature ($\frac{1}{16} \times \frac{1}{16} \times \frac{7}{16}$ in.)
 VC2 See text
 VR1 5K Semilog with switch—Radiospares
 D1, D2 OA79, etc see text
 L1, L2 Ferrite slab $2 \times \frac{3}{4}$ wound m.w. coil with secondary
 L3 R.F. choke 2.5mH, see text
 Loudspeaker 75Ω, $2\frac{1}{2}$ in. diameter
 Miniature jack plug and socket, earphone
 9V battery—PP3—see text (Ever Ready)
 Two Soap Dishes (Boots)
 Veroboard $2\frac{1}{8} \times 2\frac{1}{2}$ in. (0.1 in. holes spacing)
 Battery clips wire etc

this; here eight turns are required, fixed as before. In all cases about 3in. of wire should be left for fixing. Unlike a superhet where the coil has to be adjusted for correct alignment, the coil can be wound directly on to the slab, no movement being required. Where a ferrite rod is bought complete with the required windings the rod will probably have to be shortened; this may be done as detailed. Some aerials available are designed for low capacity tuners and the inductance will be too high. If the correct range is not covered the rod should be shortened further and in extreme cases fitted with part of the coil over the end of the slab.

Choice of components

Miniature components should be used throughout. The tuning capacitor used is readily available as a replacement used for imported radios; similarly the volume control incorporating the on/off switch. The only component that should be chosen with care is the r.f. choke. The particular value (2.5mH) can be quite large and a small one should be used; the value of this component is not critical and may range from 1.5 to 5mH. The diodes used may be of almost any type used for detection.

The knob for the tuning capacitor can be bought from certain suppliers or one intended for certain volume controls can be used, it should be about 1in. in diameter.

Construction

All the components, with the exception of the speaker, the battery and the earphone jack are mounted on a piece of Veroboard which must be cut to the shape shown in Fig. 3. A hacksaw will cut this and it should be filed smooth afterwards. The holes for fixing the board and for the tuning capacitor should be drilled and the laminate strips broken as in Fig. 3, this may be done using a tool marketed

by the manufacturers but can also be made by using a drill about $\frac{1}{16}$ in. diameter.

The tuning capacitor and volume control should be mounted first. The volume control will require small wires soldered through the holes in the connections and then these are passed through the Veroboard. The arrangement shown makes the holes in the Veroboard and wire line up quite nicely. The wires are bent over and soldered. The tuning capacitor is fitted to the board by means of two small screws (they must be small to avoid snagging the vanes in the tuning capacitor). Normally these will be 6BA but some versions on the market use a weird foreign thread—here the ingenuity of the constructor will be tested (probably by forcing a screw in!). The connections from the tuning capacitor must be bent to fit into the correct holes; the oscillator section (not used) and earth leads are bent under the body, this does not place any undue strain on them.

The battery wires are fixed next. Battery connections need not be bought as they may be taken from an old PP3 battery etc.; break the metal enclosure at the top and pull away the plastic plate to which the terminals are fitted, cutting away the wire. After this fit the two jumper wires which connect the earth strips.

The other components may now be slipped in, bent over and soldered. Where a component is mounted vertically it should be made as short as possible since height is restricted. For the same reason keep the solder joints neat as some of these rest on the loudspeaker. If this is hard to accomplish, the joints may be filed flat when soldering is completed. The r.f. choke should be mounted after the other parts as these are surprisingly fragile.

The wires to the loudspeaker should next be fitted, followed by the aerial coil. The end not covered by the windings should be laid against the tuning capacitor and a piece of adhesive tape stuck from the bottom of the capacitor body to the underside of the Veroboard. The coil connections can then be wired to the board but do not fix the overwind wires permanently. Finally two pieces of thin, single core insulated wire should be fitted—these make up VC2 when twisted together.

Testing

After wiring the loudspeaker (ignore the earphone socket for the time being), connect the battery. Hey-presto! . . . it doesn't work (unless you are very careful, very lucky or very clever). There should be a "mush" on the loudspeaker—if this is not the case the trouble is in the amplifier circuit—check the wiring. If nothing wrong is found, measure the current consumption by inserting a meter in one of the battery leads, this should read between 7 and 15mA. If it still doesn't work the components must be checked.

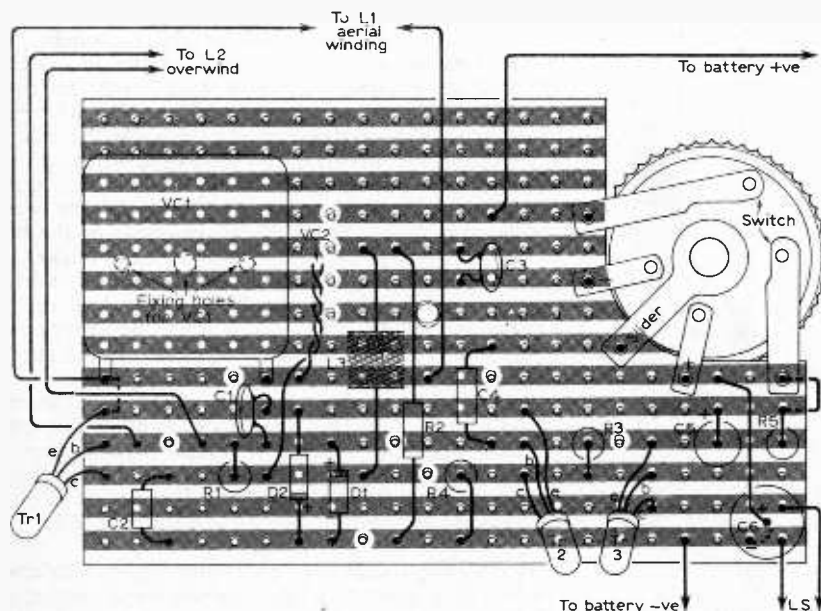


Fig. 3: The layout of the components on the Veroboard panel. The shading shows the breaks in the copper strip.

Assuming there is something on the loudspeaker, work back, prodding a moist finger at the junctions C3/VR1, L3/C3, C1/L3 and the base of Tr1 in that order—in all cases a little plop should be heard. If not, check between the point at which it is not heard and the last point at which results were achieved.

If all is well, check back on the circuit, making certain that the diodes are correctly wired the right way round. When a signal is received, twist the wires making up VC2 together. If there is a whistle after a few turns all is well. If the signal gets weaker or there is no change, reverse the overwind connections and try again. The wires should be adjusted so that there is very nearly a whistle on Radio Luxembourg or the highest frequency (lowest wavelength) that you wish to receive. In this condition the set is working at its peak and there should be a few whistles at the highest frequencies but other stations will be received satisfactorily. (Radio Luxembourg has been received perfectly well on four separate prototypes, it is no idle boast that it can be heard on the Mite.)

Variations

The circuit chosen was not one for individual transistors as is often the case with simple sets of this type. Several OC44s, OC71s and OC81s were tried with only a marginal difference in performance. Almost any similar transistors will work and WHITE and RED spot surplus transistors work perfectly well but here the performance varied (according to the individual transistors). By altering the resistance values virtually any types will work. This is a tedious business but even better performance can be achieved by doing this: an eye, however, should be kept on the current consumption which should not be much over 15mA.



An inside view of the Mite.

The case

The hardest part about building a radio of this sort is the case. Having searched high and low the author found that the tops of two "Boots" soap boxes were perfect when placed back to back. These give the perfect size to hold all the components and they are made from polystyrene, a plastic easily worked and glued.

The drilling and shaping of the case are shown in Fig. 4. The loudspeaker holes can be drilled with a normal $\frac{3}{16}$ in. drill and the cutouts for the dial and volume controls can be cut out by first scratching the desired shape with a sharp point and then carving out the plastic with the hot bit of a soldering iron. The rough edges can then be filed to shape. If the plastic cracks or breaks it can easily be glued with the cement used for plastic models. Heavy scratches disappear when rubbed hard with metal polish. The case, when finally finished can be painted, but care must be taken with the choice of paint and the best is that used for plastic models.

The loudspeaker is laid over the holes in the case (a piece of expanded speaker metal may be fitted between the speaker and the box itself). The ear-phone socket is screwed to one through the side of the box. A 1 in. 4BA countersunk-head screw should be fitted through the hole provided, this should come just beside the speaker. A small piece of the waste polystyrene should be glued on the inside of the box, beside the screw and opposite the loudspeaker. A small washer can be dropped over the screw and this will rest on the rim of the loudspeaker and on the plastic pad. Two nuts should then be screwed to this, holding the loudspeaker in place. The speaker is a tight fit in the box and will be held securely.

An insulated washer should be fitted over the nuts and the circuit board dropped on, another nut fitted to secure it. The hole in the back should line up and a nut in the form of a screw fitted through the hole will hold the lot together. The jack socket, if fitted as shown, should locate the bottom exactly.

A finishing touch is to cover the tuning condenser knob with a piece of white adhesive paper and mark off the stations.

The Mite should be a very satisfying project for a beginner, relatively cheap and economical on the batteries.

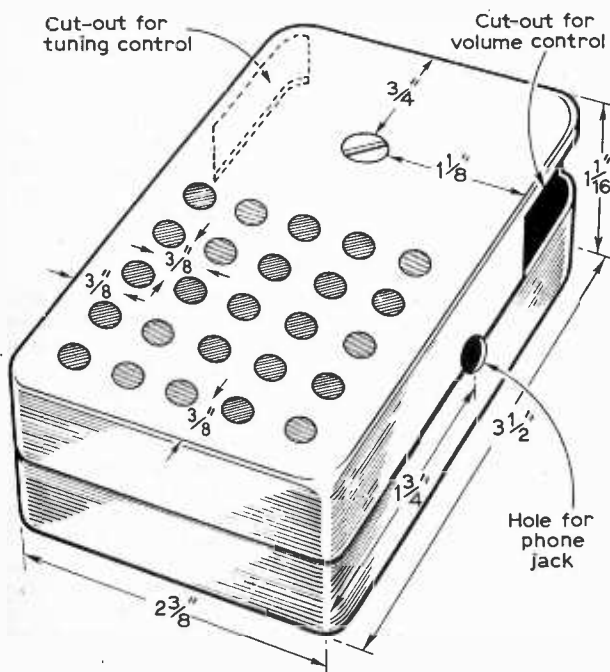


Fig. 4: The case for the Mite is made from the tops of two Boots' soap boxes.

DESPITE the vast number of solid-state devices which are capable of acting as switches, the humble electromagnetic relay over a hundred years old, is still going strong, and in some new forms is still capable of opening up new applications.

In the older forms of relay, there are three quite distinct parts. The *magnetic circuit* consists of a coil of insulated wire wound round an easily magnetised ("soft") core which forms part of a complete circuit of magnetic material when the relay is actuated. When current is passed through the wire, magnetic *flux* (the magnetic equivalent of electric *current*) flows in the magnetic circuit and produces magnetic force at any gap in the magnetic circuit.

RELAYS AND THEIR USES

K. T. WILSON

The *mechanical system* varies considerably from one type of relay to another but always serves the same purpose; to convert the magnetic force at a gap in the magnetic circuit into mechanical force which can open or close switch contacts. In many relays, the mechanical system takes the form of a pivoted *armature*, one arm of which moves to close the magnetic circuit while the other arm operates the contacts.

The *contacts* of the relay perform the job of switching external circuits, and are operated by the mechanical system. Various types of switching are possible: all the contacts may close ("make") when the relay operates, all may open ("break"), some may make and some break or all may changeover from one circuit to another. Contacts can also be arranged so that one type of operation takes place before another, where we find the make-before-break changeover, or break-before-make (much more common). The *materials* used for the touching surfaces of the contacts are extremely important, as these determine the life and application of the relay.

Using relays

In both amateur and professional use, there can be few components which are so badly chosen and so poorly used as relays. Much of this misuse is an example of familiarity breeding contempt; relays have been around so long that they are treated as something to be wired in and forgotten. Even a humble resistor must have its values of resistance and wattage calculated before it can be placed in circuit; considerably more effort is needed for the proper use of a relay, and this article outlines the choices which have to be made.

Most of these choices concern the contacts and the coil, for the mechanical system and the shape of the magnetic circuit are chosen by the designer of the relay. These choices affect the sensitivity of the relay, and may decide which type of relay is to be used, but cannot be changed.

The contacts

The number and type of contacts are quickly determined for any application by considering what

circuits are to be switched by the relay. The contact materials must then be chosen. An ideal contact material would have negligible resistance, be completely resistant to corrosion and resist damage caused by sparking and excessive current. No ideal contact material exists, as might be expected, and we must in practice choose a material which comes closest to the requirements of a particular relay. These materials are, usually, silver, palladium-silver, silver-nickel or gold.

Silver is the most common contact material in small relays. Since silver has the lowest known resistivity of all metals, the contacts have a very low contact resistance and can therefore pass high currents without any risk of local welding which would cause the contacts to stick together. Silver tarnishes rapidly in the atmosphere, forming a film of poorly conducting silver sulphide, so that relays using silver contacts should have fairly high contact pressures and use quite high contact voltages in order to pierce this film each time the relay is operated. For example, silver contacts would be unsuitable for a sensitive relay switching a low voltage, such as in a model aircraft radio control circuit.

Palladium silver alloy has much higher contact resistance than pure silver, but is not nearly so easily contaminated by sulphide films. Sparking between the contacts does not readily transfer metal from one contact to another, making this a favourite material for inductive circuits.

Silver-nickel has low resistance and is not easily damaged by high currents. It is used for loads where high currents flow when contacts are made, for example, lamps (whose resistance is very low at switch-on) and capacitors (which take a high initial charging current).

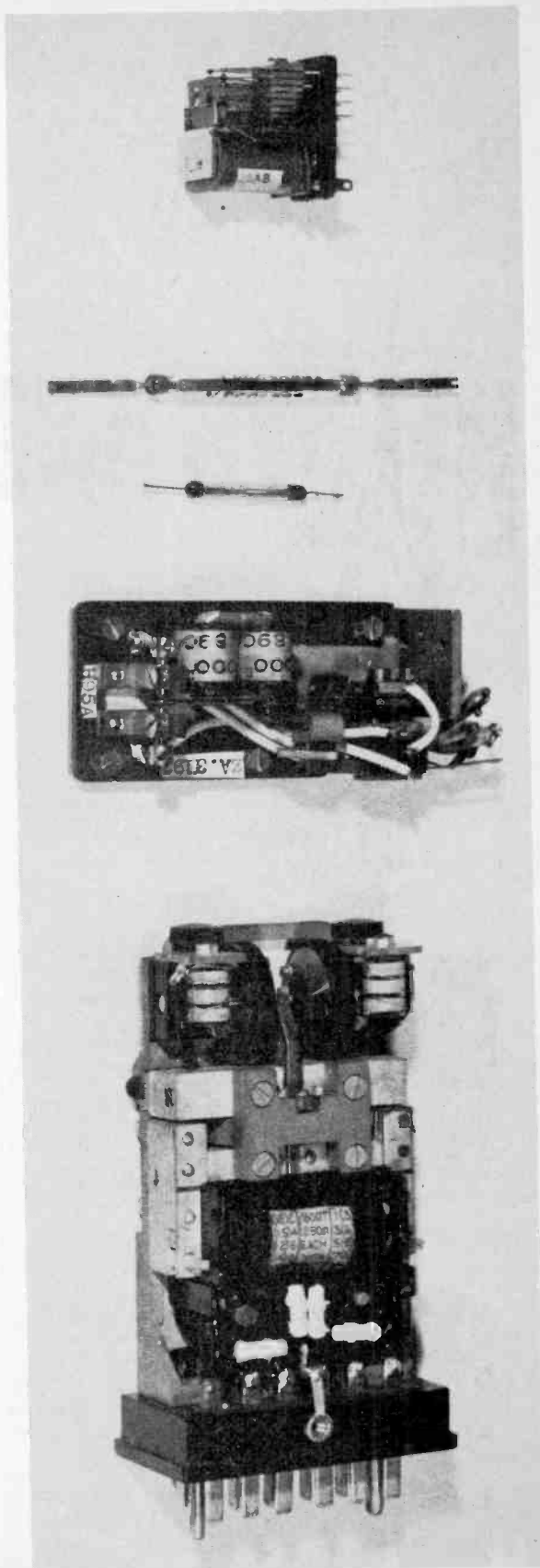
Gold is used as a contact material for switching very low voltages and low currents. The contacts do not corrode in any atmosphere, but are soft and have a short life if any rubbing occurs, so that gold contacts are used only if contact pressures are low and no rubbing action is used.

Voltage and current

The size of the contacts used determines what current rating can be applied to the relay. The voltage rating is decided by the contact material used (which must be resistant to the sparking which occurs when the contacts break), the final separation of the contacts (which must be enough to avoid continuous sparking) and the insulation of the contact leaves. In general, different ratings will be used for a.c. or d.c., for inductive, capacitive or lamp loads.

The highest ratings of current can be used when the contacts are switching a.c. to a resistive circuit, but the voltage rating in this case must be the *peak* voltage, which is 1.4 times the r.m.s. voltage usually quoted for alternating voltage. D.C. resistive loads at low voltages can be used at full rated currents, but high direct voltages require some derating, due to sparking. Sparking is always a problem with direct voltage, since the voltage across the contacts is steady when they break; when alternating voltage is being broken the sparking is always extinguished as the voltage reaches zero before reversing.

A.C. capacitive, lamp and inductive loads require



some derating; d.c. capacitive lamp loads require the lowest ratings quoted as well as choice of contact material which can cope with the surges of current which take place when such circuits are made. D.C. inductive circuits are the worst possible case, because of the back-e.m.f. across an inductor when current is broken. This back-e.m.f. can cause very serious sparking unless some means of suppression is used.

Spark suppression

When an inductive circuit is broken by relay contacts, the sparking due to the back-e.m.f. can be suppressed *either* by using the voltage to charge a capacitor through a resistor or by using a rectifier to bypass the excess voltage. The circuits involved are shown in Fig. 1. When CR suppression is used, the values of C and R are best found by experiment, using an oscilloscope to monitor the voltage across

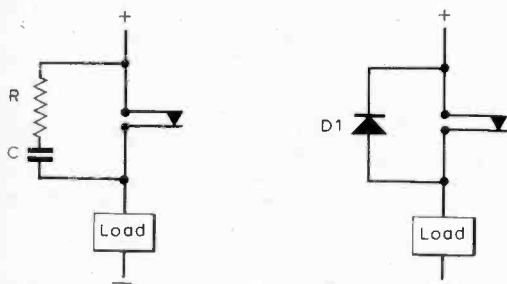


Fig. 1: Spark suppression of relay contacts for inductive loads.

the contacts. As a rough guide, R should be about half of the d.c. resistance of the load and C about half as many μF as the load inductance in Henrys (for example, for a load of 2H and 1k, use 1 μF and 500 Ω to start with) but these figures are only a starting point. When a rectifier is used for suppression, the only conditions are that the peak current and voltage ratings of the rectifier must not be exceeded. This is very much easier than deciding the correct values for a CR suppression circuit, and the low price of modern semiconductors has made this method the most frequently used.

The operating coil

The purpose of the operating coil of a relay is to provide the magnetic force which operates the mechanical system. To provide the magnetic force, the coil must have a high inductance, but the steady current through the coil is determined by its resistance, and both quantities are of considerable importance in relay operation.

As the current through a relay coil is steadily increased, a value is reached at which the armature completely operates the contacts. This value of current is called the *static pick-up current*, and is the minimum possible current to operate the relay. To be sure of operating the relay, a rather larger current, the *rated operating current* is needed.

When the *rated operating current* is applied to the coil of a relay, the contacts will close within a short time, the *pull-in time*, of applying the current, and, as long as the current is applied the coil will dissipate its *rated operating power*, which is the resistance of

the coil multiplied by the square of the rated operating current.

Note carefully that applying excessive current improves pull-in time at the expense of contact bounce. Excessive current usually causes the contacts to come together with such force that they bounce apart again, causing irregular operation. Many cases of faulty relay operation are caused by circuit designers playing safe and specifying much more relay current than necessary.

When the current through the coil is decreased again, it eventually reaches a value, the *static drop-out current*, at which the relay switches back again. The static drop-out current is usually less than the static pick-up current.

Selecting a coil

Where a relay draws current from a mains supply through a switch or through the contacts of another relay, the selection of a coil is fairly easy. The contact arrangement used fixes the steady power which must be dissipated in the coil to ensure that the armature remains pulled over. Divide this operating power by the supply voltage to find the required operating current, and then divide supply voltage by operating current to find coil resistance. The coil is now completely specified. In some cases, makers specify the operating voltage so that the correct coil may be chosen without calculation.

When a relay is being driven by a valve or a transistor, the operating current is the important factor. The lowest possible current should be used so that the voltage across the relay (resistance $\times$ operating current) is nearly equal to the supply voltage at rated operating power. If a high operating current is used, this is a severe drain on the power pack and causes high dissipation in the valve or transistor. The voltage across the relay is much less than the line voltage, again the power dissipated in the valve or transistor is high. Ideally, a relay switched by a transistor would have practically all the line voltage across the relay coil, leaving only 0.5V across the transistor and at a low current.

The inductance of the coil becomes important when the relay is driven by a transistor. The speed with which a relay can be switched on depends on the mechanical time constant, which cannot be altered, and the electrical time constant L/R (L in Henrys, R in ohms). For a coil of 0.5H and 5 Ω this would be 0.1 seconds, or 100mS. This time constant can be reduced by adding resistance *in series* with the coil, but the total voltage across coil and resistor is higher this way, and this method is best used with valve circuits.

When the current through a relay coil is switched off, there will be a surge of voltage across the switch in a direction which tends to keep current flowing. If the "switch" is a valve or a transistor, damage may be done, especially in the case of a transistor, unless the excess voltage can be removed. The problem is the same as that of spark suppression on contacts feeding an inductive load, and is best solved by using a rectifier to remove the excess voltage.

Latching Relays are so designed that when the relay operates, the armature is held by a "latch" which prevents the armature returning when the

current through the coil is switched off. The release of the latch may be done mechanically, by pressing a button or lever on the relay (mechanical de-latching) or electrically by means of a second operating coil which operates the latch (electrical de-latching). Any relay may be made to latch electrically by means of the circuit of Fig. 3, which keeps current flowing through the coil even when the actuating switch is off. In this case, however, the current in the coil is not switched off as it would be in the genuine latching relay and the relay must be able to dissipate the heat produced.

Polarised Relays use a permanent magnet in addition to the electromagnetic system. The magnetic effect caused by the current in the coil either adds to or subtracts from (according to direction) the magnetic effect due to the permanent magnet so that several different effects can be obtained.

Double throw polarised relays have contacts which are normally held in one state (open or closed). When current flows in the coil so as to oppose the permanent magnet, the armature switches over, and remains over when current ceases; no switchover takes place if the current aids the permanent magnetism. A biased double throw polarised relay behaves similarly, but the contacts return to the unenergised position when the current in the coil falls below some specified amount. Double throw centre neutral polarised relays have a central rest position. When the coil is energised the armature moves either to left or to right of the central position, according to current direction, making contacts on that side only. When the current is cut off, the armature returns to the central position.

Reed switches are made by sealing two blades of metal into a glass tube. The metal is nickel-iron, which magnetises easily in a magnetic field, and loses its magnetism whenever the field is removed. The reeds are made to overlap within the tube so that a circuit can be made between them when they touch. To keep the contact resistance low, the overlapping areas can be coated with any of the contact materials mentioned earlier. When a magnetic field is applied to the tube, the reeds are magnetised in opposite senses, and the overlapping ends are attracted together, making the contact. When the magnetic field is removed, the nickel iron is demagnetised and its own springiness causes the contacts to separate. The leads to the reed relay form part of the magnetic circuit, and should not be cut to size unless the operating coil can cope with the increased current which may be required to pull the relay in reliably. Two reed switches are illustrated on the second page of this article.

Reed switches have considerable advantages over the conventional relay as far as contact contamination, contact resistance, speed of operation, life and insulation resistance are concerned. The power which must be applied to the coil to operate the reed switch is also low, and the separation of switch assembly from coil assembly also means that reed relays can be made to fit almost any application provided sufficient operating power is available. When a large number of reed relays are to be operated simultaneously, it is usually possible to pack them together into a tubular former, filling in gaps with soft iron wire to concentrate the magnetic flux, and then winding a coil round the

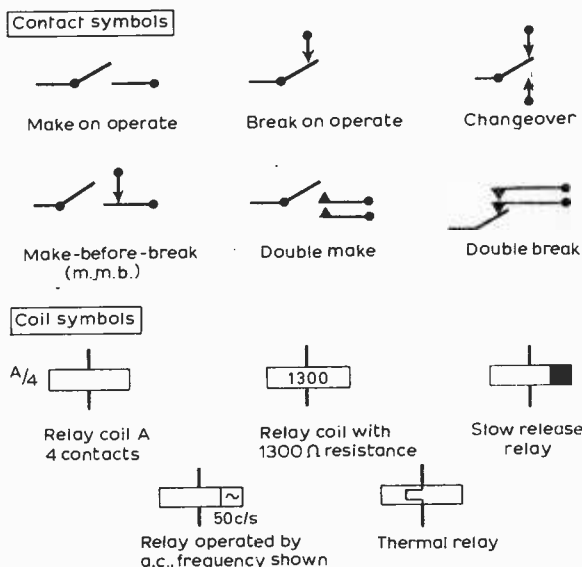


Fig. 2: Symbols for relay contacts and coils. The coils shown are drawn as they would appear in circuit, with their reference numbers such as A/3, which means relay A, 3 contacts. The contacts belonging to relay A are identified in circuit as A1, A2 and A3. All contacts must be shown as though the relay is unenergised.

whole assembly. The number of turns and operating current required is a matter of cut-and-try, but the circuitry simplification gained may easily make it worthwhile.

Relay diagrams and circuits

Figure 2 shows a few of the symbols from BS 3939, 1966 (reproduced by permission of the British Standards Institution, 2 Park Street, London, W.1, from whom copies of the complete standard may be obtained). The symbols are used at the point where they occur in circuit, so that the relay coil may be shown in one place and its contacts at another, the two being linked by their code numbers.

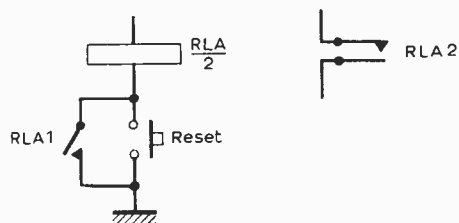


Fig. 3: An electrical latching circuit. When the reset button is pressed RLA/2 is energised, and the coil remains in this state through RLA1 closing. The circuit will not release until the supply voltage is removed.

As an example of the use of the symbols, Figs. 3, 4 and 5 show some useful circuits.

Figure 3 shows a self-latching circuit in which a pair of contacts holds a relay on and interruption

of the supply de-energises the relay until it is reset. This type of circuit is found in time delay circuits (particularly in large transmitters where heaters must be on for one minute before h.t. is switched on) where the "reset" switch is a thermal switch. Such an application is shown in Fig. 4.

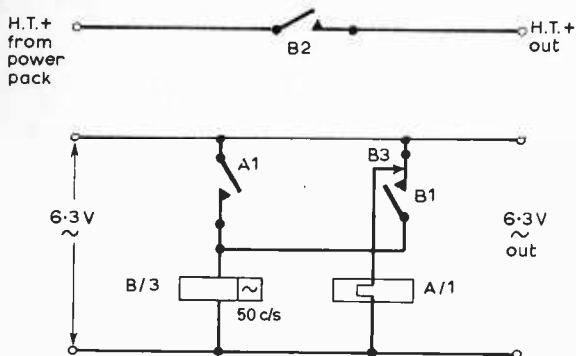


Fig. 4: A method of automatically delaying switch-on of an h.t. line. Notice that the thermal relay A/1 is taken out of circuit when B/2 operates, so that it can cool for the next time it is used.

Figure 5 shows a scale-of-two circuit using relays. This circuit seems to be little known, yet represents a considerable saving over the transistor scale-of-two driving a relay, which is so often used. Each relay coil is fed from a load resistor which must be capable of taking the full voltage of the supply across it.

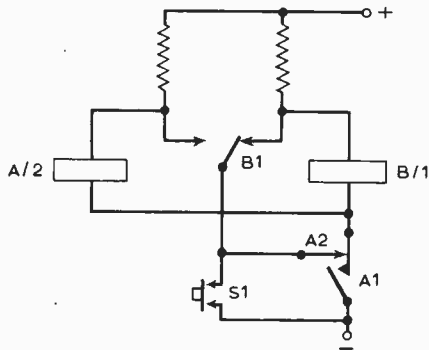


Fig. 5: A relay scale-of-two circuit.

When the operating switch S1 is closed, current flows through S1 and A2 so that A/2 is energised. B/1 is shorted out by the connection through B1 and A2. Since A/2 is energised, A1 closes and A2 opens. When S1 is released, B/1 is no longer shorted and B1 changes over; this has no effect since A2 is open.

When S1 is closed again, A/2 is shorted out through B1 and S1 so that A/2 releases, A2 closes to maintain the short and A1 opens. When S1 is opened again, both relays are de-energised and B1 returns to its initial position. Sequential switching can then be carried out by other contacts on either relay, and sets of "bistable" relays can be used to count in exactly the same way as transistor bistables. Note, however, that in the relay circuit either both relays are on or both are off, unlike the normal transistor circuit.

THE MW COLUMN

MEDIUM Wave stations in West and North Africa are frequently audible in the UK in the late evening. Two regulars from West Africa are Dakar (764) in Senegal, after Sottions leaves the air at 2300hrs GMT (except on Saturday) and Guinea (1403) which does not close down until midnight GMT. Both stations broadcast in French. Also from West Africa is ELBC (630) in Monrovia, Liberia, which comes through with programming in English after Vigra (629) has closed down. There is a nightly news bulletin at 2345hrs. ELBC may appear in some station lists as being on 650 but it is now on 630. The Canary Islands are well represented by three stations; RNE (620) is the easiest but EAK92 (827) *Radio Popular*, Las Palmas, and CES4 (1097) also in Las Palmas can generally be heard. EAK92 is mixed with EAJ1 in Barcelona and CES4 is mixed with EFE14 in Madrid but both stations can peak above the QRM. From Madeira CSB91 (1529) in Funchal is best looked for between 2330hrs and midnight GMT.

Quite a number of stations along the North African coast come regularly. Tangier (1232) is frequently strong at 2330hrs. Oujda (593) and Agadir (935) both in Morocco, are audible about the same hour. From Algeria there is Algiers 1 (980) with the Arabic programme and Algiers 2 (890) with the French programme. Tunis 1 (629) and Tunis 2 (962) are not too difficult around 2300hrs, both stations carrying Arabic programming. Benghazi (674) in Libya is rather more tricky though owing to the amount of QRM but the station peaks above it at times and has been heard at 2200hrs. Further east in Egypt, Batra broadcast the Voice of the Arabs on 620 and the internal Arabic programme on 818. Other Near East stations to be heard during the evening are Aleppo (746) in Syria, Baghdad (760) in Iraq (logged at 2130 hrs) and Jerusalem (677) in Israel. These three stations broadcast in Arabic.

Conditions to North America have been quite good this winter with peaks occurring from 29th November to 1st December and again from 3rd to 5th January. Robert Dinning of Ayrshire, Scotland, has heard CBN (640) at 0100hrs GMT; WNBC (660) 0105hrs; CKCM (620) 1112hrs; WCBS (880) 0117hrs; WINZ (940) 0150hrs; WINS (1010) 0152 hrs; CBA (1070) 0201hrs; WWVA (1170) 0159 hrs; WHAM (1180) 0150hrs; WOWO (1190) 0148hrs; WCAU (1210) 0200hrs; WGAR (1220) 0201hrs and WNEW (1130) at 0030hrs. These loggings were made during the period October 1st to January 4th, using an HRO receiver and either a 380ft V antenna at 50ft or an indoor loop. Thanks for the log Robert, many DXers would like to have your 380-footer. During the peak on 4th-5th January the writer logged WJR (760) Detroit. *The Great Voice of the Great Lakes*; KMOX (1120) St Louis; WOAI (1200) in San Antonio, Texas, using a CR100 receiver and an indoor loop antenna.

CHARLES MOLLOY

HOME WORKSHOP PRACTICE

BY P. HAMLEY PART 2



IN the preceding article newcomers to the hobby were given details of a basic tool kit and some suggestions were made about possible sources of supply of components and materials with which to build equipment. It was suggested that dismantling old equipment could be a rewarding pastime, and in this article details of some special techniques which have proved in practice to be useful for dismantling and rebuilding equipment will be given.

Let us assume that an old chassis, practically complete, has been obtained, and is to be stripped for parts. Arrange your chassis on the workbench so that plenty of light falls on it, leaving as much clear space around it as possible. Just before attacking the old veteran, spend a few moments looking at the set and note the short neat wiring. Note the ample provision of anchorage points, the rigidity of the structure and the general cleanliness of the layout. The amateur can learn a great deal from good commercial design simply by looking at it.

This preliminary inspection will reveal parts which obviously have no further useful life, for example resistors which have been overrun and overheated. Components which are fractured, dented, charred or generally tatty should be ignored, although a component should not be discarded simply because it is dirty, this is easily removed and underneath may be a perfectly good part. With a little practice one learns to recognise many defective parts by their appearance.

Having decided roughly which parts are to be salvaged, start by cutting out all resistors with the side-cutting pliers. Keep the leads on all components as long as possible, but don't worry unduly if the leads are quite short as a method will be described of extending these. Do not attempt at this stage to sort resistors into values and ratings because subsequent testing might disclose a fairly high proportion of duds, and time spent sorting now would be wasted.

Having removed all the resistors, start on the capacitors. Here it is a good plan to make a distinction, certainly between electrolytics and other types, and preferably between the mica, paper and polystyrene capacitors.

During these operations remove any useful lengths of hook-up wire and any component which gets in the way. Valves and their bases should be removed carefully before turning the chassis on its back, and in the case of miniature bases it may be necessary to drill out the rivets which attach the base to the chassis. Small transformers, i.f. cans and coils of all descriptions should be carefully taken out, because even if the coils as wound are of no use, the coil formers almost certainly will be.

Diodes, rectifiers, plugs and sockets, fuses and fuse-holders, potentiometers, knobs and switches follow. Special care should be taken in removing grommets which are usually in short supply in the average workshop. Small nuts, bolts and washers, self-tapping screws and speednuts cost over a penny each to buy new and the tedium of removing these from the chassis is made more bearable when one reflects that, at a removal rate of one every five seconds, one is earning about three pounds an hour! Finally, the aluminium chassis is itself dismantled, and panels, brackets, stays and clips recovered.

During the cutting operations, it may be found that the jaws of the side-cutting pliers are frequently too wide to enter the space available for cutting. The writer overcame this problem by purchasing a very cheap pair of long-nosed pliers from a chain store and grinding a cutting-edge at the very tip of each jaw so that when the pliers were closed the ends of the jaws became, in effect, a tiny pair of shears which would work in the smallest space. Used sensibly on small gauges of wire only, the long-nosed cutters provide a very convenient means of reaching otherwise inaccessible bits and pieces.

Cutting is not, of course, the only way to recover the components. Sometimes the joints can be unsoldered, but owing to the professional practice of turning and clenching all leads firmly before soldering the method is not recommended. Printed circuit parts are somewhat easier to remove by unsoldering if they have been dip-soldered on assembly.

THE TESTMETER

Having fully dismantled the set, the various components now have to be tested. This brings us to the question of a workshop test meter; this was not included in the Basic Tools list for the simple reason that the constructor might wish to build his own multimeter. Many designs are available, including several excellent ones published in this journal. Most public libraries will have radio books containing good, simple designs for test meters. The author has built several of these to published designs, all of

which worked satisfactorily, but a proprietary test meter will almost always be better than a home-made one.

The "heart" of a test meter is the meter movement, and the quality of this movement will determine the accuracy. Moving coil meters are available, ex-equipment, having full-scale deflection of $500\mu\text{A}$, which is quite sensitive, but these meters have no damping at all, and as often as not, do not have jewelled bearings. Furthermore, each meter has to be calibrated to suit the various circuits in which it will work, and this procedure alone calls for a sophisticated test set-up. In addition, the resistors used in a good test meter are very stable, one per cent or better and for the builder to buy these and other items new would largely offset the price advantage.

Finally, it is not at all easy to calibrate to a.c. ranges of a test meter and often the capacity across the meter rectifiers will lead to wildly inaccurate readings. All things considered, a good multimeter will prove to be a lifetime's investment.

Returning to our dismantling exercise, the test meter is set to the ohms range and one by one the resistors are checked, firstly for continuity, and secondly for actual value compared to the colour-coding. Resistors which are somewhat off tolerance are often perfectly useful if they are not to be used in a circuit where their deficiency would affect the operation of the circuit. Resistors which are widely off tolerance should be discarded, because the chances are they would be noisy, and might lead to irritating failures.

Capacitors are checked to ensure no d.c. path, and coils are tested for continuity and insulation from adjacent coils. Electrolytic capacitors cannot be fully tested by static methods, but if their resistance builds up smoothly to a few hundred $\text{k}\Omega$ they are probably worth a gamble. Rectifiers can be checked for a reasonable ratio between the *go* and *no-go* sides, bearing in mind that in a test meter the positive lead is the source of electrons in the external circuit.

Valve filaments can be tested for continuity using the ohms range of the test meter after referring to a valve data book for pin connections. Care must be taken not to exceed the voltage rating of the valve filament with the meter's own voltage. The only other static test which can be applied to a valve is to ensure that no undesirable d.c. path exists between the various electrodes.

Fuses, switches, lamps, etc. are tested similarly for correct operation, and potentiometers, particularly those of the carbon track type, can be checked for smooth increments.

Eventually it will be found that an hour or so spent snipping, cleaning and testing will be rewarded with several nice piles of usable components, and the remaining scrap is consigned to the scrap bin. The problem of short flying leads remains, however. This is best tackled by preparing a few short lengths of wire, each having one end hooked like a crochet needle. The leads on the component are then similarly hooked, and the extension wire hooks are engaged and clenched firmly with pliers. The union is then soldered, using a heat shunt near the body of the component, a hot, clean iron should be used to get the job done quickly. The writer must

have reclaimed thousands of parts in this way over the years, with only a tiny proportion of failures.

MAKING YOUR OWN TOOLS

Earlier it was mentioned that certain tools and accessories could be made at home. Foremost amongst these are the punches of various types. On sale in engineers tool shops, and in certain hardware shops is a type of steel called *Silver Steel*, known by this name because of its chromium content. The steel is sold in thirteen inch lengths in round flat section, and in its normal state is tough, but readily worked by all the usual methods of filing, grinding, turning etc. However, when the steel is heated to a dull cherry red colour, and plunged in water it becomes very hard indeed, and can be used to cut any softer material. Thus it will be evident that if a length of Silver Steel is first formed into the shape of a chisel and then hardened, one has a useful addition to the tool kit.

However, in the fully hard condition, the Silver Steel is far too brittle for most uses and consequently they are always tempered or "let back" before use. The tool is heated, this time away from the cutting edge until a narrow band of colours begins to run away from the area of heating. The colours will be seen to be a pale yellow, dark yellow, light blue, dark blue, cherry red, and bright red. Now the object in tempering is to run the pale yellow just down to the cutting edge, and then immediately dip into clean cold water. The tool is then ready for use, although a little grinding or honing of the cutting edge will probably improve the performance of the tool and extend its life between regrinds.

It should be noted that hardened Silver Steel can be softened by once again heating to a cherry red, and allowing it to cool slowly in air. Because of this, care must be taken when tempering not to overheat the tip of the tool, nor to delay the dipping unduly. The heat treatment of Silver Steel becomes child's-play with a little practice.

The question of heating the Silver Steel to the correct colour is another matter. Those who cook by gas will have no difficulty, using a good fierce flame on the cooker, an open coal fire will also do the trick. Those, who, like the author, live in a central-heated, electric cooker type house will probably have to invest in a blowlamp of some description. The author uses a small paraffin blowlamp, which has so many other uses around the house that it is not really an integral part of the electronics tool kit. The small Butane lamps on sale will produce adequate heat to treat all but the largest steel sections.

Now we have a means of making not only standard tools such as centre punches, chisels, piercing punches, screwdrivers, gouges, scrapers and the like, but also useful specials such as extension Allen keys, socket drives, trepanning tools, boring bars and literally hundreds of others.

Another aid to good construction practice in the workshop is a pair of extension jaws for the vice. These are made from a length of angle-iron obtainable from steel stockholders. Each jaw should be about 8in. in length, and all sides and ends are filed flat and square, and a small radius filed on the

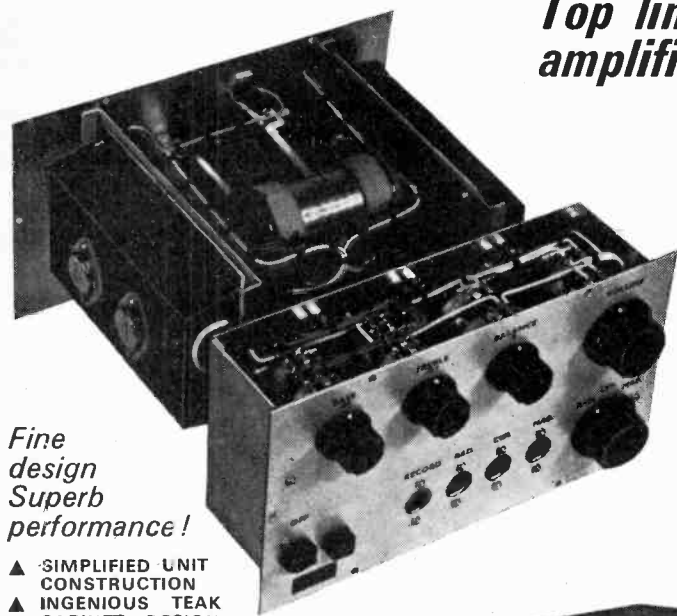
—continued on page 953

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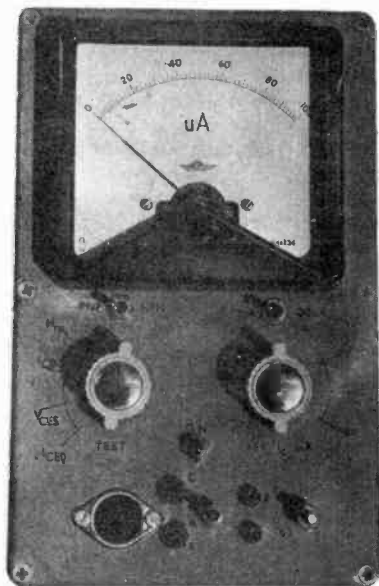
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● In next month's PRACTICAL WIRELESS

● HOW TO SOLVE YOUR TRANSISTOR PROBLEMS

Every constructor should have a means of checking transistors and other semiconductors if he is to obtain the best from his equipment. This compact unit to be described next month determines the important parameters and will be invaluable in deciding whether cheap unmarked devices can be used in particular projects.

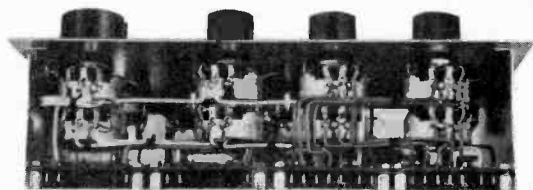


● PULSE CIRCUITS IN OPERATION

Transistors are ideal switches, thus lending themselves for use in multivibrators and digital circuitry. Bistable, monostable and astable multivibrators are described in detail in four articles starting next month which will enable those who treat these devices as black boxes to adapt them for different circuit conditions.

● THE PW 'DOUBLE-12' HI-FI STEREO AMPLIFIER

Continuing constructional details are given for building this true high fidelity project suitable for a variety of inputs. Next month's PRACTICAL WIRELESS deals with the completion of the preamplifier and the metalwork for the complete unit.



● A COMBINED LOUDSPEAKER AND S-METER

Many communications receivers are without a loudspeaker and a signal strength meter. These can easily be put into one cabinet and connected to the receiver. The Author has done this and explains his method in next month's issue.



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Testing

The Superverter may be tested initially in conjunction with the station receiver switched to the medium waveband and tuned to a quiet spot at the high frequency end of its scale. When a grid-dip oscillator is available it is a simple matter to get T1, T2 and T3 roughly pre-tuned before switch-on; in other cases a signal generator may be used but when no signal frequency setting equipment is available a more tedious "test and try" procedure must be adopted and patience will be required!

Socket SK2 may be connected initially to the receiver aerial socket via screened lead and an aerial applied to socket SK1. With a 9V battery connected across C3—observing polarity—some noise or signals should be heard as VC1 is manipulated with VR1 at maximum. Immediately any signal is heard—and a weak one is preferred—the tuning should be left and the cores of IFT1 carefully adjusted for maximum received signal strength, attenuating as required by

means of VR1. When both cores have been peaked—and they do so quite sharply—they should be left; the receiver tuning should also be left untouched.

It is thereafter a matter of manipulating the cores of T3, T2 and T1 to locate the band centre and when this has been found it should be possible to tune over the whole range of 1800-2000kc/s by using VC1 and peaking as required with the panel control provided. The vanes of VC1 should be almost fully disengaged at the high frequency end of the band but if they are not a slight adjustment to the core of T3 should do the trick. If it is found that the tuning range of VC1 is excessive C11 should be reduced in value; similarly a restricted tuning range can be increased by making C11 larger in value. In either case the core of T3 will need slight readjustment.

When the Superverter is to be used solely for "Top Band"/M phone working, full band coverage due to VC1 is unimportant for few such QSOs take place near the band edges. If no signals can be received TR2 may not be oscillating—although this is unlikely to be the case if the components used in this section are above suspicion and wiring is correct; alignment may be a long way out. Fixed tuning capacitors C1 and C6 may need to be modified slightly but if their values have to be reduced to get on the band either too much core is "in" the coil or insufficient turns have been removed.

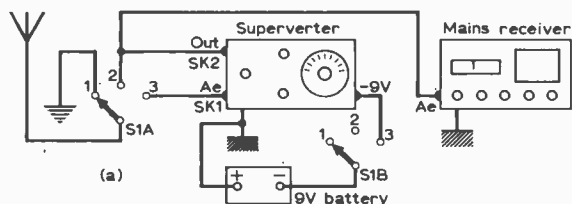
Switchery

The wiring of the selector switch and SK1 and SK2 must be left to individual requirements but some suggestions are given in Fig. 8, S1 being the appropriate switch.

At Fig. 8a the Superverter is associated with a mains receiver itself not capable of tuning "Top Band" and in this case a small dry battery can be located on the chassis for powering purposes.

In Fig. 8b the Superverter is associated with a 12V car radio both items being powered by the car battery via a fuse. In cars of recent manufacture a single wire supply line is possible the "return" being made through the car frame. A positive earth is supposed. Aerial switching is also shown in Fig. 8.

In Fig. 9 a more elaborate switching system is adopted for a full mobile "Transmit/Receive" function permitting single switch control. The transmitter depicted is the popular "Ten-Five" which was described in the January, 1967 issue of PRACTICAL WIRE

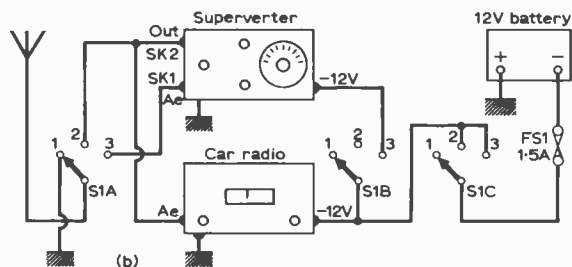


S1 = 2-pole, 3-way, rotary switch.

1..... Off - aerial grounded.

2..... Superverter 'Out' but aerial through to main receiver.

3..... Main receiver fed by superverter 'On'.



S1 = 2-pole, 3-way, rotary switch

1..... Off - aerial grounded

2..... Superverter 'Out' car radio 'On' and aerial connected.

3..... Car radio plus superverter 'On' with aerial to superverter.

Fig. 8: Some suggested switch forms.

LESS. This transmitter has attracted many praiseworthy reports and has proved an excellent little rig within the range of its capabilities. All legends in Fig. 9 are thus identified with the "Ten-Five" Transmitter.

Ganged switches SA, SB, SC and SD (a four-pole, four-way banked rotary component) permit of the following conditions; switch positions are:

- 1 All units "dead" and the aerial disconnected.
- 2 Car radio "On" alone via fuse F2. Aerial connected to receiver.
- 3 Car radio "On" plus Superverter "On". Aerial through to the Superverter. Protection by fuse F2.
- 4 Car radio "On", Superverter "On" via fuse F2 and transmitter switch S1d. Transmitter heaters "On" and aerial through to Superverter via transmitter panel function switch S1a. Looking now at transmitter panel function switch S1d it is seen that when "Transmit" is selected both the Superverter and the car radio receiver "die" instantly for lack of power which is automatically transferred by this switch to the relay coil at "X". The relay operates and 12V d.c. passes via fuse F1 to a d.c.-d.c. transistorised inverter which starts up instantly to provide 300V d.c. for the transmitter. Simultaneously, since transmitter function switches S1a and S1d are ganged together the aerial is applied to the transmitter tank circuit.* Use of a car with positive "earth" is assumed. The functions in this connection can be readily understood if the plan of Fig. 9 is compared with the original "Ten-Five" Transmitter design, the only additional item required being a small transmitter panel-controlled switch connected between tag "T" of S1d and pin 7 of SK4; this switch will provide h.t. for "Netting" purposes.

Tuning other bands

Although it may be possible to make the Superverter tune bands other than "160" this has not been

* Using the "Ten-Five" plus car radio/Superverter current demands from the car battery are: "Transmit", 3-8A; "Net", 2A; "Receive", 0-9A (radio only); 1-5A (Radio plus heaters of transmitter).

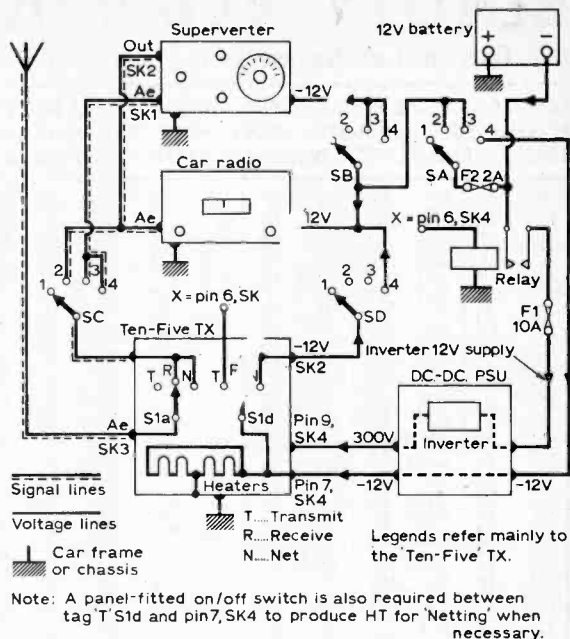


Fig. 9: A complete "Mobile" Transmit/Receive (single switch function) Switching system. The transmitter is the "Ten-Five".

attempted, the aim being to produce a first-class item of equipment for /M working. Some suggestions regarding other bands are included, however, but results obtained are quite problematical.

To tune a different band both r.f. and interstage circuits plus the oscillator section must be adjusted and different coils will be needed. The intermediate frequency—and hence IFTI—remain untouched. Coils for use in the Superverter each require three windings and some suggestions regarding approximate component values required for some amateur bands and utilising ready-made coils by Denco are given in Table I. It must be again emphasised that values are only calculated and no practical tests whatever have been made.

Table 1. Calculated values are for 1-6Mc/s output—excluding "stray" circuit capacitances.

Band centre (Mc/s)	T1			T2			T3				
	L μ H	Range No.	pF value	L μ H	Range No.	pF value	Osc F'cy	L μ H	Range No.	pF value	C pin
3-65 (80)	27-2	3B	70	27-2	3Y	70	5-25	66	2W	15	2
								13-6	3W	70	3
7-05 (40)	2-9	4B	175	2-9	4Y	175	8-65	13-6	3W	27	3
14-15 (20)	2-9	4B	39	2-9	4Y	39	15-75	2-22	4W	47	4
21-25 (15)	2-9	4B	20	2-9	4Y	20	22-85	2-22	4W	23	4
29-0 (10)	0-65	5B	47	0-65	5Y	47	30-6	2-35	5W	47	6

Blue=Blue coil. Y=Yellow coil. W=White coil. C pin=Osc. coil chassis pin.
[All coils are miniature transistor types by Denco].

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OB2 6/1	6D6 3/6	12AD6 6/7	77 6/6	DL94 5/6	EF91 3/3	MH4D 8/3	R16 34/11	VU120 12/7	BA129 2/6	OA79 1/9
OZ4 4/8	6E5 7/6	12AE6 7/8	78 4/6	DL96 7/7	EF92 2/6	MHLA 12/6	R17 17/6	VU120A12/7	BA130 2/7	OA81 1/9
IA5 4/6	6F1 8/9	12AT6 4/6	8A2 8/6	DL10 9/6	EF94 5/7	MHLD6 7/6	R18 9/6	VU13 7/3	BCY10 5/7	OA85 1/8
IC1 5/6	6F6G 4/6	12AT7 3/6	90AG 6/7	DM70 7/6	EF95 4/8	MU12/14/4	R19 6/6	W42 10/6	BCY12 5/7	OA86 4/6
IC1 5/6	6F8M 12/6	12AU6 4/9	90AV 6/7	DM71 7/6	EF97 7/6	MX40 12/6	RK34 7/6	W61M 24/6	BCY33 6/7	OA90 2/6
IC2 7/9	6F12 3/3	12AU7 4/6	90CC 34/7	DW4/350	EF98 10/7	N78 38/4	SP4 9/7	W63 10/6	BCY34 4/6	OA91 1/9
IC3 7/9	6F13 3/6	12AV6 5/6	90CV 33/6	DW4/500	EF183 5/9	N105 26/7	SP13C 12/6	W76 5/9	BCY38 5/7	OA182 1/9
IC5 4/9	6F15 9/6	12AV7 8/7	90C1 16/7	DW4/500	EF184 5/9	N152 7/3	SP42 12/6	W77 2/6	BCY39 4/6	OA200 1/7
LD5 6/9	6F17 12/6	12AY7 9/9	150C2 14/6	DY86 5/9	EF804 20/5	N339 25/7	SP61 3/3	W81M 6/7	BCZ11 3/6	OA202 2/6
LD6 9/6	6F18 7/6	12BA6 6/7	161 15/7	DY87 5/9	EH90 6/8	N359 7/3	TD04 8/3	W101 26/2	BC107 4/7	OA210 9/6
LD7 9/6	6F18 7/6	12BA6 6/7	161 15/7	E800 24/7	EL32 3/8	P61 2/6	TH4B 10/7	W107 7/7	BC108 4/3	OA211 13/6
LD8 9/6	6F23 12/3	12B26 5/9	185B7 35/7	E801 24/7	EL33 12/6	PABC80 7/3	TH233 7/7	W229 10/7	BC109 4/3	OA2200 12/6
LD9 9/6	6F23 12/3	12B26 5/9	185B7 35/7	E802 24/7	EL34 9/6	PC86 9/6	TP22 5/7	X24 16/6	BC113 5/7	OA2201 10/6
LD10 9/6	6F24 11/9	12B27 6/7	301 20/7	E803 24/7	EL35 10/6	PC88 9/6	TP25 5/7	X41 10/7	BC115 3/7	OA2202 9/6
LD11 9/6	6F25 11/9	12E1 17/7	302 16/6	E804 24/7	EL36 8/6	PC95 8/3	TP2620 8/9	X61 5/9	BC116 5/7	OA2203 9/6
LD12 9/6	6F26 11/9	12J5GT 2/6	303 15/7	E805 24/7	EL100 8/7	PC97 7/9	TY86F 12/2	X63 5/6	BC118 4/7	OA2204 9/6
LD13 9/6	6F27 12/6	12J5GT 2/6	303 15/7	E806 24/7	EL101 17/6	PC98 7/9	TY86F 12/2	X63 5/6	BC119 4/7	OA2205 9/6
LD14 9/6	6F28 12/6	12J5GT 2/6	303 15/7	E807 24/7	EL102 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC120 4/7	OA2206 9/6
LD15 9/6	6F29 12/6	12J5GT 2/6	303 15/7	E808 24/7	EL103 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC121 4/7	OA2207 9/6
LD16 9/6	6F30 12/6	12J5GT 2/6	303 15/7	E809 24/7	EL104 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC122 4/7	OA2208 9/6
LD17 9/6	6F31 12/6	12J5GT 2/6	303 15/7	E810 24/7	EL105 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC123 4/7	OA2209 9/6
LD18 9/6	6F32 12/6	12J5GT 2/6	303 15/7	E811 24/7	EL106 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC124 4/7	OA2210 9/6
LD19 9/6	6F33 12/6	12J5GT 2/6	303 15/7	E812 24/7	EL107 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC125 4/7	OA2211 9/6
LD20 9/6	6F34 12/6	12J5GT 2/6	303 15/7	E813 24/7	EL108 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC126 4/7	OA2212 9/6
LD21 9/6	6F35 12/6	12J5GT 2/6	303 15/7	E814 24/7	EL109 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC127 4/7	OA2213 9/6
LD22 9/6	6F36 12/6	12J5GT 2/6	303 15/7	E815 24/7	EL110 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC128 4/7	OA2214 9/6
LD23 9/6	6F37 12/6	12J5GT 2/6	303 15/7	E816 24/7	EL111 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC129 4/7	OA2215 9/6
LD24 9/6	6F38 12/6	12J5GT 2/6	303 15/7	E817 24/7	EL112 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC130 4/7	OA2216 9/6
LD25 9/6	6F39 12/6	12J5GT 2/6	303 15/7	E818 24/7	EL113 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC131 4/7	OA2217 9/6
LD26 9/6	6F40 12/6	12J5GT 2/6	303 15/7	E819 24/7	EL114 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC132 4/7	OA2218 9/6
LD27 9/6	6F41 12/6	12J5GT 2/6	303 15/7	E820 24/7	EL115 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC133 4/7	OA2219 9/6
LD28 9/6	6F42 12/6	12J5GT 2/6	303 15/7	E821 24/7	EL116 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC134 4/7	OA2220 9/6
LD29 9/6	6F43 12/6	12J5GT 2/6	303 15/7	E822 24/7	EL117 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC135 4/7	OA2221 9/6
LD30 9/6	6F44 12/6	12J5GT 2/6	303 15/7	E823 24/7	EL118 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC136 4/7	OA2222 9/6
LD31 9/6	6F45 12/6	12J5GT 2/6	303 15/7	E824 24/7	EL119 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC137 4/7	OA2223 9/6
LD32 9/6	6F46 12/6	12J5GT 2/6	303 15/7	E825 24/7	EL120 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC138 4/7	OA2224 9/6
LD33 9/6	6F47 12/6	12J5GT 2/6	303 15/7	E826 24/7	EL121 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC139 4/7	OA2225 9/6
LD34 9/6	6F48 12/6	12J5GT 2/6	303 15/7	E827 24/7	EL122 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC140 4/7	OA2226 9/6
LD35 9/6	6F49 12/6	12J5GT 2/6	303 15/7	E828 24/7	EL123 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC141 4/7	OA2227 9/6
LD36 9/6	6F50 12/6	12J5GT 2/6	303 15/7	E829 24/7	EL124 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC142 4/7	OA2228 9/6
LD37 9/6	6F51 12/6	12J5GT 2/6	303 15/7	E830 24/7	EL125 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC143 4/7	OA2229 9/6
LD38 9/6	6F52 12/6	12J5GT 2/6	303 15/7	E831 24/7	EL126 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC144 4/7	OA2230 9/6
LD39 9/6	6F53 12/6	12J5GT 2/6	303 15/7	E832 24/7	EL127 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC145 4/7	OA2231 9/6
LD40 9/6	6F54 12/6	12J5GT 2/6	303 15/7	E833 24/7	EL128 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC146 4/7	OA2232 9/6
LD41 9/6	6F55 12/6	12J5GT 2/6	303 15/7	E834 24/7	EL129 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC147 4/7	OA2233 9/6
LD42 9/6	6F56 12/6	12J5GT 2/6	303 15/7	E835 24/7	EL130 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC148 4/7	OA2234 9/6
LD43 9/6	6F57 12/6	12J5GT 2/6	303 15/7	E836 24/7	EL131 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC149 4/7	OA2235 9/6
LD44 9/6	6F58 12/6	12J5GT 2/6	303 15/7	E837 24/7	EL132 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC150 4/7	OA2236 9/6
LD45 9/6	6F59 12/6	12J5GT 2/6	303 15/7	E838 24/7	EL133 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC151 4/7	OA2237 9/6
LD46 9/6	6F60 12/6	12J5GT 2/6	303 15/7	E839 24/7	EL134 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC152 4/7	OA2238 9/6
LD47 9/6	6F61 12/6	12J5GT 2/6	303 15/7	E840 24/7	EL135 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC153 4/7	OA2239 9/6
LD48 9/6	6F62 12/6	12J5GT 2/6	303 15/7	E841 24/7	EL136 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC154 4/7	OA2240 9/6
LD49 9/6	6F63 12/6	12J5GT 2/6	303 15/7	E842 24/7	EL137 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC155 4/7	OA2241 9/6
LD50 9/6	6F64 12/6	12J5GT 2/6	303 15/7	E843 24/7	EL138 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC156 4/7	OA2242 9/6
LD51 9/6	6F65 12/6	12J5GT 2/6	303 15/7	E844 24/7	EL139 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC157 4/7	OA2243 9/6
LD52 9/6	6F66 12/6	12J5GT 2/6	303 15/7	E845 24/7	EL140 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC158 4/7	OA2244 9/6
LD53 9/6	6F67 12/6	12J5GT 2/6	303 15/7	E846 24/7	EL141 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC159 4/7	OA2245 9/6
LD54 9/6	6F68 12/6	12J5GT 2/6	303 15/7	E847 24/7	EL142 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC160 4/7	OA2246 9/6
LD55 9/6	6F69 12/6	12J5GT 2/6	303 15/7	E848 24/7	EL143 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC161 4/7	OA2247 9/6
LD56 9/6	6F70 12/6	12J5GT 2/6	303 15/7	E849 24/7	EL144 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC162 4/7	OA2248 9/6
LD57 9/6	6F71 12/6	12J5GT 2/6	303 15/7	E850 24/7	EL145 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC163 4/7	OA2249 9/6
LD58 9/6	6F72 12/6	12J5GT 2/6	303 15/7	E851 24/7	EL146 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC164 4/7	OA2250 9/6
LD59 9/6	6F73 12/6	12J5GT 2/6	303 15/7	E852 24/7	EL147 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC165 4/7	OA2251 9/6
LD60 9/6	6F74 12/6	12J5GT 2/6	303 15/7	E853 24/7	EL148 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC166 4/7	OA2252 9/6
LD61 9/6	6F75 12/6	12J5GT 2/6	303 15/7	E854 24/7	EL149 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC167 4/7	OA2253 9/6
LD62 9/6	6F76 12/6	12J5GT 2/6	303 15/7	E855 24/7	EL150 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC168 4/7	OA2254 9/6
LD63 9/6	6F77 12/6	12J5GT 2/6	303 15/7	E856 24/7	EL151 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC169 4/7	OA2255 9/6
LD64 9/6	6F78 12/6	12J5GT 2/6	303 15/7	E857 24/7	EL152 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC170 4/7	OA2256 9/6
LD65 9/6	6F79 12/6	12J5GT 2/6	303 15/7	E858 24/7	EL153 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC171 4/7	OA2257 9/6
LD66 9/6	6F80 12/6	12J5GT 2/6	303 15/7	E859 24/7	EL154 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC172 4/7	OA2258 9/6
LD67 9/6	6F81 12/6	12J5GT 2/6	303 15/7	E860 24/7	EL155 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC173 4/7	OA2259 9/6
LD68 9/6	6F82 12/6	12J5GT 2/6	303 15/7	E861 24/7	EL156 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC174 4/7	OA2260 9/6
LD69 9/6	6F83 12/6	12J5GT 2/6	303 15/7	E862 24/7	EL157 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC175 4/7	OA2261 9/6
LD70 9/6	6F84 12/6	12J5GT 2/6	303 15/7	E863 24/7	EL158 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC176 4/7	OA2262 9/6
LD71 9/6	6F85 12/6	12J5GT 2/6	303 15/7	E864 24/7	EL159 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC177 4/7	OA2263 9/6
LD72 9/6	6F86 12/6	12J5GT 2/6	303 15/7	E865 24/7	EL160 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC178 4/7	OA2264 9/6
LD73 9/6	6F87 12/6	12J5GT 2/6	303 15/7	E866 24/7	EL161 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC179 4/7	OA2265 9/6
LD74 9/6	6F88 12/6	12J5GT 2/6	303 15/7	E867 24/7	EL162 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC180 4/7	OA2266 9/6
LD75 9/6	6F89 12/6	12J5GT 2/6	303 15/7	E868 24/7	EL163 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC181 4/7	OA2267 9/6
LD76 9/6	6F90 12/6	12J5GT 2/6	303 15/7	E869 24/7	EL164 17/6	PC99 7/9	TY86F 12/2	X63 5/6	BC182 4/7	OA2268 9/6</

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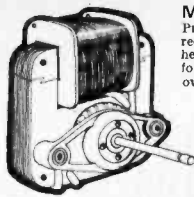
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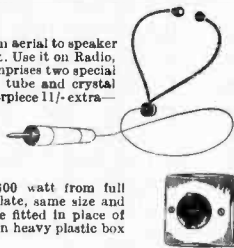
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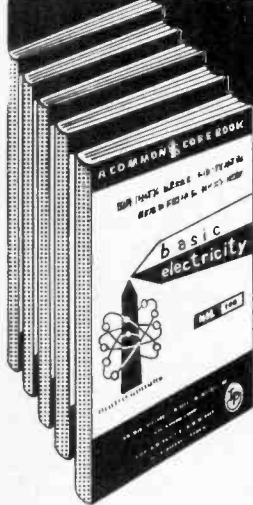
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practically wireless

commentary by HENRY

WHEN Pax led me astray for the fiftieth time, the Editor was good enough to suggest that, though this column was indeed "practically" about wireless matters, some digressions could be excused by the "light-hearted approach."

Sorry, but this month Henry is far from light-hearted, and the cause is much the same as that of No. 50, viz., the skulduggery of the Postmaster-General.

No consolation to know that he will soon be a more powerful knave-in-office either. Calling the Minister of Posts and Telecommunications by any other name would not make his misdeeds smell sweeter. Take the scandalous case of the "increased licence finesse."

Do you remember when the licences went up? That's right, at the turn of the year. Just one day after Henry's renewal date, glory be! So Mrs. Henry went with £5 in her hot and sticky little hand to see her friendly sub-postmaster. He has suddenly become an iron-faced gorgon. No licences can be paid until after 1st January. No, not even of that poor pensioner just before us in the queue who has been saving all year for the exact, exorbitant amount.

It may be all right for us—we can cut down on the *au pair's* chocolates, or spread a little less *foie gras* on the chips—but for

the neddy that extra pound was a dastardly blow.

All right, so it had to be paid. It was due. You want stereo radio, don't you? But somewhere a line had to be drawn. At some date the rise had to be imposed, and if your licence renewal date fell just prior to that line you were dead lucky, chum. Or should have been.

In practice you—and Henry and many others—were not. For the post offices calmly refused to accept the contents of our piggy banks for several days prior to the £6 deadline.

This is sheer sharp practice. What ordinary business would have got away with such a trick? For the benefit of the reader who thought Henry was a disguised manufacturer let me assure you that he is a plain working engineer. Imagine *his* customers' reaction when presented with a repaired radio priced 20% above the estimate—on the grounds that costs would be going up some time in the future! Or, for a more exact parallel, with his wireless set withheld until the price rise came into force. *That* is the sort of trick our lords and masters perpetrate.

There is more to protest about. And I don't mean Citizens' Band, Morse Code tests, pirate radio, local broadcasting or sponsored TV. Not even Pay-TV, which has been dropped with a dull thud of well-bred disapproval and a sneer at would-be entrepreneurs.

Point at issue is Parliament's distaste for communications, *per se*. We could understand a reluctance to reveal the cut and thrust of debate for the dull succession of harangues we visitors to the Strangers' Gallery know it to be. And only a very few members are as photogenic as you and I, Joe. Indeed, the sort of comedians who guffaw at jokes in the class of "Who was that lady . . . ?" would compete rather badly with



The customer's reaction . . .

those wits who send them up for our entertainment. (Will the *real* Mr. Heath please stand up!)

But it cannot be denied that many of our public guardians, though wary, can be bold when they get the chance to speak. Some contrive to sound assertive even when reading the fourth paragraph of the fifteenth amendment to the second clause of . . . etc. The performance of others makes one wonder how they ever got elected.

So it is hardly surprising to hear that the House was pretty evenly divided on the subject of being broadcast; even less certain about being ready for television. It seems a wonder that they even permit the shorthand writers to be augmented by that new-fangled device, the tape recorder.

Have you noticed that they want to spend £100,000 on equipment for a pilot scheme of excerpt broadcasts? Considering that the existing sound reinforcement scheme in the Commons is really superb—and I assure you it is—we must beg leave to wonder what they intend to spend this huge whack of public loot upon. Plush seats for the new Minister of Monopolistic Telegraphs perhaps? One correspondent in *Hi-Fi News* last January worked out costs in generous detail and calculated that there was a discrepancy of some £95,000.

No wonder A. W. Benn, Esq., does not want to leave broadcasting to the broadcasters.



Cut down the au pair girl's chocolates.

Another saga?

At the risk of turning the "switch-on thump" into another saga on the scale of that concerning Mr. McFarlane's (Jan. 1968) soldering iron (by the way, why did no one suggest buying a new soldering iron instead of auto-transformers, diodes or whatnots) might I add my practical experiences to those of Mr. Wood (Feb. 1969).

Having read the many letters recommending cures for the switch-on thump, I acquired two electrolytics and proceeded to modify my amplifier as instructed. The result was very interesting: the thump remained unchanged (or did I detect a slight increase?) and the amplifier began to hum at an intolerable level. After some investigation, I decided the thump was caused by charging of capacitors in the driver stages, and cured it effectively by fitting a muting switch to the output. As for the hum, this was cured by restoring the amplifier to its original circuitry.

In conclusion, might I remark that, if Mr. Wood's amplifier does require 2A for full output, the 10 Ω resistors if inserted in the power supply line will reduce his output by about 75%, a far more serious drawback than a "thump" once a day.—P. Gray (*Oxford*).

The state of things

For several months now I have been following with great interest the replies printed to Mr. Tomlinson's inquiry regarding the definition of solid state.

I think, however, that Mr. Davison's interpretation (P.W. Feb. 1969) is totally unjustified. If solid state devices are to be regarded as devices in which *electrons* flow only through materials only in the solid phase of matter this will still include both transformers and capacitors.

In transformers electrons do not "travel between the poles in almost free air", an alternating flow is set up in the primary winding which creates an alternating magnetic flux which in turn induces electrons to vibrate in the secondary winding. Thus it is only the magnetic flux which travels through "almost free air" and this flux is usually directed and concentrated by laminations of

a conducting material in a mains type transformer.

As for capacitors, Mr. Davison must know that capacitors are infinitely resistive to direct currents, the plates becoming charged and finally saturated with electrons from one terminal and exhausted on the other. The only way in which this current can then flow is to reverse the direction of the electron flow and hence reverse the quantity of charge on respective plates. Thus a capacitor will appear to pass an alternating current but resist the flow of direct current.

I can assure Mr. Davison that the only way in which electrons can be made to "jump the gap" is to apply an excessive potential difference to the circuit and cause arcing between either the windings of the transformers or the plates of the capacitor.—J. G. Owen GW8BFT (*London, W.12*).

★ ★ ★

As a student of electrical engineering I feel that I should clarify certain misconceptions which Mr. Davison (February edition) appears to have concerning current flow and "solid state".

Firstly, Mr. Davison wrongly assumes that nothing impedes the flow of electrons in a "conventional" circuit. If this is so what is the purpose of resistance, capacitance, inductance, and the other circuit devices?

The vacuum valve does not allow free passage of electrons from cathode to anode. Instead the space charge, caused by emission of electrons from the cathode, provides a barrier to electron flow. This barrier must be overcome by the application of a voltage between anode and cathode. If this was not the case all the electrons emitted from the cathode would arrive at the anode without the application of any potential.

In the case of the transformer, Mr. Davison states that "electrons travel between the poles in almost free air". A transformer is constructed on a closed magnetic circuit (of laminations) and therefore has no poles. Secondly, the transfer of energy from primary to secondary is accomplished by means of a magnetic field produced in the primary winding. If this field varies (i.e. if it is produced by a varying

current) then an e.m.f. will be induced in the secondary winding (Faraday's law).

Capacitors are constructed in such a way that electrons cannot flow from one terminal to the other. The dielectric whether air or any other insulating material provides a barrier to current flow. (30,000 volts would be required across a gap in air of 1 centimetre to produce a current!). Current is only assumed to flow in capacitors to assist some calculations even though an electron cannot pass from one terminal to the other through the dielectric.

Thus electrons in conventional circuits do not jump across gaps (except in valves) but only pass through solid material, e.g. copper or carbon.

As far as "solid state" is concerned I can only add to the numerous explanations of this term. I would say that any circuit which uses semiconductor circuitry is "solid state" because the components used to control electron (or hole) flow are made of solid semiconductors such as germanium or silicon.—L. Macari (*Lanarkshire*).

Let's end it folks

In the July 1968 issue of PRACTICAL WIRELESS, I posed the question of a definition of "solid state". Subsequent issues produced a most interesting result. I feel that perhaps the Editorial Department would like to call a halt to the discussion and if this is so, I would sincerely like to thank all who have taken part for the views and interest.—W. J. Tomlinson (*London, E.17*).

CR100/1328 output

I recently purchased a CR100/1328 receiver from a well-known dealer with the assurance that the output was suitable for 3 Ω speaker. This however was found to be for 1,000 Ω output. Reference to the circuit shows that the output transformer is identical in all CR100 models and all that is required is to wire the 3 Ω speaker to tags 9 and 10 which are not in use, or change over the wires from tags 5 and 6 to 9 and 10.—S. Wright (*Kirkcudbrightshire*).

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MONTHLY NEWS FOR DX LISTENERS

Times GMT
Frequencies in kc/s

THE BROADCAST BANDS by CHRISTOPHER DANPURE

WELL, the spring transmission season is upon us, autumn south of the equator. This is the month for you DX-ers to send off reports to get that long sought after QSL card, particularly in respect of hearing *R. New Zealand*. The best time to try is between 0800-0845 on the 25mb, frequency is usually 11,780 Mc/s, they are also in the 31mb using either 9,520Mc/s or 9,540Mc/s. Another station which is hard to hear in the British Isles is the *Voice of Free China*, Taipei, this station is heard quite well during March and April during its English transmission from 1800-1900, I have heard them at poor to fair strength in the 19mb.

In the February issue I brought up the question of the swamping of the short wave broadcast bands by *R. Moscow* and Russian jammers, and the large number of frequencies used by the *Voice of America*. But there is also another nuisance on the short wave broadcast bands, that is stations who operate off frequency and cause heterodynes on stations operating on the correct frequency. The chief culprits of this form of interference are *R. Tirana* operating on 15,402-3, 11,863, 11,858 and 9,718 instead of 15,400 or 405, 11,865, 11,860 and 9,715. Another station is *R. Tehran* on 15,137Mc/s and 11,730Mc/s. So perhaps these stations would spend some money on new frequency measuring equipment in 1969 and rid the bands of those horrible heterodynes.

Now here are this months propagation predictions.

West Africa: 0800-1600 25, 21, 17 and 15Mc/s; 1600-1800 25, 21, 17, 15 and 11Mc/s; 1800-2000 21, 17, 15, 11 and 9Mc/s; 2000-2200 17, 15, 11, 9, 7, 6, 5 and 4 Mc/s; 2200-0200 15, 11, 9, 7, 6, 5, 4 and 3Mc/s; 0200-0400 11, 9, 7, 6, 5, 4 and 3Mc/s; 0400-0600 11, 9, 7, 6 and 5Mc/s; 0600-0800 15, 11 and 9Mc/s.

East Africa: 0800-1400 25, 21, 17 and 15Mc/s; 1400-1800 25, 21, 17, 15, 11 and 9Mc/s; 1800-2000 17, 15, 11, 9 and 7Mc/s; 2000-2200 15, 11, 9, 7, 6 and 5Mc/s; 2200-0200 11, 9, 7, 6 and 5Mc/s; 0200-0400 11, 9 and 7Mc/s; 0400-0600 11 and 9Mc/s; 0600-0800 21, 17 and 15Mc/s.

South Africa: 0800-1200 25 and 21Mc/s; 1200-1400 25, 21 and 17Mc/s; 1400-1600 25, 21, 17 and 15Mc/s; 1600-1800 25, 21, 17, 15 and 11Mc/s; 1800-2000 21, 17, 15, 11 and 9Mc/s; 2000-2200 17, 15, 11, 9, 7, 6 and 5 Mc/s; 2200-0200 15, 11, 9, 7, 6 and 5Mc/s; 0200-0400 11, 9, 7, 6 and 5Mc/s; 0400-0600 11 and 9Mc/s; 0600-0800 21, 17 and 15Mc/s.

South Asia: 0800-1200 25, 21, 17 and 15Mc/s; 1200-1400 25, 21, 17, 15 and 11Mc/s; 1400-1600 21, 17, 15, 11, 9 and 7Mc/s; 1600-1800 15, 11, 9, 7, 6, 5 and 4Mc/s; 1800-2000 11, 9, 7, 6, 5 and 4Mc/s; 2000-2200 11, 9, 7, 6, 5, 4 and 3Mc/s; 2200-2400 9, 7, 6, 5, 4 and 3Mc/s; 2400-0200 7, 6 and 5Mc/s; 0200-0400 9 and 7Mc/s; 0400-0600 11 and 9Mc/s; 0600-0800 21, 17 and 15Mc/s.

South East Asia: 0600-0800 21 and 17Mc/s; 0800-1000 25, 21 and 17Mc/s; 1000-1200 25, 21, 17 and 15 Mc/s; 1200-1400 25, 21, 17, 15 and 11Mc/s; 1400-1600

21, 17, 15, 11 and 9Mc/s; 1600-1800 17, 15, 11, 9, 7, 6 and 5Mc/s; 1800-2200 11, 9, 7, 6 and 5Mc/s; 2200-2400 9 and 7Mc/s; 2400-0200 9Mc/s only; 0200-0600 circuit closed.

North East Asia: 0600-0800 15Mc/s only; 0800-1000 21, 17 and 15Mc/s; 1000-1200 17 and 15Mc/s; 1200-1400 15 and 11Mc/s; 1400-1800 11 and 9Mc/s; 1800-2200 9Mc/s only; 2200-0600 circuit closed.

Australia (East) via Asia: 0600-1000 21Mc/s only; 1000-1200 17Mc/s only; 1200-1400 15Mc/s only; 1400-1600 11 and 9Mc/s; 1600-2000 11, 9, 7 and 6Mc/s; 2000-2200 9Mc/s only; 2200-0600 circuit closed.

On 2nd March most shortwave broadcasting stations changed over to spring/autumn transmission schedules. So now here are the latest DX-tips.

AFRICA

South Africa: *R. R.S.A.*, Johannesburg, now has English broadcasts as follows on weekdays only: 0413-0427 on 11,900 and 9,525; 0428-0442 on 21,535 and 17,805; 0458-0512 on 7,270 and 5,980; 0513-0527 on 21,535 and 17,805; 0643-0657 on 17,805 and 15,220. Daily 0956-1050 on 21,535, 17,805 and 15,220; 1056-1150 on 25,790, 21,535, 15,220 and 11,900; 1156-1250 on 21,535, 17,805 and 15,220; 1256-1450 on 25,790, 21,535, 15,220 and 11,900; 1556-1650 on 15,220 and 11,900; 1656-1750 on 25,790 and 21,535; 1756-1850 on 21,535 and 17,805; 1856-1950 on 17,795 and 11,875; 2056-2150 on 21,535 and 17,805; 2326-0320 on 11,875, 9,705 and 6,075.

EUROPE

Denmark: *The Voice of Denmark*, Copenhagen, is now beaming its transmission to South America from 2200-2315 daily in Danish, but on Mon, Wed and Fri the last 30 minutes are in Spanish.

Holland: *Radio Nederland* now has English transmissions on weekdays for 50 minutes at the following times from transmitters at Lopik: 0730-0820 on 11,730 and 9,715; 1430-1520 on 21,480, 17,810 and 6,020; 1900-1950 on 11,730 and 6,020; 2000-2050 on 11,730 and 6,020; 2100-2150 on 15,425 and 11,730

In May the length of all English transmissions will be 80 minutes for weekdays only. On Sundays the Happy Station will go out at the same times.

CARIBBEAN AREA

Bonaire: The planned full operation of this base in March has been postponed until May. There now are new programme times for *R. Nederland* English transmissions with new transmissions. 1900-1950 to Africa on 15,220; 2130-2220 to W. Africa and Spain on 17,810 and 15,220. From 2330-0110 the Spanish/English programme will go out on 6,085 as well as 800kc/s; 0130-0220 on 11,730 and 9,590; 0500-0550 on 11,730 and 9,590.

Deadline this month 14th, so good listening and 73s.

SPRING, when a young c.w.l.s. fancy lightly turns to topband—or does it. The sunspots are on the wane but still the DX seems to be coming through so it would seem to be a good idea to make r.f. hay while the sunspot shines.

All bands have been very good although only one report was received on the topband transatlantics. The W stations in some areas are now allowed considerably more power on this band so you stand a very good chance of hearing your first W on 160 if you listen really hard.

Ten metres going well with VK, VU, and ZD9 all coming through plus quite a few more prefixes which eluded my front end. Fifteen has been excellent and stayed open longer. At 0530hrs the stirrings can be heard and it doesn't seem to want to hit the sack until 2200. Twenty—even better than 15 for me. It opens earlier and closes later and only dies from about midnight to 0300. Seven megs is a devil of a din but the noise was well modulated with sigs from JA, DU, VK and the likes. This last month seems to have favoured 40 metres with regards to Oceania.

Eighty and 160 have, at times, been excellent. On 3.5Mc/s Oceania has peaked through albeit mighty weak while the African continent has featured quite prominently on this band.

A reminder, especially for anyone just starting to listen on the amateur bands. The mobile rally season is almost upon us and my diary makes the first one the North Midlands Rally at Drayton Manor Park near Tamworth in Staffs. There's nearly always a talk-in station on topband so if you locate him, then you will be able to hear all the mobiles making contact. Listen for the lads who conduct QSO's on this frequency too. (Fall out the men with red faces!). Be on the look out for cars with weird looking aerials, but be careful. Rushing up to a police car and asking for a QSL just isn't appreciated.

Little birds have whispered that Italian stations are shortly to have a prefix shuffle. The I callsign stays but the number which follows will indicate the province. Another correspondent told tales of a DXpedition to Chatham Island but I didn't hear anything of them at all. Perhaps my front end is more selective than I think; anyone hear sigs from that direction?

SIGS RECEIVED

Desmond Clark (Amersham) is hoping to visit CN8 and 7XØ this summer and says he hopes to hear G3JDG on topband—I hope he hears G3JDG on topband too! Meanwhile his P.W. progressive s'het has been modded and multi-band log reads: 80—CT2AS, EA6BG, K1ANV, OD5BA, VE1IE, VO1AL, W1BL, ZL4KE: 40—HCØBU/HP1, LX1BW, XE3EB; 20—CE6EZ, CE8AA, FP8CS, FR7ZG, HS1MD, JA3IG, OA4AI, UWØJA, VE6TP, VE7ZA, VE8RCS, VK2WD, VK3AK, VKØIA, VP8KD, VP8KO, YBØAAB, ZL2ACP, ZL3KV, ZL4LM, 5V4EG, 6W8DY, 9K2CF, 9X5AA, 9Y4EH. All these on s.s.b.

R. Dinning (Ayrshire) HA350 plus PR30X, 380ft. long wire (my, that is a long wire) got these on 15 s.s.b.—CT2AS, EL2J, FM7WQ, HC2HM, HR1KAS, HR1WTA, KP4AZV, KV4CF,

MP4BGY, OD5AT, PJ2CQ, SVØWN, TF2WJR, TI5CPG, VK2FA, VK2SI, VP8KO, VQ8CC, ZL3KV, 9G1GK. Ten metres s.s.b. raised—CR6KD, KP4DED, KV4FA, KZ5EK, MP4BGX, OD5BZ, SVØWN, VP2LX, YO9CN and hosts of W's.

Paul Sams (Romford) RX—60N, 55ft. end fed, had a session on 20 s.s.b. for—EL4BU, HBØLL, JA9KG, KL7EBK, PY2RE, PY7VON, VK2AYE, VK9NT, YN1HF, ZD8NK, ZL1AON, ZL2JB, ZL4BC, 7X2ARA, 9K2PS.

P. Cavill (Glos.), who has a CR45, received a mixture of s.s.b. and a.m. from—CT1LM, EA2DZ, TI2CMF, VE1ASN, VE3ETS, VK2PL, WA2EUA/P1, YV1WX, 5A1TX, 6Y5JB, 9H1BG. Aerial was 130ft. long wire and the band 10 metres.

Pat Johnson (Durham) has an unstable RX60 plus PR30 with a 60ft. wire thrown in for good measure. Eighty metres produced s.s.b. from—CT1SQ, EA7ID, HB9XL, K2ADY, K3NPV, LX1JE, OA8VE, OD5BA, OX3WX, TF3BE, TF5TP, VE1AAW, VE1AX, VE2BBY, VO1AK, W1EFM, WB2RDO, WØHP, XE1KB, YV5DU, 9H1BL. Forty metres produced—CR7HM, CT1WA, EA3JO, HK3AIS, HV3SJ, YV1PW. (Psst! How can I make my rx unstable OM?) Pat says that EUs average 5 and 9 plus 10dB, OX and TF 5 and 9, VO/VE/W/K 5 and 7 to 9, S. America 5 and 5. This is for 80. Best listening times—2400 on for Canada and USA, 0630—0730 for S. America, East coast Ws and Oceania.

M. Pipes (Derby), Trio rx, 66ft. end fed is a 20 s.s.b. fan. The log reads—CR7PC, HR2WTA, KV4EY, MP4TCE, OD5FA, PY7APS, SV1CA, TA1KT, TG9EP, VK3RZ, VK7KJ, YV5AG, ZD8Z, ZS3JJ, ZS5DC, ZL6OY, 3A2CQ, 4Z4HG, 5A1TF, 5Z4KL, 6Y5GB, 7XØBF, 9H1I, 9Y4GM.

C. Davis (Stoke-on-Trent) confesses to neglecting his homework to hear—CN8DT, CR6LF, HI8XPM, TF2WLM, UAØBS, VK2AOF, VK3LA, W7LFA, 4X4IH, 9Y4VT. All heard on a Monarch HAM-1 and 50ft. end fed.

A. Hall (Folkestone), 888A plus a.t.u. (ten out of ten), 110ft. end fed, admits he has tendencies towards 80. His best for the band includes CT1LN, GB2IBS, K1RA/P, K2INO, K3UED, K4ASA, K4GSU/P3, VE1IE, WØGEP, W1HO, W2OKI, W3AQX, W4EYM, WAØRZR, WA2APQ, 9H1BL.

J. Hill (Germany), CR70A plus PR30 logged these on 28Mc/s a.m.—OZ1AD, W3BIW, W4CSR, W9DLC, and UA3VKT running 10W.

C. Morgan (Wallsend) CR150/2, 25ft. vertical has been roaming topband. He hooked—GD3VWN, GI6TK, GM3HLQ, HB9CM, HB9YL, OK1ATP, OK1JOE, OM2BM, W1BB/1, W2GGL, W2RAA. He hopes to erect a 132ft. wire soon so that it's ready and tested by next winter.

CONTESTS

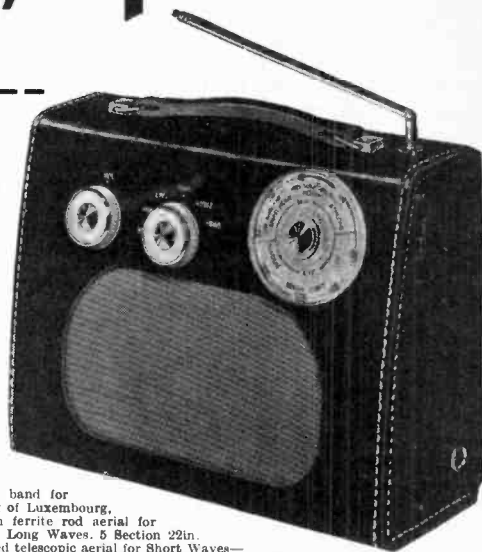
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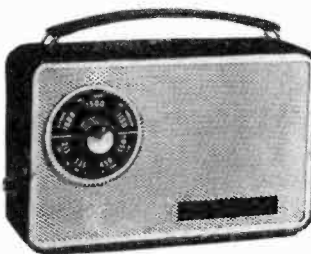
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6AM6	3/6	6G6	2/6	6X5G	4/6	12S7G	6/-	35Z3	20/-	CL33	20/-	EBF89	9/6	EF184	7/6	M14	7/8	PL84	7/6	UBC81	9/3	Tubes	
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MAGNETIC SOUND RECORDING

W.S.FOWLER

IN THIS FINAL ARTICLE IN THE SERIES, DETAILS ARE GIVEN OF PRACTICAL CIRCUITS USED IN TAPE RECORDERS.

FOR general usefulness, the mains powered tape recorder has several advantages over battery models. A possible exception to this are the recent *cassette loaded* recorders which employ tape of half the normal width; $\frac{1}{4}$ instead of $\frac{1}{2}$ in. Two tracks are used and the machine thus approximates to the standard four track machines in performance. The vexed problem of capstan speed stability is tackled by the use of a transistorised "feedback" regulator. Furthermore the disadvantages of d.c. bias and permanent magnet erasure are obviated by the use of a.c. bias, coupled with the use of an a.c. erase head. Again, because of power requirements this last feature is generally restricted to mains powered recorders.

Constructors who wish to build a useful and reliable mains tape recorder are referred to the article in *PRACTICAL WIRELESS* for March, 1968. Using a B.S.R. TD2 deck, this recorder can be cheaply constructed and it would be difficult to improve on this without considerable expense.

The TD2 deck does however operate at a fixed speed of $3\frac{1}{2}$ i.p.s. and for those constructors who wish to obtain increased economy on the one hand,

and also have the availability of a higher quality performance, it is suggested that the TD2 deck should be replaced by the TD10 B.S.R. deck. Alternative decks providing similar facilities are the Thorn and the Collaro Magnavox, four track versions are also available.

FREQUENCY CORRECTION

It has been assumed so far that the frequency response of the recording tape is linear, i.e., the output of the tape will correspond to the input. In practice this is not so and the losses in the tape head itself, together with the irregular response of the tape, necessitate some form of frequency correction. Normal practice consists in reducing the bass frequencies and accentuating the treble frequencies during the recording process while on playback the bass frequencies are boosted.

Some tape recorders employ a frequency selective choke which is connected in the grid circuit of the second stage of the amplifier and is brought into circuit when the machine is in the record position. A more common method is the use of frequency selective negative feedback.

A simple method giving good results shown in Fig. 11, consists of limiting the value of the cathode by-pass condenser of the second stage of the amplifier. The normal 25mfd by-pass condenser should be disconnected on its positive (cathode) side. A 0.05mfd paper condenser can then be connected across the cathode by-pass resistor. The disconnected positive lead of the electrolytic condenser is connected to a small on/off switch. The other connection of the switch is taken to the cathode. In the record position, the switch is "off" and the 0.05mfd condenser provides any easy path to earth for the higher audio frequencies. While the low frequencies are reduced through negative feedback. In the play position, the switch is "on" and the electrolytic condenser is brought into circuit, restoring normal linear amplification.

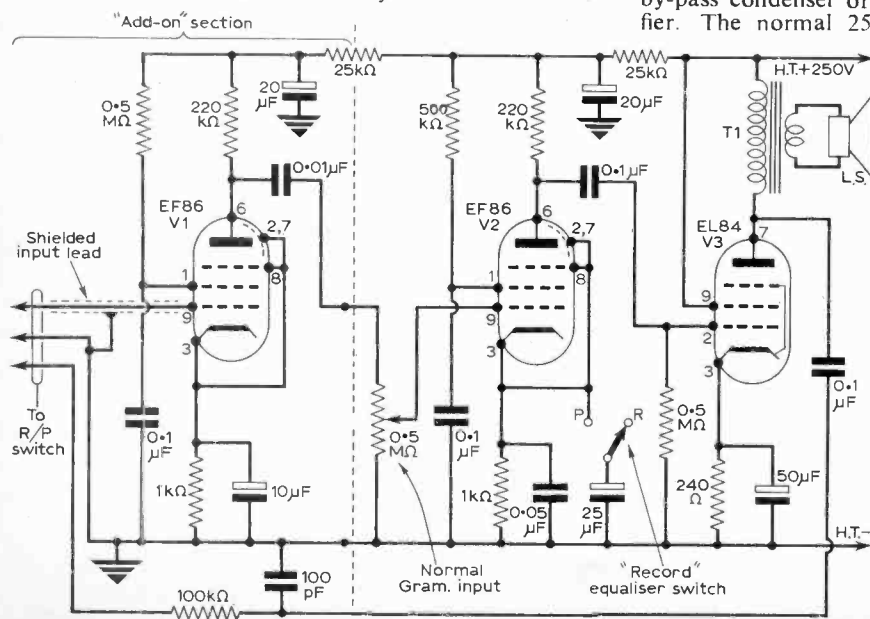


Fig. 11: Circuit of an add-on unit which may be used in conjunction with a record player amplifier.

AN ADD-ON UNIT

The B.S.R. TD2 tape deck unit can be purchased fairly cheaply and if this deck is installed in, or adjacent to, an existing radiogram or player unit, the total cost of providing recording and playback facilities need not exceed £10. The deck itself needs the normal mains connections to power the drive motor; the only other connections are those to the record/play head and to the erase head.

The signal which is to be recorded on to the tape must be derived from the main radiogram amplifier. Referring to Fig. 11 it will be seen that the signal is taken from the anode of V3 (the output valve). In this case the valve is an EL84, but this is unimportant, nor does it make any difference if the final circuit is in push-pull. All that is required is to obtain a signal from the anode side of the output transformer T1. This is fed via the capacitor/resistor chain to the record/play head, through a two-way switch, the other lead of the record/play head is permanently connected to earth.

For to replay the output of the record/play head is too low to feed directly into a gramophone amplifier and pre-amplification is provided by the add-on valve V1. This is an EF86 high gain amplifier circuit and the a.f. output is fed via a 0.01mfd to the volume control circuit of the gram amplifier. If desired, a small transistorised preamplifier could be used here.

ERASE AND BIAS

So far, little has been said about the provision of a.c. bias and erase voltages which are necessary when an erase head is used in place of the simple permanent magnet. Basically, a small output valve such as an EL84 is used in an oscillator circuit to

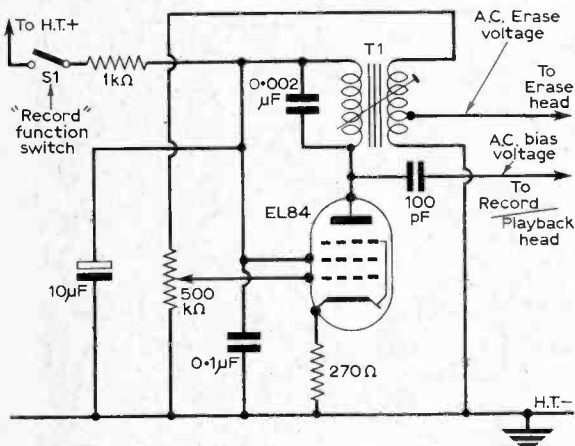


Fig. 12: Circuit of an oscillator for providing a.c. bias and erase currents.

provide a frequency of about 50-70kc/s. Details of the circuit are shown in Fig. 12.

The oscillator coil, T1, shown can be purchased for about seven shillings. The coil usually has a ferrite dust core which gives some control over the actual oscillator frequency. It will be noted that this circuit also provides a.c. bias for the record/play head. Only a small amount of bias is necessary and this is fed directly from the anode through a 100pF capacitor. This capacitor is connected permanently to the record/play head, but as the oscillator is only

brought into operation on record, it performs no function when the machine is in the play position.

The oscillator coil has a secondary winding and it is this which is connected directly and permanently to the erase head. Most erase heads function at low impedance in order to avoid the build up of awkward r.f. potentials in the recorder circuit. A simple test to ascertain if the oscillator/erase system is functioning correctly consists in connecting a 6V flashlight bulb

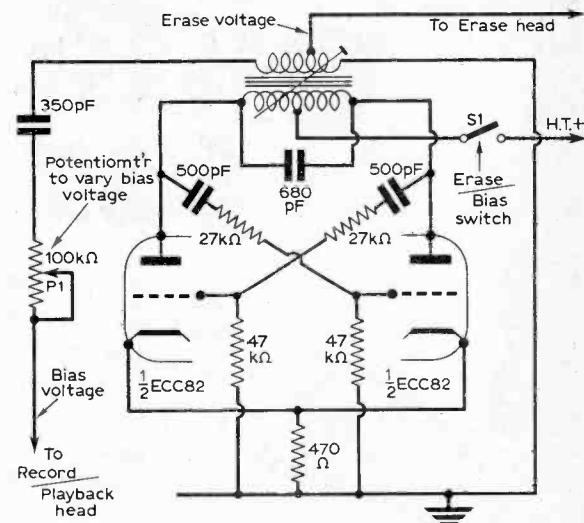


Fig. 13: Arrangement using a double-triode for a push-pull oscillator.

across the erase head, in the record position enough power should be generated to light this bulb.

If an EL84 valve is not readily available, a double triode a.f. amplifier valve such as an ECC82 may be employed instead. The circuit for this type of oscillator is shown in Fig. 13 and the output is provided by the push-pull operation of the two halves of the triode. This gives a purer waveform for the bias and erase. In this circuit, variable control of

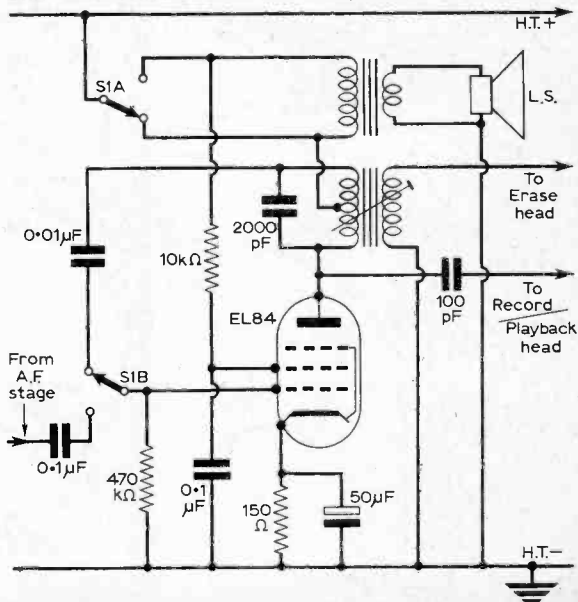
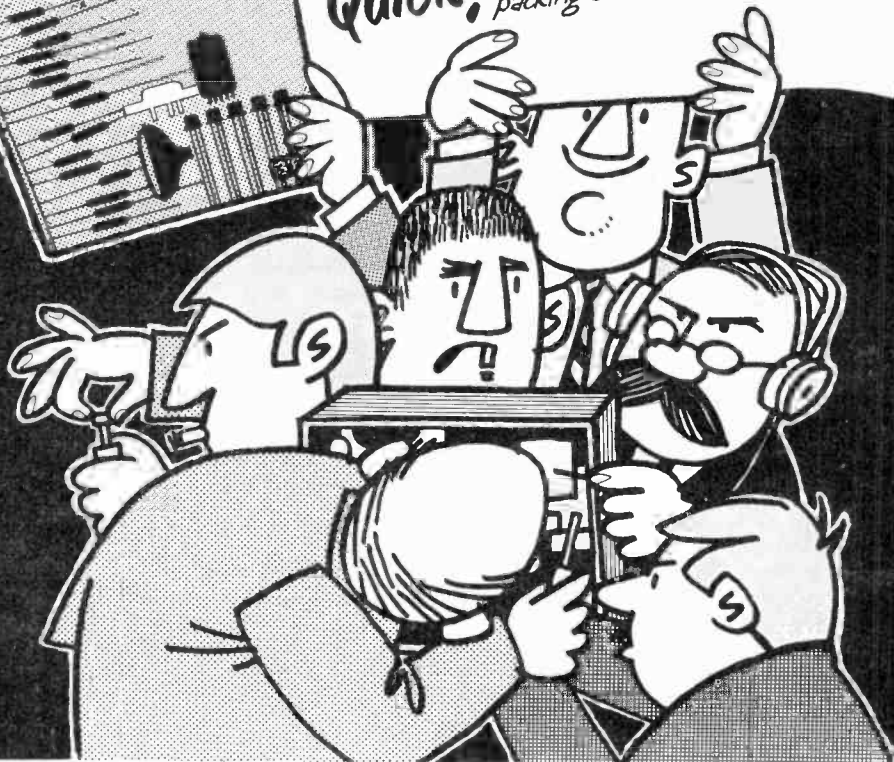
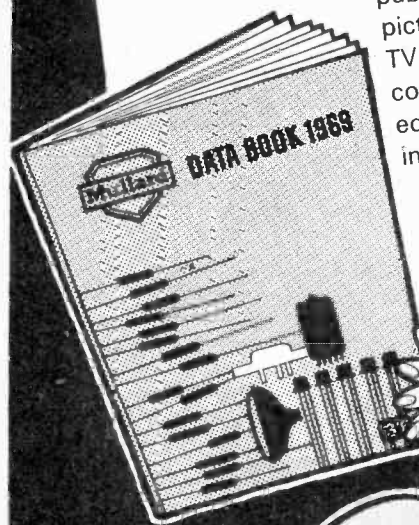


Fig. 14: The output pentode may be used in the circuit shown for providing erase and bias current while recording.

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the bias voltage is also provided by the 100k Ω potentiometer.

It is also possible to make an output valve do double duty, so that it performs its normal output function on replay, but is switched to perform as the oscillator during record. This system is often used on domestic recorders and for constructors who wish to experiment with this method the requisite circuit is given in Fig. 14. Here the EL84 output valve has its transformer replaced by the oscillator coil by the operation of S1 when the recorder is switched to the "record" position. It should be noted that if this circuit is employed, the tape "take-off" point cannot be made at the anode of the output valve, since this valve will not be in circuit during the recording process.

RECORDING LEVEL INDICATION

If the signal level applied to the record head is insufficient the recording made will be weak and the background level of noise high. Conversely, if the signal level is too high, severe distortion will be apparent on playback. It is therefore necessary to

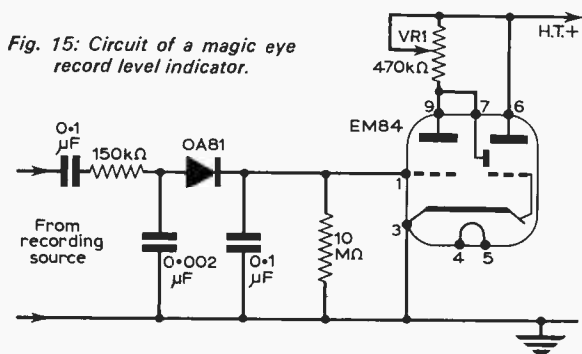


Fig. 15: Circuit of a magic eye record level indicator.

provide some method of indicating the strength of the applied signal. This is frequently done by means of a "magic eye" valve and for constructors who wish to employ this method, the circuit is given in Fig. 15. The reference signal is taken via a 0.1mfd condenser from the same point as the record signal and several experimental recordings should be made while VR1 is adjusted so that it just closes on the maximum permissible signal obtainable without distortion. Future recordings should then be made with the magic eye just failing to close on peaks.

A simple alternative method of assessing recording level, which may well be employed with the "add-on" deck, utilises the loudspeaker output signal. A 1mA meter is connected directly across the loudspeaker connections in series with a miniature diode detector rectifier and a 25 Ω potentiometer. This is set so that the meter reads just below full scale deflection (f.s.d.) on the loudest permissible signal (see Fig. 16).

Heater and h.t. supplies are required for the add-on unit. This can often be done by tapping-off from the unit's own supply, provided that the gram or

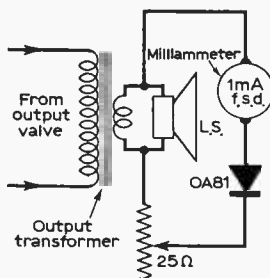


Fig. 16: A simple record level meter.

player is of the a.c. only type and with 6.3V heater valves. It must NOT be attempted with a.c./d.c. radiograms or players. In this case a small separate power pack should be constructed. Alternatively, a transistor amplifier module could be employed to amplify the head signals on replay, and a similar module should be used to provide oscillator erase and bias. The only mains connection will then be to the deck itself, for the purpose of driving the deck motors.

HOME WORKSHOP PRACTICE

—continued from page 934

sharp external corners. The jaws are smoothed off with a medium emery paper.

The jaws are used mainly to raise the edges of a chassis and where it is possible to grip only one end of the jaws in the vice because of the width of chassis being held, it is a good plan to pinch the other ends of the jaws together with one of the "G" clamps from the tool kit. The secret of successful sheet metal working is to hold the work *firmly*.

As and when finance becomes available to add to the tool kit, the following are strongly recommended:

One of the modern **wire-strippers**, which are adjustable for depth of cut. A set of **taps and dies** for thread cutting. It really is amazing how frequently this item is used once it is a part of the tool kit. In fact, the author never buys medium to large bolts nowadays, but simply runs a thread on to a round nail of suitable diameter, at one-quarter the price of a bolt. Most of the power tools in the author's workshop are bolted down with threaded six-inch nails and wing-nuts.

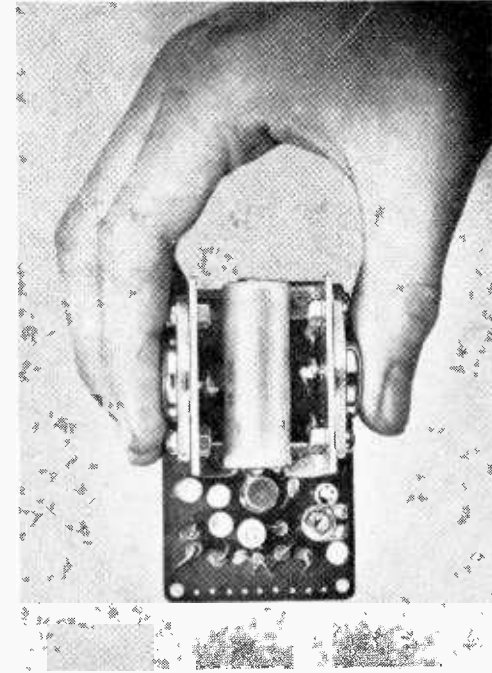
As soon as possible, add a "**Pop-Rivet**" kit to the workshop tools. These are extremely easy to use and the fastenings are permanent, although the rivet is easily drilled out if necessary. Pop rivets are half the price of nuts and bolts.

A good **electric drill** has numerous uses in the workshop. The modern two-speed type allows bits to be run at the correct speed, and the inexpensive kits which are often sold with the drill usually include a small grinding wheel which will be found essential for keeping edge tools in good condition. When the need is felt for an entirely separate power grindstone, a washing machine motor can be obtained, and a thread run on to the spindle in order to bolt the grinding wheel up tight, using large washers each side of the wheel for support. An effective cage of robust construction *must* be built round the grinding wheel in case of fracture at high speed.

A stand can be obtained for the pistol drill which converts it into a drill press, or pedestal drill. This allows accurate vertical drilling, and frees one hand to hold the work. However, the slight inconvenience of continually changing attachments prompted the writer to obtain another motor and fit a chuck to it. This motor is lashed to the drill stand and remains permanently in position as a drill press.

A machine vice for use in conjunction with the drill press is a useful little accessory, although the extension jaws previously mentioned, pinched together with the "G" clamps, is a makeshift substitute.

Sinclair



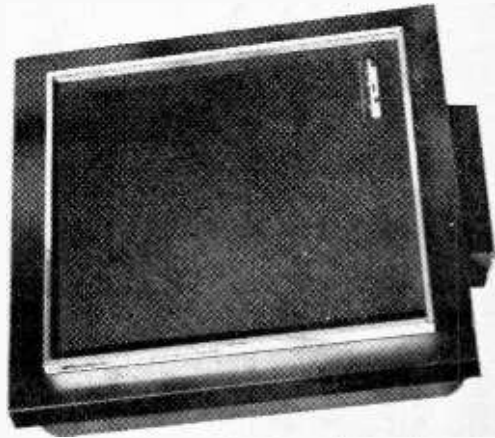
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The Z.12 is a most versatile integrated amplifier and pre-amp in which power, compactness and true high-fidelity standards are combined within a unit of very modest price. The most widely used unit of its kind in the world, the Z.12 has an output of 12 watts R.M.S. continuous sine wave (24 watts peak) or 15 watts music power (30 watts peak). It has Class B ultralinear output which can be fed into any loudspeaker from 3 to 15 ohms. (Two 3 ohm speakers can be used in parallel). Frequency response—15 to 50,000 Hz $\pm$ 1dB; input sensitivity—2mV into 2 K/ohms. The Z.12 will operate from any power source between 6 and 20 volts d.c. As such, a car battery or the PZ.4

are eminently suitable, giving much wider than usual scope in the applications to which the Z.12 may be put. As well as hi-fi, these include systems for P.A., electronic guitars, organs, intercom systems, laboratory, education or industry. You will find the Z.12 in use in such instances again and again. The Sinclair Z.12 is supplied ready built, tested and guaranteed, complete with manual of circuits and instructions for matching it to your precise requirements. Two may be used in stereo when, with the Stereo 25 and PZ.4 together with two Q.14s, you will have an ideal high fidelity assembly. In addition, you will enjoy an appreciable saving in outlay.

89/6

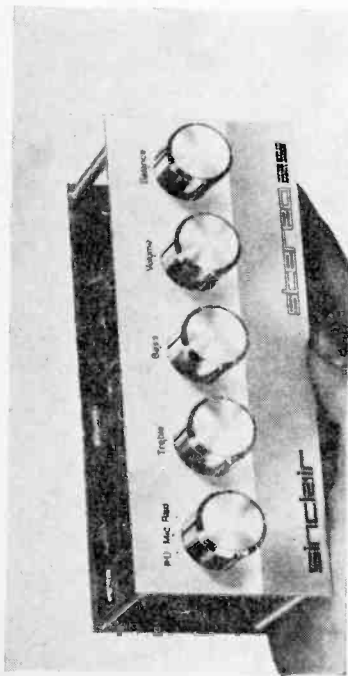
Q.14 - the unique loudspeaker



New materials and original design techniques have been used to produce a speaker of fantastic quality at a most attractive price. Experts and reviewers have enthusiastically endorsed its performance. The shape and size of the Q.14 make it far more adaptable to its environment than is the case with conventionally styled speakers, so that it is much easier to position this speaker in the room in which it is to be heard. The Sinclair Q.14 has a substantially flat

frequency response from 60 to 16,000 Hz and outstandingly good transient response. It will comfortably handle up to 14 watts loading and is positively brilliant in stereo. Measuring 9 3/4 in square by 4 3/4 in deep, this loudspeaker is finished in matt black with solid aluminium bar trim. Try the Q.14 in your own home without delay. If you are not delighted with it, your money including cost of return postage to Sinclair will be refunded immediately.

£7.19.6



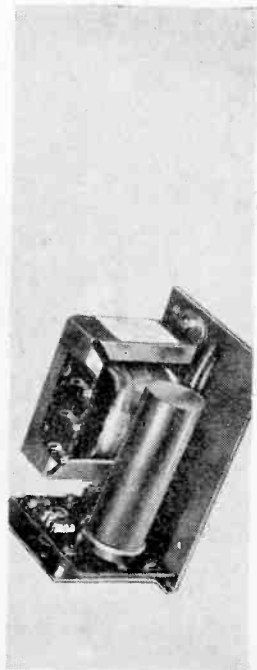
Stereo 25 - de-Luxe pre-amp/ control unit

This is a very elegantly styled unit, which, although designed basically for use with the Z.12, is readily adaptable for use with any high quality power amplifier system. The switched input selector allows for Pick-up, Radio and Auxiliary and there are controls for bass cut and lift, treble cut and lift, volume and stereo balance. P.U. input is equalised to R.I.A.A. curve from 50 to 20,000 Hz ± 1 dB and the

instructions manual provided gives matching details for pick-ups, shows how to connect up etc. The front panel of the Stereo 25 is finished in brushed and polished aluminium embellished in black. The control knobs are in solid aluminium to match. Size 6 $\frac{1}{2}$ in. x 2 $\frac{1}{2}$ in x 2 $\frac{1}{2}$ in plus knobs. Supplied built, tested and guaranteed.

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PZ.4-stabilised power supply unit



Designed specially to meet the power requirements for an assembly of two Z.12s and the Stereo 25, this heavy duty transistorised power supply unit has stabilised output of 18 volts d.c. at up to 1.5A. It is for AC mains operation 200/250V. Supplied built, tested and guaranteed.

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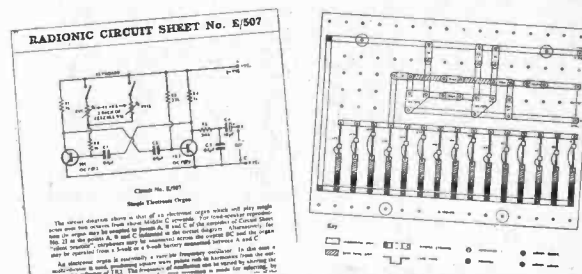
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Transformer	13/6
Tube	8/-

*Post and Packing 3/-

TRANSISTORS

OC200, OC203, OC204, all at 2/- each.
ASY22, 2N753, BSY28, BSY65, 2G344A, 2G345A, 2G345B, 2G371A, 2G378A, all at 1/6 each.

Transistors similar to OC44, OC71 and OC72, all 1/- each.

Unmarked, untested transistors, 7/6 for 50.

LIGHT SENSITIVE TRANSISTORS (similar OCP 71), 2/- each.

30 watt transistors (ASZ17), 10/- each.

ORP 12 Cadmium sulphide light-sensitive resistors, 9/-.

RECTIFIERS

BY100, 800 p.i.v., 2/6 each, 24/- per doz., £7/10/- per 100, £50 per 1,000. BYZ13, 6-amp, 400 p.i.v., available on same terms.

MULLARD POLYESTER CAPACITORS FAR BELOW COST PRICE!

0.001µF 400 volts	3d	0.15µF 160 volts	6d
0.0015µF 400 volts	3d	0.22µF 160 volts	6d
0.0018µF 400 volts	3d	0.27µF 160 volts	6d
0.0022µF 400 volts	3d	1µF 125 volts	1/-
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VERY SPECIAL VALUE! Small Silver-mica, Ceramic, Polystyrene Condensers. Well assorted. Mixed types and values. 10/- per 100. **PAPER CONDENSERS, MIXED BAGS, 0.0001 to 0.5µF, 12/6 per 100.**

RESISTORS! Give-away offer! Mixed types and values. 1/6 to 1/2 watt 6/6 per 100, 55/- per 1,000. Individual resistors 3d each. Also 1/2 to 3 watt close tolerance. Mixed values. 7/6 100, 55/- 1,000.

WIRE-WOUND RESISTORS. 1 watt to 10 watts. Mixed bags only. 16 for 10/-.

RECORD PLAYER CARTRIDGES

ACOS

GP 67/2 Mono.	15/- complete with needles.
GP 91/3 Stereo Compatible	£1/-
GP 93/1 Stereo Ceramic	£1/5/-
GP 94/1 Stereo Ceramic	£1/5/-

Small pick-up arms complete with cartridge and needle, 10/- only.

UNREPEATABLE OFFER! GIANT SELENIUM PHOTO-CELLS PRODUCE UP TO 6ma. FROM DAYLIGHT!

67mm. Diameter (29.2sq.cm.) 10/- each.
50mm. x 37mm. (16.5sq.cm.) 2 for 10/- each.

TRANSISTORISED SIGNAL INJECTOR KIT R.F./I.F./A.F. 10/- only

TRANSISTORISED SIGNAL TRACER KIT 10/- only

TRANSISTORISED REV. COUNTER KIT 10/-

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24in x 1in 0.15in matrix	1/6	17in x 2 1/2in 0.15in matrix	11/-
34in x 2 1/2in 0.15in matrix	3/3	17in x 3 1/2in 0.15in matrix	14/8
34in x 3 1/2in 0.15in matrix	3/11	3 1/2in x 2in 0.1in matrix	4/2
5in x 2 1/2in 0.15in matrix	3/11	3 1/2in x 3 1/2in 0.1in matrix	4/9
5in x 3 1/2in 0.15in matrix	5/6	5in x 2 1/2in 0.1in matrix	4/7
		5in x 3 1/2in 0.1in matrix	5/6

Spot Face Cutter 7/6. Pin Insert Tool 9/6. Terminal Pins 3/6—36.

MULTIMETERS. 20,000 ohms per volt.

Ranges: a.c. 1,000V, 500V, 100V, 50V, 10V.
d.c. 250mA, 2.5mA, 50µA.
d.c. 2,500V, 500V, 250V, 50V, 25V, 5V.
Resistance: 0/60kΩ and 0/6MΩ.
Special price £4 only.

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0.25µF 3 volt	4µF 4 volt	10µF 25 volt	64µF 9 volt
1µF 6 volt	4µF 12 volt	20µF 6 volt	100µF 9 volt
1µF 20 volt	4µF 25 volt	25µF 6 volt	320µF 4 volt
1.25µF 16 volt	5µF 6 volt	25µF 12 volt	320µF 10 volt
2µF 3 volt	6µF 6 volt	25µF 25 volt	400µF 6.4 volt
2µF 350 volt	8µF 3 volt	30µF 6 volt	All at 1/- each.
2.5µF 16 volt	8µF 12 volt	30µF 10 volt	20 assorted
3µF 25 volt	8µF 50 volt	50µF 6 volt	(our selection)
3.2µF 64 volt	10µF 6 volt	64µF 2.5 volt	10/-.

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TRANSISTORS etc.

AC107	3/-	OC35	7/6
AC126	2/-	OC44	2/0
AF115	3/-	OC45	2/0
AF116	3/-	OC70	2/3
AF117	2/9	OC71	2/-
BFY18	4/6	OC72	2/2
GET113	2/6	OC73	2/3
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OA81	1/6	OC81D	2/-
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OA91	1/9	OC140	5/-
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OC25	5/-	OC170	2/2
OC26	5/-	OC171	2/2
OC28	6/8	OC202	4/6
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Crystal Diodes—6 for 2/6 (7d.).

Also 8P1 350V 1/2, 25μF 25V 1/3 and 50μF 50V 1/9. Other electrolytics in current list. Postage, Packing and Insurance all above 7d. up to 3; 1/- from 4-11; 12 and over paid.

2 GANG VAR. CONDENSER: Mod., air-spaced, .0005 ea. sec. 5/- (1/-).

TRANSFORMERS: Sub-min Output (3Ω for OC72 etc.) and Driver 2/6 each (6d.).

MULTIMETER: 20,000 Ω/V D.C., 10,000 Ω/V A.C. 0-5/25/50/250/500/1K volts D.C. ● 0-10/50/100/500/1K volts A.C. ● 0-50μA/2-5mA/250mA D.C. ● 0-6K Ω/6 meg. ● 10μF—100mF/10mF. ● —20 to +20dB. ● In leather carry case. Complete with test leads and instructions. ● Over-load protected 1969 model with every refinement. 24.7.6 (2/6). JUNIOR MODEL at 35/- (1/6) 1000 Ω/V described in free list.

SOLDERING IRON. Slim Mod. British High speed, 8in., all parts replaceable, fully guaranteed for professional, radio and general D.I.Y. use. 19/6 post free. GUN TYPE, Built in transformer for instant power, 45/- (4/6).

DIAMOND STYL: Replacements for TC81P, TC8/Stereo, TC81P/Stereo, Studio 'O', BF40LP Ronette, GC2, GC8, GP65/7, all at 7/6 each. Also GP91-LP/8 at 13/6. SAPPHIRE STYL. All these types, also GP37 at 3/3. GP91 at 6/9 (6d. each all types). No 78 rpm available in diamond or sapphire.

PICK-UP CARTRIDGES. All fitted Styl and Standard fittings. Mono GP67/2, 13/6. ● Mono de Luxe GP91/2, 17/-. ● Stereo Compatible—Mono which also plays Stereo records monaurally with min. wear. GP91/SC, 19/6. ● Latest Stereo GP93, 23/-. ● Ceramic Stereo, top quality for expensive outfits, GP94, 38/6 (all 1/-). New MOVING MAGNET STEREO TYPE, 4 coil, 4 pole, diamond stylus at 24.12.6 (post etc. paid). Full details in list of this, the lowest price high quality cartridge available.

PP3 ELIMINATOR (A.C.) 17/6. (1/6) TWO STATION TRANS. INTER-COM. Excellent baby alarm. Instant, easy fitting. All you require 52/6 (3/-).

FOUR TRANSISTOR 3 WATT AMPLIFIER 2 1/2 x 1 1/2. 9V: 8Ω and 16Ω. excellent on 30Ω speakers. 45/6 (1/6).

TELEPHONE AMPLIFIER, transistorised, batt. op. Fitted in seconds—leaves both hands free when phoning 52/6 (1/6).

Extra High Torque MINI-MOTOR, 4 1/2 to 12V, 1 1/2 x 1 1/2 in. 5/- (9d.). 9,000 r.p.m. Mech. REV. COUNTER to 999, long spindle, reset wheel, for T/records etc. 4/6 (1/-).

BATTERY CHARGERS: Small, sturdy, neat; 2 amp. 12V 35/-; 6V/12V 39/- (4/6 either type). Larger British 6V and 12V with meter, fuse, etc. 42/6 (6/-). All absolutely complete (4/6 either type).

RECORDING TAPE: Finest quality British Mylar. STANDARD: 5in. 600ft. 7/3, 5 1/2in. 800ft. 9/9, 7in. 1200ft. 11/3. LONG PLAY 5in. 900ft. 10/-, 5 1/2in. 1200ft. 11/3, 7in. 1800ft. 18/- (1/3 reel). Other types in our list.

MICROPHONES—CRYSTAL MIC91, Desk, 16/3; MIC45, curved hand grip 17/3; Stick "60" 20/3; Stick "39" 28/6 (1/6 each type). Cream plastic hand type 7/6, or with "strut" stand, switch and 2 leads with 2.5 and 3.5 plugs 11/-. Lapel (or hand) with clip 6/6 (1/-). Machined metal tapered stick type with neck cord and adaptor to fit standard floor stands, 25/- (1/6). DYNABEAT. Cream hand/table 14/- (1/-). MS10 50K Ω, 3 1/2 x 1 1/2 in. with Base, Adaptor and Neck Cord 37/6 (2/6). MS11, similar, but fixed on flexible Swan neck to switched base 42/6 (2/6). PIEZO 50K Ω black/chrome 2 1/2 in. dia. x 1 1/2 for stand use only. Standard inside thread 33/6 (1/6).

CARDIOMID DYNAMIC OMNI-DIRECTIONAL: Professional types now available to all at really sensible prices. Extremely handsome with every possible new feature making for perfection in sound amplification. For use in or out of doors—full details in our list. Both wire-mesh screen types. For stand mounting: "Square" type, 208, £5.10.0 delivered free. "Ball Type" with built-in vol. control, on/off switch and optional hi/lo impedance (50k Ω or 600 Ω), £5.17.6 delivered free. An exactly similar mike bearing a world famous name is sold at over twice this price. All mikes are supplied with leads.

SPEAKERS: 12in round, fitted Tweeter, 6W, 3 or 15Ω (state which), 35/6 (5/6); 2 1/2in-80Ω British, 5/- (1/-); 2 1/2in. 3Ω 6/6 (1/-); 6 x 4 heavy duty 3Ω 13/6 (2/6) or for Stereo 30/- pair, post etc. paid; 8 x 3in., 8Ω, 8/6 (1/-). HEADPHONES High Res. 2000 Ω, Min. Plug Earpiece 18/6 (1/6); Stereo Dynabead 16/6 65/- (3/-); EARPIECES with lead etc., Min. Plug Magnetic 1/6; Crystals 2/9 (either 6d.).

MICROPHONE INSERTS: Diameter 1.75in. or 0.9in. either size 5/6 (6d.).

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FOR ALL PORTABLES and F.M. SETS. Telescopic 5 section 5 1/2-22in. with swivel, 5/-; 7-section 5 1/2-32in., no swivel, screw hole in base, 6/6; 10-section 6 1/2-47 1/2 in., no swivel, screw hole in base, 12/6 (1/- all sizes).

SWITCHES: Standard toggle, metal, 250V 2A. One hole fixing: DPST 2/3, DPDT 2/9. DPST 3/-, DPDT 3/3. Slide types. Sub-min. DPDT 1/6 each. Small DPDT 3 way, centre "off" 1/9. Reed magnetic on/off 1/9 (7d. each, all types). Rotary Switches etc. in list. VIBRATORS: Famous makes only. 12 volt 4 pin non-synch 2/6. 12 volt 7 pin synch 10/- 6 volt 7 pin synch 10/- (1/- each, all types).

MAINS NEON TESTER: Fly leads 2/- (7d.). Pocket screwdriver type 3/6 (6d.). PLUGS: Std. Jack, plastic body 2/- Screened 2/8. Sockets 1/6 (all 7d.). VALVE HOLDERS: B7G or B9A, Moulded 6d. (rd. up to 4, 1/- over 4). CONNECTING WIRE: 5 coils asstd. coils, each 5 yds. Solid Core 2/3. Flexible 2/8. Super thin for transistor wiring etc. 3/- (6d. types, per 5 coils). PICK-UP WIRE: Twin Super thin for transistor wiring etc. 1/3 yd. (6d. up to 6 yds., over 6 yds. post free). TWIN MIKE CABLE: 1/3 yd. (up to 6 yds. 8d., over post free). SINGLE MIKE CABLE: 7d. yd. (up to 6 yds. 8d., over post free). Both flexible, screened and sheathed. ● FEEDER CABLE: Twin r.f. bal. "Hg. 8", 80Ω, or flat 300Ω transparent polythene insulated, either 6d. per yd. (as mike cable).

VOLUME CONTROLS: Limited supply of best mod. Brit. makes—most values still available, without switch 1/9, with d.p. switch 3/- (9d. either).

CURRENT LIST: Sent with all orders or free for s.a.c. details of cable, croc., clips and leads, Continental din plugs for Grundig, Telefunken equipment, etc., (dials, plugs and sockets, panel meters, record players and tape recording accessories, rectifiers, relays, wire wound resistors, test equipment, test props, tape recorder, special transistors, portable sets, car radio, more switches and other components, tools, vero board, etc., etc. If interested in surplus equipment and units please say so. This advertisement cancels all previous ones and lists supplied prior to January 8th, 1969.

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(PW17)

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SILICON DIODE RECTIFIERS		Midget Electrolytic Conds. Wire Ends	
BY100 800 piv	2/10	New 500 mA	At 6d. each
250 piv	1/9	0-8μF	-25 volt
Avalanche 1 1/2 A		2μF	150 volt
1200 piv	4/-	4μF	150 volt
		640μF	2-5 volt
Six Amp Series			
BY213 300 piv	3/6	At 9d. each	
BY212 600 piv	4/6	2μF	300 volt
BY211 900 piv	5/-	4μF	12 volt
BY210 1200 piv	5/6	8μF	12 volt
Mullard Stack FW		10μF	25 volt
Bridge		16μF	16 volt
12A 100 piv 39/6 (3/-)		30μF	10 volt
THYRISTORS		80μF	6-4 volt
5 amp series		100μF	6 volt
100 piv	7/6	125μF	4 volt
200 piv	9/-		
300 piv	10/6		
400 piv	12/-		
1 amp series		At 1/- each	
50 piv	10/-	16μF	250 volt
100 piv	12/-	50μF	10 volt
100 amp series prices		100μF	12 volt
available on request		320μF	10 volt

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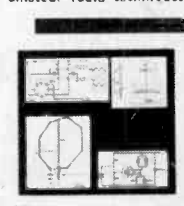
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amateur radio techniques



amateur radio techniques



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THE CLASSIC

Controls: Selector switch Tape speed equalisation switch (3½ and 7½ i.p.s.). Volume, Treble, Bass, 2 position scratch filter and 2 position rattle filter.

Specification: Sensitivity for 10 watt output at 1KHz. Tun. head: 3mV (at 3½ i.p.s.). **Mag. P.U.:** 2mV. **Cr. P.P.:** 80mV. **Audio:** 100mV. **Tape/Rec. output:** 100mV. Equalisation for each input is correct to within ±2dB (R.I.A.A.) from 20Hz to 20KHz. **Tone control range:** Bass = 13dB at 60 Hz. Treble = 14dB at 15KHz. **Total distortion:** (for 10 watt output) <1.5%. **Signal noise:** <-60dB. A.C. mains 200-250V. Size 12½in. long, 4½in. deep, 2½in. high. Teak finished case. **Price 8½ gns.** + 7/6 p. & p. Built and Tested



THE DORSET (600mW output)



7-transistor fully tunable M.W.-L.W. superhet portable—with baby alarm facility. Set of parts. The latest modularised and pre-alignment techniques makes this simple to build. Sizes: 12 x 8 x 3in.

MAINS POWER PACK KIT: 9/6 extra.

PRICE £5.5.0 plus 7/6 p. & p. Circuit 2/6 FREE WITH PARTS.

THE ELEGANT SEVEN MK. III (350mW output)

7-transistor fully tunable M.W.-L.W. portable. Set of parts. Complete with all components, including ready etched and drilled printed circuit board—back printed for foolproof construction.

MAINS POWER PACK KIT: 9/6 extra.

Price £4.9.6 plus 7/6 p. & p.

Circuit 2/6 FREE WITH PARTS.



X101 10W SOLID-STATE HI-FI AMP WITH INTEGRAL PRE-AMP

Specifications: Power Output (into 3 ohms speaker) 10 watts. Sensitivity (for rated output): 1mV into 3K ohms (0-33 microamp). Total Distortion at 1KHz. at 5 watts 0.35%, at rated output 1.5%. Frequency Response: Minus 3dB points 20Hz and 40KHz. Speaker: 3-4 ohms (3-16 ohms may be used). Supply voltage: 24V d.c. at 800mA (0-24V may be used).

Control assembly: including resistors and capacitors.

1. Volume: PRICE 5/-.

2. Treble: PRICE 5/-.

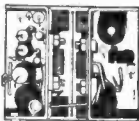
3. Comprehensive bass and treble: PRICE 10/-.

The above 3 items can be purchased for use with the X101.

Power Supplies for the X101:

P101 M (for mono) 35/- plus 4/6 p. & p.

P101 S (for stereo) 42/- plus 4/6 p. & p.



Price 49/6

plus 2/6 p. & p.

THE RELIANT MK II

10W SOLID-STATE HIGH QUALITY AMPLIFIER

SPECIFICATIONS

Output—10 watts

Input—1. external mic 10mV

2. gram/radio 250mV

Output Impedance—3 to 4 ohms

Tone Controls—Treble control range ±12dB at 10KHz

Bass control range ±13dB at 100Hz

Frequency Response—(with tone controls central) Minus 3dB points are 20Hz and 40KHz

Signal to Noise Ratio—better than -60dB. Transistors—4 silicon Planar type and 3

Germanium type. Mains input—220-250V. A.C. Size of chassis—10" x 3½" x 2"

A.C. Mains, 200-250V. For use with Std. or L.P. records, musical instruments, all makes of

pick-ups and mikes. Separate bass and treble lift control. Two inputs with control for gram.

and mike. Built and tested. 8" x 5" speaker to suit price 14/6 plus 1/6 p. & p. Crystal mike

to suit 12/6 plus 1/6 p. & p.

Reliant Mark II. 6½ gns., plus 7/6 p. & p.

In teak finished case.



THE VISCOUNT

Integrated High Fidelity Transistor Stereo Amplifier

SPECIFICATIONS: Output: 10 watts per channel into 3 to 4 ohms speakers (20 watts mono). Input: 6 position rotary selector switch (3 pos. mono and 3 pos. stereo). P.U., Tuner, Tape and Tape Rec. Sensitivities: All inputs 100mV into 1-8M ohm. Frequency response: 40Hz-20KHz ±2dB. Tone controls: (Baxandall type), separate bass and treble controls. Treble 13dB lift and cut at 15KHz. Bass 15dB lift and 25dB cut at 60Hz. Volume controls: Separate for each channel. A.C. Mains input: 200-240V. 50-60Hz. Size 12½" x 6" x 2½in. In teak-finished case. Built and tested.

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A complete Loud Speaker system on one frame, combining three matched ceramic magnet speakers with a low loss cross over network. Peak handling power 10 watts. Impedance 15 ohms. Flux density 11,000 gauss. Resonance 40-60 c/s. Frequency range 500c/s to 20Kc/s. Size 13½ x 8½ x 4½ inches. By famous manufacturer. List Price £7. Our Price 74/8 plus 5/- P. & P. Similar speaker to the above without tweeters in 3 and 15 ohm 44/8 plus 5/- P. & P.

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This tape deck takes 5½in. spools complete with two-track heads. Size 13½in. long by 8½in. wide. **£8.18.6 plus 7/6 p. & p.**

2½ watt ALL TRANSISTOR AMPLIFIER

AC mains 240V. Size 7" x 4½" x 1½". Frequency response 100 c/s—10 Kc/s. Semi conductors, two OC 75's two AC 128's and two stabilizers AA129. Tone and volume controls on flying leads. **£2.10.0 plus P. & P. 3/6.** Suitable 8" x 5" 10,000 line high flux speaker, 18/6 plus 2/- P. & P.



FIRST QUALITY P.V.C. TAPE

5½" Std. 850ft.	11/6	5" L.P. 850ft.	12/-
7" Std. 1200ft.	13/-	3" T.P. 600ft.	12/-
3" L.P. 240ft.	5/6	5" T.P. 1800ft.	27/-
5½" L.P. 1200ft.	13/-	5½" T.P. 2400ft.	34/-
7" L.P. 1800ft.	20/-	7" T.P. 3600ft.	44/-
5½" D.P. 1800ft.	20/-	4" T.P. 900ft.	16/6

P. & P. on each 1/6.

50 WATT AMPLIFIER A.C. MAINS 200-250V

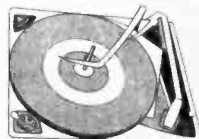


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RECORD PLAYER SNIP A.C. MAINS 240V

The "Princess" 4-speed automatic record changer and player engineered with the utmost precision for beauty, long life, and trouble free service. Will take up to ten records which may be mixed 7" to 10" or 12". Patent stylus brush cleans stylus after each playing and at shut off, the pick-up locks itself into its recess, a most useful feature with portable equipment—other features include pick-up height adjustment and stylus pressure adjustment. This truly is a fine instrument which you can purchase this month at only **£5.19.6** complete with cartridge and ready to play. Post and insurance 7/6 extra.

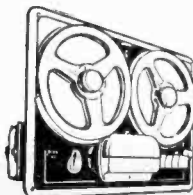


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(by famous manufacturer)

For 6 volt or 12 volt positive earth systems. Comprising: special high voltage working hermetically sealed silicon transistor mounted in finned heat-sink, high output ignition coil, ballast resistor and hardware (screws, washers etc.).

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Incorporating 3 motors.

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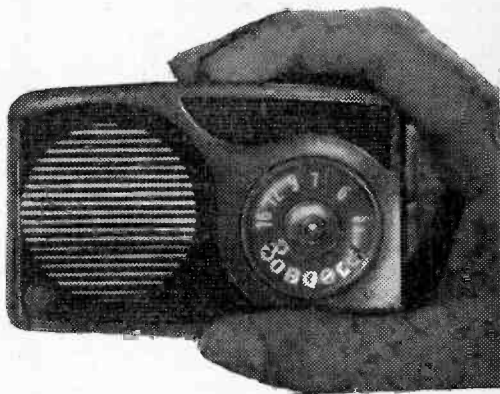
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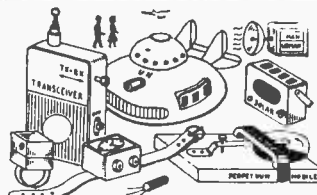
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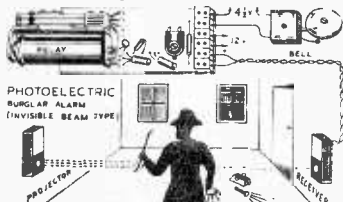
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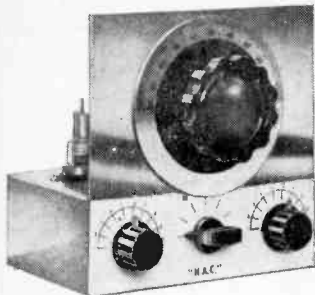
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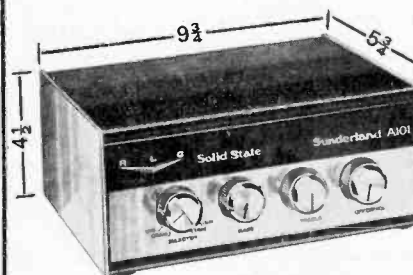


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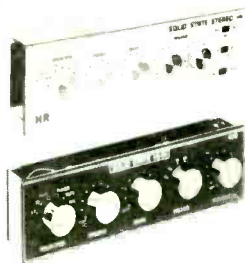
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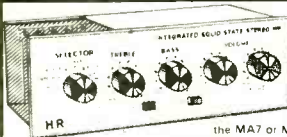
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