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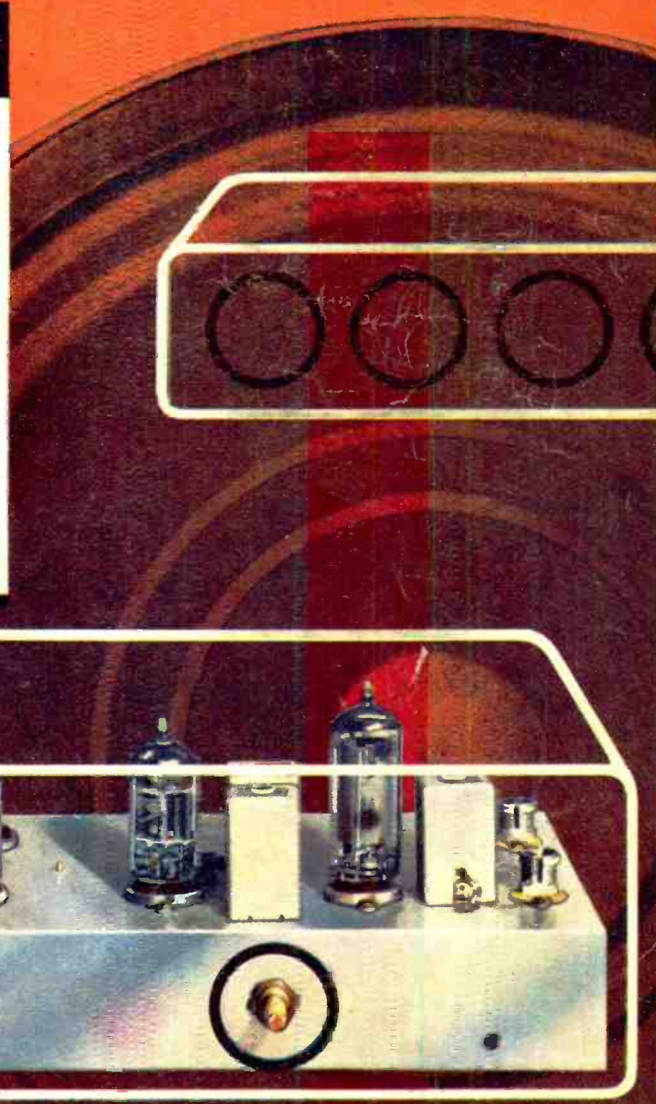

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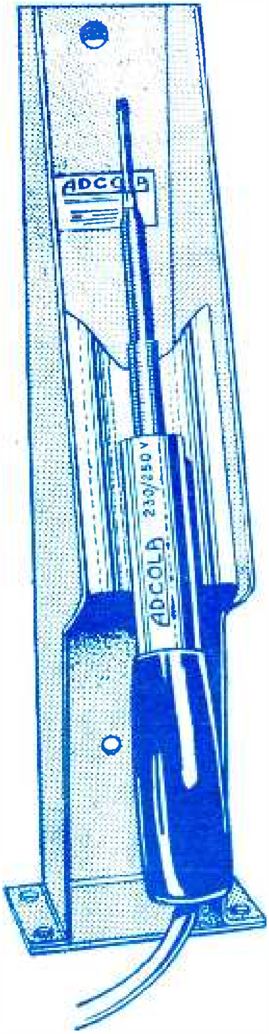

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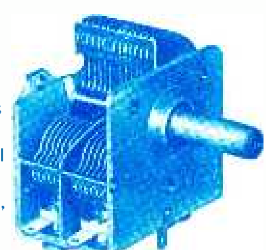

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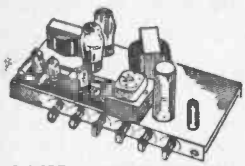

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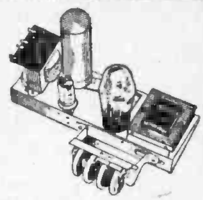

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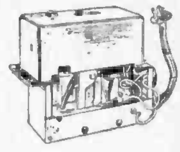

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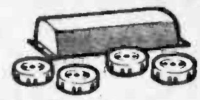

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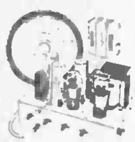

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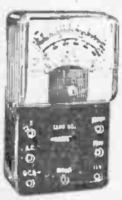

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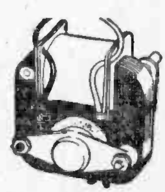

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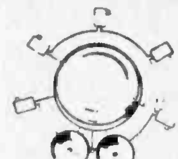

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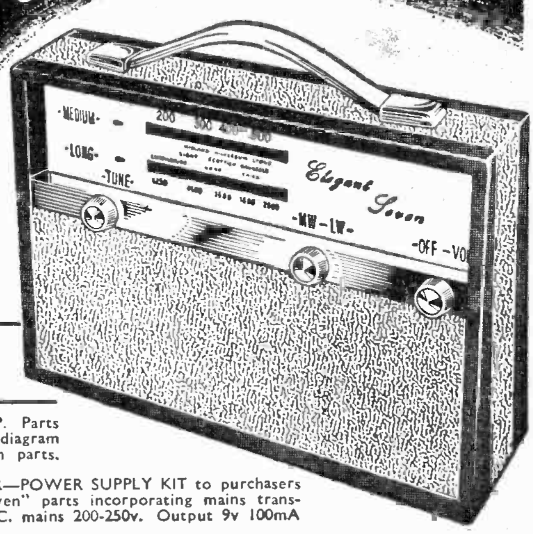

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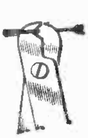

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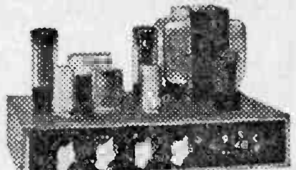

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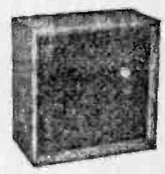

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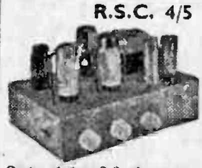

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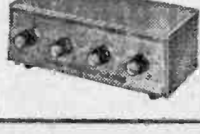
TRANSISTORISED SOUND MIXER

Enables mixing of up to 4 inputs, i.e., mic., tape, gram., tuner, etc., into single output.



Compact and completely self-contained, uses standard 9 volt battery. Four standard jack inputs.

PRICE **49/6**

R.S.C. G5 AMPLIFIER

for Guitar, 'Mike', Gram or Radio

5 watt high quality output. Incorporating high flux 12in. 10 watt 12,000 line loudspkr. Sensitivity 30 m.v. High impedance jack input. Handsome strongly made cabinet (size 14 x 14 x 7in. approx.) finished in complementary shades of Rexine/Tygan. 200-250 v. A.C. mains. Suitable for Lead or Rhythm Guitar in home or small club, etc. £9.19.6 Or DEPOSIT 22/3 and 9 monthly payments of 22/3 (Total £11.2.6) Carr. 7/6.

R.S.C. BABY ALARM or INTER-COMM KIT. Complete set of parts with diagrams, etc. Housed in two polished walnut finished cabinets of pleasing design. High sensitivity. For 200-250 v. A.C. mains. Fully isolated. Controllable at both units. An intercomm. of this class would normally cost £20-£30. Only 89/6. carr. 5/- or assembled ready for use, 6 gns.

R.S.C. (MANCHESTER) LTD.

R.S.C. G100 100 WATT AMPLIFIER

TERRIFIC POWER OUTPUT FOR ALL PURPOSES!

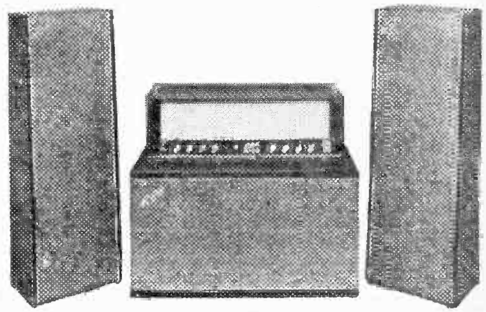
For ELECTRIC ORGAN, LEAD, RHYTHM and BASS GUITAR and any other musical instrument. FOR VOCALIST, Gram, RADIO and Tape etc.

- ★ Incorporating SIX 12 in. PLUS TWO 15 in. HEAVY DUTY LOUDSPEAKERS. Total Rating, 140 watts.
- ★ Housed in 4 substantial Wood Cabinets of pleasing design and covered in contrasting shades of Rexine and Vynair with 'gold' trimmings.
- ★ 4 Jack Inputs in TWO CHANNELS with 4 Independent Volume Controls.
- ★ Separate Bass and Treble Controls on each channel.
- ★ For standard 200-250 v. A.C. mains operation.

Fantastic Value at only $89\frac{1}{2}$ Gns. Carr. 30/-

Or Deposit £10.14.2 and 52 weekly payments of 35/- (Total 97½ Gns.)

Send S.A.E. for full descriptive leaflet, or visit one of our many branches and hear this fabulous amplifier

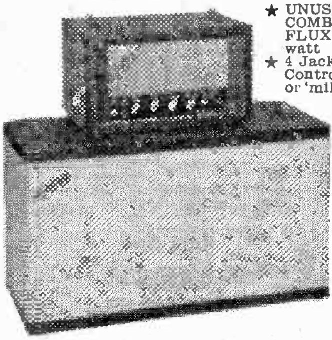


INTEREST CHARGES DEDUCTED IF SETTLED IN 6 MONTHS

R.S.C. BASS-REGENT 50 WATT AMPLIFIER

AN EXCEPTIONALLY POWERFUL HIGH QUALITY ALL-PURPOSE UNIT

For lead, rhythm, bass guitar and all other musical instruments
For vocalist, gram, radio, tape and general public address



- ★ UNUSUALLY POWERFUL LOUDSPEAKER COMBINATION consisting of a FANE HIGH FLUX 15in. 30 watt unit PLUS A FANE 12in. 20 watt unit with extended frequency response.
- ★ 4 Jack Socket Inputs and two independent Vol. Controls for simultaneous use of up to 4 pick-ups or 'mikes'.
- ★ Separate cabinets fully covered in contrasting tones of Rexine/Vynair with 'gold' trimming, for speakers and amplifiers.
- ★ Separate Bass and Treble Controls giving 'boost' and 'cut'.

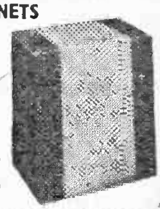
Send S.A.E. for leaflet. Or call at one of our many branches and compare the Bass Regent with units at more than three times the cost. Carr. 17/6.

47 Cash Price Gns. Or Deposit £5.11.0 and 12 monthly payments of £4. (Total 51 Gns.)

INTEREST CHARGES REFUNDED IF SETTLED IN 6 MONTHS

HEAVY DUTY LOUDSPEAKERS IN SUBSTANTIAL CABINETS

TYPE BG1



Two Tone Rexine/Vynair covered. Suitable for Bass Guitar. Speaker Unit 15in. High Flux, 15 ohms, 30 watts. Cabinet size approx. 24 x 21 x 13in. Only $19\frac{1}{2}$ **Gns.**

Or Deposit 51/9 and 9 monthly payments of 44/5. (Total 21¼ Gns.)

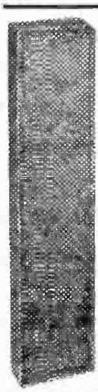
R.S.C. BASS/20 AMPLIFIER

suitable for BASS GUITAR

A highly efficient unit incorporating massive 15in. high flux loudspeaker specially constructed to withstand heaviest load conditions. Rating 25 watts. Individual bass and treble controls give ample "Boost" and "Cut". Two jack socket inputs separately controlled. Cabinet is of substantial construction and attractively finished in two contrasting tones of Rexine and Vynair. Size approx. 24 x 21 x 13in. Carr. 17/6

Send S.A.E. for leaflet $29\frac{1}{2}$ **Gns.** Or deposit £3.4.6 & 12 monthly payments of 51/6. (Total 32¼ Gns.)

R.S.C. COLUMN SPEAKERS



Covered in two-tone Rexine/Vynair. Ideal for vocalists and Public Address. Normally supplied for 15 ohm matching but can be supplied for 100v. line for 35/- extra.

Type C58, 15-20 watts. Fitted five 8in. high flux speakers. Overall size approx. 42 x 10 x 5in. **12 Gns** Carr. 10/-

Or deposit of 29/- and 9 monthly payments 29/- **(Total £14.10.0)**

Type C412. 40 watts. Fitted four 12in. 12,000 line 10 watt speakers. Overall size 52 x 13 x 7in. approx. $19\frac{1}{2}$ **Gns** Carr. 15/-.

Or Deposit of 51/9 and 9 monthly payments of 44/5 **(Total 21¼ Gns.)**

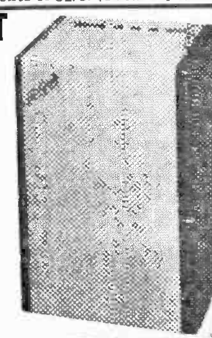
R.S.C. BASS-MAJOR 30 WATT AMPLIFIER

A MULTI-PURPOSE HIGH FIDELITY HIGH OUTPUT UNIT FOR VOCAL AND INSTRUMENTAL GROUPS

Eminently suitable for lead, rhythm, bass guitar and all other musical instruments

- ★ Incorporating two 12in. 25 watt Heavy Duty, High Flux Fane Loudspeakers, one with dual cone for high frequencies.
- ★ Robust wood cabinet with exceptionally attractive covering of Rexine/Vynair with gold trimmings.
- ★ Four Jack Socket Inputs and two independent Volume Controls for simultaneous connection of up to four Pick-ups or "Mikes".
- ★ Separate Bass and Treble Controls.

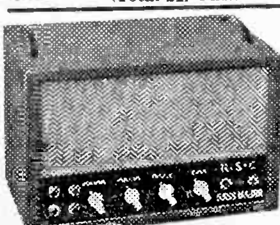
SUPERIOR TO UNITS AT TWICE THE COST.



$39\frac{1}{2}$ **Gns.** Carr. 17/6. **Send S.A.E. for leaflet or call for demonstration at any branch.**

Terms: Deposit £4.3.0 and 12 monthly payments of £3.8.4 (Total 43 Gns.).

30W. HIGH QUALITY AMPLIFIER



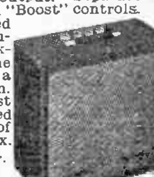
A Four Input, two volume control Hi-Fi unit with separate Bass and Treble "Cut" and "Boost" controls. Designed for vocal or instrumental groups. For Bass, Lead or Rhythm Guitar. Six Mullard or Brimar latest type valves. Housed in strong Rexine covered cabinet with twin chrome carrying handles. Attractive black and gold perspex fascia plate. For 200-250 v. A.C. mains. Output for 3 or 15 ohm speakers. Send S.A.E. for leaflet.

$16\frac{1}{2}$ **GNS.** Carr. 10/- or Deposit 2 Gns. and 9 monthly payments of 38/6 **(Total 18¼ Gns.)**

R.S.C. G15 15 WATT AMPLIFIER

for Lead or Rhythm Guitar, 'Mike', Gram, or Radio

High-fidelity push-pull output. Separate bass and treble "Cut" and "Boost" controls. Twin separately controlled inputs so that two instruments or "mike" and pick-ups can be used at the same time. Loudspeaker is a heavy duty high flux 12in. 20 watt model with cast chassis. Cabinet is covered in contrasting shades of Rexine/Vynair. Size approx. 18 x 18 x 8in.



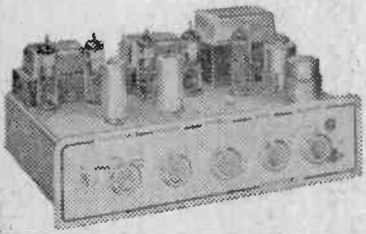
Only **19Gns.** Carr. 10/-

Send S.A.E. for leaflet. Or DEPOSIT 2 Gns. and 12 monthly payments of 33/3 **(Total 21 Gns.)**

R.S.C. STEREO 20/HIGH FIDELITY AMPLIFIER

PROVIDING 10/14 WATTS ULTRA LINEAR PUSH-PULL OUTPUT ON EACH CHANNEL

SUITABLE for "MIKE", GRAM., RADIO OR TAPE. INTENDED FOR THE HOME OR STUDIO BUT SUITABLE FOR LARGE HALLS OR CLUBS



Features include:

★ Four-position tone and compensation Input Selector switch.
★ Stereo/Mono switch so that peak monaural output of 28 watts can be obtained.
★ Separate Bass "Lift" and "Cut" and treble "Lift" and "Cut" controls.
★ Neon panel indicator.
★ Handsome Perspex Frontplate.

13 Gns.

Send S.A.E. for illustrated leaflet. Carr. 10/- Complete set of parts with point to point wiring diagrams and instructions, or Factory assembled, tested and supplied with our usual 12 months' guarantee for 18 gns, or DEPOSIT 2 gns. and nine monthly payments of 41/6 (Total £20,15.6.)

Based on a current Mullard design and employing valves ECC83, ECC83, ECL86, ECL86 ECL86, ECL86, EZ81. Output transformers are high quality sectionally wound to required specification. Output matchings for 3 and 15 ohm speakers on each channel.

FREQUENCY RESPONSE ± 2dB. 30-20,000 c.p.s.

HUM LEVEL 65dB down.

SENSITIVITY: 15 millivolts maximum.

HARMONIC DISTORTION (each channel) 0.2%.

For operation on 200/250v. A.C. Mains.

AUDIOTRINE HI-FI TAPE RECORDER KIT 25½ GNS. Carr. 17/6

REALISM AT INCREDIBLY LOW COST, CAN BE ASSEMBLED IN AN HOUR

Incorporating the latest Collaro Studio Tape Transcriptor. The Audiotrine High Quality Tape Amplifier with negative feedback equalisation for each of 3 speeds. High Flux P.M. Speaker, empty Tape Spool, a Reel of Best Quality Tape and a Handsome Portable Carrying Cabinet tastefully covered in two contrasting shades of Rexine and Vynair, size 14¼ x 15 x 8½in. high and circuit. Total cost if purchased individually approximately £40. Performance equal to units in the £60-£80 class. S.A.E. for leaflets. **TERMS. Deposit** £3 and 12 monthly payments of 44/-. (Total 28 Gns.).

ONLY 3 PAIRS OF SOLDERED JOINTS PLUS MAINS

INTEREST CHARGES REFUNDED on H.P. and CREDIT SALE Accounts settled in 6 months.

HI-FI CRYSTAL PICK-UP HEADS. (Cartridges.) Acos Standard replacement for Garrard, B.S.R. and Collaro. 16/9. Acos Stereo-Monaural, 29/9. Ronette Stereo-Monaural 39/9. B.S.R. Stereo 39/9. **PICK-UP ARMS.** Complete and with latest Acos/hi-fi Turnover Cartridge 29/11. **CRYSTAL MICROPHONES.** Hand type NP110 12/9, R.T.C. 19/9, Acos Mic 40 25/9, Acos Mic 45 29/9, Stick type Acos 39-1 39/9, BM3 with neckband and heavy table stand 49/6. Lapel type 29/9.

COLLARO JUNIOR. 4-speed Single Player Unit and Crystal Pick-up with hi-fi Turnover head. Only 59/6.

B.S.R. UA14 4-sp'd AUTO-CHANGERS with hi-fi turnover head. £5.19.6. Carr. 4/6.

GARRARD AUTO-SLIM 4-SPEED AUTO-CHANGER with high fidelity pick-up. Latest model. For 200-250 v. A.C. mains, £6.19.6. Carr. 4/6.

GARRARD AT6 AUTO-SLIM DE-LUXE 4-SPEED AUTOCHANGERS. Turnover GC8 head, for 200-250 v. A.C. mains, £11.9.0.

R.S.C. POWER PACK, 39/9. Louvred metal case only 8 x 5¼ x 2¼in. Stove enamelled. For 200-250 v. A.C. mains. Output at 4-pin plug and socket 250 v. 60 mA. Fully smoothed and 6.3 v. 2 a. Suitable for Pre-amp. or Radio Tuner.

SCOOP PURCHASE OF HIGH QUALITY RECORD CHANGERS

Brand new Garrard 3000 LM. Very latest model. Normal Retail price approx. £12.15.0. Heavy Turntable and lightweight pick-up arm. High fidelity Stereo/Mono cartridge. Fully guaranteed. **10 Gns.** Carr. 5/6.

S4/4 STEREO AMPLIFIER

A complete set of parts to construct a good quality Stereo amplifier with an undistorted output total 8 watts. For A.C. mains input of 200-250 v. Sensitivity 180 m.v. Ganged Vol. and Tone Controls. Preset balance control. Full instructions and wiring diagrams supplied. **5 Gns.**

AVAILABLE AT ALL BRANCHES

ARMSTRONG, TRUVOX, LINEAR ROGERS, LEAK and JASON EQUIPMENT, GOODMANS, W.B. AND FANE SPEAKERS, GARRARD AND GOLDRING T/TABLES, LUSTRAPHONE, GRAMPIAN, RESLO AND SHURE MICROPHONES.

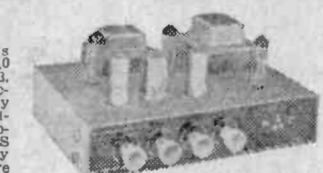
CASH OR TERMS

W.B. "STENTORIAN" HIGH FIDELITY P.M. SPEAKERS HF1012. 10 watts rating. Where a really good quality speaker at a low price is required. we highly recommend this unit with an amazing performance. £4.12.0. Please state whether 3 ohm or 15 ohm required.

R.S.C. JUNIOR BASS REFLEX CABINET. Designed for above speaker, but suitable for any good quality 8in. or 10in. speaker. Acoustically lined and ported. Polished walnut veneer finish. Size 18x12x10in. Strongly made. Handsome appearance. Ensures superb reproduction for only £3.19.6.

HIGH FIDELITY 12-14 WATT AMPLIFIER TYPE A11

PUSH-PULL ULTRA LINEAR OUTPUT "BUILT-IN" TONE CONTROL PRE-AMP STAGES

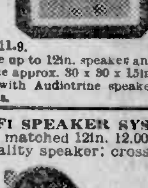


Two input sockets with associated controls allow mixing of "mike" and gram., as in A10 High sensitivity. Includes 5 valves. ECC83, ECC83, EL84, EL84, EZ81. High Quality sectionally wound output transformer specially designed for Ultra Linear operation and reliable small condensers of current manufacture. INDIVIDUAL CONTROLS FOR BASS AND TREBLE "Lift" and "Cut". Frequency response ±3 dB 30-20,000 c/s. Six negative feedback loops. Hum level 60 dB down. ONLY 23 millivolts INPUT required for FULL OUTPUT. Suitable for use with all makes and types of pick-ups and microphones. Comparable with the very best designs for **STANDARD or LONG PLAYING RECORDS.** For **MUSICAL INSTRUMENTS** such as **STRING BASS, LEAD OR RHYTHM GUITARS, etc.** **OUTPUT SOCKET** with plug provides 300 v. 30 mA. and 6.3 v. 1.5 a. For supply of a **RADIO FEEDER UNIT.** Size approx. 12 x 9 x 7in. For A.C. mains 200-250v. 50 c.p.s. Output for 3 and 15 ohms speaker. Kit is complete to last nut. Chassis is fully punched. Full instructions and point-to-point wiring diagrams supplied. Only **8 Gns.** Carr. 10/-. (Or factory built 51/- extra.)

If required louvred metal cover with 2 carrying handles can be supplied for 18/9. **TERMS ON ASSEMBLED UNITS. DEPOSIT** 25/- and 9 monthly payments of 25/- **(Total** £12.10.0). Send S.A.E. for illustrated leaflet detailing Cabinets, Speakers, Microphones, etc., with cash and credit terms.

LINEAR TAPE PRE-AMPLIFIER. Type LP/1, Switched Negative feedback Equalisation, Positions for Record 1⅞in., 3¾in., 7½in. and Playback. EM84 Recording Level Indicator. Designed primarily as the link between a Collaro Tape Transcriptor and a high fidelity amplifier, but suitable for almost any Tape Deck. Only 9½ Gns. S.A.E. for leaflet.

R.S.C. STANDARD BASS REFLEX CABINET. For 12in. loudspeakers, acoustically lined and ported. Size 20 x 14 x 13in. Beautiful walnut veneer finish. Especially recommended for use with Audiotrine Speaker System £5.19.6.

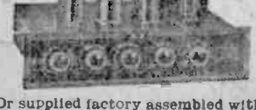


AUDIOTRINE CORNER CONSOLE CABINETS. Stronglymade. Beautiful polished walnut veneered finish. Pleasing design. **JUNIOR MODEL.** To take up to 8in. speaker. Size approx. 20x11x8in. 49/9.

STANDARD MODEL. To take up to 10in. speaker. Size 27 x 18 x 18in. £4.11.9.

SENIOR MODEL. To take up to 12in. speaker and with Tweeter cut-out. Size approx. 30 x 30 x 15in. (Recommended for use with Audiotrine speaker system). 7 gns. or terms.

R.S.C. STEREO/TEN HIGH QUALITY AMPLIFIER



A complete set of parts for the construction of a stereophonic amplifier giving 5 watts high quality output on each channel (total 10 watts). Sensitivity is 50 millivolts. Suitable for all crystal stereo heads. Ganged Bass and Treble Control give equal variation for "lift" and "cut". Provision is made for use as straight (monaural) 10-watt amplifier. Valve line-up ECC83, ECC83, EL84, EL84, EZ81. Outputs for 2-3 ohm speakers. Point-to-Point wiring diagrams and instructions supplied. Send S.A.E. for leaflet. **8 Gns.** Full constructional details and price list 2/6. Carr. 10/-.

Or supplied factory assembled with 12 months guarantee for **11 gns.**

Terms: Deposit 2 gns. and 9 monthly payments of 24/2 (Total £12.19.6).

AUDIOTRINE HI-FI SPEAKER SYSTEMS. Consisting of matched 12in. 12.000 line. 15 ohm high quality speaker; cross-over unit (consisting of choke, condenser, etc.) and Tweeter. The smooth response and extended frequency range ensure surprisingly realistic reproduction. Standard 10 watt rating. £4.19.9. Carr. 5/-. Or Senior 20 watt. £6.19.6. Carr. 7/6.

LASKY'S RADIO

Offer the Finest Value and HOME CONSTRUCTORS

We consider our construction parcels to be the finest value on the home constructor market. If on receipt you feel not competent to build the set, you may return it as received within 7 days when the sum paid will be refunded less postage.

The "SKYROVER" RANGE

GENERAL SPECIFICATION:
7 transistor plus 2 diode superhet, 6 waveband portable receiver. Operating from four 1.5 v. torch batteries. The SKYROVER and SKYROVER DE LUXE cover the full Medium Waveband and Short Waveband 31-94 M. and also 4 separate switched band-spread ranges, 13M, 16M, 19M and 25M, with Band Spread Tuning for accurate Station Selection. The coil pack and tuning heart is completely factory assembled, wired and tested. The remaining assembly can be completed in under three hours from our easy to follow stage by stage instructions.

SPECIFICATION:
Superhet 470 Kc/s. All Mullard Transistors and Diode Uses 4-U2 betteries, 5in. Ceramic Magnet PM Speaker. Easy to read Dial Scale. Band Spread Tuning, 500 MW Output. Telescopic Aerial & Ferrite Rod Aerial.
WAVEBAND COVERAGE: 180-576M; 31-94M and Band Spread on 13, 16, 19 and 25 metre Bands.

NEW!

The SKYROVER Mk II

Now supplied with redesigned cabinet, edgewise controls, new colour tuning scale and cabinet in Sierra Tan.
Controls: Waveband Selector, Volume Control with on/off Switch. Tuning Controls. In plastic cabinet, size 10 x 6½ x 3½ in. with metal trim and carrying handle.
Can now be built for £8.19.6 P. & P. 5/-
H.P. Terms: 20/- dep. & 11 mths at 16/6. Total H.P.P. £10.1.6.

A simple additional circuit provides coverage of the 1100/1950 M. band (including 1500 M. Light programme). This is in addition to all existing Medium and Short wavebands. All necessary components with detailed construction data **Only 10/- extra** Post Free
This conversion is suitable for both models that have already been constructed.

The SKYROVER DE LUXE

Tone Control Circuit is incorporated with separate Tone Control in addition to Volume Control. Tuning Control and Waveband Selector. In a wood cabinet size 11½ x 6¾ x 3in. covered with a washable material with plastic trim and carrying handle. Also car aerial socket fitted.
Can now be built for £10.19.6 P. & P. 5/-. **Total H.P.P.** £12.5.0
H.P. Terms: 25/- dep. & 11 mths at 20/-.

Data for each Receiver 2/6 extra. Refunded if you purchase the parcel. Four U2 batteries 3/4 extra.
All Components Available Separately.

The "Sixteen" Multirange METER KIT

This outstanding meter was featured by *Practical Wireless* in the Jan. '64 issue. Lasky's are now able to offer the complete kit of parts as specified by the designer.
RANGE SPECIFICATION: D.C. volts: 0-2.5-25-50-250-500 at 20,000 Ω/V A.C. volts: 0-2.5-50-250-500 at 1,000 Ω/V. D.C. current: 0-50μA. 0-2.5-50-250 mA. Resistance: 0-2,000 Ω. 0-200Ω. 0-20MΩ. Basic movement: 40μA f.s.d. moving coil. With universal shunt full scale deflection current is 50μA. Size/finish: Black plastic case, 3¾ x 5¾ x 1¾in. Controls: 12 position range switch: separate slide switch for A.C. volts—D.C. ohms; ohms zero adjustment pot. meter; meter zero. External connections: Two 4mm. sockets for test lead plugs. Power requirements: One 15V. and one 1.5V. batteries. Complete with all parts and full construction details.
Data and circuit available separately. 2/6 refunded if all parts bought. Pair of Batteries. 2/5 extra.

LASKY'S PRICE £5.19.6 P. & P. 5/- **H.P. Terms: 21/- dep. and 5 mths at 21/-. Total H.P.P. £6.6.0.**

NEW SINCLAIR SUPER MINIATURES

THE MICRO-6

Self-contained pocket radio. Size only 1⁴/₅ x 1³/₁₀ x ½in. A marvel of modern miniaturisation—truly amazing performance. Without a doubt the most advanced transistor circuit ever offered to home constructors—yet may be built in an evening. Complete with earphone and detailed construction data.
Can be built for only 59/6 Mercury cell 1/11 extra (2 required). All parts sold separately.

THE SLIMLINE

The new 2-transistor pocket radio. Size only 2¼ x 1¼ x 1⅛in. Micro alloy transistorised and printed circuit. All components available separately. Easy to assemble. **CAN BE BUILT FOR 49/6**

THE X10

10 watt power amplifier fitted with integrated pre-amplifier. Requires only 1 mV. for an output of 10 watts undistorted. Frequency response, is flat ½ dB from 5 c/s. to 20 kc/s. Size only 6 x 3 x ¾in. Weight 5 oz. Built on printed circuit. Operates from 12 v. D.C. at 75 mA. quiescent. Circuit uses 7 M.A.T.s and 4 RF power transistors. **KIT PRICE £5.19.6** Post Free
AVAILABLE READY BUILT, TESTED AND GUARANTEED, £6.19.6. Post Free
3 pots for volume, Bass and Treble. 7/6 the 3 extra. Mains power pack, if required, 54/-.

E.M.I. 4-SPEED RECORD PLAYER

New, unused and individually boxed fitted with lightweight pick-up with ACOS G.P. 73/2 stereo cartridge. Cabinet space required 13¼ x 12¼ x 4½in. A 9in. metal turntable is fitted. For use on 200/250 volt A.C. Mains with Auto-stop. The stereo cartridge will play all types of Mono Records, 78's, L.P.'s etc.
LASKY'S PRICE 79/6 P. & P. 3/6 extra

The "REALISTIC" Seven

★ 7-transistor Superhet. ★ 350 milliwatt output into 4in. high flux speaker. ★ All components mounted on a single printed circuit board ★ Full medium and longwave cover. ★ Plastic cabinet with carrying handle, size 7 x 10 x 3½ in., Blue/Grey or all Grey. ★ Easy to read dial. ★ External socket for car aerial. ★ I.F. frequency 470 Kc/s. ★ Ferrite rod internal aerial. Operates from PP9 or similar battery. ★ Full comprehensive data supplied with each receiver. All coils and I.F.'s etc. fully wound ready for immediate assembly. An Outstanding Receiver **LASKY'S PRICE** for the complete parcel including Transistors, Cabinet, Speaker, etc. and Full Construction Data. Can be built for **£5.19.6** P. & P. 4/6
PP9 Batt. 3/9. Data and Instructions separately 2/6. Refunded if you purchase the parcel.

REALISTIC Seven DE LUXE

With the same specification as standard model—PLUS a superior wood cabinet in contemporary styling. ALSO a full vision circular dial.
FOR ONLY **£1** EXTRA
P. & P. as std. model.

RECORD PLAYERS

45 r.p.m. 6 volt Batt. operated Complete with pick-up fitted crystal cartridge. Size only 7½in. x 6in. Fitted auto. stop and start. New and perfect.
45 r.p.m. Model 49/6 P. & P. 2/6

2-speed model for 33 and 45 r.p.m. (as illustrated) 59/6 P. & P. 2/6

TRANSISTORS

ALL BRAND NEW & GUARANTEED

GET 81, GET 85, GET 86, 2/6; 873A, 874P, 3/6; OC45, OC71, OC81D, 4/6; OC44, OC70, OC76, OC81 (match pair 10/6) 5/6; AF117, OC75, OC200 6/6; OC42, OC43, OC73, OC82D 7/6; OC201, OC204 15/-; OC205, OC206 19/6; OC28 24/6.

TRANSISTORISED TELEPHONE AMPLIFIER

Powerfully amplifies the incoming call. The pick-up is suction fixed to phone. Battery-operated at negligible cost. Fitted with on/off switch and vol. control. Size: 4½ x 3 x 1¼in. Complete with PP3 battery. **LASKY'S PRICE 69/6. P. & P. 2/6.**

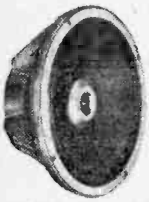
GUITAR PICK-UPS

CG M5 Crystal-high imp. Size only 1½ x ½ x ⅛in. Clips to finger board—no screws. Complete with cable.
LASKY'S PRICE 15/11 P. & P. 1/-

CGM35. Fully adjustable pick-up position carrier. Simply fixed. Separate tone and volume control. Heavy chrome finish. Pick-up size 3½ x 1½in., control size 2½ x 1½in. Complete with long lead and jack plug.
LASKY'S PRICE 59/6 P. & P. 1/6

LASKY'S FOR D.I.Y. CONSTRUCTION BARGAINS

LOUDSPEAKERS



We supply a complete range of Goodmans, Wharfedale, Stentorian, TSL Speaker Units and complete systems. A comprehensive leaflet is available on request this covers technical specifications and prices of nearly 50 types including:—

Celestion Model CX1512 (as illustrated) £11.10.0. Celestion Model CX2012 £16.10.0. Stentorian HF812 5 watts £3.16.0. Stentorian HF1012 10 watts £4.12.0. Goodmans Axiette 8, 6 watts £5.5.7. Goodmans Axiom 10, 10 watts £6.5.11. Goodmans Axiom 201, 15 watts £10.17.4. Wharfedale Super 8/RS/12/DD 6 watts £6.14.2. Wharfedale Golden RS/DD 8 watts £7.17.5 Wharfedale RS/12/DD, 15 watts £11.10.0.

Guitar Speakers include:—
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Wharfedale W15EG 20 watts £17.10.0.
Goodmans Audiom 51B, 15 watts £9.2.8. Goodmans Axiom 61B, 20 watts, £14.7.8

Carr. and Ins. extra

THE TRAVLER Mk. II CAR RADIO

Our ready built transistorised car radio for only

9½ Gns.

P. & P. 5/-

including 7 x 4in. speaker fitted to baffle, fixing brackets filter unit, all nuts and bolts with fitting instructions.

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★ Handsomely Styled ★ Mullard Valves and Transistors ★ Push Buttons. ★ 1½ watts output. ★ Long and medium Wavebands. ★ Quality Speaker (E.M.I.). ★ Easily fitted. ★ Radio Luxembourg (and many other foreign stations). ★ 12-volt Positive Earth only (applies to 99.8% of cars on the road). ★ Dimensions: 7 x 2 x 7in. depth. Optional extras: 3-section chromium plated weatherproof telescopic aerials type 1. 17in./44in., 19/6. Type 2 2in./43in., 29/6, both plus p. & p. 2/6 if purchased separately.

THE "HIGHWAYMAN" CAR RADIO TO BUILD YOURSELF

Similar in appearance to above but with on/off push-button switch. Complete set of parts only **£7.19.6** P. & P. 5/-

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Acos Crystal Model MIC 45/1, 19/6 Acos "Stick" Microphone Crystal, MIC 39/1, 32/6. DM.303 Dynamic High Impedance Desk Microphone complete with stand, Metallic Green Finish 5 gns. BM.3 Quality Crystal Microphone with Muting Switch. Complete with Lead, Neck Harness and Removable Stand Adaptor 39/6. Matching Table Stand 12/6 extra. DX29 Dynamic High Impedance. Black Crackle Finish with Desk Stand 59/6. DM301 Dynamic High Impedance with On/Off Switch. Omni-directional. Chrome plated diecast frame 99/6. DM.304 Dynamic Dual High or Low with On/Off Switch. Satin chrome finish 89/6. DM.107 Dynamic High Imp. with Switch. Chrome and black enamel finish 69/6.

MICROPHONE STANDS
MS.4 3 section floor stand 59/6.
MS.8 2 section floor stand 105/-.
MS.2 2 section desk stand 22/6.
P. & P. 2/6 extra on all above.

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DUVIDAL MODEL NT. 120. Completely erases old recordings in seconds. Suitable for all sizes up to 7in. 230-250v. A.C. Size 4½ x 4 x 3½in. Price 4 Gns. P. & P. 3/6.

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Mullard "5-10" Main Amplifier Model 510/M. 10 watts	£10 0 0	£13 10 0	6/6	2/-
Mullard "5-10" Amplifier with Tone Control Unit, 10 watts	£12 0 0	£16 0 0	7/6	2/-
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Mullard "10+10" Stereo Amplifier, 10 watts per Channel	£16 0 0	£20 0 0	8/6	3/-
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Mullard Dual Channel Pre-amplifier	£12 10 0	£15 0 0	7/6	3/-
The above two items purchased together	£27 0 0	£34 0 0	15/-	—
Mullard 4-channel Electronic Mixer Unit Model 2H for 2 Mics. Radio and Gram.	£8 8 0	—	5/-	2/6
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Type "C" Tape Pre-amplifier with Power Unit	£14 0 0	£19 10 0	7/6	3/6
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AMERICAN ACETATE TAPE

5in.	600ft.	Standard	8/6
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5¾in.	1,200ft.	Long play	12/6

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3¼in.	600ft.	Double Play	11/6
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5in.	600ft.	Standard	12/6
5in.	900ft.	Long Play	15/-
5¾in.	1,200ft.	Long Play	18/6
7in.	1,200ft.	Standard	18/6
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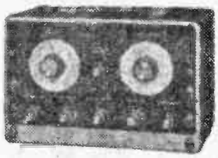
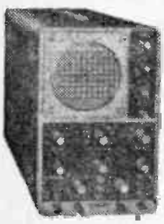
£44.10.0 Assembled



HFW-I



10-12U

5in. OSCILLOSCOPE Model 10-12U. Laboratory quality at utility oscilloscope price. Wide band amplifiers essential for T.V. servicing. F.M. alignment, etc. T/B covers 10 c/s-500 kc/s in 5 ranges.
£41.10.0 Assembled **£32.12.6** Kit

PORTABLE 'SCOPE Model OS-I A compact portable oscilloscope, ideal for servicing and general work. Printed circuit board. Case 7⅞ x 4⅞ x 12½in. long. Wt. only 10½ lbs
£30.8.0 Assembled **£22.18.0** Kit

REGULATED POWER SUPPLY Model IP-20U. Transistorised 0-5-50 v. D.C. Up to 1.5 amps. Compact 9½ x 6½ x 11in.
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VALVE VOLTMETER, Model V-7A. The world's best selling VTVM. Measures up to 1,500 volts (d.c. and r.m.s.) and 4,000 pk. to pk. Res. 0.1Ω 1,000 MΩ. Centre zero dB scale, d.c. input resistance 11MΩ. 4½in. meter. Complete with test prods, leads and standardising battery.
£19.18.6 Assembled **£13.18.6** Kit

V-7A

DE-LUXE 6in. VALVE VOLTMETER. Model IM-13U. Similar spec. to model V-7A but with improved accuracy. Larger meter. Unique gimbol mount.
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KV PROBE. HV-336 measures up to 30,000 v. d.c. **£2.19.6** Kit

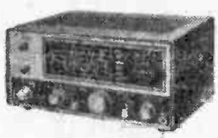
RF SIGNAL GENERATOR. Model RF-1U. Up to 100 Mc/s fundamental, 200 Mc/s harmonics. Up to 100 mV output on all bands.
£19.18.0 Assembled **£13.8.0** Kit

MULTIMETER, Model MM-1U. Ranges: 0.1.5 v. to 1,500 v. a.c. and d.c.; 150µA to 15A d.c.; 0.2Ω to 20MΩ. 4½in. 50µA. meter.
£18.11.6 Assembled **£12.18.0** Kit

A wide range of other test instruments available including: **R/C Bridge C-3U £10.10.0. AF V/Voltmeter AV-3U £16.10.0. Wattmeter AW-1U, £17.5.0. (Capacitance meter) CM-1U £15.15.0. Power supplies. Decade boxes etc.** Many other instruments available under American Mail Order scheme. Why not send for full details?

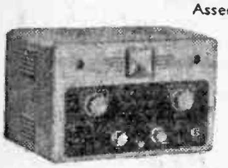
"AMATEUR" EQUIPMENT

AMATEUR BANDS RECEIVER Model RA-1. Covers all amateur bands from 160-10 m. Half lattice crystal filter. 8 valve, "S" meter, tuned R.F. amplifier stage.
£39.6.6 Kit
Assembled £52.10.0



RA-1

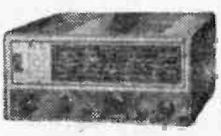
AMATEUR TRANSMITTER, Model DX-100U. Covers all amateur bands 160-10M. 150 w. d.c. input, self contained with power supply. Modulator, VFO
Assembled £104.15.0 **£79.10.0** Kit



DX-40U

AMATEUR TRANSMITTER Model DX-40U. Covers 80-10 m. Power inputs 75 w. C.W., 60 w. peak C.C. phone. Output 40 w. to aerial. Prov. for V.F.O.
£33.19.0 Kit
Assembled £45.8.0

COMMUNICATIONS TYPE RECEIVER RG-1. A high performance low cost receiver for the discriminating listener. Freq.: cov. 600 kc/s-1.5 Mc/s and 1.7 Mc/s to 32 Mc/s. Send for details.
£53.0.0 Assembled **£39.16.0** Kit



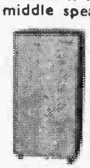
Other kits in the amateur range include: **SSB Adaptor SB-10U, £39.5.0. Variable freq. Oscillator VF-1U, £10.17.6. Balun Coil Unit, B-1U, £4.15.6. Grid-Dip Meter GD-1U, £10.19.6. Q Multiplier QPM-1, £8.10.0. Reflected Power Meter HM-11U, £8.5.0.** Wide range of models under American Mail Order Scheme.

SPEAKER SYSTEMS

SSU-1 MODEL

A practical solution to the problem of a moderately priced speaker suitable for Stereo Mono amplifiers. where the equipment has to be compact. Two speakers, balance control, ducted port reflex cabinet. Horizontal or vertical (with matching legs).
Inc. P.T. **£11.12.0** Kit

COTSWOLD STANDARD MODEL
Acoustically designed enclosure "in the white" 26 x 23 x 15½in., 12in. bass speaker, elliptical middle speaker, 2in. pressure unit. Covers 30-20,000 c/s.
Complete kit with all controls.



MFS SYSTEM
A minimum floor space model for the smaller room. 26in. high x 16½in. x 14in. deep. Similar performance to standard model.
Price either model **£23.4.0** Kit

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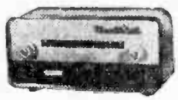
Model FM-4U. Tuning range 88-108 Mc/s. Tuning unit (FMT-4U) with 10.7 Mc/s I.F. (£2.15.0 inc. P.T.). I.F. Amp. (FMA-4U) complete with cabinet and valves (£13.3.0).
Total **£15.18.0** Kit



FM-4U

Assembly can be arranged.

AM/FM TUNER. Covers FM 88-108 Mc/s. A.M. 16-50, 200-550, 900-2,000 m. Tuning heart (£4.13.6 inc. P.T.), and I.F. Amp (£21.16.6). Total **£26.10.0** Kit
Send for leaflets. Assembly can be arranged.

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A large range, in kit form or assembled and finished, available to meet most needs. Illustrated details on request.
Prices from **£7.15.0** to **£44.2.0**

Many other models covering a wide range of equipment for HOME, OFFICE or Workshop

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PUBLIC ADDRESS AMPLIFIER, PA-1. 50 w. output, two heavy duty speakers, variable Tremolo. Ideal for use with guitars, etc.
£74.0.0 Assembled **£54.15.0** Kit

Legs optional extra 17/6. Set of 4.

50 W POWER AMPLIFIER, MA-50
Ideal for PA work, electronic organs etc.
£27.18.0 Assembled **£19.18.0** Kit

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"OXFORD" LUXURY TRANSISTOR DUAL WAVEBAND RECEIVER.

The ideal domestic or personal portable receiver. 10 Semi-conductors. Solid leather case. Send for full details.
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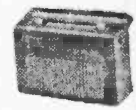

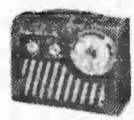

6 TRANSISTOR PORTABLE. Model UXR-1. Prealigned I.F. transformers. Printed circuit, 7in. x 4in. high flux speaker. Real hide case. Very easy to build.
Inc. P.T. **£12.11.0** Kit

7 TRANSISTOR PORTABLE. Model RSW.1. Two short trawler and medium wave bands. Incl. P.T. **£19.17.6** Kit

"MOHICAN" GENERAL COVERAGE RECEIVER. Model GC-1U. Excellent portable or general purpose receiver for "amateur" or short wave listening. See full spec. leaflets.
Assembled £45.17.6 **£37.17.6** Kit

GC-1U

SPEAKERS FOR YOUR OWN ENCLOSURE

12" Heavy-duty Bass (Fane 122/12) £7.7.0.
2" Tweeter (Fane 301) £3.1.6.
(both as used in the Cotswold systems)
12" Bass speaker (Audiom-51) £9.12.5.
8" Goodmans General Purpose G8 £1.8.6.
Two Speakers' + Cross-over, System SCM-1.
(As used in model SSU-1) with details for enclosure £4.12.0.

RPM INDICATOR (Electronic rev counter). A must for the motoring enthusiast. For 4 cylinders, 12V. pos. or neg. earth. £8.19.0 (complete). Send for details.

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S-33H

6W STEREO AMPLIFIER Model S-33. 3 w/ch. Inputs for radio tape and gram. Stereo/Mono ganged controls. Sensitivity 200mV.
£18.18.0 Assembled **£13.7.6** Kit

6W DE-LUXE STEREO AMPLIFIER. Model S-33H. An inexpensive stereo/mono amplifier with high sensitivity. Suitable for use with Decca Deram cartridge.
£21.7.6 Assembled **£15.17.6** Kit

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TA-1M (Mono), £19.18.0. Kit **TA-1S** (Stereo), £25.10.0 Kit

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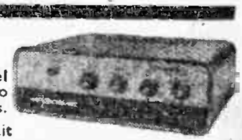
18W STEREO AMPLIFIER. Model S-99. Ganged controls. Stereo/Mono gram, radio and tape recorder inputs. P/B selection.
£37.19.6 Assembled **£27.19.6** Kit



5W HI-FI MONO AMPLIFIER. Model MA-5. A low priced amplifier based on the S-33. Printed circuit construction makes it easy to build.
£15.10.0 Assembled **£10.19.6** Kit

HI-FI MONO POWER AMPLIFIER. Model MA-12. Ideal for use with Models USC-1 and UMC-1, 0.1. THD at 10 W Wide freq. range. £15.18.0 Assembled **£11.18.6** Kit

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Transistor ferrite rod aerial with medium and long wave coils with circuit, 7/6.
Oscillator Coil and set of 3 I.F. transformers for transistor set with circuit, 12/6. **Tuning Condenser** to suit air-spaced with trimmers, 9/-. Ditto but min. 10mm., 12/6 the set; two gang Condensers to suit, 8/6 (request sub. min. circuit).
Midget 3in. P.M. Loudspeaker 3 ohm, 12/6. 80 ohm, 13/6.
Midget 208 pF + 176 pF two-gang Tuning Condenser with trimmers for transistor set Price 9/-.
Push-Pull Transformer. Sub-miniature, 8/6.
.0005 mfd. Single Tuning Condenser. Solid dielectric ¼in. spindle for transistor or Crystal set, with spindle tapped 6 BA, 2/6.
46 Sets (Receiver/Transmitter pack set). Unused sets complete except for crystals. Packed with parts and easily rebuildable into other gear. 19/6 each. Post 3/-.
Mains Transformer. 250-0-250 at 80 mA. 6.3 volts, 5a (normal mains input), 12/6 each. Carriage 2/6.
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Other gear. 19/6 each. Post 3/-.
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T.C.C. or Dubilier Tubular Condensers.

.5 mf 500 v.	10/- doz.
.25 mf 500 v.	7/6 doz.
.25 mf 350 v.	6/- doz.
.05 mf 500 v.	5/- doz.
.0001 mf 1,000 v.	5/- doz.
.001 mf 1,000 v.	6/- doz.
.002 mf 1,000 v.	7/6 doz.
.005 mf 1,000 v.	9/- doz.
.02 mf 750 v.	8/6 doz.
.01 mf 1,000 v.	10/- doz.

Battery Charger Rectifier—selenium 12.15 v. 5 amp., 9/6.
Metal Chassis—punched for Mullard 510 Amplifier, complete with inner screening sections and stove enamelled, 12/6 set.
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Neon Lamp—midget wire ended. Ideal mains tester, etc., 2/-. Ex Govt., 1/6.
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Tag Panels. Ideal for constructors, experimental circuits, etc. 3 of each of 12 different types, 5/-.
Slydlok Panel Mounting Fuses with carrier, 5 amp., 2/- each. 15 amp., 2/6 each.
Metal Rectifier. 250 v. 60-80 milliamps, ideal for mains set or instrument or to replace that expensive valve, 4/6.
Piano Key Type Switches. 3 key type, 3/-, 1 key type 3/9, 5 key type 4/6 post and packing 1/-, regardless of number ordered.
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Black Light Unit. 125 watt intensity comprises quartz lamp, adjustable lamp holder and 125 watt choke. Only 29/6 + 6/6 carriage and insurance.
Packard Bell Pre-Amp. Contains a relay push-pull input and output transformers and many useful spares. Less valves 6/6 each + 2/6 post and insurance.
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B7G Valve Holder. Best make (Amphenol). 3/- dozen, post 1/6. 3 dozen, post free.
Precision Wheatstone Bridge. opportunity occurs to build—100k wire wound 15 watt potentiometer price 5/- + 1/- postage.
Cyldon Turret Tuner. 35 Mc/s. with band 1 and band 3 coils. Brand new, 9/6 each post 2/6.

Timer Kit

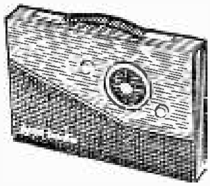
Special offer of all components except metal box to make mains operated interval timer for photography etc., 12/6 plus 2/6 post.

Waterproof Heater Wire

16 yds. length, 70 watts, self regulating temperature control. 10/- post free.

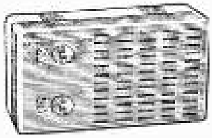
Where postage is not definitely stated add 2/- all orders under £3.

GOOD COMPANION Mark III



The 6 transistor set with the 8 transistor performance. Incorporating all the latest requirements. Anyone who can solder can make it. Many thousands already in use all over the country. Full coverage of Long and Medium wavebands. Fine looking cabinet size 11 x 8 x 3in. Q.P.P. Output approx. 750 mW. Excellent reception of difficult stations like 208. Variable feed back gives excellent tone. Complete Kit, everything for ONLY **£4.19.6** P. & P. 5/-.

OUR BARGAIN OF THE YEAR



A complete kit of parts to build 6 transistor 2 wave superhet receiver at only 45/-. Post and Ins. 3/6.

"CORONET" Mk. IV

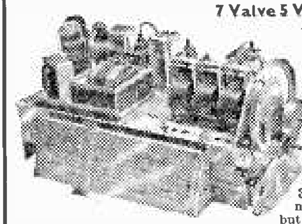
It fully covers the medium waveband and that part of the long waveband to bring in B.B.C. Light. The circuit includes a highly efficient slab aerial and 2½in. P.M. speaker. Overall size approximately 4½ x 2½ x 1¼in. Supplied complete with carrying case.

Infra Red Heater

Make up one of these latest type heaters, ideal for bathroom, kitchen, bedroom etc. They are simple to make from our easy to follow instructions—uses silica enclosed elements designed for the correct infra-red wavelength (3 microns). Price for 750 watt element and metal casing as illustrated, 19/6 plus 2/6 post and insurance. Pull switch, 3/- extra.

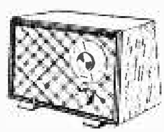
THIS MONTH'S SNIP

7 Valve 5 Wave Superhet.



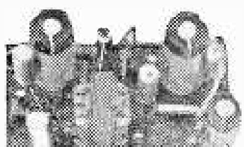
Famous maker—has L.F. Stage and many special features—covers Medium and 4 Short bands to 11 metres—3 models all offered for less than the valve of the coil pack alone. Mains model, 39/6; 12 volt model, 39/6; no power pack model, 27/6. Unused but a little dusty, all less Scale and drive—also less valves but there are Standard octal types 6K7. 6Ks, 6K7, 6Q7 6V6, 5V4 available, price 20/- the set. Carriage and insurance, 7/6. DON'T MISS THIS!

INTERCOM BARGAIN



Cabinet as illustrated, less knobs, ideal if you are making small radio, office intercom amplifier, etc. Has the modern look: originally sold at 29/6, limited quantity available at 15/- plus 2/6 postage. All components to make two of the intercoms described in "Practical Electronics," 75/-.

750 mW TRANSISTOR AMPLIFIER



4 transistors including two in push-pull-input for crystal or magnetic microphone or pick-up—feed back loops—sensitivity 5 m/v..

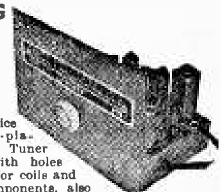
Price 19/6

Post and insurance 2/6. 35 ohm Speaker, 12/6 extra.

MAINS POWER PACK

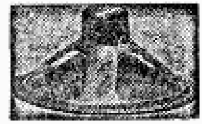
Designed to operate transistor sets and amplifiers. Adjustable output 6v—9 to 12 volts for up to 500mA (class B working). Takes the place of any of the following batteries: PP1-PP3-PP4-P6-PP7-PP9 and others. Kit comprises: mains transformer-rectifier, smoothing and load resistor 5000 and 500 mfd condensers, zener diode and instructions. Real snip at only 14/6 plus 2/6 post.

MAKING AN FM TUNER



Available at present is a very nice cadmium-plated F.M. Tuner chassis with holes punched for coils and other components, also a nicely printed perspex front, calibrated usual F.M. frequencies. Real bargain 6/6 + 2/- or with two-gang tuning condenser 10/- + 2/- postage.

Speaker Bargains



12in. High-fidelity loudspeaker. High flux permanent magnet type with either 3 ohm or 15 ohm speech coil. Will handle up to 10 watts. Brand new by famous maker. Price 27/6 + 3/6 post and insurance.

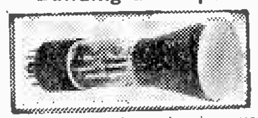
Hi-Fi Speakers

Hi-Fi Speakers—E.M.I. Ceramic magnet 12,000 lines, size: 13 x 8in. (roughly equivalent to 12in. round speaker). Bass frequency 40-50 c/s. Handles up to 10 watts. Price 33/6 plus 5/- carriage and ins. State whether 15 ohm or 3 ohm.

TRANSISTOR SET CASE

Very modern cream cabinet, size 5¼ x 3 x 1¾in. with chrome handle, tuning knob and scale. Price 4/6, plus 1/6 postage.

Building a 'Scope



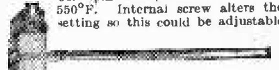
3in. oscilloscope tube. American made type No. 3PF7, 6.3 v. 0.6 amp. heater electrostatic deflection, brand new and guaranteed with circuit diagram of 'scope 15/- each. Plus 2/6 post and insurance.

Simmerstat Heater Regulator

Suitable to control elements, heaters, soldering irons and boiling rings up to 2,500 watts. Complete adjustable, normal price 55/- each, special snip price 12/6. plus 1/6 postage and insurance.

THERMOSTATS

Type 'A' 15 amp. for controlling room heaters, greenhouse, airing cupboard. Has spindle for pointer knob, quickly adjustable from 30-80°F. 9/6 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



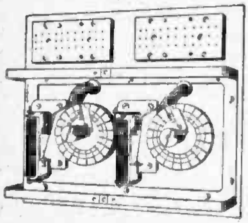
over 30° to 1,000°F. Suitable for controlling furnace, over kiln immersion heater or to make flame-stat or fire alarm. 3/6 plus 2/6 post and insurance.
Type 'C' is a small porcelain thermostat as fitted to electric blankets etc. 1½ amp. setting adjustable by screw through side. 3/6. P. and P. 6d.
Type '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 loft pipes from freezing, if a length of our heater wire (16 yds. 10/-) is wound around the pipes, 7/6. P. & P. 1/-.
Type 'E'. This is a standard refrigerator thermostat. Spindle adjustments over normal refrigerator temperatures 7/6 plus 1/- post.

ELECTRONICS (CROYDON) LTD

266 LONDON ROAD WEST CROYDON SURREY

Post orders to: 43 Silverdale Road, Eastbourne, Sussex

UNIQUE BARGAINS — DEPOT MUST BE CLEARED

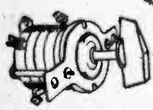


MOTORISED ROTARY SWITCHES

Ministry Ref. No. AP57579. This is a motor-driven switch, the driving motor being a synchronous type for working on 110 volts 50 cycles. The two switches have 20 positions each and are enclosed by a Perspex fronted lid. separately operated relays providing interlocks. Sale price 27/6 each. Carr. 3/6.

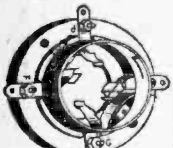
FERRANTI ELECTRIC METER MOVEMENT

A complete check meter, except for case brand new and unused. Has many uses, one for instance is that of telling the number of hours a piece of apparatus has worked. Price is only 7/6, post. etc. 3/6.



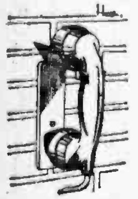
30 AMP ROTARY SWITCH

Double pole on/off a very robust switch made by one of our most famous firms. Will give lifetime of service. Price complete with pointer knob, 4/9.



JUMBO VALVE BASES

Ceramic 4 pin for transmitting valves. Price 3/6 each.

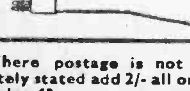


SELF ENERGISED TELEPHONES

These require no batteries; in fact they have only to be connected by a pair of wires. They can thus be fitted into existing bell circuits. Results are extremely good and maintenance costs are nothing. Handsets only complete with wall mounting bracket as illustrated. 15/- each post etc. 2/6. Two post free.

VCR517 CATHODE RAY TUBE

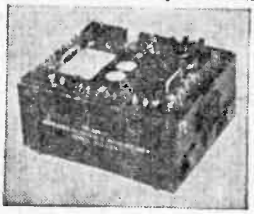
New and unused, 9/6 each. Carr. & Ins. 6/6.



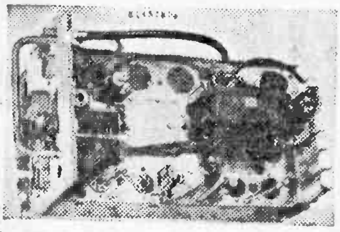
Where postage is not definitely stated add 2/- all orders under £3.

TELEPHONE REPEATER No. 1 MARK I

This equipment is for amplifying telephone signals in both directions of traffic and also to remedy line distortion of speech. It is intended for use with two wire or four wire circuits, has four amplifiers and is in fact two quite independent repeaters mounted on the same panel and having a common power supply. The power supply may be operated from a 12-volt car battery or from standard A.C. mains. The units are absolutely new in original packing complete with spares and instructional manual. Price £7.10.0 each. Post and packing 12/6.

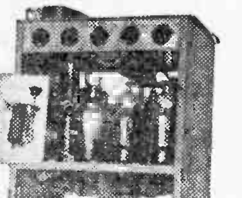


KLYSTRON RECEIVER



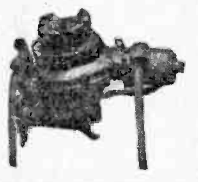
Partly stripped but containing valuable Klystron with tuning mechanism and a host of spares including condensers (paper and mica), transformers, relay bobbins, pot. meters, resistors, delay line, coils, coil formers, knobs, pye sockets, trimmers, valve holders, a very useful chassis and case size approx. 15 x 9 x 7½in. and hundreds of other useful sundries. Price only 9/6 plus 7/6 carriage and packing.

BUILDING AN AMPLIFIER



Here is a buy for you! Modulator Unit type 20. Contains parts ideal for building a large output amplifier and all ready set out in metal case. To name a few: Four high output valves Type KT44. Driver valve Type MH4L. Iron cored choke for up to 200 milli-amps. Dozens of wire wound and carbon resistors, paper and mica condensers. Terminals and tag panels, etc., etc. Three other items of interest to everybody and well worth the price asked for the unit are: 1. Transformer Reference 10K/143. This can act as auto-transformer to convert 230 to 110 or 230 to 460, and also as a filament transformer 230 to 6.3 or 230 to 12.6 volts. 2. Miniature Circuit Breaker. For breaking 10 amps A.C. reset by pushing knob. 3. Steel Case. With heavy gauge chassis, all ready cut out and fitted valve holders etc. Price for complete unit is 12/6. Carriage 7/6.

UNITS FOR CONTROLLED AUTOMATIC ROTATION



Two units work together to form a Tower rotating device, with remote control.

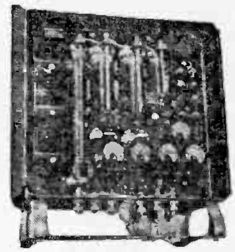
Item 1, known as Tower 24A, is in fact the geared driving motor which rotates the mast. This is quite a heavy construction and would rotate a heavy scanner, reflector, beam array, etc., etc.

Item 2, known as Indicator 1-221-A is the remote controller which enables the azimuth position of Tower 24A to be controlled from a remote point. Conversely, it enables the azimuth position of the tower to be known at any time. Both the Tower and the Indicator contain selsyn transmitter/receivers and it is these that provide the impulses which cause the aerial to rotate backwards or forwards. The equipment intended for 117 volt A.C. mains but will operate from our mains if connected through step down transformer of 1 kW rating. Prices: 1-221-A, £25. TR24A, £35. Special discount of £5 for cash with order or C.O.D. if both units purchased together.

TETRODE TYPE VT31 TRANSMITTING VALVE

This is a high-powered air-cooled tetrode, specification of which is as follows: Heater volts 11.25, heater current 8 amp, maximum anode voltage 5 kV, anode dissipation 250 watts, size approximately 14½in. long and 6½in. across the bulb. Limited quantity only at £1 and 4/6 P/T each, still in original packing.

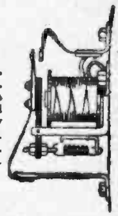
CHARGING SWITCHBOARDS



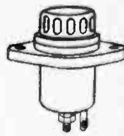
Type A. 550 w. 18 v.—contains three reverse current relays, one voltmeter rated 25 v. f.s.d. one main ammeter rate 40 amps f.s.d., one secondary ammeter rated 15 amps f.s.d., and two secondary meters rated 20 amps f.s.d.. one 2 ohm variable resistor, one 11 ohm variable resistor and two 1.2 ohm variable resistors. Complete in metal case 2ft. 6in. x 2ft. 8in. approx. Price £2.15.0. Carr. & Ins. 15/-.

Type B. 1260 w. 50 v. 12 amps—contains one 14 ohm variable resistor and four 1 ohm variable resistors, one main ammeter rated at 40 amps f.s.d., four secondary meters rated at 20 amps f.s.d., and one voltmeter rated at 50 volts, and two reverse current relays. Complete in metal case—size approximately 2ft. 6in. x 2ft. 8in. Price £4.15.0. Carr. 15/-. Connecting Leads for these switchboards with Nifam plugs, 30/- each.

CONTACTOR

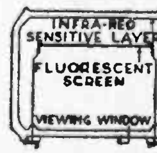


For breaking 25 amps, coil voltage is 24 v. D.C., but with a re-wind or a small rectifier these will close off A.C. mains. Very heavy duty contacts. Enclosed in bakelite case. Price 2/6 each, 24/- doz.



INDICATOR LAMP

Fitted Perspex top. Takes standard screw-in flash light bulb. Price 18/- doz. Similar thing but flush, 12/- doz.



SNIPERSCOPE

Famous wartime "cats 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. It follows that as light from an ordinary lamp is rich in infra-red these cells will work burglar alarms, counting circuits, smoke detectors and the hundred and one other devices as will the simpler type of photo cell. Here then is a golden opportunity for some interesting experiments, price 5/- each. Post 1/-. Data will be supplied with cells if requested.

SLIDER RESISTORS

Heavy Duty Type. Size 7 x 1½in. 11 ohms 4.5 amp, 22/-. Size 9 x 1½in. 1.2 ohms 15 amp, 15/-. Size 13½ x 1½in. 3 ohms 10 amp, 15/-. 1 ohm 25 amp, 15/-. .4 ohm 160 amp, 10/- plus post.

INSTRUMENT COMPANY

43 SILVERDALE ROAD, EASTBOURNE

Mail Order only from this address—goods may be seen by appointment in Oxfordshire.

BENTLEY ACOUSTIC CORPORATION LTD.

Suppliers to H.M. Government. 38 CHALCOT ROAD, LONDON, N.W.1 Telephone: PRIMROSE 9090

**NEAREST UNDERGROUND: CHALK FARM. . ALL GOODS LISTED BELOW ACTUALLY IN STOCK
ALL GOODS ARE NEW, BEST QUALITY BRANDS ONLY, AND SUBJECT TO MAKERS' FULL GUARANTEE, PLEASE NOTE THAT WE DO NOT SELL ITEMS FROM USED EQUIPMENT NOR MANUFACTURERS' SECONDS & REJECTS, WHICH ARE OFTEN DESCRIBED AS "NEW AND TESTED" BUT HAVE A SHORT AND UNRELIABLE LIFE**

OA2 4/6	6BS7 25/-	7A7 12/6	25Y5 7/9	AC5PEN/	EABC80 5/9	EL42 7/6	LN152 6/-	R12 5/9	U76 4/6	BYZ13 11/6
OB2 6/-	6BW6 8/9	7B6 12/6	25Y5G 7/9	DD 23/3	EAC91 3/3	EL81 8/3	LN309 7/9	R16 29/-	U78 3/9	GD3 5/6
OZ4GT 4/3	6BW7 5/-	7B7 9/6	25Z4G 7/-	AC6PEN 4/9	EAF42 7/6	EL83 6/9	LN319 8/6	R17 17/6	U101 19/6	GD6 5/6
1A3 2/6	6BX6 4/-	7C5 8/-	25Z5 7/3	AC/PEN	EB34 1/-	EL84 4/6	LP2 9/6	R18 9/6	U107 17/6	GD14 10/-
1A4 12/6	6C4 2/3	7C6 6/9	25Z6GT 8/-	(5) 17/6	EB41 4/9	EL85 7/6	LZ319 6/6	R19 6/6	U191 9/6	GET103 7/-
1A5 5/-	6C5 4/-	7C7 5/-	27SU 23/3	AC/PEN	EB91 2/3	EL86 7/3	LZ329 6/6	R52 7/6	U251 9/-	GET104 10/-
1A7GT 7/9	6C6 3/-	7D3 15/-	28D7 6/9	(7) 17/-	EBC3 20/6	EL91 2/6	MH4 3/6	RG1/240A	U281 8/9	GET106 17/6
1C1 4/-	6C8 3/-	7D5 14/6	30C1 6/6	AC/SG 22/6	EBC33 6/-	EL95 5/6	MHD4 7/6	54/-	U282 12/3	GET111 12/-
1C2 8/-	6C9 10/9	7D6 14/6	30C17 17/6	AC/SG/VM	EBC41 6/6	EL360 27/-	MHLD6 12/6	RK34 7/6	U301 11/6	GET113 6/9
1C3 6/6	6C10 8/-	7H7 5/9	30C18 10/6	12/-	EBC81 5/9	EL820 16/4	ML6 5/9	S130 22/6	U329 9/-	GET114 6/6
1C5 5/-	6C12 5/9	7R7 12/6	30F5 5/9	AC/TH1 10/-	EBC90 3/9	EL822 18/6	MS4B 20/5	SP4B 19/6	U339 9/6	GET873 9/3
1C6 10/6	6CD6G 18/-	7V7 5/-	30L1 5/6	AC/TP 18/-	EBC91 5/6	ELL80 13/6	MSP4 12/-	SP13C 12/6	U403 9/9	GET874 9/6
1D5 6/6	6CH6 5/-	7Y4 5/-	30L15 9/3	AC/VP1 12/-	EBF80 5/9	EM4 17/9	MU12/14 4/6	SP41 2/-	U404 6/-	GEX13 3/6
1D6 9/6	6CW4 24/-	8D2 2/6	30P4 12/3	AC/VP2 12/-	EBF83 7/3	EM34 11/6	MX40 8/9	SP42 12/6	U801 16/3	GEX35 3/-
1FD1 6/-	6D1 1/6	9BW6 9/6	30P12 7/6	ATP4 2/3	EBF89 6/-	EM35 12/-	N37 10/6	SP61 2/-	U4020 6/6	GEX36 10/-
1FD9 3/6	6D3 9/6	9D2 3/-	30P16 5/3	AZ1 5/9	EBL21 10/6	EM71 15/6	N78 26/-	SU25 27/2	VMP4G 11/9	GEX45 6/6
1G6 6/-	6D6 3/-	9D7 7/6	30P19 12/3	AZ31 6/6	EC52 4/3	EM80 6/3	N108 26/2	T41 9/-	VM84B 12/-	GEX64 11/6
1H5GT 7/9	6E5 9/6	10C1 8/9	30PL1 8/6	AZ41 6/6	EC53 12/6	EM81 7/-	N339 15/-	TDD2 12/6	VP2 3/6	GEX66 15/-
1L4 2/3	6F1 9/6	10C2 12/3	30PL14 12/6	B36 4/9	EC54 6/-	EM84 6/9	P41 3/6	TDD4 7/6	VP2B 9/6	MAT100 7/9
1LA4 17/6	6F6G 3/9	10D1 7/-	33 12/6	BL63 10/6	EC70 4/9	EM85 8/9	P61 2/6	TH4B 10/-	VP4 14/6	MAT101 8/6
1LA6 16/10	6F6GT 7/6	10D2 11/8	35/51 12/6	CI 12/6	EC90 2/3	EM87 7/6	PABC80 6/9	TH21C 10/6	VP4A 14/6	MAT120 7/9
1LD5 4/-	6F7G 5/-	10F1 10/-	35A5 20/9	CCH35 12/6	EC91 4/-	EN31 10/-	PC86 10/3	TH30C 14/6	VP4B 12/-	MAT121 8/6
1LN5 4/6	6F8 5/-	10F9 9/9	35L6GT 6/-	CK506 6/6	EC92 6/6	EN91 5/6	PC88 9/6	TH41 10/-	VP13C 7/-	OA5 6/-
1N5GT 8/6	6F11 17/9	10F18 9/9	35W4 4/9	CL4 19/6	ECC31 7/3	EY51 5/9	PC95 6/9	TH233 6/9	VP23 2/6	OA10 6/6
1P1 6/-	6F12 3/-	10LD3 6/3	35Z3 16/2	CL33 11/6	ECC32 4/-	EY81 7/3	PC97 6/9	TP22 5/-	VP41 5/-	OA70 3/-
1P10 4/6	6F13 3/9	10LD11 9/6	35Z4GT 4/6	CV6 2/6	ECC33 29/1	EY83 9/3	PCC84 5/6	TP25 5/-	VP133 9/9	OA73 3/-
1P11 5/3	6F14 23/3	10P13 8/3	35Z5GT 5/9	CV63 10/6	ECC34 21/7	EY84 9/6	PCC85 6/9	TP2620 7/6	VR75 21/-	OA79 3/-
1R5 4/-	6F15 6/9	10P14 11/6	36 12/6	CV85 14/6	ECC35 5/-	EY86 5/9	PCC88 10/6	TY86F 11/8	VR105 5/6	OA81 3/-
1S4 5/-	6F17 12/6	11D3 17/6	39 2/6	CV271 12/6	ECC40 7/-	EY88 8/9	PCC89 8/6	UABC80 5/-	VR150 4/9	OA85 3/-
1S5 3/6	6F18 13/5	11D5 17/6	40SUA 6/6	CV428 19/-	ECC81 3/6	EY91 3/-	PCC189 10/6	UAF42 7/-	VT61A 7/-	OA86 4/-
1T2 29/-	6F23 6/3	11E1 15/-	41MTL 8/-	CY1 16/4	ECC82 4/6	EZ35 4/6	PCF80 6/6	UB41 10/6	VT501 3/-	OA90 3/-
1T4 2/3	6F24 9/6	11E3 17/-	41STH 10/-	CY1C 6/6	ECC83 4/6	EZ40 5/3	PCF82 6/3	UBC41 6/3	VU111 5/-	OA91 3/-
1U4 5/6	6F32 3/-	12A6 2/3	42 5/-	CY31 5/9	ECC84 5/6	EZ41 6/3	PCF84 8/6	UBC81 6/3	VU120 10/-	OA95 3/6
1U5 5/3	6F33 3/6	12A8 16/6	43 10/-	D1 1/3	ECC85 5/9	EZ80 3/9	PCF86 7/9	UBF80 5/9	VU120A 10/-	OAZ204 9/6
2A7 12/6	6G6 2/6	12AC6 8/6	45 17/6	D15 13/6	ECC88 8/9	EZ81 4/6	PCF801 10/-	UBF89 6/9	VU133 7/-	OA210 9/6
2C26 2/9	6H6 1/6	12AD6 9/6	45Z6GT 15/-	D42 10/6	ECC189 11/6	EZ90 3/9	PCF802 10/-	UBL21 10/9	W21 5/-	OAZ210 7/6
2D13C 7/-	6J5G 3/-	12AE6 8/-	50A5 21/10	D63 5/-	ECC807 15/-	FC2 14/6	PCF805 10/6	UC92 6/3	W42 12/-	OA211 13/6
2D21 5/6	6J5GT 4/3	12AH7 5/-	50B5 6/6	D77 2/3	ECF80 6/6	FC4 8/9	PCL82 6/6	UCC84 8/9	W61M 24/6	OC16W 35/-
2P 23/3	6J6 3/-	12AH8 10/9	50C5 6/6	DAC32 7/9	ECF82 6/3	FC13 14/6	PCL83 7/9	UCC85 6/6	W63 10/6	OC19 25/-
2X2 3/-	6J7G 4/6	12AT6 4/6	50CD6G 40/9	DAF91 3/6	ECF86 11/6	FC13C 17/-	PCL84 7/6	UCF80 8/9	W76 3/6	OC22 23/-
3A4 3/9	6J7GT 7/-	12AT7 3/6	50L6GT 6/3	DAF96 6/-	ECF804 24/-	FW4/500 6/6	PCL85 7/6	UCH21 8/-	W77 2/6	OC23 57/-
3A5 6/9	6J8 12/6	12AU6 5/9	52KU 14/6	DCC90 6/9	ECH3 23/3	FW4/800 8/6	PCL86 8/9	UCH42 8/-	W81M 5/9	OC25 12/-
3B7 5/-	6K6GT 5/6	12AU7 4/6	53KU 14/6	DD4 12/6	ECH21 9/-	GT1C 9/9	PCL88 12/6	UCH81 6/6	W101 26/2	OC26 8/-
3D6 3/9	6K7G 1/3	12AV6 6/6	72 6/6	DD41 10/6	ECH33 22/8	GU50 55/-	PEN40DD	UCL82 7/9	W107 10/6	OC28 23/-
3Q4 5/3	6K7GT 4/-	12AX7 4/6	77 5/-	DDT4 7/6	ECH35 6/3	GZ30 7/6	34/-	UCL83 9/-	W729 17/6	OC29 16/6
3Q5GT 7/-	6K8G 3/3	12AY7 9/9	78 4/9	DET25 7/6	ECH42 8/-	GZ32 8/-	PEN45 7/-	UF41 6/9	X14 7/9	OC35 9/6
3S4 4/6	6K8GTM 8/6	12BA6 5/9	80 5/3	DF33 8/6	ECH81 5/9	GZ33 17/6	PEN45DD	UF42 4/9	X18 8/-	OC36 21/6
3V4 5/3	6K25 24/-	12BE6 4/9	83 22/6	DF66 15/-	ECH83 6/6	GZ34 10/-	12/-	UF80 6/3	X24 16/6	OC41 8/-
4D1 3/9	6L1 10/-	12BH7 6/-	83V 8/-	DF72 30/-	ECH84 9/6	GZ37 14/6	PEN46 4/-	UF85 6/9	X41 10/-	OC42 5/-
5R4GY 8/6	6L5G 12/6	12E1 16/9	85A2 6/6	DF91 2/3	ECL80 6/-	H30 5/-	PEN383 10/3	UF86 9/-	X61 6/3	OC43 12/6
5T4 7/-	6L6GT 7/-	12H6GT 1/6	90AG 67/6	DF96 6/-	ECL82 6/6	HABC80 9/3	PEN453DD	UF89 6/-	X63 5/9	OC44 4/9
5U4G 4/6	6L7GTM 5/6	12J5GT 2/6	90AV 67/6	DF97 10/-	ECL83 9/6	HL2 7/6	10/-	UL41 7/3	X64 4/6	OC44PM 11/-
5V4G 8/-	6L18 10/-	12J7GT 7/3	90CG 42/-	DH30 15/6	ECL86 8/9	HL13C 4/-	PENA4 7/-	UL44 23/3	X65 5/6	OC45 4/9
5Y3GT 4/9	6L19 19/-	12K5 10/-	90CV 42/-	DH63 4/-	ECLL800	HL23 12/6	PEN/DD	UL46 8/6	X66 7/3	OC45M 8/-
5Y4 9/6	6LD3 6/6	12K7GT 3/6	90C1 16/-	DH76 3/6	26/2	HL23DD 5/-	. 4020 17/6	UL84 6/-	X76M 9/-	OC65 22/6
5Z3 6/6	6LD13 7/-	12K8GT 9/-	150B2 16/6	DH77 3/9	EF6 20/6	HL41 3/9	PFL200 20/5	UM4 15/2	X78 20/6	OC66 25/-
5Z4 7/6	6LD20 5/6	12Q7GT 3/6	150C2 4/6	DH81 23/3	EF9 20/6	HL41DD 12/-	PL33 9/-	UM34 16/10	X79 27/-	OC70 6/6
6/30L2 9/-	6N7GT 7/-	12SA7GT 6/9	161 13/-	DH101 25/-	EF22 6/6	HL42DD 12/-	PL36 9/-	UM80 8/3	X81M 29/1	OC71 6/6
6A6G 8/9	6P1 9/3	12SC7 4/-	185BT 34/11	DH107 16/11	EF36 3/3	HL133DD	PL38 16/-	UR1C 6/6	X101 23/6	OC72 8/-
6A8G 5/9	6P25 6/9	12SG7 3/-	215SG 6/6	DK32 7/9	EF37A 6/-	9/6	PL81 6/9	UU5 7/-	X109 26/-	OC73 16/-
6AB7 4/-	6P26 9/-	12SH7 3/-	220B 10/6	DK40 15/6	EF40 8/9	HN309 25/-	PL82 5/3	UU6 11/-	X118 8/9	OC74 8/-
6AC7 3/-	6P28 11/6	12SJ7 5/-	301 20/-	DK91 4/-	EF41 6/9	HVR2 8/3	PL83 6/-	UU7 7/6	X119 6/6	OC75 8/-
6AG5 2/6	6Q7G 4/-	12SK7 3/-	302 10/6	DK92 8/-	EF42 3/9	HVR2A 8/9	PL84 6/6	UU8 11/6	X142 8/-	OC76 8/6
6AG7 5/9	6Q7GT 7/9	12SQ7 8/-	303 15/-	DK96 6/6	EF50 2/6	IW3 5/6	PL500 15/9	UU9 5/3	Y63 5/-	OC77 12/-
6AJ5 8/6	6R7G 5/3	12SR7 5/-	304 15/-	DL33 7/-	EF54 3/-	IW4/350 5/6	PM84 9/3	UU12 4/6	Y65 5/-	OC78 8/-
6AK5 4/9	6R7GT 11/-	12U5G 7/-	305 13/-	DL35 5/-	EF73 5/-	IW4/500 6/-	PT15 10/-	UY1N 10/3	Z63 4/6	OC81 4/-
6AK6 6/-	6SA7GT 7/-	13D1 5/-	306 13/-	DL63 5/3	EF80 4/-	KBC32 20/5	PX4 9/-	UY21 7/9	Z66 7/3	OC81D 4/-
6AK8 5/9	6SC7 4/9	13D3 5/6	866A 12/6	DL68 15/-	EF83 9/9	KF35 12/6	PX25 8/6	UY41 5/-	Z77 3/-	OC81M 8/-
6AL5 2/3	6SG7 4/9	14B6 20/9	956 2/-	DL72 15/-	EF85 4/6	KL35 11/6	PY31 7/-	UY85 5/-	Z729 6/6	OC82 10/-
6AM5 2/6	6SH7 3/-	14H7 9/6	1203A 7/-	DL75 30/-	EF86 6/6	KLL32 21/7	PY32 8/9	U10 9/-	Z749 6/3	OC83 6/-
6AM6 3/-	6SJ7 4/6	15D2 6/-	1622 12/6	DL92 4/6	EF89 4/-	KT2 5/-	PY33 8/9	U12/14 7/6	Z759 36/-	OC84 8/-
6AQ5 5/9	6SK7 4/6	18 12/6	2101 12/6	DL94 5/3	EF91 3/-	KT8 15/-	PY80 5/-	U16 15/-	*Transistors*	OC139 12/-
6AR6 20/-	6SL7 5/3	19 10/6	4033 15/-	DL96 6/-	EF92 2/6	KT32 4/9	PY81 5/-	U17 5/-	*and diodes*	OC140 19/-
6AT6 3/9	6SN7 4/-	19AQ5 7/3	4687 71/-	DL810 10/6	EF97 10/-	KT33C 4/-	PY82 4/9	U18/20 6/6	AA129 4/6	OC170 8/6
6AU6 5/3	6SQ7 5/-	19BG6G 20/5	5763 7/6	DM70 5/-	EF98 10/-	KT36 29/1	PY83 5/9	U19 48/6	AC107 14/6	OC171 9/-
6AV6 5/6	6SR7 12/6	19H1 6/-	6067 10/-	DM71 9/9	EF183 7/-	KT41 7/6	PY88 7/3	U22 5/9	AC127 9/6	OC200 10/6
6B5G 12/6	6SS7 2/-	20D1 10/-	7193 1/6	DW4/350 8/6	EF184 7/-	KT44 5/-	PY800 6/-	U24 12/6	AD140 25/-	OC201 29/-
6B8G 2/6	6U4GT 8/6	20D2 21/-	7475 2/9	DW4/500 8/6	EH90 7/-	KT61 6/9	PY801 6/3	U25 8/6	AF102 27/6	OC203 14/-
6BA6 4/6	6U5G 5/-	20F2 11/6	9002 4/6	DY86 6/9	EK32 5/9	KT63 3/9	PZ30 9/6	U26 7/6	AF114 11/-	OC204 10/6
6BE6 4/9	6U7G 7/-	20L1 12/6	9006 2/6	DY87 8/-	EL2 19/6	KT66 12/3	QP21 5/-	U31 7/-	AF115 10/6	OC206 10/6
6BG6G 13/6	6V6G 3/9	20P1 12/6	A1834 20/-	E80F 24/-	EL32 3/6	KT74 12/6	QP22B 12/6	U33 13/6	AF116 10/-	OCP71 17/6
6BH6 5/3	6V6GT 5/6	20P3 12/-	ACO42 23/3	E83F 24/-	EL33 6/9	KT88 28/-	QP25 5/-	U35 16/6	AF117 5/6	ORP12 12/6
6BJ6 5/6	6X4 3/9	20P4 13/6	ACO44 9/-	E88CC 10/-	EL34 8/6	KTW61 4/9	QQVO3/10	U37 29/-	AF118 20/-	8X641 10/-
6BQ5 4/6	6X5 4/6	20P5 12/3	AC2HL 10/6	E180F 19/6	EL35 10/-	KTW62 5/6	30/-	U45 15/6	AF124 11/-	TS2 12/6
6BQ7A 7/6	6Y7G 12/6	25A6G 7/6	AC2pen 11/6	E1148 1/9	EL36 8/9	KTW63 5/6	QS7520 10/6	U47 8/6	AF125 10/6	TS3 15/-
6BR7 8/8	6Z4 5/-	25L6 4/9	AC2PEN/	EA50 1/6	EL37 12/3	KTZ41 5/6	QS150/15 9/6	U50 4/9	AF126 10/-	V10/15A 12/-
6BR8 8/-	6Z5G 15/-	25U4GT 16/2	DD 12/6	EA76 6/9	EL41 7/3	L63 3/-	R10 15/-	U52 4/6	AF127 9/6	XA103 15/-

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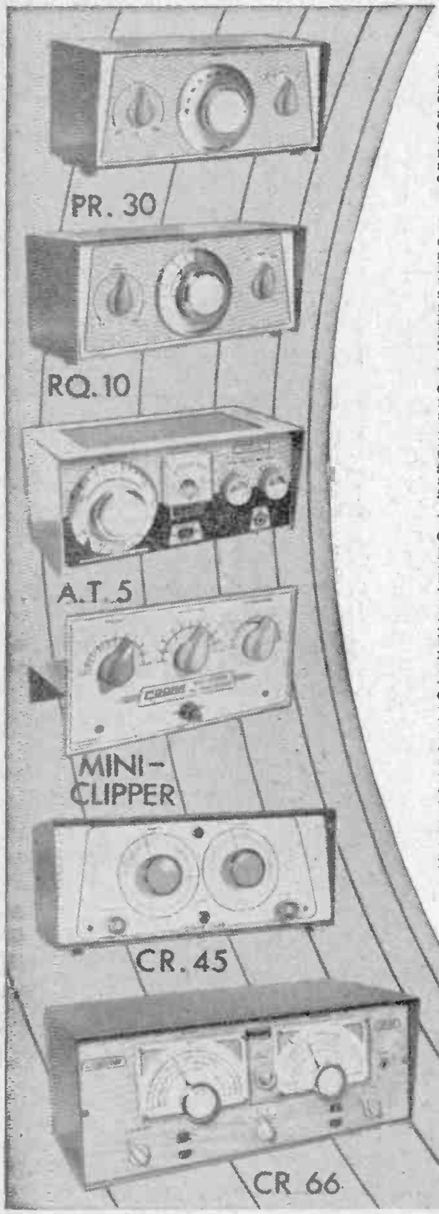

Advanced design and craftsmanship plus an unequalled reputation proved by the many hundreds of testimonials received from CODAR users is your guarantee of complete satisfaction. Only the best is good enough for CODAR—Mullard, Brimar, Jackson, Denco, Electroniques, Thorn, A.E.I., are just some of the famous names built into CODAR equipment. CODAR-KITS are supplied with clear pictorial diagrams and easy to follow instructions—no technical knowledge or special tools are required for complete success. Build your Short Wave Station with CODAR-KITS and enjoy peak performance and world wide reception previously possible only from much more expensive equipment.

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PRACTICAL WIRELESS

APRIL 1965
VOL 40 NO 698

ONE STEP AHEAD

THE transistor marches triumphantly on! There are still areas of application more suited to the use of thermionic valves, some of which must remain exclusively "valved" at least within the foreseeable future, but with new techniques, better materials, and improved performance, the family tree of semiconductors continues to flourish.

A mere nursery of devices has developed into a veritable forest during the past decade. One by one, the bastions of valved equipment have fallen to the persistent onslaught of the rapidly evolving semiconductor. We do not agree that, at the moment, transistors are *always* better or desirable, but it would be foolish to ignore the fact that they are still gaining ground and will continue to do so.

One stronghold of the valve is the television receiver, but even here the transistor is beginning to infiltrate. Tuners using transistors are a definite improvement and one or two sets using transistors throughout have appeared. The signs are ominous for the valve.

We have been keeping an eye on the situation. More than that, we have been quietly active. The result? A transistor TV receiver for the home constructor! Anyone at all interested in transistor circuitry cannot afford to be left behind by missing the details of this first-ever design for the amateur.

You can read all about it in this month's issue of *Practical Television*. And even if you have no intention of building the set, you will want to know what makes it tick. There is no commercial set yet available using transistors *and* a 14in. wide angle picture tube. Make sure you get with it—by ordering a copy of the April *Practical Television* now!

CONTENTS

All correspondence intended for the Editor should be addressed to: The Editor, "Practical Wireless", George Newnes Ltd., Tower House, Southampton Street, London, W.C.2. Phone: TEMple Bar 4363. Telegrams: Newnes Rand London. Subscription rates, including postage: 29s. per year to any part of the world.

ROUND THE WORLD of WIRELESS

NEWS AT HOME AND ABROAD

Radio Show Successor—The '65 Show

THE National Television and Radio Show has gone for ever it seems, and in its place comes "The '65 Show", or to give it its full title, "The '65 international television radio recordplayer disc taperecorder stereo hi-fi and musical instrument Show".

The organisers of the Show—Industrial and Trade Fairs Ltd.—plan a new "look" for the show as well as a new title. Emphasis this year will be on attracting the public, who will be admitted during all the open hours. (Last year at the National Radio Show public admittance was restricted to allow the trade time to entertain dealers in a relatively deserted Earls Court.) The one aspect of the show that has remained the same is its venue, Earls Court Exhibition Hall, London.

The dates of the show are August 25th to September 4th and the doors will be open from 10 a.m. to 10 p.m. each day except Sunday.

Perhaps the most noticeable change in the show—after the new name—will be the participation of manufacturers from abroad (see Round The World of Wireless, February issue). This innovation is expected to add fresh interest to the Show and make it one of the leading showplaces for the world's radio and television industry.

The 1965 P.W. Film Show

FRIDAY, February 5th was the occasion of the 1965 PRACTICAL WIRELESS and PRACTICAL TELEVISION Film Show.

Once again this year the show was well attended by readers from all parts of the country. Many in the audience had been coming to the show for years, but there were also plenty of new readers attending for the first time.

The show is held every year at the Caxton Hall, Westminster, London, in collaboration with Mullard Ltd., and readers of PRACTICAL WIRELESS are invited to attend free.

Because of ill health, the Editor of PRACTICAL WIRELESS, Mr W. N. Stevens, was unable to take the chair at the show, and his place was taken by the Assistant Editor Mr. L. E. Howes. After his address of welcome. Mr. Howes introduced Mr. A. T. Collins, the Managing Editor, and Mr. I. Nicholson (see photograph) of Mullard, the speaker for the evening.

Mr. Nicholson then introduced the first film, which was entitled "The Electromagnet Waves". After this, a short talk with film and slide accompaniment dealt with some recent cathode ray tube developments.

An interval of 25 minutes followed when there were refreshments for the audience.

Mr. I. Nicholson of Mullard Ltd., who was the speaker at this year's Film Show.

In the second half of the programme Mr. Nicholson gave a talk on "Current Topics and Present Trends" and had on display a number of new Mullard devices which fall into the microminiature class.

The evening ended with a question and answer session during which Mr. Nicholson replied to questions put by the audience.

NEW SCOTTISH V.H.F. RELAY STATION

THE BBC's new television and v.h.f. sound relay station which has been built near Grantown-on-Spey, Morayshire, was recently brought into service.

This new transmitting station will transmit the BBC-1 television programme and the three v.h.f. sound programmes. On v.h.f. horizontal polarisation will be used with the following frequencies: Scottish Home Service 94·2Mc/s; Light Programme 89·8Mc/s and Third Network 92·0Mc/s.

CARIBBEAN AND CHINA SEA CABLES

THE huge communications project for a large group of islands in the Caribbean announced by Cable and Wireless (West Indies) Ltd. last year, has been revised to take a link on to Bermuda. The new plans also provide for the re-routing of the tropospheric scatter links from Antigua to Tortola instead of St. Thomas.

The 900 nautical mile link from Tortola to Bermuda will be an 80-channel submarine telephone cable to be laid by the Cable and Wireless C.S. Mercury.

The revision of the scheme has put back the completion date some months and has added another £1·4 million to the estimated total cost of the project.

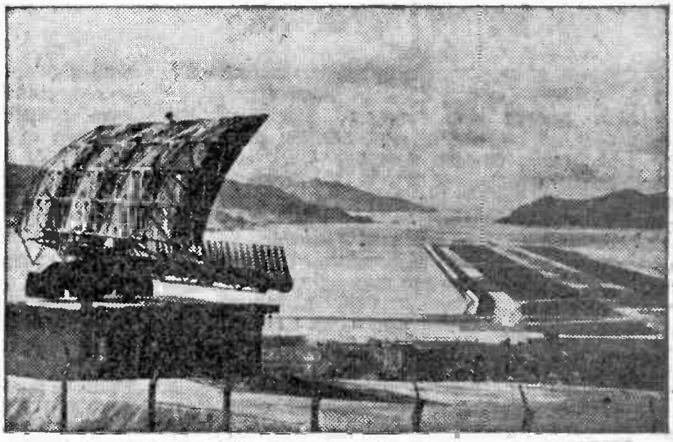
Originally it was planned to connect the Caribbean system to the United States by way of the 128-channel St. Thomas-Florida submarine telephone cable. Now that the terminal station will be sited on Tortola, a line-of-sight radio link will be introduced to span the 15 miles which separates this island and St. Thomas.

As work proceeds in the Caribbean, Cable and Wireless Ltd. in the Far East look forward to the opening of the Malaysia-Hong Kong section of the South East Asia Commonwealth telephone cable (SEACOM). The completion of SEACOM will be sometime in 1966, when a cable has been laid to link Hong Kong with Australia. At this time, the total length of submarine telephone cable in the SEACOM network will be some 6,500 miles.

Daylight Radar Display for Hong Kong Airport

This photograph is of Kai-Tak airport runway which extends far out into Hong Kong harbour. In the foreground is the aerial head of a Marconi 50 cm radar which provides information for recently ordered radar displays.

An important advantage of the new Marconi radar displays, which have also been ordered for Jersey airport, is that they present an accurate display in broad daylight. Aircraft positions within 10 miles of the runways during landing and take-off procedures are clearly visible under all lighting conditions, which is an important consideration in the "glasshouse" roof-top control towers of airfields where the ambient light level is very high.



World Politics Lead to Breakdown of African Radio Conference

AFTER only four days of discussion, the African L.F./M.F. Broadcasting Conference, organised in Geneva by the International Telecommunication Union, collapsed and was abandoned.

The Conference—the first at which newly admitted African nations were represented in sufficient numbers to out-vote the nations of Western Europe—had been arranged to draw up an African Broadcasting Plan; an African equivalent to the European Broadcasting Plan. However, the inaugural session saw the beginning of the end of the Conference, when the Algerian delegation proposed that the delegations of Portugal and South Africa be expelled from the Conference. The consensus of opinion of the African and East European countries was behind the Algerian proposal and despite a challenge from the United Kingdom delegate that the question was outside the competence of the Conference, the proposal was upheld in vote.

The Portuguese and South African delegations refused to acknowledge the ruling that banned them from the Conference and continued to attend. This eventually led to the walk out of many African delegations and thence to the breakdown of the Conference.

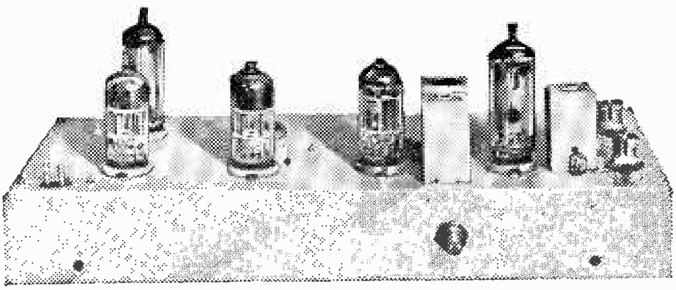
Equipment for S.H.A.P.E.

SUPREME Headquarters Allied Powers Europe (SHAPE) has selected Marconi transportable microwave link equipment for an Allied Command Europe (ACE), communications system requirement.

Marconi Italiana of Genoa, a subsidiary of The Marconi Company, will supply all the necessary equipment for a number of complete terminal and repeater stations providing either a single long-distance radio link or a number of independent medium-distance links.

The heart of this microwave system is a super-high-frequency, 300-channel, radio link transmitter/receiver, a number of which have been ordered together with a full range of ancillary equipment.

COVER SUBJECT



Distortionless reception of f.m. broadcasts with a "pulse-counter" discriminator associated with RC-coupled i.f. stages in a tuner of remarkable simplicity.

FIDELITY F.M. TUNER

WITH PULSE COUNTER DISCRIMINATOR

by W. Groome

IT is, of course, a mistake to assume that all v.h.f. is hi-fi. This seems to have been realised by those readers who requested details of the relatively unknown f.m. discriminator mentioned in my article in the October 1963 issue of PRACTICAL WIRELESS—a circuit that appears to be more suitable for quality reception than the conventional discriminators, which can produce as much as two or three per cent distortion.

This article has been unavoidably delayed both by other work and by the experiments needed in selecting from many possible variations the arrangements now given. There has been little or no commercial interest in the system but for the home constructor it offers uncomplicated circuitry, an astonishing absence of alignment work, and a standard of fidelity not available to most other listeners.

For an understanding of the system it must be recalled that the f.m. carrier is swung about the central frequency by the modulation. For example, at 100% modulation by a 50 c/s a.f. tone the carrier swings 75 kc/s each way fifty times per second. Therefore the number of carrier cycles reaching the receiver aerial changes from rapid to (relatively) slow fifty times per second. If the cycles could be made to set up voltages dependant only upon their rate of arrival in a given small period of time these voltages would rise and fall in a replica of the modulation wave-form.

To be accurately additive in a " counter " circuit the cycles must be identical in amplitude and duration at all frequencies. Sine waves are unsuitable because their widths vary with frequency, so it is necessary to convert the signal cycles into pulses which can be of fixed small duration. The conversion, at intermediate frequency, is not difficult. A method described by M. G. Scroggie, B.Sc., M.I.E.E. uses a pentode working with a fairly low anode voltage, over-driven by the i.f. sine-waves at its grid. In Fig. 1 the final valve (V5) and the simple network following it combine the functions of limiter and pulse-forming valve, discriminator, and de-emphasis network. Compare its simplicity with the corresponding circuitry of conventional receivers and note particularly the absence of the usual transformer which presents the formidable problem of alignment. Formidable indeed in the absence of professional gear, especially as audio quality is absolutely dependant, in conventional circuits, upon very accurate alignment.

When a valve is cut off the disappearance of current in a resistive load enables the anode voltage to rise sharply towards the full h.t. voltage. In the case of V5 (Fig. 1) the rise is modified by the capacitor C24; it is steep at first and then continues to rise exponentially. Beyond C24 the same initial sharp rise occurs but the exponential change is in the direction of decay. Here, then, the wave form is a spike having a steep, straight leading edge and a curved trailing edge. The pulses are substantially uniform in area and only the rate of repetition varies. The crystal diodes eliminate unwanted negative-going pulses and pass positive-going ones to the pulse-counter. This is merely a smoothing network in which the pulses lose their separate identities as they build up a.f. voltages additively.

The circuit necessitates some rather surprising departures from conventional practice in earlier stages but these, so far as construction and alignment are concerned, amount to welcome simplifications. As each pulse must be formed complete within a period rather less than the half cycle of i.f. signal during which V5 is cut off we must choose an intermediate frequency that allows sufficient time. For the circuit shown it must be centred at about 150 kc/s, which is indeed very low. but practicable.

Allowing for maximum deviation of 75 kc/s each way at full modulation and 25 kc/s for drift we can have a 200 kc/s bandwidth from 50 to 250 kc/s, and be safely clear of the highest audio frequency and of any switching tone likely to be included in future stereo transmissions. A higher i.f. and wider band are possible with a multi-stage limiter but for the present we shall concentrate on driving the economical single pentode.

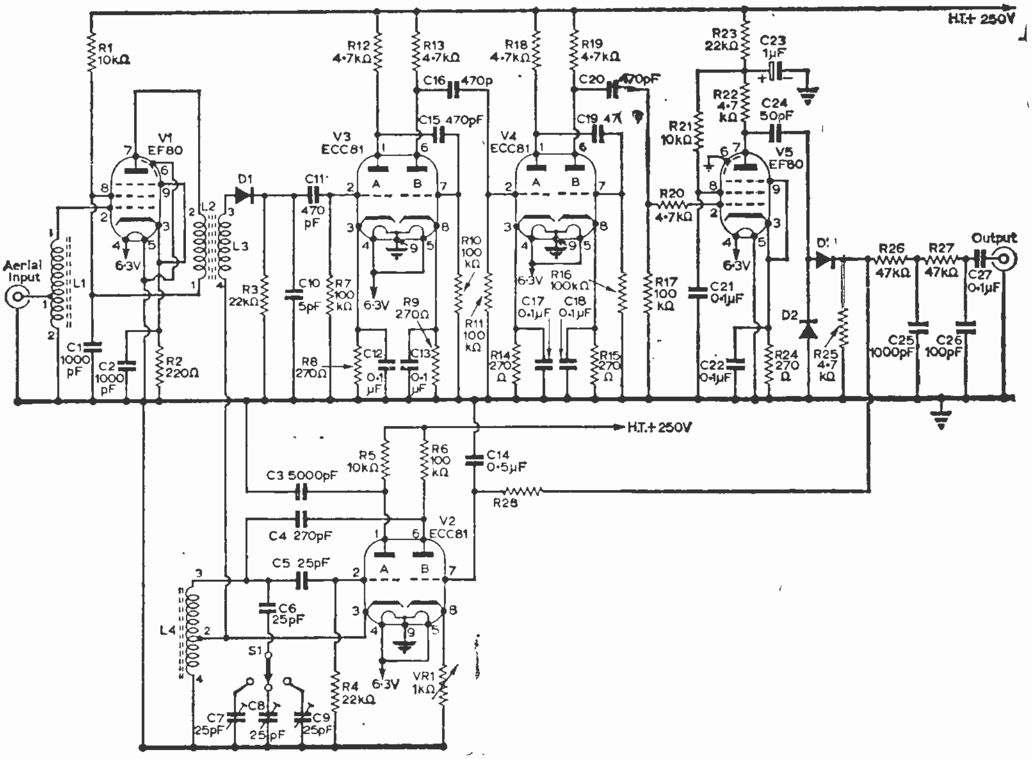


Fig. 1: The circuit of the tuner which incorporates a pulse counter discriminator and RC-coupled i.f. stages.

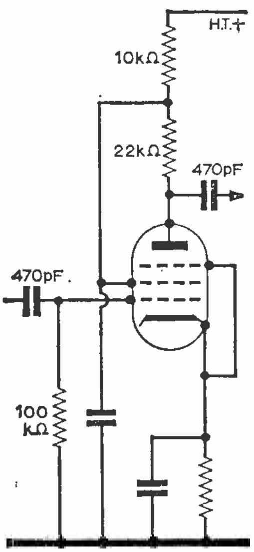


Fig. 2: An alternative pentode i.f. stage.

For wide-band amplification at kilocycle frequencies r.c. coupled i.f. stages are as good as heavily damped tuned circuits and permit the simple and cheap arrangement shown in Fig. 1 (V3, V4). The saving of the cost of i.f. transformers justifies the use of two double triodes in a four-stage amplifier that provides enough gain for any reasonable reception area. Valve for valve, double triodes give more gain than single pentodes (and for about the same number of components) but for those who would like to try EF80 valves the circuit of one stage is shown in Fig. 2.

Moving towards the front end there is the question of frequency conversion for an i.f. of 150 kc/s., which represents a difference between signal and oscillator frequencies of less than one-fifth of one per cent, too slight for reliable operation. The oscillator can, however, be run at half or one-third of the required frequency and still provide that frequency as a harmonic that will be immune from pulling or any other unwanted influence by the signal. Another method would be to adopt the double-superheterodyne principle to achieve conversion in two reasonable operations, but the complex circuit would bring back the alignment problem.

Harmonic operation is used in Fig. 1. For a range extending approximately from 88 to 96 Mc/s the fundamental frequency ranges are 44 to 48 Mc/s for second harmonic and 29 to 32 Mc/s for third harmonic. The former must be strictly avoided in areas served by channel 1 and channel 2 television, where third harmonic is preferable, but should be used in all other areas. In all superhets oscillator radiation has to be suppressed by suitable canning and screening and by using a buffer r.f. stage to prevent energy reaching the aerial (for which purpose a pentode as used in this tuner is more effective than a triode). The final precaution is to choose an oscillator range clear of frequencies in local use, hence the alternatives given above. Details of oscillator coils for both second and third harmonic generation are given in Table 1.

In Fig. 1 a modified Hartley oscillator V2a and a simple crystal mixer work sweetly with the unconventional combination of low i.f. harmonic mixing and resistive mixer load, and it is not intended to suggest any alternative to this cheap and reliable arrangement. The spare triode V2b provides a.f.c. and receives its control voltage from the discriminator network, VR1 being set to establish the reference voltage.

As the aerial and r.f. anode circuits tune broadly enough to cover the entire band only the oscillator is varied for station selection, and with only three programmes available in any area it is convenient to use pre-set capacitors selected by a ceramic three-way switch. However, if some extra gain is really needed or the r.f. tuning is not as broad as required L3 can be tuned by small pre-set capacitors switched between anode and the junction of R1 and C1 using separate contacts on S1 or ganged switches. Care would have to be taken to avoid long connections that could upset the tuning and possibly lead to instability.

Details of all coils are given in Table 1. Those for the aerial and r.f. anode circuits are conventional and it is likely that ready-made components suitable for a pentode can be used. However, I have not tried any specific make. The oscillator coil (L4) will probably have to be made in any case, but it is an easy one to wind and adjust. As the aerial is connected to the chassis both directly and via the tapped coil (L1) the tuner is intended for use only with a.c. equipment powered by a double-wound mains transformer, as is usual with good quality audio apparatus.

For "elbow room" during experimental work the chassis shown in the photograph was made rather large; a suitable size would be about 10in. x 4in. The depth is determined by the size of the switch fitted below the deck for screening. The front end wiring must conform with good v.h.f. practice —small components, short and rigid connections, single-point stage earthing, valveholders of good v.h.f. quality. Conditions are far less stringent in the remaining stages provided the components and wires are well positioned to avoid stray capacitance.

"Alignment" with this circuit is simply a matter of locating the three programmes with the oscillator capacitors C7, C8, C9 and then adjusting the aerial and r.f. anode coils for optimum results, staggering them if necessary. Have a television receiver tuned to the BBC during this work and if it indicates interference you will know you are using the wrong oscillator fundamental frequency, either through using the oscillator coil not intended for your area or through serious error in other components.

The three programmes should be tuned in when the dust core is screwed at least half way into the coil; if the inductance cannot be reduced sufficiently by unscrewing it remove one turn from the grid end of the coil. The tap will not require adjustment generally. It is possible that some such adjustment might be necessary with the third harmonic coil to be used in channel 1 or 2 areas. As I live in a channel 4 area my tests have necessarily been confined to the second harmonic inductor.

Each programme appears at two settings (signal plus i.f. and signal minus i.f.) because of the low intermediate frequency: the correct point is, of course, that which is corrected by a.f.c. and not driven off by it. VR1 is adjustable to set the reference voltage for a.f.c. Very sharp r.f. tuning suggests positive feedback; check screening and decoupling.

Background noise with a weak signal disappears as tuning brings the amplitude above limiting level. As with all f.m. receivers serious mistuning brings a.f. distortion. If the full bandwidth is achieved tuning is not critical and the unit is tolerant of reasonable drift provided the oscillator components are reliable, firmly anchored and not exposed to heat. The coil turns may be doped lightly to prevent movement and C6 should be of the negative temperature co-efficient type.

For good limiting the h.t. voltage to V5 should be fairly low and the purpose of R23 is to drop it to a suitable value. In some units it may be

TABLE 1 COIL DATA

Coil	No. of Turns	Spaced To Length	swg	Insulation	Details	Base ref.
L1	3¼	½in.	18	Bare	Tap 1 turn from earth end	1—Tap 2—Earth 3—Blank 4—Grid
L2	3½	—	26	DSC	Close bi-filar windings	1 & 2—primary
L3	3½	—	26	DSC		3 & 4 secondary
L4	13	¾in.	22	Enam.	Tap 4 turns from earth end	1—Blank 2—Tap 3—C4, C5, C6. 4—Earth
L5	10	⅝in.	22	Enam.	Tap 3 turns from earth end	As above

NOTE.—The 13-turn oscillator coil L4 is for channel 1 and channel 2 areas only; the 10-turn coil is for all other areas.

necessary to reduce the value of this resistor. Avoid increasing the i.f. anode loads for higher gain because this will reduce the bandwidth. So too will positive feedback. This has not been evident in experimental units, but if necessary R12 and R13 could together be decoupled from the h.t. line by a 2·2kΩ resistor and 0·1μF capacitor. The main limit to bandwidth is the speed with which V5 can produce pulses and this can be improved to some extent by reducing C24, provided a reduction in output can be tolerated.

Faster action can be achieved by passing the i.f. signal through a separate limiter before applying it to the pulse-forming valve as a partly squared wave capable of snapping it to cut-off at the very commencement of the operative half-cycle, avoiding the delay caused by the gradual slope of a sine wave. Retaining the final valve and counter circuit of Fig. 1, a cathode-coupled limiter has been added, as shown in Fig. 3, which makes tuning uncritical and a.f.c. unnecessary. This releases V2a for other use, such as an extra i.f. stage, an a.f. voltage amplifier or a cathode follower. In a really good reception area this might enable the two i.f. stages shown as V4 to be eliminated, leaving V2a, V3a and V3b to form a three-stage amplifier. As a matter of interest, and an indication that the pulse-counter discriminator is by no means a recent idea, it may be mentioned that an American design published about ten years ago used three cathode-coupled limiters to permit a 500kc/s i.f. easy tuning and a very high capture ratio to cope with the adverse conditions of mobile reception.

Constructional Details

The photograph of the f.m. tuner on this month's front cover shows the original prototype design and the tuner underwent a number of minor changes whilst the author endeavoured to arrive at a circuit arrangement suitable for this article.

The lay-out of the i.f. and discriminator stages is in no way critical because the i.f. frequency is so

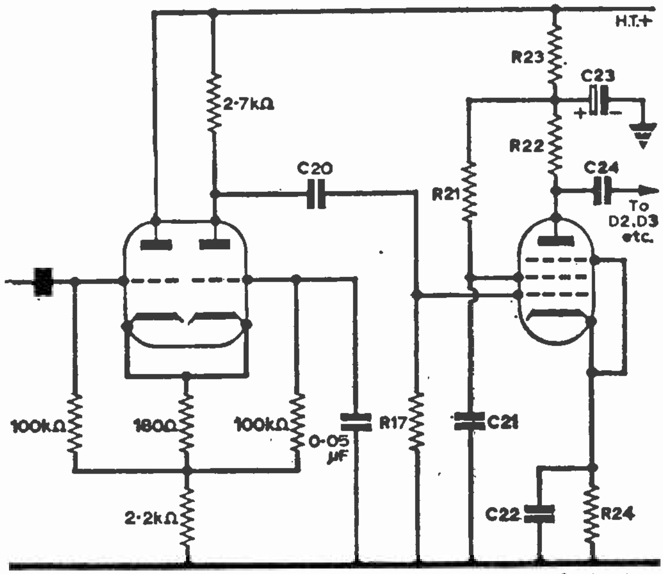


Fig. 3: Modification to include a separate limiter stage. The final valve and circuitry remain as in Fig. 1.

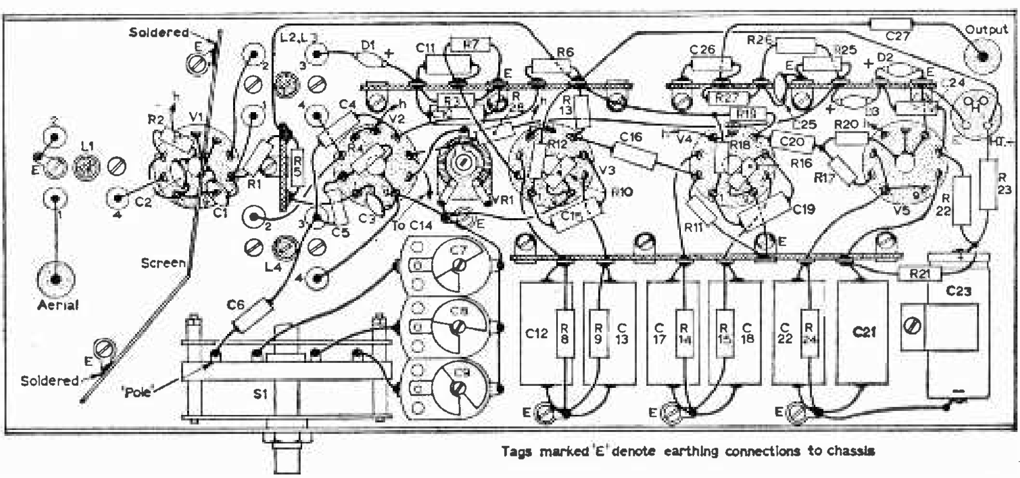


Fig. 4: A view of the underchassis of the tuner ('h' denotes heater line which should all be joined together and taken to 6·3V supply). All the wiring is carried out on this side.

COMPONENTS LIST

Resistors:

R1	10kΩ	R15	270Ω
R2	220Ω	R16	100kΩ
R3	22kΩ	R17	100kΩ
R4	22kΩ	R18	4·7kΩ
R5	10kΩ	R19	4·7kΩ
R6	100kΩ	R20	4·7kΩ
R7	100kΩ	R21	10kΩ
R8	270Ω	R22	4·7kΩ
R9	270Ω	R23	22kΩ (see text)
R10	100kΩ	R24	270Ω
R11	100kΩ	R25	4·7kΩ
R12	4·7kΩ	R26	47kΩ
R13	4·7kΩ	R27	47kΩ
R14	270Ω	R28	2·2MΩ

All 10% $\frac{1}{2}$W carbon.
VR1 1kΩ potentiometer.

Capacitors:

C1	1000pF ceramic
C2	1000pF ceramic
C3	5000pF ceramic
C4	270pF ceramic
C5	25pF ceramic
C6	25pF cerami : negative temperature coeff.
C7	25pF trimmer
C8	25pF trimmer
C9	25pF trimmer
C10	5pF ceramic
C11	470pF ceramic
C12	0·1μF paper
C13	0·1μF paper
C14	0·5μF paper
C15	470pF ceramic
C16	470pF ceramic
C17	0·1μF paper
C18	0·1μF paper
C19	470pF ceramic
C20	470pF ceramic
C21	0·1μF paper
C22	0·1μF paper
C23	1μF electrolytic
C24	50pF (see text)
C25	1000pF ceramic
C26	100pF ceramic
C27	0·1μF paper

Valves:

V1	EF80	V4	ECC81
V2	ECC81 (see text)	V5	EF80
V3	ECC81		

low, and can conform with ordinary a.f. practice. No instability has even been experienced in these stages. In the lay-out diagram an "in-line" arrangement was adopted with tag-board mounting for simplicity. The r.f. stage is conventional, the output (right side of compartment screen) having leads of 1in. and less to L2/L3. The plan view however spreads the switch and pre-set capacitor positions, and shorter connections are possible if the latter are "hidden" under the circular switch.

A component and wiring layout diagram is as useful to the experienced experimenter as to the beginner, for it saves the time of planning and avoids the "birds-nest" appearance of alterations. Fig. 4 gives a suitable lay-out for the pulse-discriminator tuner of Fig. 1, using an aluminium chassis measuring 10in x 4in., with depth to suit the switch. To give an unobscured view of all connections the tag strip groups have been expanded slightly while still allowing the positions of components and wires to be realised. For the same reason three components whose positions are not critical, and the heater wiring, have been omitted but will be described.

Remember, when marking out the chassis, that left-to-right in Fig. 4 becomes right-to-left from the top view. The valveholders are at $2\frac{3}{4}$in. centres on a common line $2\frac{3}{4}$in. from the front edge and all five are fitted with tags 1 and 9 facing the front. Fit the aerial coil on the common centreline, and the other two centred $\frac{7}{8}$in. either side of the line with the oscillator coil nearest the switch. Centre the switch $2\frac{3}{4}$in from the end of the chassis front.

One of the purposely omitted components is the potentiometer VR1, a small pre-set carrying d.c. only that can be fitted anywhere on the back of the chassis except in the r.f. compartment. Connect the centre contact and one other to earth and the third to tag 8 on V2 as shown by an arrow in Fig. 4.

A tinplate screen across V1 valveholder is soldered to the centre contact and to two chassis tags. Make sure it passes cleanly between tags 1 and 9 without touching either. The mixer, pulse-counter and i.f. bias networks are grouped on tag-strips of the well-known type having multiples of two isolated tags and one earth fixing lug; the lengths and positions of these strips will be readily ascertained from the diagram. One side of the heater circuit is earthed in the usual way, leaving only the 6·3V line to be connected, from the power input connector to tag 4 of V5, then to tags 4 and 5 (commoned) on each of the three double-triodes, and finally to tag 4 of V1. As heater wiring is sometimes troublesome in r.f. and oscillator stages these valves should be fed from above the chassis through grommets or feed-through capacitors near to the appropriate tags.

Tag by tag description of the wiring is not necessary but it is worth while to make a few points clear. A small tag-strip between V1 and V2 provides anchorage and connection to h.t. positive for R1 and R5, the latter being connected by wire to tag 1 (anode) on V2. Still with V2, the capacitor C4 from tag 6 can reach its connection to C5 and C6 directly across the valveholder rather than around as shown for clarity in the diagram. The arrow at tag 7 indicates a connection to a capacitor (C14) that has been omitted to leave a clear view of other items. It can be left until near completion of the wiring, when it can cross over other components for anchorage at any tag-strip earth point. As R28 is anchored at only one end it can, if necessary, be supported by taping to C14. The lead from R28 is not connected to any of the wires it crosses on the way to its real connection to R25 in the pulse-counter network. Tag 8 on V2 is wired to the potentiometer; tag 9 is earthed to a nearby chassis tag.

Leave enough wire on the crystal diodes to prevent prompt transfer of soldering heat to the crystal and to enable a heat shunt to be used. The mixer network (D1, R3, C10) is mounted on a tag-

—continued on page 1170

The IONOPHONE

BY A. E. FALKUS, B.Sc.

A Loudspeaker without a Diaphragm

SINCE loudspeakers first became of practical use with the development of audio amplifiers, many different types of construction have been tried. The basic plan of the great majority has been to start with some form of diaphragm, which will set air in motion, and to drive this with some form of motor, which may take the form of a moving iron, moving coil, or piezo-electric crystal unit.

Alternatively, the diaphragm may be driven by electrostatic forces acting upon it directly or the diaphragm may be in the form of a ribbon situated in a magnetic field and driven directly by magnetic forces induced in it by currents passing through it.

Inertia

Unfortunately, all diaphragms must have mass and, hence, inertia which causes them to lag behind changes in the driving forces and to continue moving after these forces have ceased. Further, all diaphragms must have some stiffness which implies that there will be certain frequencies at which they will resonate, either as a whole or in part, thus colouring the response with their own contributions. One well-known phenomenon which produces sound without the use of a diaphragm of any sort is the singing arc.

Corona Effect

It has also been noticed that if a corona discharge takes place from a point in the high voltage circuit of a radio broadcast transmitter, the sound of the programme can be faintly heard coming from the corona. A French inventor, Mr. Siegfried Klein, of Paris, conceived the idea that if this corona could be confined in a small space connected to a suitable horn a loudspeaker would result which would be completely free of all resonances and which would work equally well at all audio frequencies.

Mr. Klein started by building a 100kc/s oscillator with provision for modulating at audio frequencies. He then drew a piece of quartz glass tubing down to a point at one end and sealed in a platinum wire. This was connected to the high voltage terminal of a resonant coil in the output of the oscillator. By adding a small earthed metal strip around the outside of the quartz tube a blue glow discharge was caused inside the tube.

On modulating the oscillator at audio frequencies, sound could be heard coming from the tube and by butting the open end of the tube against the throat of an exponential horn, the Ionophone loudspeaker was born.

Initial Difficulties

A number of difficulties were encountered in trying to make the Ionophone a practical proposition. In the first place, there was a background hiss. This was found to disappear when the frequency of the oscillator was raised from 100kc/s to a minimum of 2 or 3Mc/s.

A further difficulty arose after a few hours running. This was caused by the platinum vapourising from the electrode and depositing on the walls of the quartz tube. When this deposit had built up into a conducting film, the corona discharge which had filled the inside of the tube was replaced by a high frequency arc from the electrode to a single point of the film and the audio output dropped suddenly to a very low level.

By this time, Mr. Klein had taken out world patents for the Ionophone and granted licences in a number of different countries, and it was Messrs. Telefunken, of West Germany, who solved the problem of the electrode. They found that replacing the platinum wire by one of kanthal overcame the volatilisation problem. Kanthal is an alloy of iron, chromium and aluminium and was developed in Sweden for the heating elements of electrical furnaces.

Failure to Discharge

The last difficulty that prevented the Ionophone becoming a reliable proposition was the fact that very often, particularly after a few hours use, the ionic discharge failed to start when the unit was switched on. This was found to be due to an effective change in electrical capacity of the cell when the discharge is taking place compared with its value when quiescent.

Thus, if the oscillator circuit is tuned to resonance when the cell is working, it will be considerably off resonance when the speaker is next switched on from cold. There is, therefore, a likelihood that the voltage will not build up sufficiently for the discharge to commence.

This final difficulty was overcome by Messrs. Du Kane Corporation, in America, who rearranged the oscillator circuit so that the earth electrode of the cell now returns directly to the grid of the oscillator valve. In this way, although the fundamental frequency of the oscillator changes when the discharge commences, the coil continues to oscillate at peak resonance at all times.

Frequency Response

Because the Ionophone must of necessity be a horn loaded device, its frequency response is simply the response of the horn which is used with it. When this is an exponential horn of very large size it will cover the full audio range but as a practical proposition, with a horn that can be accommodated in a domestic enclosure, it is restricted to the middle and upper frequencies.

At the present time it is available only as a tweeter for use above 3·5kc/s although a mid-range unit is a possibility at a later date.

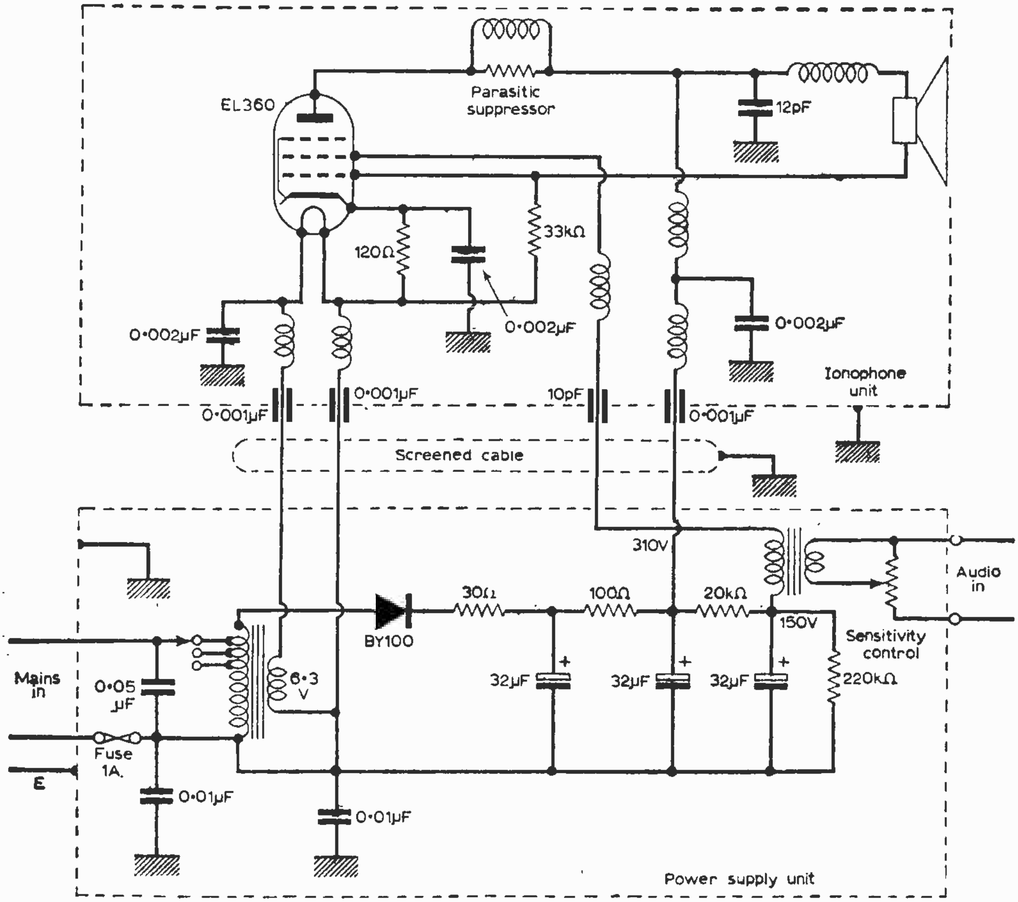


Fig. 1: The basic circuit of the Ionophone loudspeaker system.

Basic Circuit

The basic circuit of the Ionophone is given in Fig 1. The oscillator valve is of the pentode type and is screen modulated. The input audio power is, therefore, negligible and the modulation transformer is wound so that the overall sensitivity of the device is a match for the average good quality bass and mid-range loudspeakers.

The frequency of the oscillator is 27Mc/s. This frequency was chosen because it is low enough to enable the valve to work at high efficiency and is yet high enough to permit a reasonable sized high-Q coil to be used and for effective screening to be easily arranged because, of course, it is important that no radiation be emitted from the equipment that could cause interference.

The valve used is the EL360 which has an anode dissipation of 15W. This can produce a sound level which balances the output of a good mid-range and low frequency speaker supplied with 20W input. The Ionophone is, thus, easily capable of supplying the high frequency component of a high fidelity speaker combination for any domestic or small public address application.

The horn used in the Ionophone has a true exponential flare and is designed for a cross-over frequency of 3,500c/s. The mouth is a narrow ellipse which should be mounted with the major axis vertical to give a good horizontal dispersion of sound.

Mechanical Details

As mentioned above, the electrode is made of kanthal. It is no longer sealed into the quartz but fits accurately into a hole bored through from the back face of the cell. An improvement in efficiency has been achieved by reducing the diameter of the electrode behind the working point to form a short neck which reduces the heat loss by conduction along the body of the electrode.

The material for the cell in which the ionic discharge takes place is high quality quartz. The requirements are that this material must have high insulation and low loss when working at 27Mc/s at high temperature. Further, it must be able to withstand severe thermal shock. When the discharge starts, the temperature inside the cell suddenly rises by some 500° C.

Pure alumina has been tried but always cracks after a short time and pure quartz with its very low coefficient of thermal expansion is the only material that has been found satisfactory. The cell is ground to an accurate contour by ultra sonic methods.

It has been found possible to reduce the required length of the quartz cell considerably by a continuation member or bush of frequelex. This bush of frequelex is actually the first part of the throat of the horn and the internal bore increases along it in accordance with the exponential law of the horn proper against which it abutts.

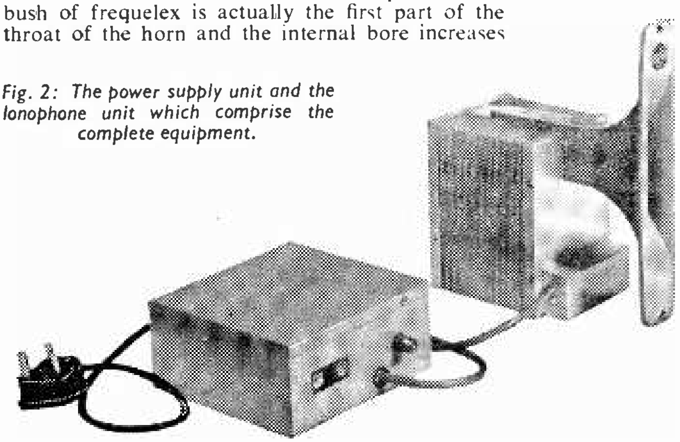


Fig. 2: The power supply unit and the Ionophone unit which comprise the complete equipment.

Power Supply

The Ionophone consists of two parts (see Fig. 2). The power supply unit is built in a metal case, measuring 5⅞in. x 5⅞in. x 2½in. and contains the mains transformer, modulation transformer, and high tension supplies for the oscillator and would normally be mounted on the floor of the speaker enclosure.

The Ionophone requires a mains supply of about 50W at 200, 220 or 240V. While the unit is working there is a small amount of ozone produced by the cell which escapes from the mouth of the horn. This can usually only just be detected by smell in the immediate vicinity of the instrument and has a beneficial effect in freshening the air of the room. There are no X-rays or other harmful rays of any sort produced.

The guaranteed life of the Ionophone is 1,200 hours. This corresponds to some two years of normal use. Eventually it may be necessary to replace the quartz cell and electrode. This can easily be done by the user; and spare cells and electrodes (see Fig. 3) are available at a modest cost.

No Colouration

The supreme virtue of the Ionophone is its perfectly linear frequency response, perfect transient response and complete absence of all colourations and resonances. Not only is the response uniform at all frequencies within the pass band of the horn but it is also directly proportional to the input at all levels up to the point where the oscillator valve commences to overload, i.e. where the modulation approaches 100 per cent.

If the audio input is increased beyond the point at which 100 per cent modulation of the radio frequency oscillator occurs, the effect is to cause the valve to cease oscillating for a portion of each audio cycle, thus causing a flattening of the lower portion of the output sound wave form and although the sound level still increases it will, of course. contain some harmonic distortion.

In practice, the Ionophone is always used well below the 100 per cent modulation point but it is surprising how little unpleasantness it introduced by even very heavy overloads.

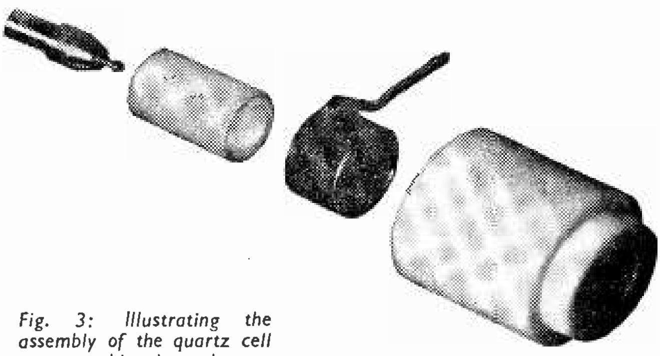


Fig. 3: Illustrating the assembly of the quartz cell and its electrode.

The Ionophone response extends, of course, up into the supersonic regions and it will reproduce 50kc/s just as happily as 5kc/s. When used with a good pick-up and amplifier in conjunction with suitable bass and mid-range units there is a freshness and naturalness about the reproduction which is in quite another class from any other that the author has heard.

Immune to Overload

Another good feature, which will be of particular interest to those who have tried to use

—continued on page 1194

PART THREE

CABINET AND CHASSIS TECHNIQUES

BY F. L. THURSTON

ONE of the most striking advances in the chemical industry in recent years has been in the field of synthetic materials and resins. Amongst these advances has been the introduction to the home constructor of glass fibre techniques, which have, for some reason, been given little attention by radio amateurs although they have many advantages in cabinet construction, and are now coming into use use in the commercial electronics field.

One of the leading manufacturers of glass fibre kits in this country is Bondaglass Ltd., of Croydon, to whom the writer is indebted for much help in preparing this section of the series.

The basic process of making glass fibre laminates consists of using a resin, which is normally in a semi-fluid state but which can be made to set hard in a fairly short time by the addition of a catalyst. The resin is brushed, after the addition of the catalyst but while still in the semi-fluid state, into a glass fibre cloth or mat that has been set to the required shape over a mould.

The resulting laminate when set or cured is extremely strong, light in weight, has good electrical resistance and insulation properties and is resistant to most chemicals.

Laminates can be made to almost any shape, three dimensional forms being easy and inexpensive to make, using a minimum of equipment. Fittings, including wire mesh for screening, can be moulded into the laminates, which can be worked in the same way as aluminium.

With care a smooth surface can be obtained on the laminates, and surface flaws can be easily rectified by filling them in with more resin. Complete changes in the design of a finished article can be made by cutting out the offending area, and moulding in a new one.

Pigments can be added to the resin to produce a wide range of self-coloured laminates, which can, in any case, be painted or cellulosed in the normal way.

The Bondaglass resin is a blend of cold setting polyester resins and accelerator, and after the addition of the catalyst the setting time is divided up into three distinct periods. The first is the "working time", in which the resin is liquid, followed by a period in which it reaches a thick consistency and by which time all tampering should have ceased, and finally, the setting or curing period.

These times can be controlled to a large degree by ratio of catalyst to resin fix. Full information is given in the manufacturer's literature, supplied with the kits. The setting time, unlike paints, is independent of thickness of application and only the exact amount of resin needed should be mixed at one time.

Incorporated in the above resin is a thixotropic resin, which prevents running of the mix, even on a vertical surface, when in the fluid state.

There are three basic types of glass fibre; mat, cloth and scrim. Mat consists of chopped strands jumbled together and loosely bonded and is graded by weight, being sold in lengths one yard wide. There are three weights (1, $1\frac{1}{2}$ and 2oz.) the 1oz. type forming a laminate $\frac{1}{16}$in. thick when saturated with resin and using about $2\frac{1}{2}$lb. of resin per square yard.

Cloth is made of woven glass fibre and gives great strength. It is sold by thickness, ranging from 3 to 15 thousandths of an inch, the latter having an open weave and being known as scrim. The amount of resin used per square yard ranges from $\frac{1}{2}$ to 1lb. Tape is also available. Where extra thickness is required (or weight is to be kept to a minimum) knitted paper cloth or paper rope may be sandwiched into the laminate.

Cloth gives great strength to a laminate but is a fairly expensive way to build up a given thickness, mat being far less expensive. It is thus general practice to use a cloth next to the surface of the laminate, giving the twin advantage of good strength to the first coat of resin and a good surface finish, mat being used for the remaining layers.

Moulds

The laminates must be built up on a firm surface of some kind. Plain sheet laminates can be built up on a working surface of glass, but in most other cases it will be necessary to make a mould.

The resin has very powerful adhesive qualities, and to prevent sticking between mould and laminate it is essential to coat the entire working

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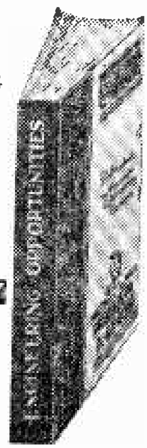

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surface with a release agent, which is supplied in the kits and is also available directly from Bondaglass Ltd.

It is very important to realise that the degree of finish obtained on the laminate will be exactly the same as the finish on the working surface of the mould, and a certain amount of trouble taken in the preparation of the latter will be well repaid.

Moulds are known as either male or female. If, for example, a cup is used as a mould, and the laminate is built up on the cone-like outer surface, the mould will be referred to as "male". If the laminate is built up on the inside of the cup, the mould is known as "female". Generally, it can be said that if a good outer surface finish is required, a female mould should be used, and the male used for a good inside finish.

If several identical laminates are to be made, the mould should be of robust construction, but for "one-off" jobs the mould can be made from any material that is at hand, such as bricks, plaster, plasticine, cardboard, wire netting, etc., as long as the resulting mould is strong enough to withstand the application of the first layer of glass fibre and resin.

After the first layer, of course, the mould will have done its job and the dried layer will act as the mould to subsequent layers. An advantage of the roughly constructed mould is that it can, if necessary, be easily broken down to release the laminate.

In some cases it may be necessary to make a "split" mould. This would be essential, for example, in the case of an object such as a vase, in which the centre bulges out to a diameter greater than the lip.

If both surfaces of the laminate must have a smooth finish, a knifing compound such as Bondafiller can be used to coat the rough surface and, after drying, can be rubbed down to give a smooth finish.

Generally speaking, a female mould will be far more difficult to make than a male, and the simplest approach to the problem is make up a male and then take a plaster cast from it. When the plaster has dried it should be treated with a stopping agent to make it non-porous, and its surface finished off smooth with a wax polish. A similar technique can be used for duplicating components, such as control knobs, handles, cabinets, etc.

A Practical Example

The best way to explain the method of making a glass fibre laminate is with a practical example, and for this purpose we have selected the cabinet type of Fig. 10 (Part 2, last month), the actual working example being shown in Fig. 14. The design includes moulded-in screening and mounting brackets.

The first step is to make the mould. As a good outer surface is required, a female mould is needed. (Note that, if the cabinet were to be finished with a covering or Rexine, in which case a good surface finish is not needed, a male mould could be used.)

The dimensions shown are the inside ones, so when making the mould allowance must be made for the thickness of the laminate, which may be taken as ⅛in. all round. A male mould is now made up, as shown in Fig. 15, making the depth of the sides, etc., greater than is needed, to allow for trimming of the finished laminate.

Finish the working surface off smooth, and then make a female mould from the male. This is done by making up a box into which the male can be fitted, blocking off the side openings of the male, and, after suspending the male inside the box, fill the area *around* the male with plaster of Paris. When the plaster is dry, remove the male (it may be necessary to break it up in the process), and stop and polish the inside of the remaining female mould as already indicated.

The glass fibre cloth is now cut to size, and a quantity of resin just sufficient for the first coat measured out and mixed. The entire working surface of the mould is now coated with release agent, brushed on, and followed by a single layer of resin, brushed evenly over the entire surface with an ordinary paint brush. Note that no glass fibre is used at this stage.

Place the mould to one side and clean the paint brush in meths or thinners. As soon as the painted-on layer of resin begins to gel, brush a second coat of mixed resin on to it and then lay down the glass fibre cloth and dab it into the resin layer, drawing

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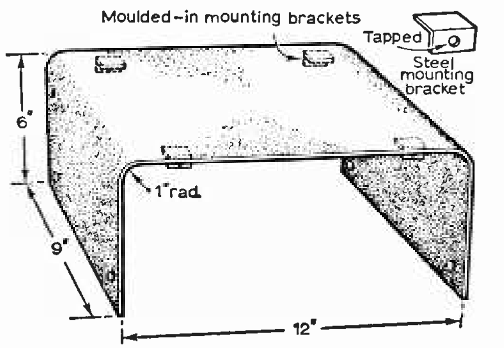

Fig. 14: An example of a cabinet cover which can effectively be made from glass fibre laminate.

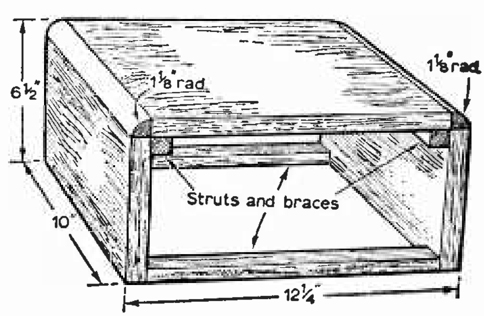

Fig. 15: Construction details of the male mould used as a former for the cover shown in Fig. 14.

S.S.B. RECEPTION FOR THE R1155

by J. M. McKinney

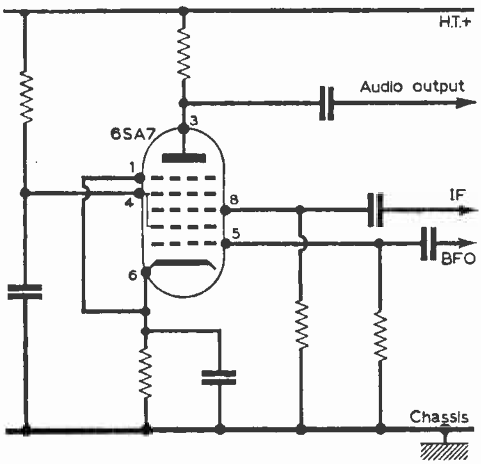

Fig. 1: The basic product detector circuit.

WITH the present popularity of s.s.b. transmission, particularly on the 80 metre band, it was decided to fit a product detector to the R1155 so that it could be utilised for s.s.b. reception. This ex-R.A.F. receiver has been used by the author for some time now, and with modifications including a Q multiplier and stabilisation of local oscillator and b.f.o. has proved very satisfactory.

It was particularly easy to fit a product detector (p.d.) to this receiver as next to the double diode triode (d.d.t.) was a valveholder which formerly held a double triode as part of the original direction-finding section and was therefore not now being used.

As can be seen from Fig. 1 a p.d. is a mixing device in which the s.s.b. signal being received is combined with the b.f.o. injection and the resultant audio signal is taken off at the anode. In actual fact, the b.f.o. is supplying a signal of the same frequency as the suppressed carrier of the transmitter. It is the most efficient method of s.s.b. and c.w. reception and shows a marked improvement in the reception of both.

Fig. 2 shows the final form of the circuit used in the R1155. The last i.f. transformer of this receiver has a tapping on the primary, again originally used in the d.f. section.

Use is now made of this tapping to supply a signal via a 50pF capacitor to G3 of the hexode, 6SA7. The b.f.o. injection, which was found to be fairly critical, was fed through a Philips-type trimmer (5-50pF) to G1 of the 6SA7. The b.f.o. signal was taken from the anode of the b.f.o. valve. This connection appears below chassis, directly underneath the b.f.o. container, and is identified as being the 3rd tag from the front on the tag panel, to which a 100pF capacitor is connected.

The audio output is taken from the anode via a screened cable, to a change-over switch on the front panel.

As can be seen from Fig. 2, the triode input is switched between the p.d. and the existing diode detector. Despite this unconventional aspect the circuit worked extremly well.

On the R1155 the switch used was formerly the d.f. speed switch and is situated to the right of the a.v.c. wafer switch. This position was chosen, as the audio feed to the d.d.t. from the a.f. volume control and is switched by the a.v.c. switch at this point. It is then only a matter of cutting the screened yellow lead going to tag 3 on the front of the first wafer and inserting the c/o switch. As the a.v.c. should be switched off to receive s.s.b. signals and only the r.f. gain control used, the

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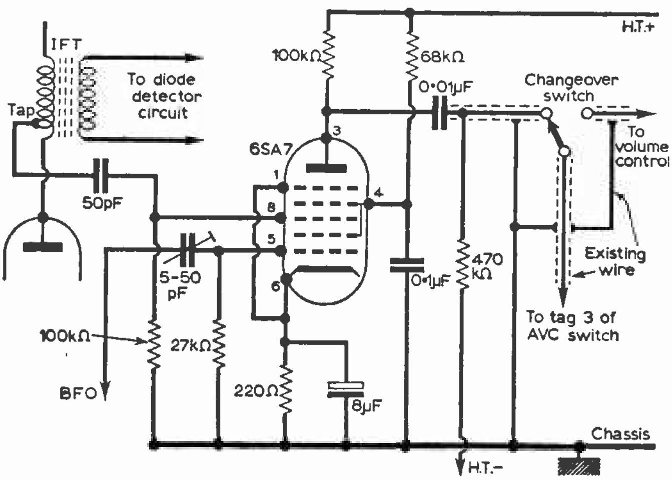

Fig. 2: The circuit arrangement as used by the author in the R1155.

COMBATING INSTABILITY

Symptoms, causes and cures in home-constructed and commercial receivers

BY J. D. BENSON

ONE of the many problems which confront the amateur radio constructor is that of instability. When this particular form of fault raises its ugly head in either a manufactured receiver or a home-constructed one, the experimenter is often at a loss as to how this type of snag should be approached. In this article we shall explain how the different types of instability can be recognised and their causes, and how their cure can be effected.

Tracing instability in a commercial receiver offers less difficulty than in the experimental set for the obvious reason that in the first case the receiver was known to have functioned correctly before the fault developed, whereas in the second case we are dealing with an unknown quantity which has probably a number of built-in faults.

"MOTOR-BOATING"

One of the commonest and most easily recognised forms of instability is known as "motor-boating," so called because the sound produced by it resembles a slow running petrol engine. The periodicity of these pulses of sound is extremely low, which can be judged by the visible movement of the loudspeaker cone, if allowed to continue, the cone suspension can be damaged and the valves in the receiver badly overloaded. This type of fault is mainly confined to mains operated receivers but can occur in battery operated receivers, as will be discussed later when dealing with transistor sets. For the present we shall assume that the receiver under examination is a commercial one.

The impedance of the h.t. supply is common to all valves and in a normal receiver is high to low frequencies. If a fault develops in the smoothing circuits then this impedance is made common to the output valve and the a.c. output of the valve will develop a voltage across this impedance which will be fed back to the earlier stages in the circuit, causing regeneration of the lower frequencies and if the feedback is large enough, motor-boating will occur. Occasionally, if the phase of the feedback produces degeneration, there is a complete absence of bass response from the receiver, but this is a case which is rarely met with.

From the foregoing it is easy to deduce that for this particular type of motor-boating, the fault will lie in the smoothing circuit of the h.t. supply.

There are two further types of fault which can produce motor-boating, but each has its own peculiar characteristics and will be dealt with separately.

In the first case, motor-boating occurs only when a strong signal is tuned in and when first met can be very frustrating. This type of fault arises when audio is fed back to the anode or screen of one of the r.f. or i.f. valves. The couplings in the r.f. or i.f. stages are too small to pass a.f. but when tuned to a carrier, the a.f. can modulate it and it then enters the valve as a modulated carrier. This explains the reason why the motor-boating is only present when the receiver is tuned to a strong signal. The fault is not a common one, but is sometimes met with in receivers with particularly good bass response. If the fault develops in a receiver which has a push-pull output, it is a sure indication that the output stage has become unbalanced. In receivers without push-pull the fault will be found to lie in screen or anode de-coupling circuits and probably prove to be a faulty capacitor or resistance which has gone low. The remaining fault which can cause symptoms closely resembling motor-boating is peculiar to receivers fitted with a.v.c. This particular fault is very difficult to recognise from motor-boating caused by faulty de-coupling as described in our first case. The clue to the fault leading to this form of instability lies in the fact that when the receiver is tuned to a strong signal, the fault disappears. When a receiver is tuned to a strong signal, the a.v.c. voltage rises and reduces the gain of the r.f. or i.f. stages. It follows then that the fault is due to abnormal conditions in the r.f. or i.f. stages.

Examination will prove that instability has developed in the early stages causing a large input to be fed to the detector which in turn biases back the controlled stages which stops oscillation. The bias will then be removed and the oscillation re-commences giving the effect of motor-boating. Careful checking of the de-coupling components by measurement or substitution in the case of capacitors, will soon reveal where the fault lies in the controlled stages.

The faults we have been considering under the heading of "motor-boating" have all been assumed to exist in a commercial receiver which has previously worked correctly. In the case of an experimental receiver, the problem is more difficult, but if approached systematically can soon be cleared. First, from the foregoing, decide which type of motor-boating exists. It then only remains to check carefully every component in the circuit affected to cure the fault. In a newly constructed receiver it is very often found that the wrong value of resistor has been fitted and very often a de-coupling capacitor has been omitted or an incorrect value used. In the case of r.f. or i.f. instability, a badly earthed screening can be the source of the trouble. In our next section the causes of r.f. instability will be examined in detail.

R.F. INSTABILITY

R.F. instability is all too often the cause of trouble in all types of receivers, old and new. We will continue our investigation, assuming that the fault has developed in a commercial receiver.

Before proceeding to specify faults, let us consider what causes the various types of instability. In every case the root of the trouble lies in unwanted coupling. The couplings may arise from a common impedance, as in the case of a fault in the h.t. filter circuits, between components and wiring or between coils and wiring due to faulty screening or bad layout.

The higher the amplification the more attention must be given to layout and screening. There is always a certain amount of coupling between components, so it is imperative that this must be kept at the lowest level possible if the maximum usable amount of amplification is to be had from a given circuit.

In a commercial receiver all these problems are taken care of by careful design and correction in prototypes, so if instability develops it is evident that it is due to component failure or a mechanical fault such as a loose screen or wiring which has been moved from its original position. Valves can also develop loose electrodes which can cause instability.

In a receiver which develops instability at the high frequency end of the tuning range the cause is almost invariably due to faulty screening, i.e. a screening can has worked loose or in displaced components or wiring. The wiring and screening shoud be carefully examined and any wiring which appears to have been displaced, carefully pushed back into its original position with an insulated rod. One is often tempted to use a pencil for this purpose. This is bad practice as the carbon centre can introduce coupling and so lead to wrong conclusions. Capacitive coupling is mainly the cause of this particular fault, so strict attention should be paid to grid and anode leads where potential differences are large.

When unstable conditions obtain at the low frequency end of the tuning scale, then the cause is most likely to have developed through common impedance coupling in the tuning circuits and the weakest link in this chain is usually the tuning capacitor. The tuning gang is subjected to a great deal of mechanical strain and more often than not has become insecure or developed a high resistance joint between the frame and chassis. The impedance of this connection which is common to all tuning circuits is considerable if not efficiently earthed and is quite sufficient to introduce instability.

Tracing instability in a known receiver offers few serious problems, but an unstable experimental receiver presents much greater difficulties which we will now examine stage by stage.

WIRING AND LAYOUT

In experimenters' circles it is often emphasised that grid leads must be kept short; this is good advice but can be carried to extremes which result in anode leads becoming inordinately long which can lead to serious trouble. In the same way, aerial leads and loudspeaker connections should be kept as far apart as possible and should never be permitted to cross near the detector circuits. The most vulnerable point from an instability point of view is the grid of the first valve followed by the aerial lead. Next in importance is the lead to the first valve, followed by the grid lead to the next valve and so on to the output. In laying out a receiver then it is very important that these vulnerable leads be kept well separated. In order to fully protect these particular points of connection, screened wires are often introduced.

Having constructed our receiver, having kept in mind the foregoing points, it may still be found that one or more forms of instability are present when a test run is made. How then can this state of affairs be tackled? The first point is to judge in what form the instability is present. If it takes one or other of the forms of motor-boating which we first discussed, then the first step is to check our h.t. filter circuits, de-coupling in r.f. or i.f. circuits and lastly, especially in receivers fitted with a.v.c. faulty screening or de-coupling or a combination of both.

CONTROLLING THE INSTABILITY

Having cured our motor-boating, instability may still obtain in a bad case. If the unstable conditions are uncontrollable, then a method to control them must be found before the trouble can be located. This may sound difficult but in practice is quite simple. If the gain of the receiver is reduced to a very low level, instability will cease. This can be accomplished by fitting a variable resistance in the cathode circuit of the first valve. The value of the resistance should be about 3,000Ω or more, shunted by an $0{\cdot}1\mu$F capacitor. If this does not control instability, it should be tried in the next valve or so on, until stable conditions can be produced.

The auxiliary gain control should be adjusted until the set is just unstable and starting with the wiring first, the leads to the most vulnerable points, i.e. grid and anode, be carefully moved and the effect on instability noted. If an improvement is made, the gain control should be advanced progressively until the receiver is stable under normal conditions.

DE-COUPLING COMPONENTS

Alterations to wiring alone may not bring about the desired results in full. It will then be necessary to check all de-coupling components by substitution in the case of capacitors, a test capacitor with flying leads being used. Resistances should receive special attention as it is very easy to misread colour coding.

While dealing with de-coupling it may not be as commonly known as it should be that the RC product of de-coupling components should be in the region of 80,000, resistance in ohms and capacitance in microfarads. This is an average figure and it may well be found that much higher RC products are used in early stages where lower anode voltages can be used. In shortwave receivers, the heater wiring can be a source of instability and should be de-coupled using 0·01μF ceramic or mica capacitors soldered directly between heater and chassis. In television equipment, heater wiring is often de-coupled by the use of miniature quarter wave chokes and 0·001μF capacitors. If all the points in this article are carefully studied and logically followed, then the most troublesome cases of instability can be located and cured.

TRANSISTOR RECEIVERS

Finally, a word or two about instability in transistor receivers. Motor-boating can occur as in mains operated equipment. Starting with the power supply, this should be checked on load, as battery failure can cause this particular fault. With the battery supply checked, if the fault still persists, the battery de-coupling should be tested by substitution. If the fault is not in this component, then the audio de-coupling should also be tested. Whilst most of the procedure for recognising and locating the cause of instability in valve receivers can be applied to transistor sets, there is one cause of i.f. instability in transistor receivers which is not common to valve receivers. This particular fault concerns the neutralising components in the tuned circuits, a faulty capacitor or resistor of incorrect value can produce instability. Transistors are very reliable components, but in cases of i.f. or r.f. instability, it is always wise to check the current or voltages in each stage, using a good h.r. voltmeter. The use of printed circuits greatly reduces the possibility of instability, but as it is still the common practice to wire receivers, it is hoped that the various points enumerated in this article will prove of help to the experimenter. ■

CABINET AND CHASSIS TECHNIQUES

—continued from page 1147

the resin into the mat until it is thoroughly impregnated. When saturated it will become semi-translucent and any faults are easily spotted.

Extra resin should be added to fill any dry spots, and all air bubbles (which look like blisters) must be dapped out from under the mat. The mould is now allowed to dry, and when ready is checked for faults.

When ready, brush on a second layer of resin and another layer of glass fibre, using mat this time, and impregnate as before. When set, remove the laminate from the mould. This should present little difficulty. As areas become free, they take up a distinct light shade, so that areas that are still stuck to the mould are easily seen.

Once removed, trim the laminate to final size, using a hacksaw and smoothing off the rough edges with a file. The screening and fittings can now be added. It was decided to use fine mesh copper net for the screen, and this was cut to size and checked up against the laminate.

The four cabinet mounting brackets were to be used also as earthing points for the screen, and after checking the positions of them against the screen and the cabinet, the screen and brackets were soldered together, and then placed to one side.

The inside of the laminate is now given another, fairly heavy, coating of resin mix, and the screen assembly is pressed down on to this layer and carefully positioned, and the resin again brushed until it impregnates the whole screen. Finally, a last layer of glass fibre, pre-cut to clear the mounting brackets, is laid in place and impregnated with resin, and the assembly placed aside to dry.

After final trimming, the outer surface of the laminate can be polished with wet-and-dry emery and metal polish, and the cabinet is then complete.

Part Four Next Month

S.S.B. Reception for the R1155

—continued from page 1148

above method of connection ensures that the p.d. is only operative with the a.v.c. off.

Wiring

The wiring is straightforward, the components being connected directly to the valveholder tags. The only point to watch, is that the triode grid load resistor must be taken to h.t. negative and not to chassis. The d.d.t. cathode is connected to the h.t. negative line via a 1kΩ resistor. If the grid load was taken to chassis the biasing conditions would be drastically upset.

Setting Up

The cores of the final i.f. transformer are adjusted to compensate for the stray capacity introduced by the connection of the p.d. to it. This is best done on a weak a.m. signal or with the r.f. gain control turned down on a strong signal so as to keep the a.v.c. inoperative.

A single sideband signal is then tuned in, the b.f.o. switched on and the p.d. switched into circuit. The trimmer is adjusted to give the optimum injection level and when a peak is obtained a dab of wax on the thread will ensure that it does not shake loose.

It was found that the p.d. output was at least double that of the existing diode detector.

Although the p.d. as described was fitted to the R1155 there is no reason why the circuit given could not be used in any receiver, the i.f. input being then taken via a 50pF trimmer from the signal diode. ■

on the Short Waves

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All times are in G.M.T. All frequencies are in kc/s.

The Broadcast Bands—by John Guttridge

WE congratulate *Radio Nederland* on being voted the most popular short-wave station in the poll recently organised by the International Short Wave Club. Hard behind Radio Nederland—in fact only ten votes behind—came *Radio Australia*, winner of the last three polls. Third was the BBC, then came the Swiss Short Wave Service, *Radio Canada*, *Voice of America*, *Radio Japan*, *Radio New York Worldwide* and *Radio Sweden*. One interesting fact is that the top half dozen stations have remained fairly constant favourites over the last ten years.

Station news must begin this month with a correction to the February information. The first English transmission from *Radio Berlin International* is from 1730—1800 and not 1700—1800 as stated. Also it seems likely that the United Nations is now transmitting on Mondays to Fridays.

Kol Israel, Broadcasting House, Jerusalem, Israel has made a slight adjustment to the 9,625 beam of its 2015—2045 English broadcast. This is now directed to the U.K. and South Africa. This broadcast is also beamed to South Africa on 9,009 and was recently heard interfering with a *Radio Free Europe* transmitter on the unannounced frequency of 9,725.

In Tipperary, D. Walsh has been getting good reception of South American stations from 2200 onwards. Those he has heard include Brazilians *Radio Sociedad de Bahia*, ZYN32 on 11,875, *Radio Banderantes*, ZYR78, 11,925; *Radio Nacional*, Brasilia, PRL8, 11,720; *Radio Clube de Pernambuco*, PRA8, 11,865; and *Radio Tupi*, ZYC9, 15,370. Radio Sociedad de Bahia and Radio Clube de Pernambuco have also been heard in London as early as 1945.

D. Walsh has also managed to identify *Radio New Zealand* (P.O. Box 98, Wellington) signing on to Australia on 9,540 at 0900. This transmission is also carried on 6,080. Finally he reports a SINPO 54555 signal from Conakry, Guinea, on 9,650 during the evenings.

According to R. Owen of Rhondda, *Radio Bucharest* (P.O.B. 111) is now back on 5,990 for its 2100—2130 English transmission to Europe. Other frequencies used are 6,190/7,190.

Confusion exists over the frequency used by *Radiodiffusion du Senegal* (B.P. 1765, Dakar) for the transmission in French, English and Spanish from 1730—1800. D Lavender of Gravesend gives it as 9,720 (a registered frequency for this station), Paul Harris, of Elgin, says it is 9,675 and the January ISWC bulletin gives it as 9,770.

D. Lavender also has been hearing the Bonaire outlet of the Trans World Radio on 9,730 as well as 800 with Spanish and English from 0200—0300. Another station he has heard is Radio Americas located on Swan Island. At 2400 6,000 it is often audible, with 1,165 medium wave occasionally so. CE970, *La Voz de Chile*, Casilla 13130, Santiago, Chile, was heard at 0100 on 9,700. The interval signal used by this station is "Land of Hope and Glory".

Full QSL verification is given by *Radio Kiev* (Radio Centre, Kiev) according, to Paul Harris. There are English transmissions beamed to North America from 0030—0100 and 0430—0500 on 9,660/7,330/7,310/7,180. Also on Mondays and Thursdays there is a half hour transmission at 2230 on 1,241 medium wave to Europe.

At 1500 Paul Harris gets good reception of the news in English from *Radio Pakistan* on 7,020. Other frequencies used are reported as 3,950/9,820. Also giving good reception are the English transmissions of *Radiotelevisione Italiana* (Via del Baberino 9, Rome) to North America at 0030—0050 on 5,960/9,575 and to Australia at 0900—0940 on 11,810/15,400/17,800.

Some notes on QSL cards have been sent in by E. H. Conduit of Wolverhampton. Trans World Radio, Bonaire, he says, gives the date only, R.A.E. Argentina, the frequency only, Radio Bucharest omits the time, Radio Peking and Radio Baghdad give no details at all and surprisingly Radio Japan, although providing space on its card for verification details did not fill them in. The Swiss Short Wave Service has, incidentally, issued a very colourful new card. No verification details are given however.

Radio Berlin International is now using 11,795 again for its 1630—1700 German transmission for Africa. French is now aired by *Radio Finland* (Unionkatu 16, Helsinki) at 1440 on 9,555 says D. Taylor, Arbroath.

Radio Baghdad, Salihiya, Baghdad, Iraq, seems to be changing the times of the various languages used in its Foreign Service on 6,030/6,095. I. Taylor, Slough, has heard English at 1930, German at 2020, and French at 2110, whilst Paul Harris says the English transmission begins at 2000.

Radio Japan, Tokyo, has replaced 15,135 by 11,780 for its North and Latin American service from 0200—0400. The other frequency used for this transmission is 9,525.

The Amateur Bands—by David Gibson G3JDG

IN past months, I bemoaned that SWLs had forsaken the l.f. bands. This month I have been snowed under with letters from indignant earphone-clad l.f. specialists, and lists of stations received on these bands have grown and grown! But *please*: the date, time, and RST for all reports (and the RX and ant.) This will enable other readers to measure how they're doing and what conditions are like.

NOTE: Deadline for next issue is 28th March.

Top Band

Still going great guns and the "transatlantics" on 16/17th January came up to expectations. This time I was waiting with an Eddystone 888A loaned by SWL Videan and a 10W TX filched from G3LXP. The aerial was some 150ft. longwire but was a bit close to the buildings for comfort. The log reads:—G3PAO, G2AIA, GM3PFQ, OK1AKU, OH3NY, GM3TMK, OE1KU, OK3CFF, OK1KVK, VP3KZ, GM3KMR, VE3KE, OK1AEZ, K2NQ, VE1ZZ, VO1FB, VP2AV, W1BB/1, W2IU, VP3CZ, VE3AGX, W2GDZ, OK3KGZ, OKAER, OK2KET, OL3ABW, W3EIS, GI3PDN, GM3IAA, OK1ALG.

All these on c.w. and in general non-G stations this side of the pond averaged 559, and from the far bank 449/559. A noticeable omission from the log were the 9L1 stations in Sierra Leone, usually in evidence. Conditions generally on 160 are excellent. Clive Carver (Shotton) says that GW's were coming in on a.m. at S9 plus 40dB on his HE30 and 75ft. longwire. While in Essex, David Griffiths lists some 30 G stations all on a.m. received with a domestic receiver, and a 60ft. longwire via an a.t.u. If conditions get any better we'll have to run a contest for the best log from the station with the smallest antenna, perhaps an end fed coat hanger, or a pair of base loaded cuff links!

80 Metres

On 80 my comments on lack of reports has really brought out the big guns. From West Bromwich Wilfred Smith sends in a colossal log of over 350 G stations including 22 GW, 7 GM and a GC. Also thrown in are 9EI's. In addition F2WW, F5HS, SM7YSF/MM, PAOPAL, F2BT, LA4ZH/MM. The whole lot on phone, using the PRACTICAL WIRELESS *Shortwave-2* (November 1963) modified to suit the line up EF80, ECL82. The antenna is 100ft. longwire.

In Dollis Hill, N.W.10, Jim Rabbitts, who listens with a modified 1155 and a 20 metre dipole, logged the following on phone DL4ZJ/P, DLØJL, DLØLD, EA1IO, LA3ZI, VE1AA, VE1AFY, VE1IE, WA1AA, WA2SFP, YO9CN, 7X2VX, while up in Sandiacre, Notts., a single conversion superhet and an inverted 14 megs dipole raised W3PHL, VE1IE, VO1CM, OE6HKG and SM6SLA for SWL Kerry. An interesting point about these l.f. bands is the number of stations using 14Mc/s dipoles, and aerials cut for other bands.

An a.t.u. will often work wonders in such cases and this point is offered as food for thought. Lastly a report that 3A2BT is wandering around the wilds of 80 on phone and shouldn't prove to difficult to hear.

40 Metres

If you can imagine listening to a loud pop group with one ear, and a symphony orchestra with the other ear both at the same time, and all this while you are sitting inside a cement-mixer, while it is mixing, then you are on 7Mc/s! The difficult part is, of course, to hear amateur stations through it all, and big pat on the back for SWL's who did just that.

Barry Austin (Solihull) using a R109A, a home-brewed pre-selector and a 50ft. longwire pulled in OZ7PA, SP7DGA, OE3NR, PAØCDV, DL1IP, F8WA, and a real piece of DX—CX1JJ.

F. C. Powell (Scarborough) says 7Mc/s is often better than 14, but claims c.w. is the thing and I agree with him. He also says the best time is from 2400—0700. Using an HRO with a PR30X pre-selector and a multi-band dipole (40-20-10) running N/S 50ft. high: DJ5KW, HA5KFR, EL2AD, IT1AGA, HAØHG, KP4ZM, PY1CKG, UF6QB, VP4VU, W1AQH, W3ZNB, W4FJG, W8BRA, W8OPA, ZL2AS. Just goes to show what's abroad in the wee small hours.

20 Metres

DX on this band seems plentiful if you know when to listen, (early mornings is the hour for Pacific DX and rare ones.) Certainly 20 is mainly a daytime band at the moment.

Alan Dailey uses an R107 and a crystal converter, with a 90ft. longwire 8-15ft. high. He submits a model log complete with RS reports and times G.M.T.: VK9NT 33 (New Guinea) KG6SB 42, (Guam) HM2BD 43, (Korea) VK2AIA 32, KG6AJI 54, VK2NN 58, ZL2UW 59, VK4YP 58, VK4DW 55, VK9CJ 34, ZL3OY 56, ZP5KT 57, PY2PA 46, KV4CF 59, FY7AO 55, KP4AXC 45, KP4CKJ 59, ZP5OG 57.

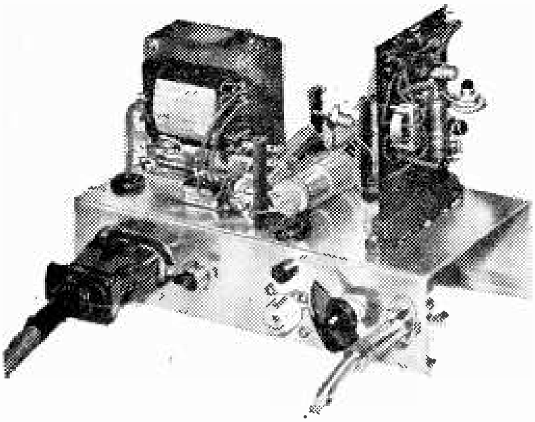
In Devon, SWL Ponsford has a CR45 with a 60ft. longwire, and sorted out on phone: W2WSM, WA4WWM, K7UPU, K8VWX, W4RHE, OZ5VL, OZ4SB, DJ2VU, UA3KBD, SM5DZH, SM5AWL; this note is with a t.r.f. receiver.

A domestic receiver and 60ft. of wire in Surrey raised the following for Kenneth Falconer: W8CVH 45, W2LS 47, W1DEP 35, I1POC 47, HB9AEC 36, W2ATZ 47, K2KAC 49, OH5NQ 48, SV1GO 36, CT1LX 48, UB5KBA 47, W1BSY 57, W3VQE 58.

Bernard Hughes (Worcester) has an Eddystone 840C with a Codar pre-selector and a 20 metre dipole. On 'phone: 5H3JR, SVØWR, UN1CC, W5RKR/MM (Maritime Mobile) W9NTP,

—*continued on page 1166*

KEYED
Audio Oscillator
By M. L. Michaelis



CONTINUED FROM PAGE 1068 OF THE MARCH ISSUE

A further group of interesting applications for the Veroboard circuit under discussion in this article concern electronic music. One such circuit board for each note can form the basis of a complete electronic organ. The frequency stability is superb, particularly if high stability capacitors and resistors are used in the feedback networks between Tr3 and Tr2. Tuning to the correct musical scale is easily possible with small trimmers across C1 to C4 on each board. It is not essential to go to the full expense of making one unit for each note of the keyboard because, in principle, only the feedback networks between Tr3 and Tr2 need be individual for each note. Thus one single Veroboard unit with many feedback networks would already provide a complete electronic organ—but this could not play chords. The cheapest arrangement without these drawbacks would be some five or six units—just as many as the number of notes in the largest chord envisaged —and some suitable method of multiplex switching on the contacts behind the keyboard to switch the particular feedback network for any key depressed through to a "still free" Veroboard unit regardless of other keys already depressed. The simplest arrangement from the point of view of construction and design, but the most expensive, is the use of an individual circuit board for each note of the keyboard. However, this has two major advantages. Firstly the keyboard contacts have to switch nothing but low d.c. voltages at mere microamperes so that even simple designs will ensure fault-free operation. Secondly, as a separate Veroboard circuit is used for any given note, various combinations of inductances and capacitors can be used in parallel with or in place of R12 to modify the quality of the electronic organ (stops).

Apart from the Veroboard units only a single common audio amplifier of conventional design, giving the desired power output and feeding suitable loudspeakers, is required.

Using the larger values, between 0·05 and 0·5μF for C1 to C4, very low audio frequencies of a few cycles per second are obtained at an output of 4V r.m.s. maximum. Using the arrangement of Fig. 3, with the Morse tapper built as a foot pedal operated by the guitar player, the output of the Veroboard unit can be fed into an available input socket of the main guitar amplifier, giving an excellent tremolo effect upon suitable adjustment of relative gains and of VR3. This arrangement is immediately usable with any guitar amplifier without modification.

Detailed Circuit Operation

The above discussion has included the principal uses to which this very versatile circuit may be put as far as the average reader of this journal is concerned. It has by no means exhausted all possibilities. However, more space is unfortunately not available here so we must devote the rest to a description of the essential principles of the basic circuit in Fig. 1, necessary for constructing the unit and getting it to work correctly.

Transistors

The three transistors operate as emitter followers for obtaining a low output impedance (determined solely by R14) for a very high input impedance at the base of Tr1 (approximately 10MΩ). The sole purpose of this impedance conversion arrangement is to achieve the very high current sensitivity at the input, i.e. an input impedance of a magnitude otherwise customary only with valve circuits, so that even very low output devices such as photocells can be used directly without a preamplifier at the input. The final transistor Tr3 also has a collector load R13 so it also functions as a conventional voltage amplifier. The amplified signal is fed back to the base of Tr2 via the conventional form of network constituting a phase-shift oscillator. When the feedback network consists of four *equal* C and R sections, as here, the frequency of oscillation is roughly $\frac{1}{10}$CR c/s, where C is the capacity of one capacitor in μF and R is the resistance of one resistor in MΩ. The resistors are largely dictated by the characteristics of the transistors used so that the capacitors should be varied to change the frequency. The prototype operated well over the frequency range from 1c/s to 5kc/s and beyond, requiring capacitors ranging from 0·5μF to 100pF.

GEC transistors of type 2N1613 were used in the prototype. There is no objection to the use of any other types which are for the purposes of this circuit equivalent. It is essential to use the modern silicon epitaxial types (which are n.p.n., hence the positive collector voltage! CARE!) as only these have the exceedingly low leakage currents necessary for obtaining the high input impedance and the requisite impedance level stability throughout the circuit. All types of germanium transistors are unsuitable. The only other characteristics required of a particular transistor for it to be suitable in this circuit are a differential current gain of about 30 to 40 under conditions of some 1 to 3mA collector current and a voltage rating (collector to emitter) of at least 60V.

Impedance Levels

The phase-shift oscillator arrangement will not work unless the chain is terminated at the base of Tr2 with another equal 220kΩ resistance. But we cannot just connect such a resistance there physically because the effective impedance at the base of Tr2 already in fact represents such a resistance and we must merely take steps to ensure that it has the desired value. This is controlled by R14, the output-end emitter load, which clamps the impedance levels right back through the entire circuit. Every time we move back through the circuit by one transistor the level of impedance rises by a factor equal to the current gain of the transistor in question, this being the fundamental principle of the emitter follower.

The 2N1613 has a current gain of 30 in the arrangement here used so that the impedance at the base of Tr2 is $30 \times 30 \times R14$, i.e. just about the required 220kΩ. If alternative transistors are used it may well be found that the circuit refuses to oscillate at first with the given value of R14 because the current gain can be different and therewith reflect an incorrect impedance to the base of Tr2 for terminating the feedback network properly. In such cases the value of R14 should be adjusted until the circuit oscillates properly. R13 must be at least 30 times R14 as the gain is otherwise not sufficient to sustain oscillation. It may thus be necessary to adjust the value of R13 as well if using other types of transistors.

Moving back to the input end, to the base of Tr1, the impedance level is again 30 times greater there than at the base of Tr2, i.e. it is some 6 to 10MΩ. This permits the use of an extremely sensitive high-impedance input circuit.

The Operating Point

Consider the base of Tr1 disconnected. The entire chain of three transistors then remains cut off. It still remains cut off even for slight positive bias applied to the base of Tr1 until the threshold voltage, which lies at about 1·5V, is reached. The whole cascade then begins to draw current and as soon as the gain of Tr3 has risen sufficiently, which is already at an insignificantly small rise of the input voltage above the threshold, the transistors Tr2 and Tr3 burst into oscillation. If the entire network ahead of the base of Tr1 is for the moment considered to be absent, the input voltage being applied directly to the base of Tr1, the three transistors have reached the mid-point of the linear part of the characteristic about a ½V above threshold, i.e. at some 2V input. The oscillation amplitude is then a maximum, about 4V r.m.s. at output terminal 6. Further increase of input voltage at Tr1 base begins to saturate the circuit, the oscillation amplitude decreasing again in proportion. Full saturation is reached at about 2·5V input to Tr1 base, when all oscillation ceases for any higher input voltage.

The circuit thus oscillates whenever and as long as the input voltage at Tr1 base is not less than 1·5V and not more than 2·5V. If this "voltage band discriminating function" is desired for any particular application the input network shown in Fig. 1 can be omitted. A simple potentiometer to shift the voltage response band to any desired higher level can then be used to feed Tr1 base directly.

The purpose of the input network shown in Fig. 1 is to remove the upper limit, i.e. to leave the threshold at which oscillation commences and to sustain oscillation regardless of how much the input voltage is then raised above this threshold.

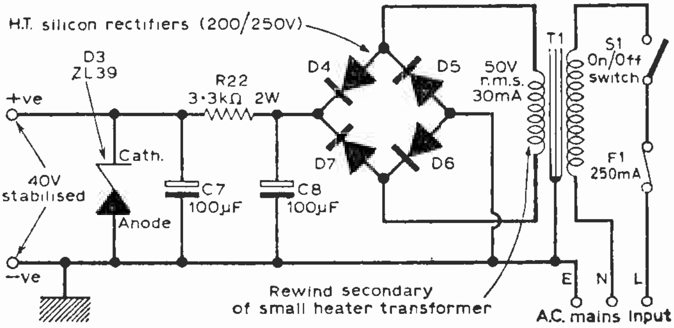


Fig. 5: A suitable mains-operated power pack of the oscillator.

Threshold Selection

R4 and R5 form a voltage divider biasing the diode D1 such that it just *begins* to conduct when the input voltage reaches the threshold level, this diode reaching full cut-on some 0·5V later, i.e. when the three transistors have just been driven to the mid-point of the characteristic by the increased input voltage (class A point, optimum for oscillation of Tr2 and Tr3). D1 and R5 then present a much lower resistance than R7 so that further increases of input voltage or current is largely diverted through D1. There is, in other words, a limiting action which is, however, not strong enough. When the input voltage is raised to about 6V (instead of 2·5V) some 2·5V nevertheless reach Tr1 base and oscillation ceases were D2 not present. D2 has the same function as D1 only it is biased more heavily on the bleeder R3, VR2, so that it cuts on later. In fact VR2 must be adjusted such that D2 just starts to conduct and assists D1 in the limiting function when the transistors reach the class A point. The combined limiting actions of D1 and D2 then hold the transistors at class A operation even if the input voltage at P1 is raised to 50V or more. In other words, the input is rendered fully non-critical.

Adjustments

Since D1 must start to conduct at the threshold the voltage delay bias applied by R5 for this diode must suit the threshold voltage of the particular type of transistors used, less the intentional pre-bias for the transistors injected through R6 and R9 to drop the actual threshold level to the lowest possible stable limit for the most sensitive setting at P1. R5 must consequently be chosen to suit the threshold voltage of the particular transistors; 5·6kΩ is correct in this circuit for 2N1613 transistors but may need slight trimming for others. However, the choice of R5 is nowhere near as critical as the adjustment of VR2 (voltage delay bias for D2, class A operating point stabilisation). Hence only VR2 is a screwdriver preset whose range of adjustment, however, will most likely cater for any type of transistor used. The detailed adjustment procedure is as follows:

First turn VR2 slider to the top (R6 end) of the track so that D2 is heavily cut off and never operates. Temporarily replace R5 by a small variable resistor (about 20kΩ lin.). Connect an oscilloscope to output. Apply d.c. voltage from a potentiometer to P1 until oscillation just commences with variable resistor substitute for R5 at maximum. Then reduce R5 until the amplitude of oscillation is still just *not* reduced thereby. Measure the resulting resistance and substitute as fixed resistor for R5. Now raise the input d.c. voltage at P1 slowly until maximum amplitude of oscillation is shown on oscilloscope, showing that the class A operating point has been reached. Then gradually turn VR2 slider down the track towards the chassis end until the amplitude of oscillation *just* begins to fall as observed on the oscilloscope. The adjustments should therewith be complete. Check by suddenly applying the full 40V positive line voltage to P1. If this causes only temporary oscillation or no oscillation at all, turn VR2 a very slight amount further towards the chassis end and try again. Stable oscillation should be obtained for any input voltage between 1·5V and 40V at P1, the amplitude not changing between about 1·8V and 40V even by the slightest amount.

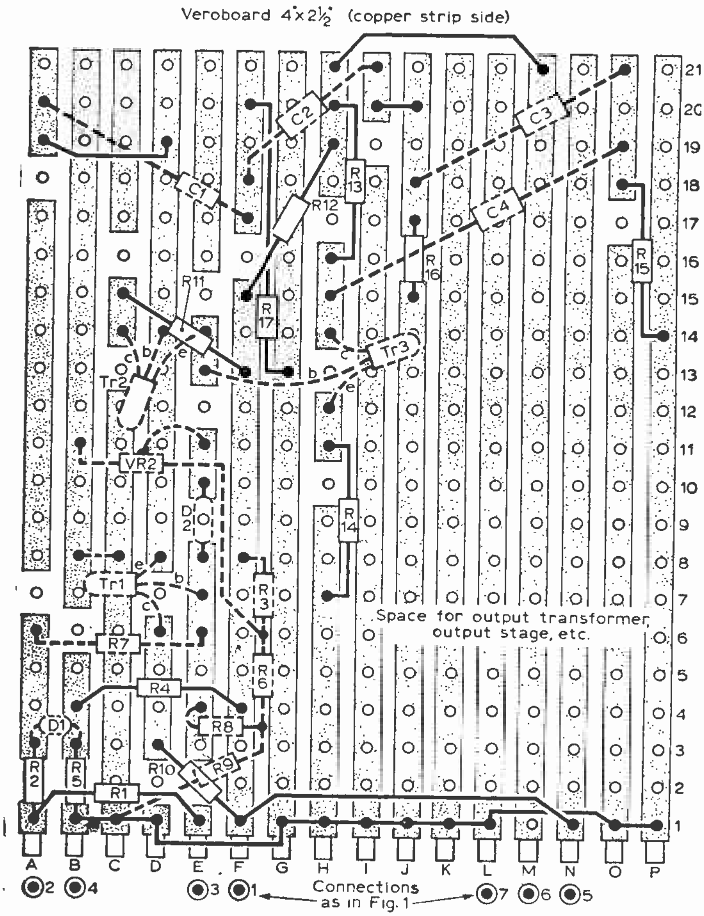


Fig. 6: A wiring diagram of the Veroboard panel. Components on the plain side shown dotted. This layout allows for the addition of the output transformer (Fig. 4) or other output circuits. Large capacitors for low frequencies can be accommodated on the plain side if required.

Input Sensitivity Adjustment

The main part of Fig. 1 shows the arrangement to be adopted at the input side for current operation such as obtained with vacuum-type photocells. VR1 then acts as a shunt for reducing the threshold current in the same way as the shunt of a multimeter reduces the deflection sensitivity of the meter. The range of coverage as shown extends from about 0·5μA in the most sensitive position to about 12μA in the least sensitive position.

The insert in Fig. 1 shows the arrangement for voltage operation. This is a simple voltage divider (potentiometer) arrangement. With the slider of VR1a at the chassis end infinitely large voltage is required at P1 to reach the threshold, i.e. the sensitivity is zero. With the slider at the top end the threshold voltage is about 1V.

Power Supply

Fig. 5 shows a suitable power supply circuit for mains operation. The current rating is sufficient for one Veroboard unit. If several such units are employed simultaneously in any of the

—continued on page 1165

HIDING the lou

G.R.Fletcher

FOR quite a long time my wife had been quietly hinting that I should change the column-type loudspeakers in our lounge for something less obtrusive.

After a period of meditation and inward discussion I decided to incorporate a loudspeaker system in a pelmet over a large window at the end of the lounge. The system I had in mind would use two separate loudspeaker enclosures suitable for either stereo or monaural reproduction.

The pelmet, a 15in. wide piece of hardboard, extended the width of the room, a matter of 12ft. approximately. This was supported on the inside by a 2in. x 1in. wooden strip at the top and bottom of the pelmet, making it quite a rigid structure (Fig. 1). An overhang of 5in. would allow for fitting curtain railing and hanging curtains, leaving a height of 10in. for the loudspeaker enclosure area. The pelmet was fixed 6in. from the wall, giving a cross-section of 6in. x 10in., making the total enclosure volume approximately 8,600 cu. in. This volume is sufficient for good quality reproduction over a wide frequency range, even when used for two separate enclosures, although the one drawback to the scheme is that the enclosures might be too narrow in proportion to the length for best effect. However, I determined to continue with the job.

I decided on HMV elliptical loudspeakers (Part No. 95130BP), the dimensions of these being approximately 5in. x 9in. with a resonant frequency around 90c/s. These speakers fitted the space available and, I decided, would handle the 3W from my amplifier.

This brought me to the baffle boards and using the data given in Fig. 2. I prepared the left and right hand boards according to the length available.

I used a ducted port to obtain optimum effective

Fig. 1: The construction of the wall-to-wall pelmet as it was originally.

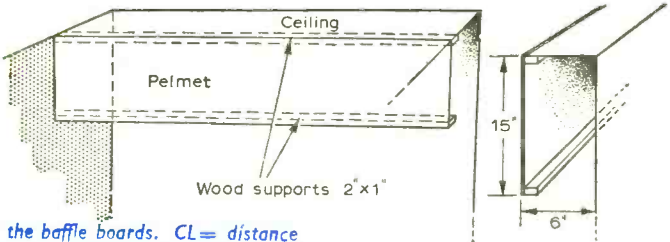
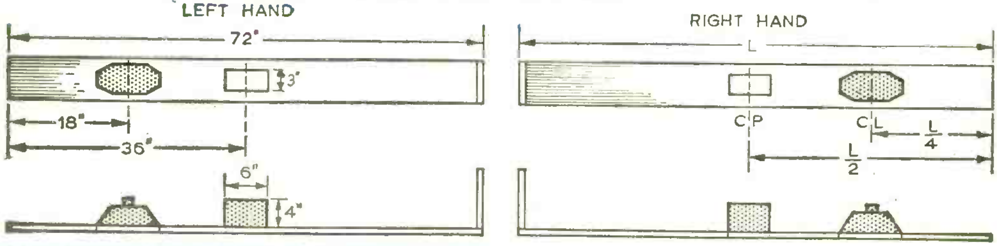


Fig. 2: Below: Detailed construction of the baffle boards. CL = distance from end to centre line of speaker = ¼ length of baffle board = L/4. CP = distance from end to centre line of port = ½ length of baffle board = L/2.



dspeaker

enclosure volume: the port dimensions given are suitable for the loudspeakers already mentioned and tune the enclosure to a resonant frequency of approximately 90c/s.

The dimensions arrived at were as follows:

Width of pelmet	144in.
Height available	10in.
Depth available	6in.
Total available for each enclosure	4,300 cu. in.
Dimensions of port	3 x 6in.
Length of ducting	4in.
Centre line of loudspeaker from end (CL)	$\frac{L}{4} = \frac{72}{4} = 18$in.
Centre line of port from end (CP)	$\frac{L}{2} = \frac{72}{2} = 36$in.

After mounting the loudspeakers, a check that they are in phase is possible by ensuring that the marked terminal on each speaker is connected to the amplifier chassis by the connecting wire when plugged into the LS socket.

The next step was to prepare and fit a wooden batten 1in. x $\frac{1}{2}$in. along the wall behind the pelmet, and another opposite, inside the pelmet 10in. below the ceiling. These two battens were used for securing the baffle boards inside the pelmet (Fig. 3). To reduce the transmission of sound through the ceiling and walls I lined the interior of the enclosure with polystyrene plastic insulating material, using $\frac{1}{2}$in. ceiling tiles cut to size. The baffle boards complete with speakers and port ducts were then fitted and screwed to the wooden battens making sure that the connecting wires were taken to the corner nearest the amplifier. To finish off I inserted a 1in. thick separation piece of polystyrene between the end pieces of the loudspeaker enclosures. A coat of paint was then applied to the baffle boards before completing with the curtain railing.

Monaural reproduction with this arrangement was sparkling and I am confident that stereo would be even better. And, of course, those speakers once such an eyesore are now completely hidden from view.

Although this idea can, of course, be applied to any suitable existing pelmet, where a pelmet is less than 4ft in width it is probably advisable to fit one enclosure only. ■

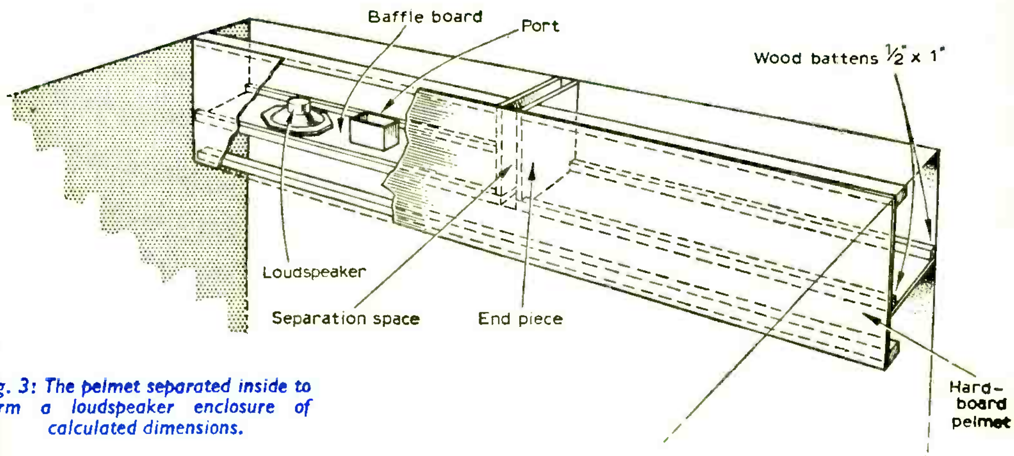
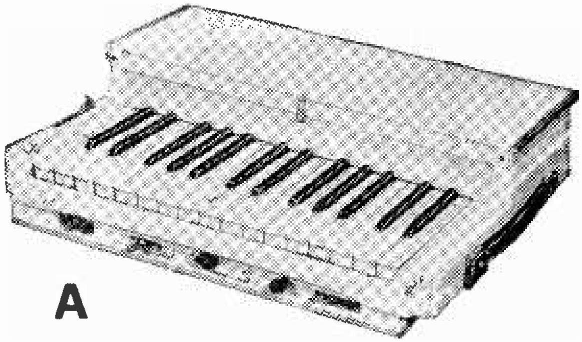


Fig. 3: The pelmet separated inside to form a loudspeaker enclosure of calculated dimensions.



BUILDING A TRANSISTOR SOLO ORGAN

by G. W. Hardy

CONTINUED FROM PAGE 1074 OF THE MARCH ISSUE

AFTER checking the work done so far on key contacts—as described last month—attention can be given to the contact springs.

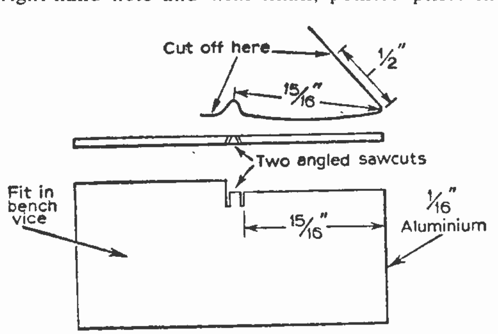
Remove assembly and rubber tubing on spikes at rear only, remove hoppers, check that they are numbered and lay aside in order. Drill for $\frac{1}{32}$in. holes in each as Fig. 11 (last month).

No. 24 s.w.g. spring brass wire obtained from a local builder's merchant was used for the contacts. If obtained from a pianoforte dealer ask for music wire gauge No. 9; 5yd will be ample. Cut into 1yd lengths, fix one in a bench vice, stretch tightly and clean and polish with a cloth.

To make the springs a small piece of $\frac{1}{16}$in. aluminium was fixed in a vice, a V-shape cut made for forming the hook and metal sawn off at correct length of the spring where each was bent at an angle (Fig. 12).

Some experimenting will be needed here and it is advised that a few springs be made up in a similar gauge copper wire, even fitted to a hopper to get the feel of the job.

The springs should be threaded through the top right-hand hole and with small, pointed pliers the tail should be bent over in an arc and threaded into the lower right-hand hole, kneading the rest of the wire through after it has been pulled as far as it will come.



TOOL FOR MAKING SPRINGS

Fig. 12: How the contact springs are formed round an aluminium pattern.

Bend ends of wire to one side and snip off close to side of hopper and tin each with solder. The other side of hopper is finished off in the same manner.

Springs when finished and mounted should be under tension. If any are weak push hook over side and bend further in same direction, return the spring and correct any tendency to slide off the hopper by a twist in opposite direction at bottom of spring.

A 1¾in. length of thin insulated flex is bared and tinned at each end, a loop formed in middle and one end of each soldered to the springs.

Each hopper as completed is placed on its spike and followed up with rubber tubing pushed up tightly. Check for alignment with centre of supports.

The paxolin assembly is now placed on the supports and gradually lowered. The purpose of the overlap will now be seen as the rear springs can be eased on before the front ones.

Should the assembly need to be taken apart again, before doing so make a "comb" of cardboard the short teeth of which occupy spaces between the hoppers and so keep them in line.

Continuity and Distribution Strips

The continuity strip is made from a T-section of nylon, adapted from "Swish" curtain rail, placed over back of keys just in front of the hoppers. It is fixed with stem of T uppermost, stem cut away at each end and screwed to the key blocks.

Make a pencil mark in front of each hopper, remove the strip and drill a hole at each mark halfway down the stem. Make copper wire staples as before, push through from front, bend each end up and over away from hopper and cut off. Tin all these ends and connect up wires from the front contact springs (Fig. 11).

The distribution strip is a single row of tags to which is attached one wire from each of the rear contact springs. An extra tag at each end would be useful.

Tuning Resistors and Tuning

It is assumed that each rear contact spring engages with the bronze strip when key is played, if not, correct by adjusting spring hooks with small pliers. These hooks should travel and just mount the working edge of the long bronze strip, when the key is held firmly down. Undue travel may produce noises in playing, but will not matter on the percussion side.

Percussion should be switched off and is dealt with later. Clean bronze strip if needed after handling, work keys up and down. Connect an ohmmeter to bronze strip and to each tag on the distribution strip in turn, working the appropriate key. Readings should be infinity with key up and zero when down.

If desired the organ can be made so that each note is tuneable by wiring a series of small variable resistors as VR2 (Fig. 1b), padding each where necessary to bring within tuning range. However, this is not necessary unless the constructor wishes to experiment with different note generators and pitches, so procedure for using fixed resistors will be explained.

A strip with a double row of 29 tags is fixed alongside the distribution strip and wired as Fig. 13. Also connect up VR2 and leads to note generator panel as shown.

The value of tuning resistors measured in the writer's organ were given in the Components List and serve as a guide. The actual tuning must be done by trial and error and to facilitate this rather tedious job the author devised the arrangements in Fig. 14.

Two flying leads are attached to the tags of the note to be tuned. Commencing with single resistances, clean wires and push into coil springs.

VR2 must be of such value that top note (E, a tenth above piano middle C in the writer's case) can be well flattened or sharpened. In some cases it may be necessary to alter the value of R11. Piano must be tuned to international pitch if one is used. A piano-accordion or even a harmonica would do.

Switch on a couple of minutes before tuning, then check that top note is correct. It must be remembered that since any alteration of this note afterwards will affect all the others it is necessary therefore to constantly refer back to this throughout the tuning.

Use a rubber wedge to weight down key to be tuned and top note can be played without moving these when checking. Vibrato should be off.

Regulating Percussion

All percussion contacts should be in contact with short bronze strips until a note is played. Switch on percussion and slowly press down key.

The note should sound and then decay. If key is kept down owing to breakthrough, the note will continue sounding very faintly; this is quite in order and can be ignored. Gradually release key and, if in doing this the note sounds again, the front contact needs advancing by raising the hook with small pointed pliers.

For correct working there should be a point during travel when both contact springs are momentarily off the contact strips (Fig. 11).

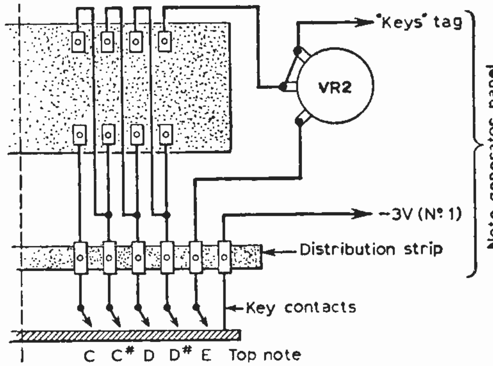


Fig. 13: Details of the tuning resistance strip.

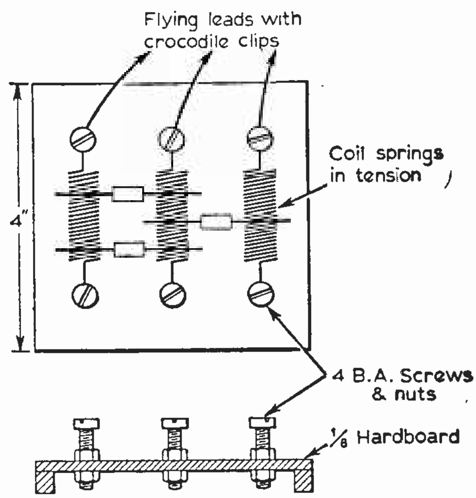


Fig. 14: A simple device to facilitate the quick selection of parallel and series connected resistances.

The Expression Pedal

Details for making this are shown in Fig. 15; ½in. Weyroc chipboard (fine quality) or plywood would be suitable. The uprights supporting the pedal were cut out of an old strap hinge but any similar piece of mild steel would serve.

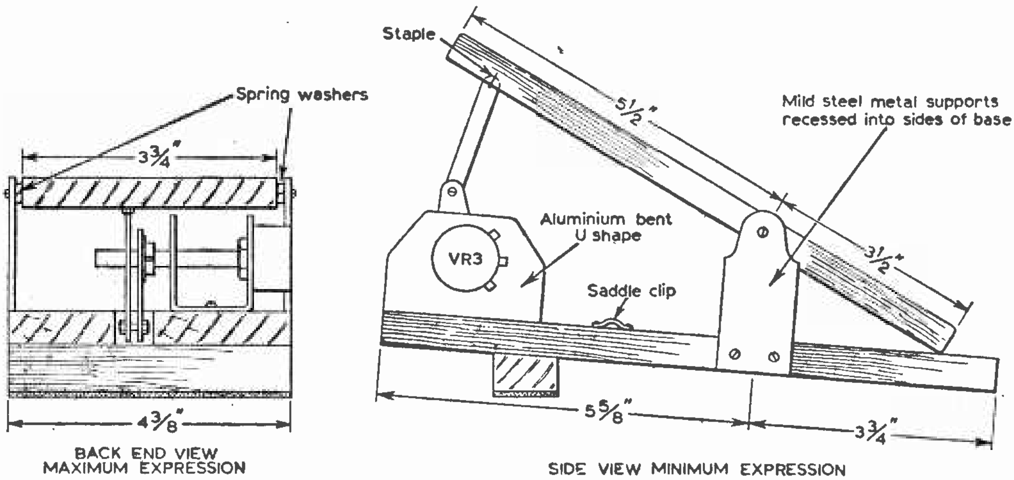


Fig. 15: Construction details of the expression pedal.

The pedal pivots upon two round-head screws inserted through holes drilled near the top of the uprights, and spring washers are followed by thin plain washers before the screws are fixed into the sides of pedal. These screws are finally adjusted so that the pedal stays in any position but moves freely.

After soldering the two leads and screening to the expression control the cable is secured by the saddle clip on the base of pedal. The metal case of the control should also be wired to the screening.

Playing to Imitate Instruments

Cello: Use lower part of keyboard with slow vibrato, imitating bowing technique with expression pedal.

Horn: Play with one level of expression and without vibrato.

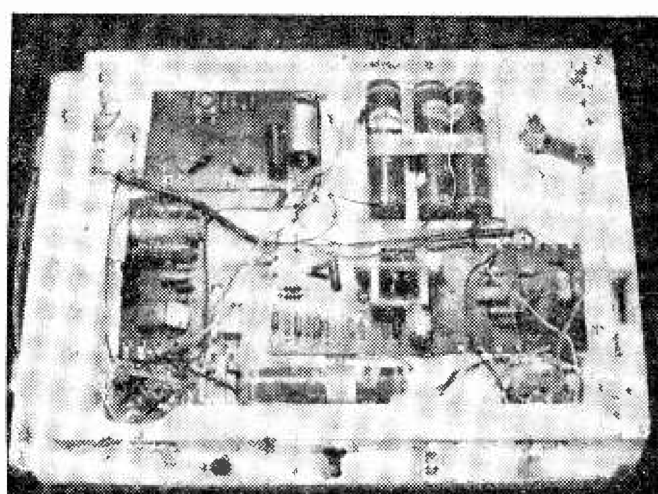
Oboe: Play legato without vibrato and sparingly use low vibrato on sustained notes. Even level of expression.

Further Notes on Making and Using the Organ

The method of finishing woodwork used by the author is to rub down with sandpaper, apply a coat of plastic emulsion paint (cream or stone colour is preferred), flick over with fine sandpaper, following with another coat and a third if necessary. Finally rub over with household wax polish and rub well to obtain a durable semi-gloss finish.

It is very easy for the organ to be left switched on, possibly for long periods, and the constructor should attend to this point. The author arranged that the switch knob projects out when on so as to be noticeable.

Tuning control VR2 should only need occasional adjustment and when correctly set to international pitch all the other notes will be in tune and the organ can be played with radio, band groups, piano-accordion, etc.



A view of the underside of the instrument cabinet. The distribution of the batteries here is seen to differ slightly from that of Fig. 8. This was a modification included after the prototype had been completed.

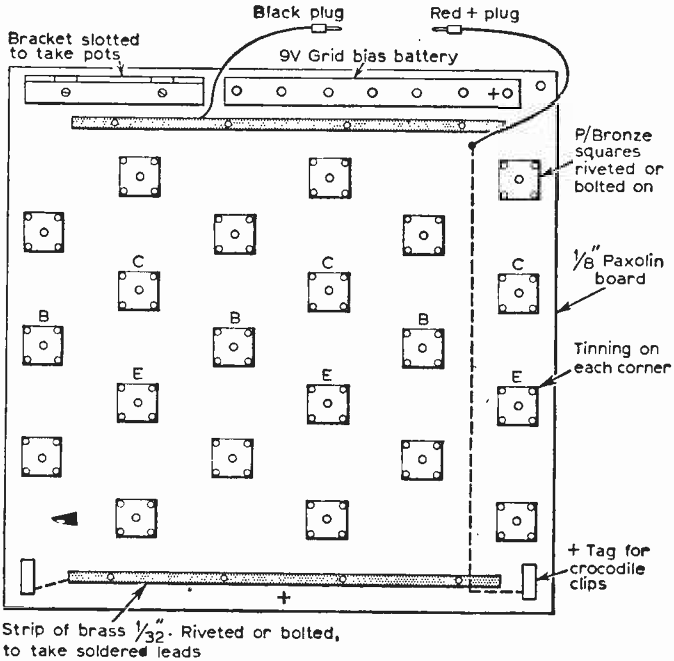


Fig. 16: The quick "hook-up" board as used by the author.

Piano-accordion: No vibrato. Use expression for sudden dynamic changes typical of this instrument.

French accordion: The same but switched to fast vibrato.

Banjo: Use horn with percussion (fast decay), no vibrato. Familiar strumming chords can be imitated by playing the notes in quick succession in arpeggio fashion.

Guitar (acoustic): Percussion (slow decay), no vibrato except at end of phasing when the sustained note should have medium vibrato switched on and off.

Guitar (electronic): For the familiar twang use horn or oboe with medium speed vibrato.

The tonal quality and appeal of this instrument is sufficient to only need moderate use of vibrato, too much of which can become boring. The aim should be variety, of which there is plenty in this little organ. ■

KEYED AUDIO OSCILLATOR

—continued from page 1158

many applications discussed in this article the current rating the transformer and rectifier must be increased accordingly and each unit should have a separate branch C7, C8, R22, D3. Such a branch may be fed directly from a 60V h.t. battery for field use without transformer and rectifier. Alternatively the transformer and rectifier may be replaced by a conventional transistor converter of vibrator circuit (or rotary converter, for that matter) delivering about 70V at 20mA maximum.

Layout and Construction

The layout of this circuit is completely non-critical, any convenient arrangement among the holes of the Veroboard panel (4in. x 2·5in.) which suits the sizes of particular components obtained being satisfactory. It is a good idea to keep roughly to the same layout as depicted on the theoretical circuit of Fig. 1, though this is certainly not essential.

The photograph shows one of the prototype units made by the author for use in recording his Geiger-head signals. The particular Veroboards used had conducting strips on one side, the whole plugging into a chassis-mounting long socket. Details about all such accessories for this and many other circuits can be obtained from the manufacturers of Veroboard, who offer a wide range of components. The matching transformer for the tape recording head is actually included on the unit shown in the photograph, the recording head being connected directly to the panel base. The input threshold sensitivity potentiometer is shown attached to a fly lead on this particular unit for mounting on the front panel of the complete unit accommodating several of these boards in a row on the chassis, one for each Geiger counter head.

Action Speed

If only brief pulses are applied to the input P1 instead of manually keyed d.c. voltages the audio oscillation follows these equally faithfully, right down to such short pulses at the input, that only a single cycle or two cycles of the audio frequency fit into them, then bursts of just one or two cycles appear at the output. The audio oscillation commences abruptly as soon as the input voltage (provided it exceeds the threshold) is applied and ceases equally abruptly as soon as the input d.c. voltage is dropped below the threshold or removed entirely. This "snap action" with accurate and cleanly keyed audio waveform output is one of the great advantages of this circuit compared to conventional ringing oscillators and "kicked" tuned circuits often used for similar applications. ■

ON THE SHORT WAVES

—continued from page 1155

VS9AAS, TF2WIA (Iceland) VE6AKU, 5A1TT, ZS4OF, 9Q5RK, 7Q7QS. No shortage of DX on 20 and note that it is all on 'phone. Where are all the c.w. specialists?

15 Metres

Unhappily, last month's jubilation was not to be repeated, and things sounded very quiet at this QTH. However, Bernard Hughes logged the following between 1535—1750 all on a.m., which appears to be very popular on this particular band: ZS6Y, CR7CO, 9J2DJ, TG9VS, KØFPL, ZE1AS, DJ8LE, VE3QW, WB2HWH, W2GBB, W8GZL, GM3BRF, K2YXY, K4DWR, W9FDD, W2VYH.

D. F. Carrington's HE30 has a 68ft. longwire with a 14ft. vertical whip at the far end, and brought in I1VCP, OK5CDR, VK3MO, SP5JJP, W2SJM, 9L1LM, 9G2BC, UA6ND, all on phone. Again no reports on the c.w. side of the business but as the above logs show there is activity on the band.

10 Metres

Alas only one lonely report this month from D. F. Carrington. From 1400—1600 the following were in evidence: G3ACR, G3NGB, G2OH, W1BNH/MM, W1MGT, W1RM, W8AGZ, W1WKO, K3UCL, WA1ACQ, all phone. A thought which might prove stimulating to 28Mc/s is that aerial experiments can easily be carried out on this band. A ground plane four 10 is only an 8ft. odd vertical whip and four 8ft. radials. Sloping the radials at 45° makes this a very compact DX antenna. A simple dipole is only just over 16ft. long, and this might be sloped to fit in an odd corner.

News in General

First on the menu, expeditions to exotic parts. CEØAG is a medical mission on Easter Island, HC8FN is on Galapagos Island, while VKØ DS is located on Heard Island. Norfolk Island is active under VK9TL as is Andaman Island (VU). Corsica radiates F9RY/FC and Sardinia IS1VAZ. In Monaco 3A2CP is reported, and a very great rarity is PX1AB in Andorra. There are two active stations on the Dodecanese Islands, one of them is SVØWF. Two rare ones for the vigilant are CR4AJ and CR4AD, Cape Verde Islands heard at 1625 on the 9th January. All the above on 20 metres. (Thanks to Alan Dailey for the information.) J. C. Wise writes from Hampshire querying 6W8—this is the prefix for Senegal.

For the contest enthusiasts March is a good month. On the 6th and 7th there is the second 144Mc/s "open" and listeners' v.h.f. contest, also on the lower frequencies the YL/OM. c.w. contest. 13th and 14th are the dates for the ARRL International DX ('Phone) competition.

20th—21st is the first Top Band contest and also International Single-Sideband contest, while 27th—28th is the c.w. section of the ARRL International DX competition. Incidentally April 4th is the date for a QRP (low power) contest.

P.S. Anyone listen on 23 cms?

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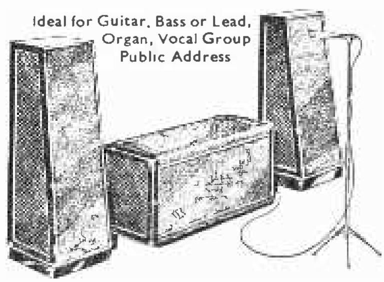

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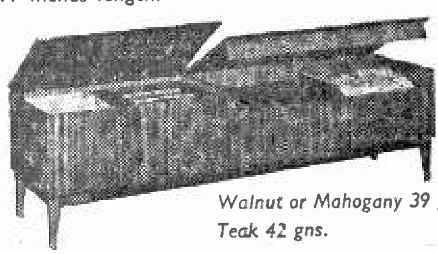

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No. 8 April Foolery

A JOKE is a joke is a joke, as Gertrude Stein forgot to say. Every occupation has its classic gags. The plumber's forgotten bag, the glazier's "hammered" window, the postman's torn trousers.

Whether because we are a "young" occupation, or whether, as I prefer to think, there is such a wealth of fun in the radio trade that it becomes difficult to choose, there has not yet evolved one typical, identifying joke.

Humour there is, aplenty. There is the old tale of the salesman faced with a box on his counter and an anxious customer on the telephone, saying: "*Yes, Madam, of course we can repair it. What is it supposed to be?*"

Many an apprentice has been fooled by a request to fetch "a box of amps", or "red oil for the warning light". Many an experienced engineer has put his meter across a high impedance circuit and forgotten to allow for the loading. Or worse, left the meter, switched to Ohms, when attempting to measure h.t., and regretted the lack of a cut-out.

The last are "banana-skin jokes". We pride ourselves in being a little less obvious. The radio fraternity has a reputation for a slightly higher standard of intelligence. Which has not prevented a few tradesmen from being caught by the innocent who approaches with a souped-up set and a request for an estimate or an opinion. Nowadays, one cannot be certain whether the envoy is from a campaigning newspaper, intent on an exposure of servicemen, from "*Which*" or even the RETRA, let alone the proliferating Consumer Councils that "protect" our interests.

Many an apprentice has been fooled.

A little while ago, we would have peeped over the set-bringer's shoulders, searching anxiously for the Candid Camera lens. We remember a riotous half-hour when Jonathan Routh tore the radio business to bits.

Apprehensive customers watched their precious receivers being battered with a ball-pane hammer; others were convinced they were radio-active, and themselves the fault of the receiver's twitches. In retrospect, one must sadly suppose that all the programme demonstrated was the gullibility of people.

Especially, it seems, about things which they cannot see working. Show them a watch, with mainspring squirming, and they'll nod sagely and trust the mechanic. But a dead set that has a blown fuse is as mysteriously ominous as the one with a "chain-reaction intermittent" fault.

Of course, if we specialise a bit in our researches, we uncover a few more candidates for the "classic joke album". There is the tape enthusiast with a full reel of silence because he forgot to plug in the microphone, or his fellow worm who complains bitterly about low output from the machine when a simple twist has caused his tape to turn over.

And there is the obvious jibe at the audiophile who pores over his dials and meters, hearing all of the sound and none of the music. Small wonder that musicians like Benjamin Britten and Anthony Hopkins come out virulently in print against the gramophone. Mr. Britten went so far, in his latest publication, as calling the loudspeaker "*the principal enemy of music*". And

Peeped over the set-bringer's shoulders.

Mr. Hopkins, after partly convincing us with some excellent writings, came out with the statement during an "Any Questions" session that ". . . *any type of canned music is inferior*".

Inferior to what? To the shrill soprano and wobbulant baritone of the average provincial oratorio performance, which is about the nearest some of us could get to "real" music unless we listened to the canned type? Who is fooling whom, may we ask?

Like all good jokes, the best is usually that we can tell against ourselves. Most radio bods have their personal favourite; such as the time we ruined our a.c. electric razor in the only d.c. hotel south of the Cairngorms; or spent hours wiring up a mains radio and aerial for a cherished maiden Aunt, only to discover she was powered by gas.

This scribe has already recounted his "aerial short-circuit" boob; and has since perpetrated an even more drastic howler. A friend brought a television receiver to the den for repair. After quite minor mending, we decided to re-align it, and concluded with the machine responding perfectly on all the local channels—only to find, after he had taken possession and re-installed, that he was on the pipeline, and used three quite different—and mistuned—channels.

FIDELITY F.M. TUNER

—continued from page 1140

strip which also supports the coupling capacitor and grid leak (C11, R7) for V3. On the same strip R6 is wired to tag 6 on V2 while its other end joins the tag that forms the main h.f. distribution point with connections to resistors 1, 5, 12, 13, 18, 19, and to the supply connector. The middle fixing lug of this strip is an earth point for three components.

All cathode bias components for V3, V4, V5, and the screen components R21, C21 of V5 are grouped by tag-strip and earthed to chassis. The electrolytic capacitor C23, clipped to chassis serves to connect and support R21, R22, and R23, the latter leading to the h.t. positive pin of the power connector.

The pulse discriminator network is mounted on a tag-strip and connected to V5 anode (tag 7) by C24. Note that three lugs on this strip are used as earth points, of which one earths the valveholder tag 6. The junction of D3 and R25 is the point from which a.f.c. voltage is taken to R28 at V2 grid. The a.f. output capacitor C27 is not shown in the diagram but arrows at C26 and the output coaxial socket indicate its connection points.

Although mounting the capacitors C7, C8, C9 under the chassis may seem a little inconvenient for adjustment this, with screening in mind, is their proper place and permits short connections to the switch distributor contacts. C6 is, of course, connected to the selector contact.

Numerical references to coil base connections to have the same orientation when the coils are fitted in positions convenient for short, direct connections, and tally with the references in Fig. 1. Foreseeing possible effects of slight variations in the winding of hand-made coils the following additional notes are offered. The range of the aerial coil is affected by stretching or compressing it. It should tune by circuit capacitance but a capacitor of 3 to 5pF can be fitted from grid to earth if necessary. The bi-filar primary and secondary windings of the r.f. transformer are wound simultaneously with side-by-side strands of wire. To achieve an accurate turns count, overwind it, dope it, and then peel back as necessary, trim and solder to the lead-out wires. Adjustment of the oscillator coil has already been described.

Many other variations are possible, but those given here after considerable thought and experiment seem most likely to suit ordinary needs. In the absence of commercial development there is no firmly established trend. Never-the-less, the system can be expected to give high quality results with very little difficulty. Sensitivity is less than that of conventional receivers but should be adequate for reception over at least twenty miles. In trials (but not for daily use) I have received signals just up to limiting level with a simple dipole two or three feet from ground level at about twelve miles from the Sutton Coldfield transmitter. It is worth mentioning, in conclusion, that although a 12AT7 (ECC81) is specified for V2 one version of the unit was found to work better with type ECC83. ■

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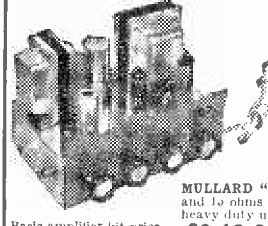

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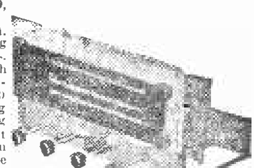

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More about the "TEN-FIVE"

BY A. S. CARPENTER, G8ABG

Further observations and some hints in connection with the communications-type transistorised receiver described in the October and November 1964 issues of P.W.

THE "TEN-FIVE" described in the October and November 1964 issues of P.W. aroused considerable interest, as might have been expected. From correspondence received it is clear that many readers have tackled the project and there is little doubt that many more will do so later. Few difficulties are likely to present themselves to constructors reasonably experienced, but some will probably incorporate snippets of circuitry to suit their own need or fancy.

By and large, however, few improvements can be made to the receiver if we are to keep within the range of components generally available to constructors. It is possible, though, to make certain small changes and these are the intention of the present offering.

Before continuing, however, it might be worth while drawing attention to a few minor errors which accidentally slipped in to the original descriptive matter. Referring to the original text and diagrams please note that the connections to L1 should be made to pins 1 and 2 and *not* pins 1 and 6 as shown. Pin 1, of T2, should be connected direct to the +ve line and the "pole" of S2B should connect direct to the negative line. In the Components List T4 should be specified as:—"Miniature Transistor-type Coil. Denco range 2 (red)."

SOME MINOR MODIFICATIONS

A very important section of any receiver of this kind is its i.f. strip (or strips) and variable selectivity is not infrequently fitted so that the bandwidth may be altered within limits.

In the "Ten-Five", selectivity of the i.f. strip is reasonably good and sharp "peaking" is possible despite the fact that only single-tuned windings are accommodated in the transformers. As mentioned earlier an improvement would result if double-tuned transformers were used but suitable specimens of dimensions small enough to suit the layout do not seem to be available.

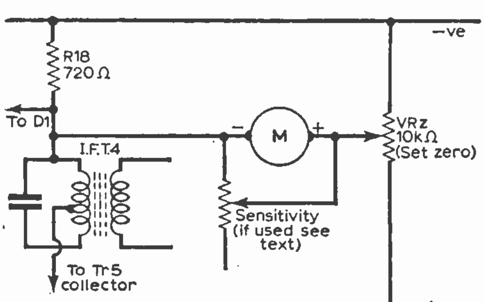


Fig. 1: An alternative 'S' meter circuit.

If sharper tuning is required use of a little judiciously applied regeneration might help. To introduce such regeneration take two short lengths of PVC wire, preferably single-strand type, and solder an end of each to pins 1 of, say, IFT3 and IFT4. Twist the wires together but do not interconnect them.

At switch-on, oscillation results whereupon the wires are gently untwisted until a point is reached where the oscillating condition just ceases. Any wire remaining above the twist may then be snipped away and the device re-adjusted after which it may be left *in situ*.

It must be appreciated, however, that the introduction of any form of regeneration does inhibit instability and it is therefore up to the user to decide whether or not the inclusion is worth while.

A MODIFIED "S" METER CIRCUIT

The signal strength meter as described originally reads backwards. With a.g.c. switched out the meter pointer is made to read full scale by adjustment of the "Zero" control. Switching in the a.g.c. causes the pointer to fall back from full scale deflection to give an indication of received signal strength. This "backwards reading" can be given the illusion of "forward reading" by rotating the meter through 180° so that it is upside down but this method might be considered somewhat crude. A more elegant method is to modify the circuit slightly, changing it to a bridge circuit. The idea is shown in Fig. 1 and here VRz is adjusted to set the meter (M) pointer to zero scale with the a.g.c. switched out. When a.g.c., due to signal strength, is applied to Tr5 the balance of the bridge is upset and the meter pointer swings in the direction of full scale. The amount of pointer swing can be used to indicate signal strength.

Unfortunately, a more sensitive meter movement than the 500μA specimen originally specified is required or a full scale reading will never be realised. A f.s.d. of about 250μA is about right although a meter with 100μA sensitivity can be used provided a shunt variable resistor is used across it and used as a pre-set "sensitivity" control.

The additional degree of sensitivity required by this meter will have to be paid for of course—in hard cash! If the system is used VRz can be mounted in place of VR2 on the front panel but a "sensitivity" control will have to be an extra item.

EXCESSIVE NOISE

When this is present on the highest frequency ranges of a newly constructed "Ten-Five" the trouble might be due to the emitter resistor bypass capacitor C8. Reducing the value of C8 frequently effects a cure and although the precise value needed might have to be found by experiment a value of around 5,000pF is a good one to commence with. The largest value possible compatible with a low "noise" level at the high frequency end of scale on Range 5 should be selected.

Still considering the "front end" of the receiver it is possible to modify the r.f. gain control circuit —and advantageously—by adopting the scheme shown in Fig. 2. The control still affects the transistor base potential but less adversely than the previous circuit. The control proper can occupy the same position on the front panel as the earlier one but the changed value assigned to it should be noted.

EXTERNAL AIDS—THE AERIAL SYSTEM

Although the "Ten-Five" is very efficient its performance does depend to a great extent on the aerial used. A discourse on aerial types will not be embarked upon here as adequate information already exists.

Many readers will doubtless use a simple, random-length long wire and if this is reasonably long and adequately high above ground many interesting transmissions will be received. The user fortunate enough to possess a good multiband antenna will be in a much better position, of course.

Considerable benefit is usually derived, however, from using a simply made A.T.U. (aerial tuning unit) between aerial and receiver. The device may be constructed as a "loose" item or it may be permanently fixed. One simple specimen is depicted in Fig. 3. The coil L is closewound on a 1in. diameter former, using 24s.w.g. enamelled copper wire tapped as indicated.

Fig. 2: A modified r.f. gain control circuit. Components additional to the original circuit are VR1A and RL.

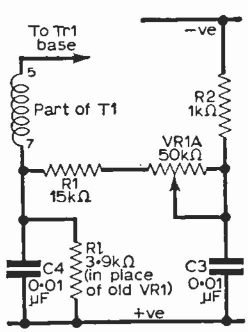
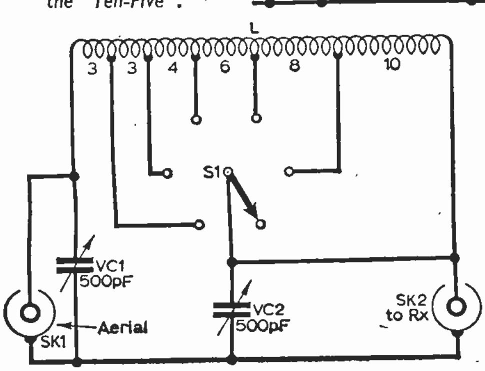


Fig. 3 (below): A simple aerial tuning unit which may be used to advantage in the "Ten-Five".



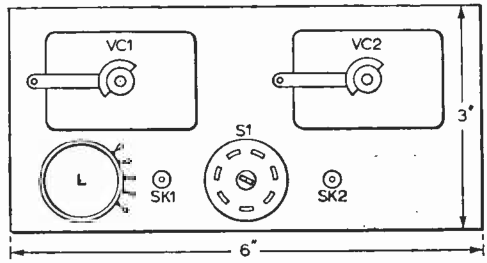


Fig. 4: The circuit of Fig. 3 may be constructed as a compact unit using the above layout.

In use rotary switch S1 is used to select windings from the coil and variable capacitors C1 and C2 are adjusted for optimum results indicated by the receiver "S" meter. These capacitors may be simple, solid dielectric specimens of the reaction type and a layout with dimensions to accommodate all the items required is given in Fig. 4.

It should be noted that this simple A.T.U. is only suitable for reception purposes.

SCALE CALIBRATION

This may be carried out using a crystal frequency marker. Calibration might not hold its accuracy, however, since inaccuracies can be introduced due to the "plug-in" type of bandchanging adopted, for there is eventually some degree of contact loss due to the coil spills and dust, etc., in the noval holders.

Switched bandchanging would without doubt be a much more refined method and optimum conditions for each range could be realised. The method would also, unfortunately, considerably complicate construction.

Whilst considering this angle it is also interesting to note that it has been found very beneficial to remove the pressure-type trimmers from the three-gang tuning capacitor and fit instead 0—30pF concentric specimens.

Despite some drawbacks, however (and these can be successfully lived with), it is worth while building a crystal frequency marker for use with the "Ten-Five" and a suitable transistorised unit will now be described.

The simple circuit shown in Fig. 5 relates to a small marker unit primarily constructed for use with the "Ten-Five" but, of course, it can be used to calibrate any receiver.

Such a piece of apparatus not only assists in band location and scale calibration but also materially assists alignment, since harmonics of its output may be heard over the various bands used.

Broadcast signals on the short wave ranges are subject to considerable amounts of fading and are not, therefore, very suitable for test purposes to any useful degree. A "marker" signal is constant even if heard progressively weaker as the receiver is tuned higher in frequency.

If required the circuitry shown may be incorporated in the receiver itself, for adequate space exists in the "Ten-Five" adjacent to the "front-end" converter section whereupon the power

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Mic. 2 —150 microvolts

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NEGATIVE FEEDBACK
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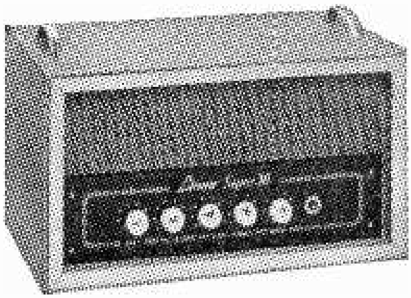

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CHP3

supply can be picked up from point "C" via suitable switching.

The total current drain of the marker is less than 2mA and may be considered negligible, particularly if the receiver is mains driven—and in any case the marker is not continually in use.

Alternatively a unit may be separately constructed on an oddment of 1½in. wide tag board and housed in a small box, using a small 6V battery. In this case a miniature on/off switch and an outlet socket need be the only externally visible components; then, too, it might be possible to omit C2 and R4.

The prototype unit functioned reliably at only 3V, but a higher potential is desirable to provide adequate amplitude.

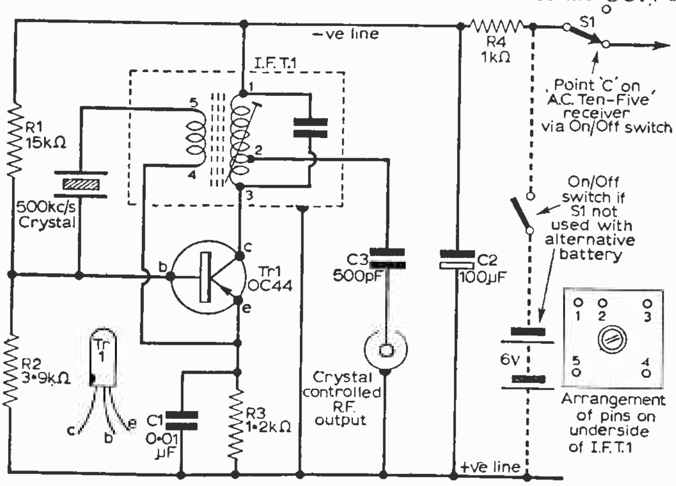

Fig. 5: A transistorised crystal frequency marker circuit which can be used to calibrate the "Ten-Five" accurately. I.F.T.I. is a Denco sub-miniature i.f. transformer, type IFT14. C2 is a 6v d.c. working component.

OPERATING FREQUENCY AND CIRCUIT DETAILS

Although a popular amateur crystal marker frequency is 100kc/s this one operates at 500kc/s and thereby enables an easily obtainable transformer to be used as the phase reversing element.

The specified transformer is constructed in a ferrite pot core assembly initially designed to operate at 465kc/s in transistor superheterodyne receivers. Physically the transformer is of sub-miniature dimensions and the slightly higher operating frequency here required is obtained by adjusting the dust core fitted.

It is thought that not all such transformers could be used successfully—for the windings ratio requires some consideration—although a type designed for use as a "final IFT" in a transistor receiver should prove suitable.

The crystal used in the prototype was a 500kc/s fundamental type (two-pin, 10X base) obtained from one of the regular PRACTICAL WIRELESS advertisers for 15s. and no tests with any other 500kc/s specimens have been made. It will be noted that the crystal unit is in series with the feedback winding of T1, which is shown in the correct sense to provide oscillations.

The primary connections at T1 are arranged so as to minimise as far as possible the detuning effects caused by some externally connected apparatus; circled numerals associated with T1 refer to the basing, for which also see the inset diagram.

Excellent temperature stability for the transistor is achieved due to the values assigned to R2, R3 and C1, and although the unit will function if neither of these items is fitted (R1 must then be increased to about 270kΩ) the financial saving is not great and may in any case be rapidly offset by transistor demise!

Regarding the transistor specified it is thought that an OC45 could be used equally well in place of the OC14 shown, but in any case a reasonably good specimen should be selected from the stock.

TESTING AND RESULTS OBTAINED

A newly constructed unit is best tested in conjunction with an oscilloscope, firstly to check that a waveform is in fact being produced and secondly that it is of adequate amplitude and is free from distortion. In the prototype model it was found that the core of T1, which needs to be gently screwed anti-clockwise from underneath out of the inductive region, required rather careful adjustment, the device jumping into action suddenly from a non-oscillating condition when the core was moved. Excessive movement of the core caused the oscillations to cease abruptly.

When coils for range 4 (20—60m) were plugged into the "Ten-Five", and the marker coupled to the aerial input, the tenth harmonic appeared at switch-on almost at full scale as indicated by the dial pointer, this being set carefully for maximum signal meter reading. Care should be taken to ensure that overloading of the receiver due to excessive coupling does not occur. The M.S.F. transmission on 5Mc/s was then heard immediately the marker input was exchanged for the aerial.

On sensitive short wave receivers signals or carriers may be heard even when no aerial is connected (especially on the higher frequency ranges) and it might be difficult sometimes to decide whether a signal is due to the marker or to a transmitter. In these cases momentarily switching off the marker removes any doubt.

CONCLUSION

Amateur bands edge-marking is not possible with the simple device described but it is thought that for SWL needs 500kc/s marker points are adequate. On "80" one obtains marker points at 3·5 and 4Mc/s (actual amateur band coverage 3·5—3·8Mc/s), whilst on "40" a marker is obtained at 7Mc/s and so on. ■

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Car Aerial Preamplifier

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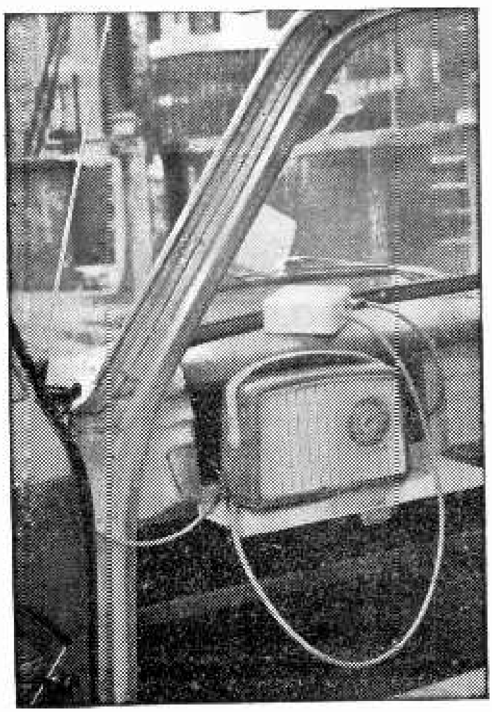
The gain is said to be not less than ten times at all broadcast frequencies. The battery is a PP4 9V and the current drain is 40μA. The dimensions are 3½ x 3½ x 2in., and the price is 50s. complete with battery and lead. *Transistor Devices Limited, New Road, Brixham, Devon.*



The Karad car aerial preamplifier

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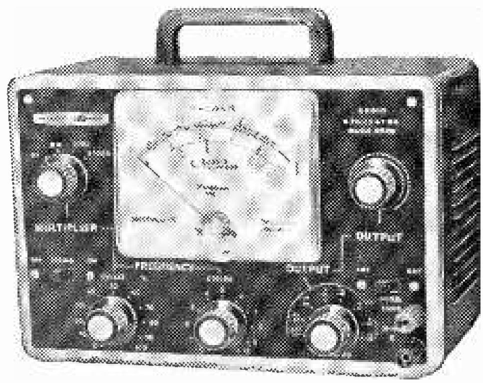

New-style audio generator from Heathkit.

Mullard Semiconductor Designer's Guide

THE November edition of the Mullard Semiconductor Designer's Guide is now available from the company.

This guide contains quick-find charts for transistors which list the devices under the main headings of collector voltage, total dissipation and cut-off frequency.

This basic information is augmented in subsequent pages under device headings which also include the full range of diodes, rectifier diodes and thyristors.

Full dimensional drawings and details of the international encapsulation to which the devices comply are given at the back of the booklet.

Requests for copies from engineers and interested parties should be made on company headed notepaper to: *Technical Office, Industrial Markets Division, Mullard Ltd., Mullard House, Torrington Place, London, W.C.1.*

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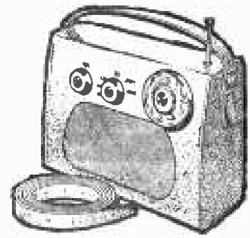

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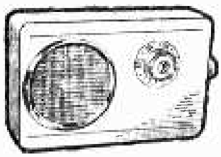

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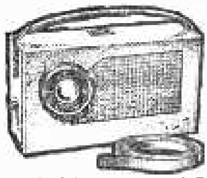

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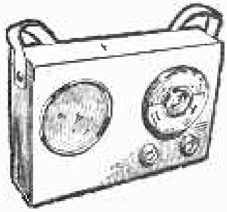

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Photo-electric Auto-stop

FOR TAPE RECORDERS

BY D. T. A. JACK

THE following circuit was designed and constructed after a number of experiments had been carried out with mechanical auto-stops (micro switches and metal foil stops), most of which were inefficient, and often requiring large power supplies. The auto stop device described here had to possess the following features:—

1. To operate on breakage of tape;
2. To be compact in size;
3. To operate from a battery or low voltage power pack;
4. To have no physical contact with the tape.

A photo-electric device immediately came to mind. The Mullard ORP12 cadmium sulphide photo-conductive cell was chosen as it can be directly coupled to a relay and battery, and does not require a transistor amplifier as do selenium cells and photo-transistors.

A Carpenter polarised relay was chosen for its positive "ON/OFF" action and ability to be easily re-set.

Two polarised relays were tried in the circuit, a 4·5Ω + 4·5Ω and 1685Ω + 1685Ω, both relays operated satisfactorily although a slight difference in sensitivity was noticed.

A slave relay was used in the initial stage of development, but was later discarded, after finding that the polarised relay contact points, after suitable suppression, would carry the motor current. The spark suppression used on the original was a 0·01µF paper capacitor (1,000V working) in series with a ¼W 220Ω resistor.

The purpose of the 50Ω pre-set pot., is to adjust the amount of light falling on the cell, the setting will depend largely on the voltage rating of the bulb.

The total current consumption was 150mA at 6·3V using a 1685Ω + 1685Ω relay and a miniature 6·3V bulb.

The device marked R/B in Fig. 1 can either be a warning buzzer, or alternatively a slave relay.

The layout of the bulb and photo-cell is not critical, although it was found necessary to place the photo-cell as near to the tape as possible, to prevent stray light reaching the cell.

It should be pointed out that if the bridge rectifier is to be connected to an amplifier with a common earthed heater supply, under no circumstances should any part of the circuit be connected to the deck, as this may result in shorting out part of the rectifier.

This photo-electric auto-stop has been used in conjunction with the "Magnavox" studio tape deck with complete success, for some time. ■

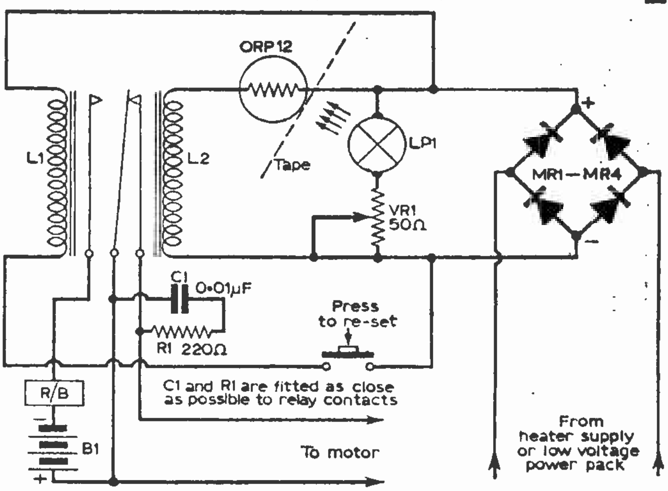
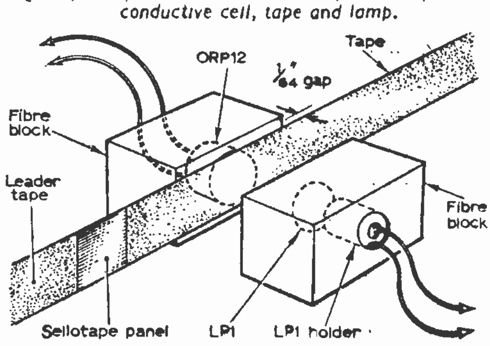


Fig. 1 (above): The Auto-stop circuit.

Fig. 2 (below): The mechanical set-up of the photo-conductive cell, tape and lamp.



COMPONENTS LIST

R1 220Ω ½W 10%
C1 0·01µF paper 1000V
RL1 Carpenter polarised relay (see text)
VR1 50Ω 1W w.w. potentiometer
ORP12 Mullard cadmium sulphide photo-conductive cell
MR1, 2, 3, 4 Silicon or germanium rectifiers. 50V P.I.V. 200mA or alternatively one 1A 6/12V selenium bridge rectifier
S1 Press switch (miniature type bell push switch)
PL1 1·5–6V 0·3A bulb and holder
R/B Buzzer or relay (see text)
B Battery to suit R/B

CLUB NEWS

ACTON, BRENTFORD AND CHISWICK RADIO CLUB
Hon. Sec.: W. G. Dyer, G3GEH, 188 Gunnersbury Avenue, Acton, London, W.13.
At the meeting on Tuesday, 16th March, at 66 High Road, Chiswick, there will be a tape-recorded lecture on 160m DX Working by W1BB.

BASILDON AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: C. Roberson, G8AA0, Milestone Cottage, London Road, Wickford, Essex.
The Club held a Junk Sale at the Cafe of the Van Gogh, Basildon, on Tuesday, 16th February, to which amateurs in the district were invited.

BROMSGROVE AND DISTRICT AMATEUR RADIO CLUB
Hon. Sec.: J. K. Harvey, 22 Elm Grove, Bromsgrove, Worcestershire.
At the meeting held on 5th February above the Co-operative Grocery, High Street, Bromsgrove, there was an informal discussion, the future programme being the main feature. All amateurs and SWLs were invited.

CHESTER AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: P. J. Holland, Field House, 19 Kingsley Road, Great Boughton, Chester.
The Society met on Tuesday, 5th January, in the Y.M.C.A., Chester, for the A.G.M., and the following members were elected to serve on the management committee: President, K. Gray, GPO; Chairman, D. Wardle, G3EWZ; Vice Chairman, H. Morris, G3ATZ; Secretary, R. Tricky, G3DRB; Treasurer, B. Fallows, G3OWY. Ordinary committee members: B. M. Poole, GW3JAZ; J. Butler, G3FNV; A. Bennett, G3SQP; P. J. Holland; A. T. Green, G3TRL. The Society's auditor is J. Goldburgh, G3ETH.

COVENTRY AMATEUR RADIO SOCIETY
Hon. Sec.: E. E. Snow, G3TKO, 11 Lupton Avenue, Coventry.
At the meeting at Westfield House, Radford Road, Coventry, on 25th January, there was a talk by K. Brown, entitled "An h.f. Bands Convertor".

DERBY AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: F. C. Ward, G2CVV, 5 Uplands Avenue, Littleover Derbyshire.
On 10th February, there was a talk by B. J. C. Brown, G3JFD, entitled "The Short Wave Listener". The Annual Dinner and Dance was held on the 13th at the Derbyshire Yeoman, Kingsway, Derby. On 17th February, there was a discussion on the 1965 National Field Day, and on the 24th Messrs. M. Shardlow and J. Anthony gave a Technical Film Show. A Surplus Sale was held on 3rd March. Meetings are held in Room No. 4, 119 Green Lane, Derby, and start at 7.30 p.m.

EAST HAM GROUP OF THE R.S.G.B.
Hon. Sec.: D. R. Durham, 43 Victoria Avenue, London, E.6.
The above Group invites all SWLs and Licensed Amateurs in the East London area to go along to their fortnightly meetings at 12 Leigh Road, East Ham, London, E.6. The host is G2COG and it is suggested that part of the evening be set aside for a station to be on the air in order that newcomers to the art may see for themselves just "how it works".

EAST KENT RADIO SOCIETY
Hon. Sec.: E. S. Wood, G3TMI, 18 Dover Street, Canterbury, Kent.
The Society now has a new hall in which to hold the meetings. The Club station, G3LTY, will now be active on 160 metres at least once a week and it is hoped to start a slow Morse transmission in the near future.
The Society meets every Wednesday night at 7.30 p.m. in the Toc-H Hall, Vernon Place, Canterbury.

HALIFAX AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: J. Ingram, G3RMQ, Lambert House, Greetland, Halifax, Yorkshire.
On 26th January, J. J. Platt, G2VO, gave a talk entitled "Radio a Long Time Ago", and on the 23rd February, D. Moore, G3LSA, lectured on "Two Meters".
Normal meetings are held in The Beehive and Cross Keys Hotel, King Cross Street, Halifax, at 7.30 p.m.

MID-WARWICKSHIRE AMATEUR RADIO SOCIETY
Hon. Sec.: H. C. Loxley, 5 Guy Street, Warwick.
The Annual General Meeting was held on 8th February, and on 22nd February, the lecture "Radio Theory" Part 3, took place.

NORTHERN HEIGHTS AMATEUR RADIO SOCIETY
Hon. Sec.: A. Robinson, G3MDW, Candy Cabin, Ogden, Halifax, Yorkshire.
On 17th February there was a Ragchew night, and on 2nd March Mrs. M. I. Shaw, G3OMM, repeated the popular lecture that she has given before, entitled "Radio on Stamps".

OXFORD AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: B. Green, G3PMI, H.Q., Cherwell Hotel, Water Eaton Road, N. Oxford.
A lecture/demonstration by Dawe Instruments was given on 24th February. Meetings on the second and fourth Wednesdays of each month at 7.30 p.m. at the Cherwell Hotel, N. Oxford.

PETERBOROUGH AND DISTRICT AMATEUR RADIO SOCIETY
Hon. Sec.: D. Byrne, G3KPO, Jersey House, Eye, Peterborough.
Meetings are held at Peterborough Technical College on the first Friday in each month—in the Lecture Hall of the Electronics Block. Other Fridays at the new clubroom in the old windmill behind the Peacock Inn on the London Road.

READING AMATEUR RADIO CLUB
Hon. Sec.: R. G. Nash, G3EJA, "Peacehaven", 9 Holybrook Road, Reading, Berkshire.
The Dinner Social held on the 9th January was very successful when 37 members and friends had a most enjoyable evening.
On 27th February, the subject under discussion was the National Field Day.

SALTASH AND DISTRICT AMATEUR RADIO CLUB
Hon. Sec.: D. Bowers, G8948, 95 Grenfell Avenue, Saltash, Cornwall.
This is a newly formed club and the present membership is 23. Several SWL members are studying for the R.A.E., one member having already been successful. A morse class is also in operation.
On 12th February there was a Two Meter Demonstration at the G3SN QTH, Saltash, and on the 26th there was a talk by R. Roper on DX-TV.

SLADE RADIO SOCIETY
Hon. Sec.: D. T. Wilson, 177 Dower Road, Four Oaks, Sutton Coldfield, Warwickshire.
There was a sale of surplus equipment on 19th February, and on the 25th the Mullard Film Evening, this year held in the Great Hall of the College of Advanced Technology, Gosta Green, Birmingham.

SPEN VALLEY AMATEUR RADIO SOCIETY
Hon. Sec.: N. Pride, 100 Raikes Lane, Birstall, Nr. Leeds
On 18th February J. A. Edwards, A.M.Inst.E., gave a lecture on Radioactive Isotopes in everyday life. On 4th March the R.S.G.B. gave a talk on the Training of Young People in Amateur Radio.

TEES-SIDE AMATEUR RADIO SOCIETY
Hon. Sec.: A. L. Taylor, G3JMO, 8 Heythrop Drive, Acklam Middlesbrough.
This club, which caters socially for the licensed amateurs of Tees-Side is at present considering plans for being of better service to the Hams of the district. A cordial invitation is therefore extended to "absent calls" to visit us at any meeting.
Meetings are held at the Settlement, 132 Newport Road Middlesbrough, Yorkshire, on alternate Fridays at 8 p.m. The 5th and 12th March, etc., are forthcoming meetings.

WELLINGBOROUGH RADIO CLUB
Hon. Sec.: J. Baker, 34 Essex Road, Rushden, Northamptonshire.
On 11th February, D. Clarke gave a talk on the fundamentals of Hi-Fi and on the following week he demonstrated some of his home-made Hi-Fi equipment. Members brought along their colour slides on 25th February and on 4th March members were invited to the home of F. Wright, where he gave a talk and demonstration on the electric organ.

WESSEX AMATEUR RADIO GROUP—G3FVU
Hon. Sec.: P. Cutler, 43 Langside Avenue, Wallisdown Poole, Dorset.
The Group held their AGM to which all members were requested to attend on 1st March at The Cricketer's Arms, Bournemouth On the agenda was the programme of events for the coming season, suggestions for which included Hare and Hounds, Jamboree on the Air, and a Constructor's Contest.

PREPARING FOR THE R.A.E.

BRIAN ROBINSON.

6: THE TRIODE

6.1 The Effect of the Third Electrode

SO far only the diode valve has been mentioned and it is fairly obvious that the diode can only have limited applications as it is unable to amplify. If a third electrode is added to the simple diode the new valve, or *triode*, can be made to *amplify*. The first triode was constructed in 1907 by de Forest, who simply placed a wire mesh or *grid* between the cathode and anode of a diode. The grid is generally made of *nickel* or some similar metal which is easy to work with.

By applying voltages to the grid the flow of electrons from the cathode to the anode can be controlled, and in fact the grid can be described as an *electrostatic shield*. The grid can be used to limit the effect of the anode voltage on the space charge surrounding the cathode, and only a *small negative voltage is required to do this as the grid is much nearer to the cathode than the anode.*

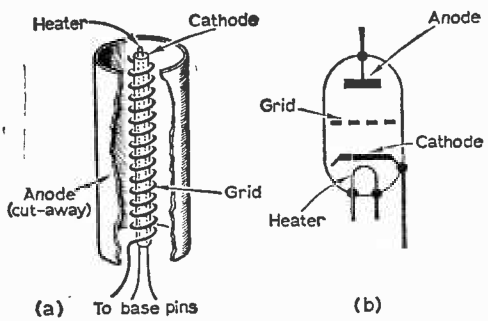


Fig. 51 (a): The mechanical construction of a triode, without the glass envelope. (b): The triode valve circuit symbol.

Simplified construction and theoretical representations of the triode are given in Fig. 51. It must be remembered that if the grid of a triode valve is kept at a negative potential no grid current can flow, but if it is given a positive potential grid current will flow as negatively charged electrons will be attracted towards it.

6.2 Characteristic Curves for a Triode

In the operation of the triode there are *four* important variables to be considered, as opposed to two in the case of the diode. The four are—

a) anode current—I_a
b) anode voltage—V_a
c) grid voltage—V_g
and d) grid current—I_g

In our considerations only the first three of the variables will be considered at this stage. Characteristic curves will be considered for the following—

a) I_a against V_a—with V_g constant
b) I_a against V_g—with V_a constant.

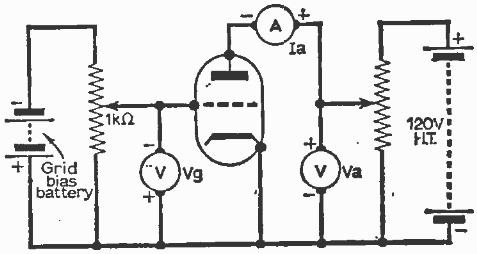


Fig. 52: The circuit arrangement used to determine the current/voltage curve (I_a/V_a) for a triode.

6.3 The I_a/V_a Curve for a Triode

To find the I_a/V_a curve for a triode the circuit shown in Fig. 52 is used. As can be seen, the anode voltage is varied and the corresponding values of anode current are noted. The grid voltage is adjusted by using the potentiometer connected across the grid bias battery. (*N.B.*—if positive values of V_g are required the grid bias battery is simply reversed.) The anode

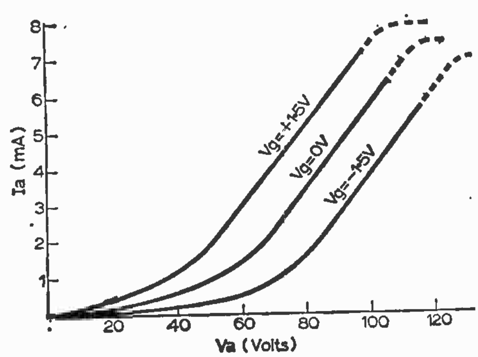


Fig. 53: A typical family of I_a/V_a curves for a triode, with grid voltage (Vg) kept constant.

voltage is increased in about 10 volt steps and each value of anode current is noted—this is repeated for various values of V_g and a series of curves (or family of curves)—of the type shown in Fig. 53 are obtained. Note that a positive value of V_g has been included and that this gives a greater value of anode current than the value of $V_g=0$.

The a.c. resistance of the triode is obtained in exactly the same way as for the diode, in Fig. 54 the a.c. resistance has been found using the I_a/V_a curve obtained when V_g is equal to 0. The saturation

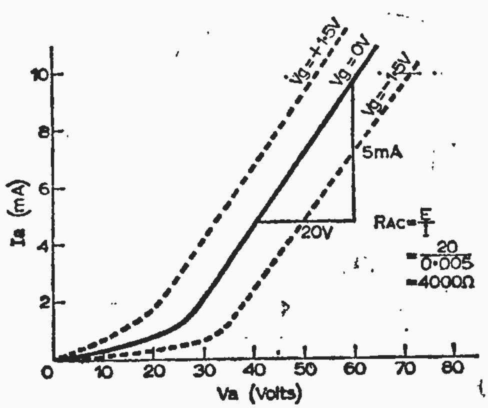


Fig. 54: Obtaining a triode a.c. resistance on the I_a/V_a graph at $V_g=0$.

current for the triode is the same as for the diode—i.e. when further increases in anode voltage cause no further increase in anode current.

6.4 The Mutual Characteristics for a Triode

The second set of triode characteristics which must be dealt with are called the *mutual characteristics* of the valve. These characteristics show the relationship between I_a and V_g when V_a is kept at a constant value. The circuit used to obtain the mutual characteristics is the same as that shown in Fig. 52, but this time the anode voltage is fixed at a certain value and V_g is varied in small equal steps—the value of I_a for each value of V_g being recorded. The process is repeated for various values of V_a. The point where the value of I_a becomes 0—i.e. where the curve touches the V_g axis—is called the "cut-off" value for the particular value of V_a used. A set of I_a/V_g curves obtained for a small triode are shown in Fig. 55. (*N.B.*—The readings obtained when V_g was positive were obtained by reversing the polarity of the grid bias battery.) As has been previously mentioned, in some cases the triode is operated with positive values of V_g. In these cases the grid current will flow as the grid is positive in respect to the cathode. This current is generally of the order of microamps or in the case of transmitting valves a few milliamps. The I_a/V_g curve of a triode is very similar to the characteristic curve for the diode.

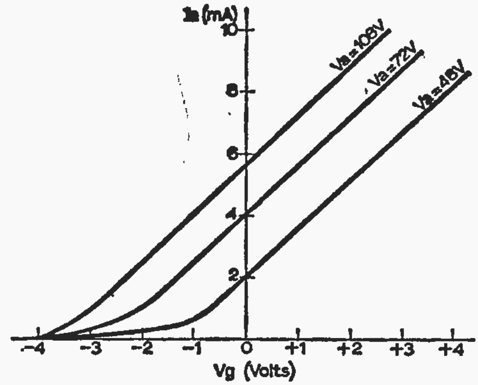


Fig. 55: A set of mutual characteristics curve of a triode.

In general the grid of a triode must only become slightly positive with respect to the cathode, otherwise the electron emission may become too copious and cathode damage will result.

6.5 The Mutual Conductance of a Triode

The *mutual conductance* of a valve is generally denoted by gm and can be defined as "the ratio of the change of I_a to that of V_g when V_a is kept constant." Since current over voltage gives *conductance* the mutual conductance of the valve is measured in the unit of conductance which is the *MHO*.

$$\frac{\text{Amps}}{\text{Volts}}=\text{mhos.}$$

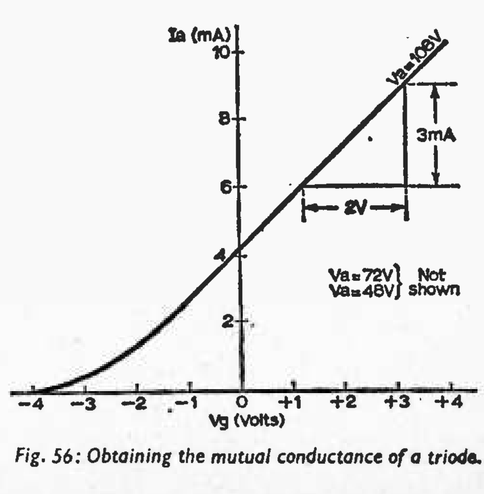


Fig. 56: Obtaining the mutual conductance of a triode.

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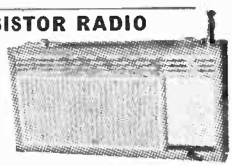

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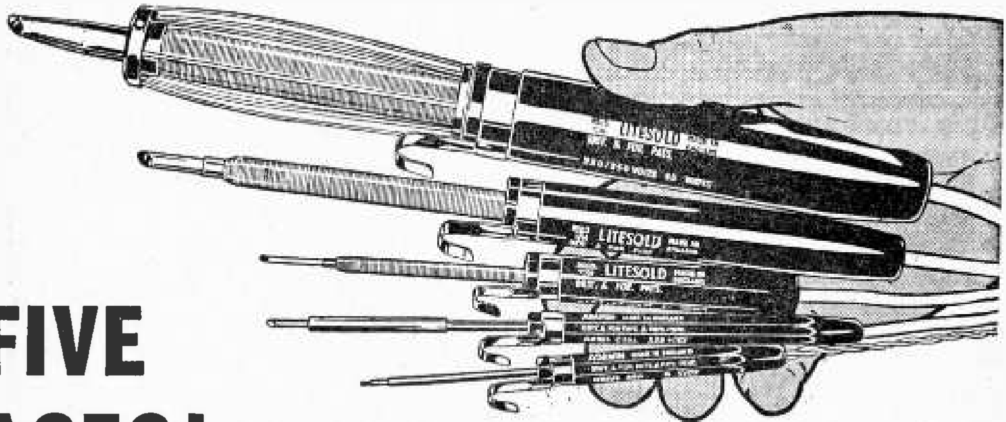
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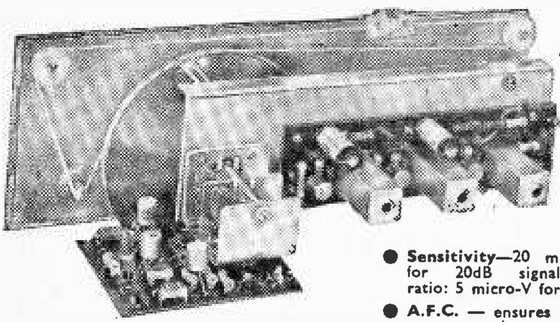
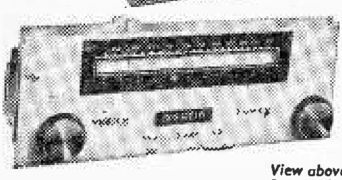




Since the mho is a fairly large unit however the *micromho* (one millionth of a mho) is generally used in radio and electronics. From the graph shown in Fig. 56 we can see that the mutual conductance would in this case be 3 (mA) divided by 2 (volts). If our units are in Amps. and Volts the mutual conductance will be in mhos—

$$\frac{0{\cdot}003}{2}=0{\cdot}0015 \text{ mhos},$$

this would be generally written however as 1500 micromhos. Mutual conductance is often expressed as being so many "milliamps per volt"—in the above case the value would be $3/2=1{\cdot}5$ milliamps per volt. The mutual conductance of a valve is the best all round indication of the effectiveness of the valve as an *amplifier*. At the present time the value of about 10mA/volt is a fairly high mutual conductance for normal type of receiving valves.

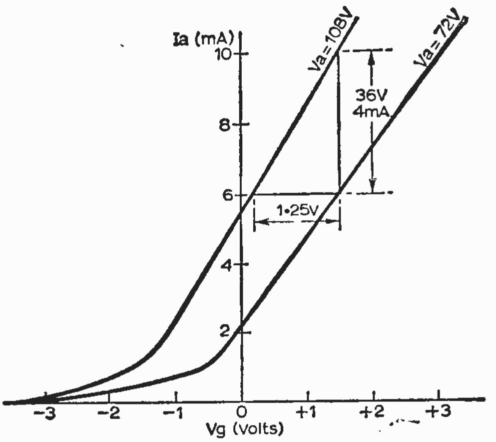


Fig. 57: Obtaining the amplification factor of a triode.

6.6 The Amplification Factor of a Triode

The *amplification factor* of a triode is generally denoted by the Greek letter μ. The amplification factor is found by dividing the change in V_a, which produces a change in I_a (V_g constant), by the change in V_g which will cause the same change in I_a, (V_a constant). Suppose that a change of 2 volts in V_g caused the same change in I_a as a change of 40 volts in V_a, then the amplification factor, μ, would be 40/2 which is 20. the conditions mentioned being obeyed of course. Note that as μ is a ratio of voltage to voltage it can have no units. In Fig. 57 it can be seen that a change in anode current of 4mA is obtained by a change in grid voltage of 1·25V—but the same change in anode current is obtained by a change in anode voltage of 36. Therefore the amplification factor is equal to 36/1·25 or 28·8.

The amplification factors of triodes range from about 3-100 or so. A "high μ" valve has an amplification factor of 30-100; a "medium μ" valve from 8-30; a "low μ" valve less than 8. These figures are of course approximate.

We have already seen that—

$$R_a=\frac{V_a}{I_a}$$

$$gm=\frac{I_a}{V_g}$$

$$\text{and } \mu=\frac{V_a}{V_g}$$

and it is fairly apparent that by simple arithmetic we can form a relationship between the three constants. This relationship is—

$$\mu=R_a\times gm$$

$$\text{i.e. } R_a\times gm=\frac{V_a}{I_a}\times\frac{I_a}{V_g}$$

$$=\frac{V_a}{V_g}=\mu$$

6.7 The Publishing of Valve Characteristics

The manufacturers of valves have obviously to provide the designers of radios, television sets, etc., with information they require in order to utilise a particular valve. They do this by publishing a table of valve characteristics, which contains all the relevant information on the operating conditions of a particular valve. A table of characteristics is shown below for an imaginary medium μ triode.

TABLE I

XXX—medium μ Triode

Filament Volts	2·0
Filament Current	0·1A
Anode Voltage	120
Grid Bias	−1·5V
Anode Current	2mA
A.C. Resistance	15,000Ω
Mutual Conductance	2000 micromhos or 2mA/volt
Amplification Factor	26

6.8 Interelectrode Capacities

As any two pieces of metal which are separated from one another form a capacitance it is clear that there must be effective capacitances formed between the electrodes of a valve. They are called "interelectrode capacities". The effect of the interelectrode capacities is to add to the circuit capacities already present, and particularly in valves which are used at v.h.f. and u.h.f. this can be a serious problem. This is why specialised valves are used at these frequencies and in fact the specialisation is mainly to reduce the interelectrode capacities.

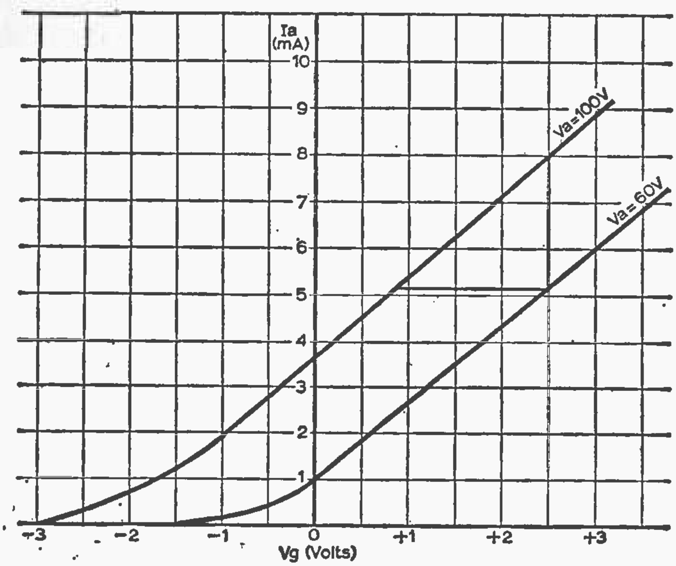


Fig. 58: The graph for this month's question.

Question

In Fig. 58 find—

1. The mutual conductance of the valve (in micromhos and mA/volt).
2. The amplification factor of the valve.
3. The cut-off value for V_a= 100 volts.
4. The cut-off value for V_a= 60 volts.

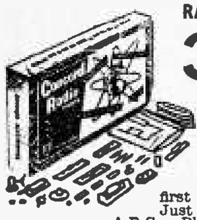
Answer to Last Month's Question

1. The X should be at the point on the graph approximately where I_a=19 mA and V_a= 120 volts.
2. The valve would normally be operated approximately between the values V_a=40—110 volts and I_a= 4— 18 mA
3. A.C. resistance=5,000Ω
4. The graph would not pass through zero as even with no anode voltage a few electrons will reach the anode.

Part 7 Next Month

TESTED BY TIME — CONCORD'S LOW PRICED KITS

MAKE 5 DIFFERENT TRANSISTOR RADIOS FOR 35/-



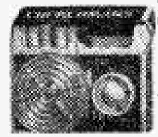
NO EXPERIENCE NECESSARY. No Soldering. Only 8 connections for first radio to work. Just look, you get A.B.C. Plans, Cabinet, Loudspeaker (alone 17/6). Earphone, 4 Semi-conductors, Coils, Condensers, Resistors, Tuner, Switch, Screws, etc. YES — EVERYTHING! Loud clear English and Foreign reception. As supplied to Educational Authorities. H.M. Forces, etc. TESTIMONIALS GALORE. Mr. R. O'D. of Londonderry, writes:— "... *I received your components and I must say that I am very satisfied with them. I have it already set up!* ..." COMPLETE HOME RADIO COURSE, Originally £6 SEND ONLY 35/- plus 2/6 post etc. (C.O.D. 3/- extra).

NEW RADIO ANYONE CAN BUILD IN 2-3 HOURS 19/6

EVEN THE OLDER CHILDREN BUILD THEM! ... no soldering—only 16 connections! then hear it reach out bringing in station after station, loud and clear. Palm-of-hand size 4¼ x 2¼ x 1¼in. Many Testimonials: M.H. of Bradford. writes: "... *I have just completed one of your sets successfully, it is the first time I have ever tackled anything like a radio, and I must state here and now. I am amazed how easy it is to a layman like me. Your instructions and plan have obviously been very carefully thought out so that even the most dim can follow them* ..." Direct from Manufacturers to You. SEND 19/6 plus 1/6 post etc. (C.O.D. 2/6 ex.).

PARTS AVAILABLE SEPARATELY

AMAZING CIGARETTE RADIO! ONLY 18/6



Yes, a perfectly ordinary packet of cigarettes!—but watch your friends astonishment on hearing it fetch in station after station, loud and clear! Still holds 10 Cigarettes—yet cleverly conceals highly sensitive, fully transistorised circuit (including tiny battery). Even a young boy can assemble it in under 2 hours. No soldering. No experience necessary. Only 16 connections to make. Ideal for taking to work with you. From our bulging testimonial file. Mr. D.B. of Huddersfield writes:—"... *I have fitted the parts in and it is working wonderfully* ..." ALL PARTS including Semi-Conductors, A.B.C. Plans, etc. ONLY 18/6 plus 1/6 post. etc. (C.O.D. 2/6 ex.). (Parts available separately).

READ WHAT SATISFIED CUSTOMERS SAY

R.C. of HARRINGAY writes *Received with thanks Skyroma ..., Very pleased. Working well.*

B.M. of HARROGATE writes *... I would like to thank you ... it is a real bargain.*

L.S. of LONDON W.8 writes *... given it a good try out and I am very pleased with the results.*

S.B. of SOMERSET writes *... delighted with this radio ... glad if you could send one more.*

D.R. of GLASGOW writes *... it is a lovely little thing and as clear as a bell.*

T.F. of STEVENAGE writes *I would just like to say how pleased my son is with this radio.*

J.W. of BRIGHTON writes *... I have recommended your radio to many of my friends.*

W.N. of MIDDLESEX writes *Thank you for my dear little radio. It is a real treasure to me.*

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ETC. ETC.

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LETTERS TO THE EDITOR

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

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

COMPETENT INSTRUCTOR

SIR,—Might I suggest that if Mr. Collister (letters page, PRACTICAL WIRELESS, February, 1965, issue) does not want to be classed with the "do-it-yourself" brigade, with their part pre-made units, he had better invest himself with some form of letters after his name so that we should be able to recognise him for what he is.

I would like to point out that the cost of buying a kit version of most equipment these days is often very little more than a few pounds and if a person goes to the point of ordering one of these package deals then it is a matter of personal choice and in the knowledge that he will be committed to quite a few hours of construction.

If, when construction is complete, he finds that the equipment works and is up to standard in performance then he is a competent constructor. This is not to say he is a theorist but just somebody embarking on a step along the road to what may well lead to a better understanding of what he is using. I think that it is wrong to say that many of these people do not want to learn the whys and wherefores of a thing; the very fact that they are being taught to construct by example is bound to instil some little knowledge if only how to make a proper soldered joint. If the first piece of equipment works then the constructor is elated and wants to start on something else, and this is as good a way as any in which to start.

Let us pay a little more thought to the editorial and, although out of context, "promote a little more goodwill and tolerance" and gather more members, not put off possible new members to the world of radio construction by egg-headedness.

Know yourself for what you are and be not troubled by others' opinions.—M. G. HUMPHRIES-HILL (Bristol 8).

SIR,—In your February edition of PRACTICAL WIRELESS a Mr. C. J. Collister, of Cheltenham, writes to you in order to impress upon you how clever he is and how stupid other people are.

He is contemptuous of the man who assembles a "tuner kit" and even calls him a snob. He then refers to his "status" as a radio constructor. I should imagine that it would be hard to find a bigger snob than himself. He does not seem to understand that for v.h.f. units, among other things, very expensive laboratory test gear is needed for final lining up.

I have constructed radio equipment since 1921 and now work in one of our greatest electronic engineering firms. The knowledge I have gained there only brings home to me how limited I am at home to carry out certain work. With precision instruments costing hundreds of pounds each the kit manufacturers can deliver a more exact article than Mr. Collister can produce, but he does not seem to know anything about this; he is too wrapped up in his self-styled "status".—T. S. ROSS (West Ealing, London, W.3).

REQUESTS FOR INFORMATION ARE INSERTED IN THIS COLUMN ON THE UNDERSTANDING THAT READERS USING THE SERVICE UNDERTAKE TO REPLY TO ALL OFFERS RECEIVED AND TO RETURN ALL DATA NOT REQUIRED. BECAUSE OF THE LARGE NUMBER OF REQUESTS RECEIVED ILLEGIBLE WRITING WILL AUTOMATICALLY DISQUALIFY LETTERS FROM PUBLICATION. FOR THE SAME REASON, WE CAN NO LONGER GIVE SPACE FOR REQUESTS FOR PAST ISSUES OF "PRACTICAL WIRELESS."

Sir—I would be grateful if any reader could sell or loan me . . .

. . . any information on the Army set No. 19.—I. CLEGG, 38 Union Road, Liversedge, Yorkshire.

. . . the circuit diagram and/or any data on a "Saja" M40 standard tape recorder.—R. G. COOMBE, 45 Saxon Road, Heavitree, Exeter, Devon.

. . . the circuit diagram for ex-W.D. modulator unit No. 31 ZC32382. Unit 6C or 10C.—A. G. THORBURN, 27 Banklands, Workington.

. . . the circuit and any data on surplus wireless set No. 31 ZA31385. It has 18 valves with 1·4V heaters and is possibly battery operated.—G. ALLEN, 35 Damask House, Flower House Estate, London, S.E.6.

. . . the circuit and wiring diagram of communications receiver M.C.R.1, and type of battery to run it.—T. BERRY, 43 Curran Street, Portadown, N. Ireland.

. . . a copy of the *Practical Wireless* handbook "Transistor Radio Circuits".—R. G. STUART, New Road, Cambuslang, Glasgow.

. . . the circuit and servicing manual for the aircraft receiver, type C.C.T.—46104, frequency 1·5 to 3 Mc/s.—C. S. BOON, 31 Hillview Road, Chislehurst, Kent.

. . . the circuit diagram of the R1155 communications receiver, and/or the R.A.Y.5 fixed frequency receiver.—A. J. MULLEY, 59 Coote Lane, Lostock Hall, Preston, Lancashire.

. . . information dealing with modifications to the No. 19 set.—F. EYLES 2 Hawkesford Road, Tile Cross, Birmingham.

. . . the circuit and modification details for the R220 and pin connections for a.c. mains.—T. RICHARDS, 28 Deane Road, Liverpool, 7.

. . . any information on the P104 v.h.f. receiver covering 100 to 150 Mc/s.—C. SEEAR, 60 Holywell Road, Watford, Hertfordshire.

. . . the circuit diagram or service sheets of the National HRO—MX communications receiver —P. OSMAN, 140 Kingsland Road, Shoreditch, London, E.2.

. . . the service sheet or any other instruction literature for an Elizabethan tape recorder fitted with a K6 mod. tech. deck (7 in. spools).—F. GREGORY, 5 Greatfield Road, Wythenshawe, Manchester, 22.

. . . any data whatsoever, handbook, circuit details etc. on the R107 receiver.—D. J. WALSH, 108 Sunny-Bank Road, Bury, Lancashire.

. . . the circuit diagram of the Stuzzi transistor tape radio tuner.—G. F. ALLAN, 17 Finnemore Road, Hainault, Ilford, Essex.

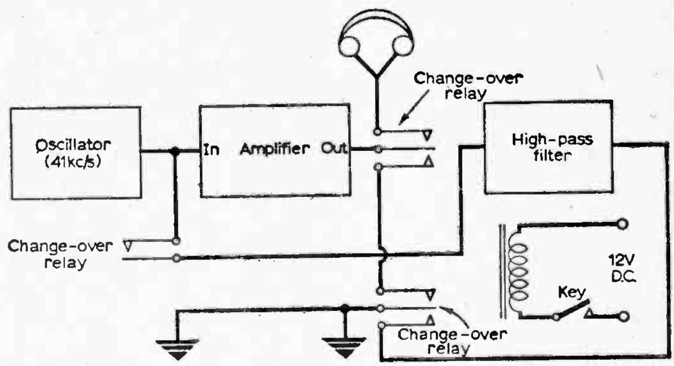
. . . the instruction manual and circuit of the R107 receiver Z.A. 3050, serial No. 14367.—D. DRANSFIELD, 12 Broad Street, Hoyland, Barnsley, Yorkshire.

COMMUNICATIONS THROUGH THE GROUND

SIR,—Mr. C. R. Bradley, in his article on the fascinating subject of communication through the ground (February, 1965, PRACTICAL WIRELESS), states quite categorically that there is no way of reducing hum. Surely, however, this could be achieved by using a carrier frequency of the order of 30 to 40kc/s, which, I believe, is the frequency last attenuated by earth and water, and using high-pass filters to cut out the hum. For c.w. transmission and reception one transmitter would operate on, say, 40kc/s and the other on 41kc/s (see diagram right). The oscillators would be kept running and used as b.f.o.'s to produce an audible note from the supersonic carrier and, when transmitting, their output would be fed into the amplifier. Since the received signal is comparatively free of hum it could be amplified by the transmitting amplifiers when receiving.

For speech communication the equipment required would be somewhat more complicated, since the supersonic carrier would have to be modulated and then amplified without distortion or, alternatively, high-level modulation of the amplifier could be employed.

In any case hum-free communication can fairly easily be achieved on c.w. and for voice communication the equipment required is much less than for an h.f. wireless station.—N. W. ROBERTS (Cambridge).



CORRESPONDENTS WANTED

SIR,—I would like to hear from readers in Great Britain or any other country, who have an interest in short wave listening and who are of my own age (14). I will promptly reply to all letters received.—G. NEWSTEAD (40 Kenilworth Court, Warwick Road, Coventry, Warwickshire).

NOTE

Would **Mr. H. Naylor Caley** (Letters to the Editor, PRACTICAL WIRELESS, May 1964 issue) please contact the Editor at his earliest convenience.

THE IONOPHONE **continued from page 1143**

ribbon tweeters at high volume, is that it is impossible to damage the Ionophone by applying too great an audio input voltage. As mentioned above, the only effect of this is to introduce momentarily a little harmonic distortion which is difficult to detect by ear.

Price-wise, of course, the Ionophone must cost a little more than other forms of conventional tweeter but should be no more expensive than a good 18in. bass speaker and, for those with sensitive ears, the extra will seem well worthwhile.

It is the author's experience that it is the defects in the present high frequency speakers which cause the harshness and unnaturalness which sometimes occur in the best of present day high fidelity reproduction.

The Ionophone has been available in the U.S.A. for the last two years and American built Ionophones are available in Paris. Now a completely British made version is going into production in this country and will shortly be available to the public. It will be demonstrated for the first time at the 1965 Audio Fair. ■

WORLD WILL YOU FIND...

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SINCLAIR X-10

INTEGRATED 10 WATT AMPLIFIER AND PRE AMP

11 TRANSISTORS
NO HEAT SINK
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Operates from 12 to 15 volts D.C.

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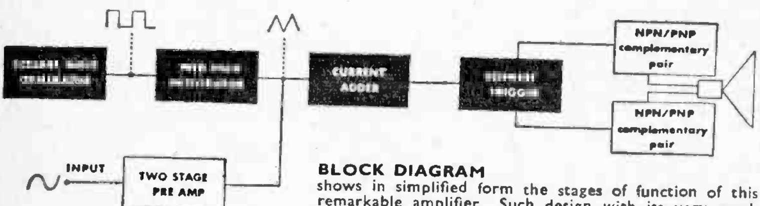
Leaving the X-10 user to add a tone control system of his own choice to the integrated pre-amplifier stage enables any sound input source to be accurately matched. The X-10 has many other very important advantages as a result of using Pulse Width Modulation including incredibly low distortion figures, no falling off of higher frequencies, better transients, and less current requirements. Indeed, the X-10 can be satisfactorily operated from a couple of 4/- lantern batteries. THE SINCLAIR X-10 MANUAL included with every X-10 explains how it functions, and also gives tone control and stereo matching circuits, none of which costs more than a few shillings. The X-10 Manual is available separately, price 1/-.

X-10 USERS WRITE

"I must say that the amplifier delighted myself and others with its beautiful crisp quality."
W.L., Leeds 2

"I was able to try it out yesterday and I would like to say that I am very pleased with its performance."
R.M., Keighley, Yorks.



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shows in simplified form the stages of function of this remarkable amplifier. Such design with its very much better standards of performance is made possible by use of the very latest transistors and high quality components.

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SPEAKER REPAIRS, cones fitted. Satisfaction guaranteed. L. S. REPAIRS, Pluckley, Ashford, Kent.

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ECC82	3/-	6F15	5/-	20F2	5/6	PCL83	5/-
ECL8	3/6	EB91	1/-	30FL1	5/-	PY81	3/6
30F5	5/-	EF85	5/-	PY32	6/-	U301	6/-
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PCF80	4/-	20P3	6/-	6F1	2/6	20D1	2/-
PL81	5/-	30PL1	4/-	ECC81	3/-	30P12	5/-
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Speakers. Ex-TV. 5in. round, 6 x 4in., 3/6; 8in. round, 6/-; post 2/-.

Line Output Transformers available. State set model No.

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RECEIVERS & COMPONENTS
(continued)

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FAMOUS TRANS/RECEIVER

Covers 2-4.5, 4.5-8 mc/s. (150-37 metres) in two bands. 230/250v. A.C. mains. Six valve superhet receiver with I.F.'s of 465 Kc/s. and six valve transmitter designed for voice and CW. Incorporates test and tuning 500 uA meter for voltages, aerial loading and current tests. Panel controls, Freq. PA. Tuning Gain MCW, CW, RT, Het Tone, Netting, On/Off Quench, Aerial, AVC, Lt-HT tests. Supplied complete. Fully tested and working

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AERIALS and pre-amplifiers. S.A.E. with a note of your requirements. Excellent high gain loft aerials combined BBC/ITV only, 51/- post paid. Radio and television spare parts service second to none; let us quote. B. BLACK & CO. LTD., 150 Richmond Road, Gillingham, Kent. Telephone 52772.

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V.H.F. Receivers P104 (R1392), 100 to 150 Mc/s. 13 valves, B.F.O., A.G.C., R.F. and I.F. gains. Tuning Meter. In good condition complete with instructions to convert to tunable; can be used crystal controlled as is. **£3.10.0,** carriage 15/-.

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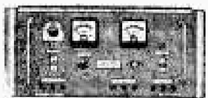
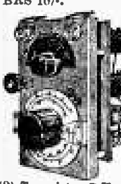
TRANSISTORS. Silicon pnp, minimum beta 10 at Ic=5mA, 1/6; Germanium npn, minimum beta 50 at Ic=5mA, 5/-; pnp power studs, minimum beta 50 at Ic=2A, 12/6. LONGLAND'S, 6 Mansfield Place, Ascot, Berks.

SCINTILLATION COUNTER 1093 (B). Using CV2316 Photo tube plus 10 other valves, magnetic counter with lens, each unit in case but made for 19in. rack mounting × 8½in.
POWER UNIT 1093 (B) for above, mains 200–50 input, output stabilised (1) 0–2 K Volts: (2) 0–300 V at 120 mA both adjustable, meter for checking voltages same size as above, made by Ferranti. These two units are the complete set, and are checked complete, but as we know very little about this kind of equipment no enquiries can be answered. ONLY £12/10/0, BRS 10/-, or either unit £7/0/0, BRS 7/6. Scaling Units 109 (A) & (B) S.A.E.

BULK PURCHASE of STABILISED POWER UNITS made by MARCONI or EDISWAN, all Inputs 200-50 AC



(1) **General Purpose P.U.** two adjustable independent outputs (11) — 0/250 V at 50 mA: (12) + 0/250 or 0/500 V at 250 mA. Also 6·3 at 9 amps using 5-GZ32, 3-12E1 and 7 other valves, meter for checking output voltage or current, both voltages adjustable, 19in. rack mounting × 10½in. ONLY £14/10/0, Matching case 20/-, BRS 10/-.



Rejector Units 1.2-10 mc/s in 4 switched ranges. Ideal for harmonic suppression of TX, or as a station rejector for RXs, just plug aerial into one socket and connect to other socket, large tuning knob and dial, in small grey case. BRAND NEW ONLY 35/-, post 5/-.

(2) **Transistor P.U. MkII** Two adjustable independent outputs (1) — 0/10, — 0/100 V; (2) + 0/10, + 0/100 V, metered output and same in looks and size as above power unit, using 20 valves £14/10/0. Matching case 20/-, BRS 10/-.
(3) As above but 0/15 V, 0/150 V.
(4) Three outputs 200–255, 255–350, at 200 mA, 350–400 at 150 mA all adjustable 6.3 C.T. 4 amps twice 19in. rack mounting × 8½in. £8/10/0. Matching Case 20/-, BRS 10/-. (Two meters Voltage and Current.)
(5) Output 120-250 Variable at 50 mA, 6.3 CT 4 amps, using two meters Voltage, Current, 19in. rack mounting × 7in. £5/10/0. Matching case 20/-, BRS 10/-.

J. T. SUPPLY
38 MEADOW LANE, LEEDS, 11

FOR SALE

CONDENSER BARGAIN! Miniature Paper Condensers, ½in. x ¼in. Ideal for transistor sets. .0001, .001, .002, .005, .02, .04μF. Your choice 7/6 per 100 or £3 per 1,000. G. F. MILWARD, 17 Peel Close, Drayton Bassett, Staffs.

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FANTASTIC BARGAIN OFFER

Lightweight Pistol Grip handle 40 watt. 240/250v. A.C. Solid copper bit. Detachable handle forms cover for iron when not in use. With 4½ft. Safety 3-core flex. Indispensable for every home handyman. A boon to model makers and a necessity for every wireless enthusiast. Offered to you at this new amazing price.

ONLY **9/6** P. & P. 1/-

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5-TON FACTORY CLEARANCE. Radio, TV Electrical Components, in mixed parcels. Example: 28lb. mixed parcel £1 pp 7/6d Speakers, grilles, valves, bases, i.f.s. covers, condensers, etc. Hundred other items. S.A.E. List and Postal Orders to P. NEWTON, 16 Shalcross Crescent, Hatfield, Herts.

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ANYTIME! from 12 volt CAR BATTERY
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Input 12v. output 200/250v. at 150 to 220 watts. Perfect for TELEVISION, POWER TOOLS and all universal AC/DC ELECTRICAL EQUIPMENT, gives wonderful results. Price ONLY £8 + 12/- carriage. Send stamped envelope for full illustrated details
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All new, few equivalent. 1/- each, Red or White Spots.

2/- each. XA101, XA102, XB103, OA90, OC430, XA112, XA111.

3/- each, OC44, OC45, OC70, OC71, OC81, OC81D, OC200, GET 16.

4/- each, AF114, AF115, AF117, OC170, OC171, SX658, XU611.

5/- each, OC72, OC139, OC140, OC204, ORP60, BY100, GET8.

10/- each, OC35, OC26, OC28, GET57, 2SO13. All new, few equivalent.

ZENER DIODES 4.7 v. to 33 volt ¼ watt, 3/6 each. 1.5 watt, 5/- each. 7 watt, 6/- each.

Send 3d. stamp for Full Price List and Free Equivalent Chart.

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88 set transmitter receiver. Chassis less valves, 20/- each. Post paid.

Copper Laminate Board, single or double sided, 5/- per square foot panels, either type 3ft. by 4ft., 33/-.

High Stab Resistors, 5%, 6d.; 2%, 9d.; 1%, 1/-. Every six packed in 7-compartment linen finish component box.

Speakers, 3 ohm P.M. 5in., 5/-, 6in., 6/-, 7 x 4in., 7/-, 8in., 8/-, 10in., 12/6.

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Must be new and boxed
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A number of suitably qualified candidates will be required for training, leading to permanent and pensionable employment. (Normally at Cheltenham but with opportunities for service abroad or appointment to other U.K. stations.)

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Pay according to age, e.g. at 19, £722; at 25, £929 (highest pay on entry) rising by four increments to £1,067.

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YOUNG MAN required, over 18 years to work in busy Radio Shop and Mail Order Dept. Some previous experience necessary. For appointment telephone Paddington 1008-9. HENRY'S RADIO LTD., 303 Edgware Road, London, W.2.

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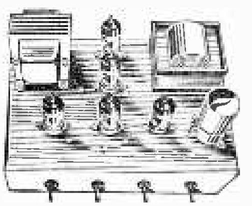
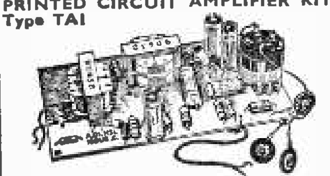
Precision 6 minute Delay Action Switch. Clockwork actuated. Made by Smiths.
Separate switching actions at intervals up to 6 mins.
Each switch action designed for current loading up to 15 amps at 250 volts. Suitable for photographic timer, sequence switching operations, etc., etc. Brand new and unused units offered at a fraction of their true value. OUR PRICE ONLY 10/- each. Post Free. 2 for 17/6.
Special quotations for quantity.

10/14 WATT HI-FI AMPLIFIER KIT



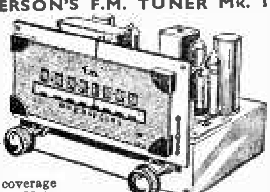
A stylish finished monaural amplifier with an output of 14 watts from 2 EL84's in push-pull Super reproduction of both music and speech with negligible hum.
Separate inputs for mike and gram. allow records and announcements to follow each other. Fully shrouded section wound output transformer to match 3-15Ω speaker and independent volume controls and separate bass and treble controls are provided giving good lift and cut. Valve line-up 2 EL84's ECC83, EF86 and EZ80 rectifier. Simple instruction booklet 1/6. (Free with parts).
All parts sold separately. ONLY **£6.19.6** P. & P. 6/6
Also available ready built and tested complete with standard input sockets. £8.15.0. P. & P. 6/6.
Carrying Case for above 28/6. P. & P. 4/-.

HIGH GAIN 4-TRANSISTOR PRINTED CIRCUIT AMPLIFIER KIT Type TAI



● Peak output in excess of 1½ watts. ● All standard British components. ● Built on printed circuit panel size 6 x 3in. ● Generous size Driver and Output Transformers. ● Output transformer tapped for 3 ohm and 15 ohm speakers. ● Transistors (GET114) or 81 Mullard OC81D and matched pair of OC81 o/p). ● 9 volt operation. ● Everything supplied, wire battery clips, solder, etc. ● Comprehensive, easy to follow instructions and circuit diagram 1/6. (Free with Kit). All parts sold separately.
SPECIAL PRICE 45/- P. & P. 2/6.
Also ready built and tested, 52/6. P. & P. 2/6.
A pair of TAI's are ideal for stereo.

HARVERSON'S F.M. TUNER Mk. I



● F.M. tuning head by famous maker. ● Guaranteed non-drift ● Permeability tuning. ● Frequency coverage 88–100 Mc/s. ● Balanced diode output. ● Two I.F. stages and discriminator. ● Attractive maroon and gold dial (7 x 3in. glass). ● Self-powered, using a good quality mains transformer and valve rectifier. ● Valves used ECC85, two EF80's and EZ80 (rectifier). ● Fully drilled chassis. ● Size of completed tuner 8 x 6 x 5½in. ● All parts sold separately. Set of parts if purchased at one time £5.19.6. plus 8/6 P. P. and ins. Circuit diagram and instructions 1/6 post free. Mark II Version as above but complete with magic eye, front panel and brackets, £6.12.6. P. & P. 8/6.
Mark III Version as Mark I but with output stage (ECL82) and tone control. £7.7.0. P. & P. 8/6.
Handsome Metal Cabinets. Choice of Black or Green. To fit Mark I, 25/-. P. & P. 2/6. To fit Mark II, 17/6. P. & P. 2/6.

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By famous maker. Brand new and unused. Complete with PCC84 and PCF80 valves, 34-38 Mc/s I.F. Biscuits for Channels 1 to 5 and 8 and 9. Circuit diagram supplied. ONLY 25/- each. P. & P. 2/6.

GORLER F.M. TUNER HEAD

88-100 Mc/s 10.7 Mc/s. I.F. 15/-, plus 1/9 P. & P. (ECC85 valve 8/6 extra).

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All Brand New in Maker's Original Packing

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GARRARD SRP10..........£5.9.11. Carr. 4/-
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All the above units are complete with t/o mono head and sapphire stylii or can be supplied with compatible stereo head for 12/6 extra.

SPECIAL OFFER!

Limited number of

E.M.I. 4 SPEED SINGLE RECORD PLAYER DECKS

with unit mounted pick-up. Incorporating the following special features: Heavy 8½in. metal turntable. Low flutter performance shaded pole motor for 200/250V. A.C. with 90V tap. Latest ultra lightweight pick-up (5 grammes tracking weight). High output mono ceramic cartridge. Autostop. Overall motorplate size. 12 x 10 x 2¾in. below and 2in above
UNREPEATABLE OFFER AT **89/6** Carr. 4/-

THE NEW HARVERSON KIT FOR THE HOME CONSTRUCTOR

A really excellent all purpose A.C. mains 200/240v. AMPLIFIER KIT TYPE HSL 'FOUR' 3 VALVE, 4 WATT USING ECC83 EL84, EZ80 VALVES
Special features include:
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PRICE **79/6** P. & P. 5/-
Comprehensive circuit diagram, practical layout and parts list 2/6. (Free with Kits.)

QUALITY RECORD PLAYER AMPLIFIER

A top-quality record player amplifier. Size 7in. w. x 2½in. d. x 5½in. h. This amplifier (which is used in a 29 gn. record player) employs heavy duty double wound mains transformer, ECC83, EL84, EZ80 valves. Separate bass, treble and volume controls. Complete with output transformer matched for 3 ohm speaker. Ready built and tested
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ALSO AVAILABLE. Mounted on board with output transformer and 6in. speaker, ready to fit into cabinet below. PRICE 89/6. P. & P. 4/6.

QUALITY PORTABLE R/PLAYER CABINET

Uncut motor board. Will take above amplifier and B.S.R. or GARRARD Autochanger or single Record Player Unit. Size 18 x 14 x 8½in.
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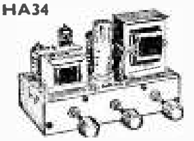
LATEST MODEL B.S.R. TU/12 4-SPEED PLAYER AND PICK-UP

ONLY **69/6** Carr. 4/-
7in. metal turntable Low flutter performance. 200/250 v shaded pole motor with 90 v. tap for valve heaters. High gain crystal pick-up with turnover LP/78 head complete with sapphire stylii.

3-VALVE AUDIO AMPLIFIER MODEL HA34



Designed for Hi-Fi reproduction of records A.C. Mains operation. Ready built on plated heavy gauge metal chassis size 7½in. w. x 4in. d. x 4¾in. h. Incorporates ECC83 EL84 EZ80 valves, heavy duty double-wound mains transformer and output transformer matched for 3 ohm speaker, separate Bass, Treble and volume controls. Negative feedback line. Output 4½ watts. Front panel can be detached and leads extended for remote mounting of controls. The HA34 has been specially designed for us and our quantity order enables us to offer them complete with knobs, valves, etc. wired and tested for only...... **£4.5.0** P. & P. 5/-

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RONETTE STEREO 105 CARTRIDGE. Stereo/LP/78. Complete with two sapphires. Original list price 67/9. OUR PRICE 24/-. P. & P. 1/-.
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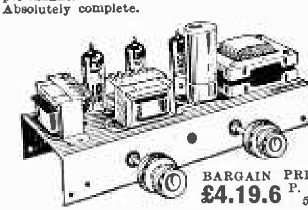
STEREO AMPLIFIERS

Incorporating 2 ECL82's and 1 EZ80 heavy duty double-wound mains transformer. Output 4 watts per channel Full tone and volume controls. Absolutely complete.



BARGAIN PRICE **£4.19.6** P. & P. 5/-

6 TRANSISTOR AND DIODE SUPERHET

A first-class 2 waveband transistor superhet. ● Printed circuit panel (size 8½ x 2¾in.). ● 3 pre-aligned I.F. transformers. ● High-gain Ferrite Rod Aerial. ● All First-grade transistors. ● Car aerial winding. ● Push-pull output. ● All parts supplied with simple instructions. All parts sold separately. Set of parts if purchased at one time. ONLY £4.5.0. P. & P. 2/6. Circuit diagram 1/6 (free with set of parts).

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Suitable for use with above. 2in. Goodmans. Ideal replacement for most pocket portables. 8/6, 3½in., 12/6; 5in., 17/6; 7 x 4in., 21/-. P.&P. 1/6 per speaker.

Portable CABINET

Size approx. 9½ x 6¾ x 3¼in. Suitable for above using 3½in. speaker. 25/-. P. & P. 2/-.

COIL AND TRANSFORMER SET FOR TRANSISTOR SUPERHET

3 I.F. transformers, one oscillator coil, one driver transformer and wound Ferrite aerial (med.. long and car aerial coupling). 32/6 complete, post 1/-. 6 transistor printed circuit board to match. 8/6. Post 9d. Circuit diagram 1/6 extra.

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GET 15 (Matched Pair) 15/-; V15/10p, 10/-; OC71 5/-; OC76 6/-; AF117 7/6; ORP12 10/6. Set of Mullard 6 transistors, OC44, 2—OC45, OC81D matched pair, OC81, 25/-.

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PXA101 6/6; XA103 6/6.
R.F.I. Pack: 1—PXA102 Mixer; 2—PXA101 I.F. Amp. (Equiv. OC44 and OC45)..........10/6
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2 VALVE GRAM AMPLIFIERS

Valves UY85 Rectifier and UCL82 Triode/Pentode giving 3½ watts output. Overall chassis size (inc. valves) 5in. high x 5½ in. wide x 2 in. deep. Each amplifier new and tested and supplied complete with valves, 3 ohm output transformer and knobs for tone and volume/on off controls.

ONLY **37/6** P. & P. 3/6

Can be used with 80v. motor tap or 1.5k. mains dropper 2/6 extra if required. *Owing to the limited number available and the extremely high value we regret we cannot enter into any correspondence.*

SPECIAL HARVERSON OFFER ! !

BRAND NEW HEAVY DUTY 12in. SPEAKERS Response 45 c/s-13 Kc/s. 1½in. voice coil. Available in 3 or 15 ohms. Guaranteed full 15 watts British rating. Heavy cast aluminium frame. These are current production by world famous maker and as they are offered well below list price we are not permitted to disclose the name. LIMITED NUMBER ONLY. UNREPEATABLE AT 89/6. P. & P. 5/-. Also 25 watt Guitar Model available at £5.5.0.

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2½in., 12/6; 5in., 12/6; 6½in., 15/-; 8in., 21/-; 10in., 25/-; 12in., 27/6; (12in. 15 ohm. 30/-). 10in. x 6in. 26/-
Latest type E.M.I. 13½ x 8in. with high flux ceramic magnet. 11,000 gauss. Aluminium centre cone. 10 watts, 50 c/s to 10 Kc/s., 42/-.
P. & P. up to 6in. 1/6; over 6in. 2/6 per speaker.

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MAINS OPERATED WATER COCK. A solenoid actuated flow control valve 200/250v. 50 c/s. A.C. operation. Operating solenoid is isolated by rubber diaphragm from valve mechanism which is contained in heavy cast brass base. ¼in. O.D. plain tube outlet, ¾in. inlet bore fitted with filter. As used in automatic washing machines and ideal for any application where remote flow control of fluids is required. Brand New. Approx. size 3¼ x 1¾ x 3¼in. high. 12/6 each. POST FREE.
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T.C.C. SUPPRESSOR CONDENSERS. 250v. A.C. .005 + .005 x .1. In tubular can 1¾in. long x ¾in. dia. 2 for 3/-. Post Free.
TRANSISTOR DRIVER and O/P TRANSFORMERS. (Tapped 3 ohms and 15 ohms output). Plus 4 suitable Transistors giving approx. 1 watt output, 25/-. P. & P. 2/6.
2-GANG .0005 TUNING CONDENSERS. 2¼in. h. x 2¼in. d. x 1¾in. w. with built-in trimmer. 4/6. P. & P. 1/-.
CONTACT COOLED BRIDGE RECTIFIERS. 250v. at 125 mA. Size 1¾ x 1¾ x ¾in., 7/6. P. & P. 1/-.
MATCHED PAIR OF 2½ WATT TRANSISTOR DRIVER AND OUTPUT TRANSFORMERS. Stock size 1¼ x 1¼ x ¾in. Output trans. tapped for 3 ohm and 15 ohm output. 10/- pair, plus 2/- P. & P. Worth double.
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TWIN TELESCOPIC AERIAL. Comprising two 3-section heavily chromed rods. Closed 12in. each extending to 32in. each. Completely adjustable from vertical to horizontal. Supplied complete with universal mounting bracket. approx. 30in. of coax. and standard coax. plug. Suitable for F.M. or T.V. 12/6 plus 2/- P. & P.
MARCONI QUARTZ CRYSTALS. Types ZHB. Still available as previously advertised.

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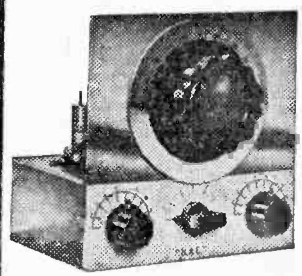

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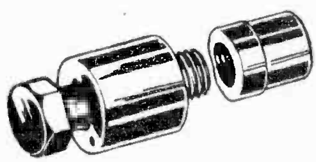

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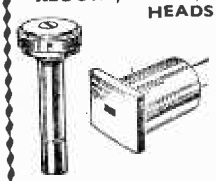

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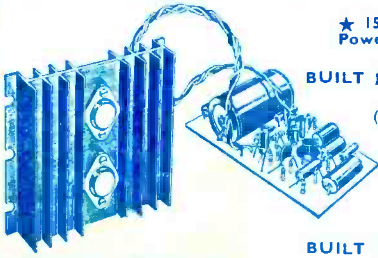

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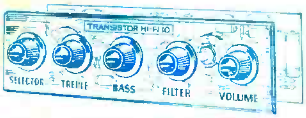

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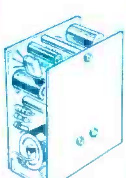

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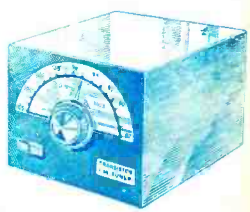

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