Published in Great Britain by the Proprietors and Publishers
Data Publications Ltd 57 Maida Vale London W9
Printed by A Quick & Co Ltd Oxford House Clacton on Sea England
Obtainable abroad through the following Collets Subscription Service Continental Publishers & Distributors Ltd William Dawson & Sons Ltd *Australia and New Zealand* Gordon & Gotch Ltd *South Africa* Central News Agency *Holland* "Radio Electronica"
Registered for transmission by Magazine Post to Canada (including Newfoundland)

The "Mayfair" Televisor, Part 2

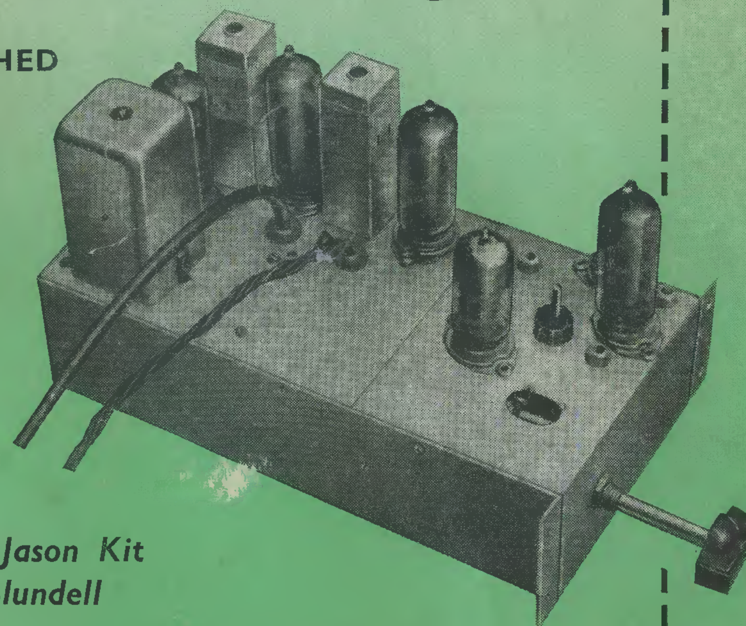
VOLUME 11
NUMBER 3
OCTOBER
1957

The RADIO Constructor

RADIO · TELEVISION · AUDIO · ELECTRONICS

The Mercury

SWITCHED
FM
TUNER



A New Jason Kit
by G. Blundell

Included in this issue
TRANSISTORISED R-C BRIDGE
GENERAL PURPOSE INTERCOM SET
BATTERY TV SOUND RECEIVER
SINGLE VALVE FM TUNER
TRANSISTOR MORSE OSCILLATOR
ELIMINATING HUM

DATA Publications 1/9

THE MODERN BOOK CO

Hi-Fi Year Book 1957. 10s. 6d. *Postage 9d.*

Rapid TV Repair. By G. Warren Heath. **23s.** *Postage 1s.*

The Radio Amateur's Handbook. By A.R.R.L. 1957 edition. **32s. 6d.** *Postage 1s. 6d.*

Radio Control Mechanisms. By R. F. Stock. **4s. 6d.** *Postage 4d.*

Frequency-Modulated Radio. By K. R. Sturley. **15s.** *Postage 6d.*

TV—It's a Cinch. By E. Aisberg. **23s.** *Postage 1s.*

The New High Fidelity Handbook. By I. Greene and J. Radcliffe. **36s.** *Postage 1s.*

TV Fault Finding. A Data Publication **5s.** *Postage 4d*

Transistors: Circuits and Servicing. By B R. A. Bettridge. **2s. 6d.** *Postage 3d.*

Radio Servicing: Supplementary Volume: Fault Finding. By G. N. Patchett. **5s.** *Postage 4d.*

Transistor Techniques. Gernsback Publications. **12s.** *Postage 8d.*

Electronic Gadgets for the Constructor. By E. N. Bradley. **3s. 6d.** *Postage 3d.*

Radio Valve Data. Compiled by "W.W." **5s.** *Postage 6d.*

Guide to Broadcasting Stations 1956-7. Compiled by "W.W." **2s. 6d.** *Postage 3d.*

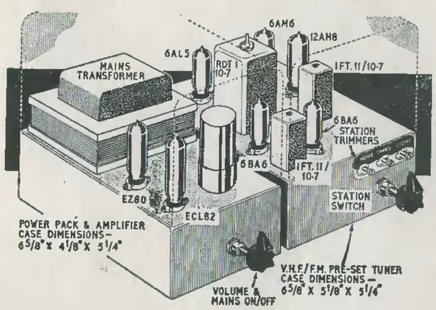
We have the Finest Selection of British and American Radio Books in the country

Complete list on application

19-23 PRAED STREET (Dept RC) LONDON W2

Telephone PADdington 4185

INTRODUCING THE COMBINED POWER PACK AND AMPLIFIER FOR THE 'MAXI-Q' PRE-SET OR VARIABLE FM TUNER WHICH NOW OFFERS YOU A COMPLETE RECEIVER

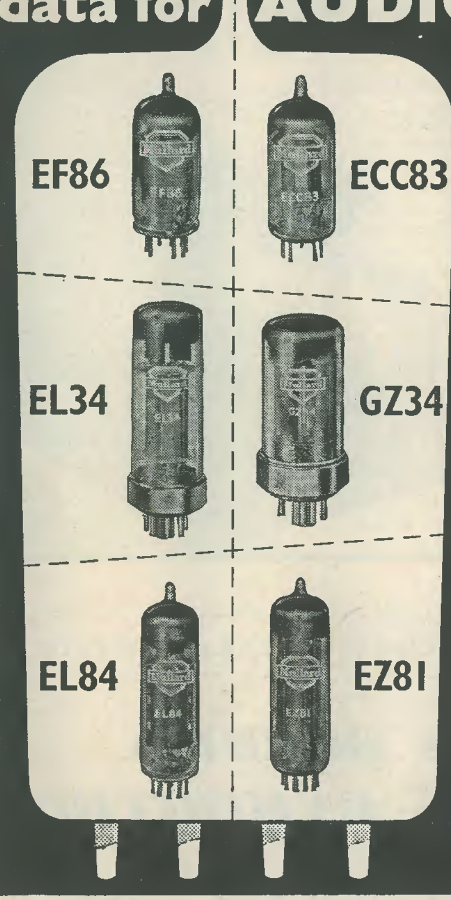


Full constructional details, point-to-point wiring diagrams and alignment instructions for building the **"MAXI-Q" COMBINED POWER PACK AND AMPLIFIER, PRE-SET FM TUNER** and also the **VARIABLE TUNED** version are given in Technical Bulletin DTB.8, 1/6 **POWER PACK AND AMPLIFIER.** This unit consists of Mains Transformer, EZ80 and ECL82 valves, Volume Control complete with mains on/off switch and is housed in a gold-finished case. Power supplies available for any tuner—Heater 1.5 amps at 6.3.V H.T. from 220V at 50mA to 265V at 20mA. The unit is available completely wired and ready for use at **£5 . 10 . 0,** plus 2/6 carriage or available in kit form at **£5.** **PRE-SET FM TUNER.** Completely punched chassis, screens and bronze-finished cover, **19/–** Station Indicator Plate, **1/1.** Three-position switch, **4/3.** Station Condenser Trimmers, 3-9pF, **2/–.** **RATIO DISCRIMINATOR TRANSFORMER,** RDT 1–10.7 Mc/s. Secondary winding of bifilar construction, iron dust core tuning, polystyrene former, silver mica condensers. Can size $1\frac{3}{8}$″ sq. x $2\frac{1}{2}$″ high, **12/6.** **I.F. TRANSFORMER,** IFT.11–10·7 Mc/s. Miniature i.f. of nominal frequency 10.7 Mc/s. The "Q" of each winding is 90 and the coupling critical. Can size $1\frac{3}{16}$″ sq. x $1\frac{7}{8}$″ high, **6/6.** **COILS, TYPE L1, T1** and **T2.** Specially designed for use in this unit, are wound on polystyrene formers complete with iron dust core tuning, **3/11** each. **THE "MAXI-Q" PRE-SET FM TUNER** is available completely wired, assembled, valved and housed in a sturdily made gold-finished cover at **£8 . 11 . 5,** plus **£3 . 8 . 7** P.T. = **£12.** **VARIABLE FM TUNER** completely assembled at **£7 . 17 . 2,** plus **£3 . 2 . 10** P.T. = **£11** (carriage 3/–, terms c.w.o.). **GENERAL CATALOGUE** covering technical information on full range of components, 1/–, post free.

TRADING TERMS for direct postal orders, c.w.o., plus appropriate postal charge

DENCO (CLACTON) LTD (DEPT. R.C.) **357/9 OLD ROAD CLACTON-ON-SEA ESSEX**

data for AUDIOPHILES*



Audiophiles all over the world are demanding Mullard audio valves for their high quality sound equipment. And who can blame them when they know that the Mullard World Series of Audio Valves is the finest in the world.

Fill in the coupon below for free data on Mullard World Series Audio Valves.

** Audiophile—Enthusiast for high quality sound reproduction who is satisfied with nothing but the best.*

This popular book is available now from most dealers, price 3/6d. It contains designs and full constructional details of the new Mullard EL34 High Quality 20 Watt Amplifier, a Mullard Band II F.M. Tuner, pre-amplifiers for the Mullard EL34 Amplifier and for the popular Mullard 5 Valve 10 Watt Amplifier, together with other useful technical information.

COUPON

TO: MULLARD LTD., PUBLICITY DIVN.

Please send me, free of charge, leaflets on the Mullard World Series of Audio Valves, and details of "High Quality Sound Reproduction".

NAME...

ADDRESS...

....

Mullard

WORLD SERIES

AUDIO VALVES

Mullard Ltd . Publicity Division
Mullard House Torrington Place
London WC1

MVM 349A

REPANCO

HIGH GAIN COILS and QUALITY COMPONENTS
for the constructor

TRANSISTOR COMPONENTS

FERRITE SLAB AERIAL TYPE FS2. A new super-sensitive aerial, Long and Medium Wave, specially designed for transistor portable receivers. Complete with fixing brackets. Length $5\frac{1}{2}''$ ... 13/6

COMBINED OSCILLATOR AND 1st I.F. TRANSFORMER TYPE OT1 (315 kc/s), fully screened, $\frac{13}{16}'' \times \frac{13}{16}'' \times 1\frac{3}{4}''$ ... 11/6

2nd I.F. TRANSFORMER TYPE TT2 (315 kc/s), $1'' \times \frac{5}{8}''$ dia. ... 5/–

3rd I.F. TRANSFORMER TYPE TT3 (315 kc/s), $1'' \times \frac{5}{8}''$ dia. ... 5/–

PUSH-PULL INTER-STAGE TRANSFORMER TYPE TT4. Ratio 1:1 ct. Stack $1\frac{3}{8}'' \times 1\frac{1}{16}'' \times \frac{7}{16}''$ 8/6

PUSH-PULL OUTPUT TRANSFORMER TYPE TT5. Ratio 15:1 ct. Stack $1\frac{3}{8}'' \times 1\frac{1}{16}'' \times \frac{7}{16}''$ 8/–

MINIATURE RANGE—For pocket receivers

FERRITE SLAB AERIAL TYPE FS3. Medium Wave only. With fixing grommets. Size $3'' \times \frac{3}{4}'' \times \frac{5}{32}''$ 7/6

OSCILLATOR COIL TYPE XO8. Medium Wave only. Overall size $\frac{1}{2}''$ dia. x 1". Enclosed in Ferrite pots ... 5/–

I.F. TRANSFORMER TYPE XT6. Suitable for 1st and 2nd I.F. 455 kc/s. Size $\frac{1}{2}''$ sq. x $\frac{11}{16}''$ ... 10/–

I.F. TRANSFORMER TYPE XT7. Designed for 3rd I.F.T. or detector I.F.T. 455 kc/s. Size as XT6 ... 10/–

PUSH-PULL INTERSTAGE TRANSFORMER TYPE TT9. Ratio 1:1 C.T. Radiometal Core. Size $\frac{3}{4}'' \times \frac{5}{8}'' \times \frac{13}{32}''$ ... 12/6

PUSH-PULL OUTPUT TRANSFORMER TYPE TT10. Ratio 8:1 C.T. Matched to 3 ohm speaker. Size as TT9 ... 12/6

Practical and Theoretical circuits enclosed with each Repanco Transistor Component

HIGH GAIN COILS

Dual-range Miniature Crystal Set Coil with circuit, type DRX1 ... 2/6

Dual-range Coil with Reaction. With 2 mains, 2 battery and Transistor Circuit type DRR2 ... 4/–

Ferrite Rod Aerial, Long and Medium Wave. With fixing brackets, type FR1 12/6

Matched pair TRF Dual-range Coils with Reaction. With mains, battery and feeder unit circuits, type DRM3 pr. 8/–

Pair Dual-range Superhet Coils. With mains and battery circuits, type SH4 pr. 8/–

Miniature I.F. Transformers, pre-aligned, 465 kc/s $\frac{13}{16}'' \times \frac{13}{16}'' \times 1\frac{3}{4}''$, type MSE ... 12/6

REPANCO EASY-TO-BUILD RECEIVERS

Constructors' Envelopes of easy wiring plans, instructions and detailed price lists of components

THE HIWAYMAN ... **Envelope 1/6** (post 3d.)
Four-valve superhet Dual-range Portable using Ferrite Rod Aerial

REPANCO ONE-VALVE ... **Envelope 9d.** (post 3d.)
Beginner's Dual-range Radio Set for use with headphones

REPANCO FM TUNER UNIT ... **Envelope 1/6** (post 3d.)
Using 4 EF91, 1 EB91, 1 EM80 Valves, Ratio Detector

REPANCO "THREE DEE" ... **Envelope 9d.** (post 3d.)
Dual-range Transistor Radio using 3 Transistors and Crystal Diode. Amazing loud-speaker reception from $7\frac{1}{2}$ volt battery supply

REPANCO "TRANSEVEN" ... **Envelope 1/6** (post 3d.)
A new 7 Transistor superhet Portable with preset station tuning using Repanco transistor components

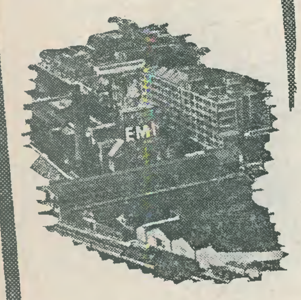
MAIL ORDER and TRADE—
RADIO EXPERIMENTAL PRODUCTS
LIMITED
33 MUCH PARK STREET COVENTRY
Telephone 62572

WHOLESALE and EXPORT—
REPANCO LTD
O'BRIENS BUILDINGS
203-269 FOLESHILL ROAD COVENTRY
Telephone 40594

Wanted!
QUALIFIED MEN AND WOMEN

Industry and Commerce offer their best posts to those with the qualifications — appointments that will bring personal satisfaction, good money, status and security. As part of a modern industrial organisation, we have skilled knowledge of what is required and the best means of training personnel for its present day and future requirements. We specialise also in teaching for hobbies, new interests or part-time occupations in any of the subjects listed below. Write to us to-day for further information. There is no obligation of any kind.

OUR BACKGROUND!



The E.M.I. Factories at Hayes, England.

PERSONAL & INDIVIDUAL TRAINING IN—

Accountancy
Advertising
Aeronautical Eng.
A.R.B. Licences
Art (Fashion, Illustrating, Humorous)
Automobile Eng.
Banking
Book-keeping
Building
Business Management
Carpentry
Chemistry
City & Guilds Exams
Civil Service
Commercial Subjects
Commercial Art & Drawing
Customs Officer
Draughtsmanship
Economics
Electrical Eng.
Electrical Installations

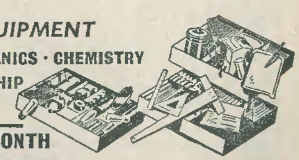
Electronics
Electronic Draughtsmanship
Eng. Drawing
Export
General Certificate of Education
Heating & Ventilation Eng.
High Speed Oil Engines
Industrial Admin.
Jig & Tool Design
Journalism
Languages
Management
Maintenance Eng.
Mathematics
M.C.A. Licences
Mechanical Eng.
Metallurgy
Motor Eng.
Painting & Decorating
Photography
P.M.G. Cert.
Police
Production Eng.

Production Planning
Radar
Radio
Radio Amateurs (C&G) Licence
Radio & Television Servicing
Refrigeration
Sales Management
Sanitary Eng.
Salesmanship
Secretaryship
Shorthand & Typing
Short Story Writing
Short Wave Radio
Sound Recording & Reproduction
Telecommunications
Television
Time & Motion Study
Tracing
Welding
Workshop Practice
Works M'gement
and many others

Also courses for GENERAL CERTIFICATE OF EDUCATION, A.M.I.H.&V.E., A.M.S.E., A.M.Brit.I.R.E., A.M.I.Mech.E., A.M.I.E.D., A.M.I.M.I., A.F.R.Ae.S., A.M.I.P.E., A.M.I.I.A., A.C.C.A., A.C.I.S., A.C.C.S., A.C.W.A., City & Guilds Examinations, R.T.E.B.Serv. Cert., R.S.A. Certificates, etc.

The only Home Study College operated by a world-wide manufacturing organisation

NEW! *Courses with PRACTICAL EQUIPMENT*
IN RADIO · TELEVISION · MECHANICS · CHEMISTRY
ELECTRICITY · DRAUGHTSMANSHIP
PHOTOGRAPHY, ETC., ETC.
COURSES FROM 15/- PER MONTH



EMI INSTITUTES

POST THIS TODAY — FREE

E.M.I. INSTITUTES, Dept. 179K, London, W.4

NAME .... AGE .... (if under 21)

ADDRESS

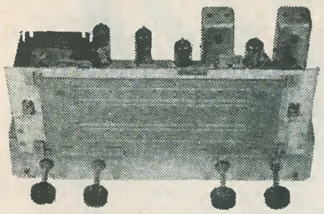
I am interested in the following subject(s) with/without equipment

.... Oct./57

BLOCK CAPS PLEASE

(We shall not worry you with personal visits). IC92

—Part of "His Master's Voice", "Marconiphone", etc., etc.



1957 RADIOGRAM CHASSIS

THREE WAVEBANDS — FIVE VALVES
S.W. 16 m.-50 m. — LATEST MULLARD
M.W. 200 m.-550 m. — ECH42, EF41, EBC41,
L.W. 800 m.-2,000 m. — EL41, EZ40

12 month Guarantee. A.C. 200/250V, 4-way switch. Short-Medium-Long-Gram. A.V.C. and negative feed-back. 4.2 watts. Chassis 13½" x 5½" x 2¼". Glass dial 10" x 4½" horizontal or vertical available. 2 pilot lamps. Four knobs, walnut or ivory, aligned and calibrated. Chassis isolated from mains.

BRAND NEW £10.10.0 Carr. 4/6

TERMS: Deposit £5 . 5 . 0 and 6 monthly payments of £1. MATCHED SPEAKERS 8" 17/6, 10" 25/–, 12" 30/–.

Recommended for above Chassis

R.C.S. SCOOP

HIGH FIDELITY AUTOCHANGER

COLLARO 1957 MODEL RC456

For 7", 10", 12" Records 16, 33, 45, 78 r.p.m.

4 SPEEDS — 10 RECORDS

WITH STUDIO "O" PICK-UP

BRAND NEW IN MAKER'S BOXES

OUR PRICE £9.15.0 Post free

Terms: Deposit £5.5 and 6 monthly payments of £1

B.S.R. MONARCH 4-SPEED AUTOMATIC RECORD CHANGERS

1957 MODELS

Brand new and fully guaranteed 12 months

NOT JOB LINE REJECT STOCK

Designed to play 16, 33, 45, 78 r.p.m. Records 7", 10", 12". Lightweight Xtal pick-up, turnover head, two separate sapphire styli, for standard and L.P.

OUR PRICE £8.15.0 each. Post free

Terms: Deposit £5 and 5 monthly payments of £1.

CUT OUT BOARD 14" x 12½", 6/–.

COLLARO 4-speed Motor and Turntable with selecting switch for 16, 33, 45 and 78 r.p.m. records, 200-250V a.c. 50 c.p.s. Also **HIGH FIDELITY** Lightweight Pick-up with Acos Xtal turnover head, separate sapphire stylus for L.P. and standard records. **SPECIAL OFFER THE TWO £4 . 12 . 6**, post 2/6. 14" x 12½" Cut Out board 6/–.

AMPLIFIER/PORTABLE RECORD PLAYER CABINET. Size 17½" x 13½" x 7" Motor Board 16¼" x 12¾". Space for any Single Record Player, Twin Speakers and Amplifier, etc. **Bargain price 45/–**

I.F. TRANSFORMERS 7/6 pair
465 kc/s slug tuning miniature can 2½" x 1" x 1". High Q and good band width. By Pye Radio. Data sheet supplied.
Wearite M800 I.F. transformers 465 kc/s, 12/6 pair

NEW AND ENLARGED SHOWROOMS NOW OPEN

C.R.T. ISOLATION TRANSFORMERS

For Cathode Ray Tubes having heater-cathode short circuit and for C.R. Tubes with falling emission.
Type A. Low leakage windings. Ratio 1:1.25 giving a 25% boost on secondary: 2V, 4V, 6.3V, 10.3V, 13.3V, **10/6** each; ditto with mains primaries, **12/6** each. All with tag panel and solder tags.
Type B. Mains input 220/240V. Low Capacity. Multi Output 2, 4, 6.3, 7.3, 10 and 13V. Input has two taps which increase output volts by 25% and 50% respectively. This transformer is suitable for all cathode ray tubes. With tag panel, **21/–** each. Ditto for 6 volt tubes, only **17/6** each.
Type C. Low capacity wound transformer for use with 2V tubes with falling emission. Input 220/240V. Output 2-2¼-2½-2¾-3V at 2A, **17/6** each.
All isolation transformers are individually boxed, labelled and clearly marked with relevant data.
NOTE.—It is essential to use mains primary types with T.V. receivers having series connected heaters.

RESISTORS. All values. 10 ohms to 10 meg. ¼W. **4d.**, ½W **6d.**, 1W **8d.**, 2W **1/–**.
HIGH STABILITY. ½W 1%, **2/–**. All preferred values 100 ohms to 10 meg.

WIRE-WOUND RESISTORS 25 ohms-10,000 ohms: 5 watt **1/3**; 10 watt **1/6**; 15 watt **2/–**
15,000 ohms-50,000 ohms, 5W, **1/9**; 10W, **2/3**

WIRE-WOUND POTS. Pre-set Min. T.V. type Knurled slotted knob. All values 25 ohms to 30 K, **3/–** each. 50K, **4/–**. Ditto Carbon Track 50K to 2 Meg, **3/–**

3W Lab. Colvern, etc. Standard size Pots., 2¼" Spindle High Grade. All values, 100 ohms to 50K, **5/6**; 100K, **6/6**. W/W EXT. SPEAKER CONTROL 10Ω, **3/–**

O/P TRANSFORMERS. Heavy duty 50mA, **4/6**. Multi-ratio push-pull, **6/6**. Miniature 3V4, etc., **4/6**. Hygrade push-pull 7 watts, **15/6**.
L.F. CHOKES 15/10H 60/65mA, **5/–**; 25/20H, 100/120mA, **11/6**; 20/15H, 120/150mA, **12/6**; 5H, 250mA, **15/–**. **MAINS TRANS.** 350-0-350, 80mA, 6.3V tapped 4V 4A 5V tapped 4V 2A, ditto 250-0-250 80mA, etc., **22/6**

CRYSTAL MIKE INSERT by Acos
Precision engineered. Size only 1⅜" x 3⁄16". Bargain. Price **6/6** — No transformer required

HEATER TRANS. Tapped 200/250V 6.3V 1½A, **7/6**
ALADDIN FORMERS and cores. ¼" **8d.**; ⅜" **10d.**
0.3" FORMERS 5937/8 and Cans TV1/2. ⅜" sq. x 2⅝" and ⅜" sq. x 1¾", **2/–** complete with cores.
SLOW MOTION DRIVES. Epicyclic ratio 6:1, **2/3**
TYANA. Midget Soldering Iron. 200/220V or 230/250V, **16/9**. **SOLON MIDGET IRON**, 25W. **24/–**
MAINS DROPPERS. 3" x 1¼". Three adj. sliders, 0.3A 750 ohms, **4/3**; 0.2A 1,000 ohms, **4/3**
LINE CORD. 0.3A 60 ohms, per foot; 0.2A 100 ohms, per foot, 2-way, **6d.** per foot; 3-way **7d.** per foot
MIKE TRANSF. Ratio 50:1, **3/9** each; 100:1, **10/6**
LOUDSPEAKERS. P.M. 3 ohm. 2¼" square, **17/6**; 5" R.A. **17/6**, 7" x 4" Goodmans **21/–**, 3½" sq. Elac, **21/–**, 8" Plessey **19/6**, 6½" Goodmans **18/6**, 10" R.A. **30/–**, 12" Plessey **30/–**, 8" M.E. 2.5K field tapped, O.P. transformer **24/6**. **TSL TWEETER LSH75 8/6.**
CRYSTAL DIODES. G.E.C. **2/–**; GEX34 **4/–**;
40 CIRCUITS FOR GERMANIUM DIODES, 3/–
CRYSTAL SET, Complete Kit **12/6**. Construction Book **1/–**. **REACTION COND.** 100pF, 300pF, 500pF, **3/6** each.
H.R. HEADPHONES, 4,000 ohms, brand new, **16/6** pr
SWITCH CLEANER Fluid, squirt spout, **4/3** tin
TWIN GANG CONDENSERS. 365pF, miniature, 1⅞" x 1⅝" x 1¼", **10/–**. 0.0005 standard with trimmers, **9/–**; less trimmers, **8/–**. Midget **7/6**; 50pF single, **2/6**

SUPERHET COIL PACK 27/6
Miniature size 2½" x 2¼" x 1¼". High Q dust cored coils. Short, Med., Long. Gram. switching with connection diagram and circuit. 465 Kc/s I.F.

Aluminium Chassis. 18 s.w.g. Plan, undrilled, with 4 sides, riveted corners and lattice fixing holes, with 2½" sides. 7" x 4", **4/6**; 9" x 6", **5/9**; 11" x 7", **6/9**; 13" x 9", **8/6**; 14" x 11", **10/6**; 15" x 14", **12/6**; 18" x 16" x 3", **16/6**.

Volume Controls
Midget size
Long spindles. Guaranteed 1 year. All values 10,000 ohms to 2 Meg.
No. S2. S.P.Sw. D.P.Sw.
3/– 4/– 4/9
Linear or Log Tracks

80 Ω Coaxial cable
Semi-air spaced Polythene insulated ¼" dia. stranded core. Ideal Band III **9d.** yd. Losses cut 50%.
STANDARD QUALITY ¼" Co-axial **8d.** yd.

Co-axial Plugs **1/–** — **Double Socket** **1/3**
Sockets **1/–** — **Outlet Boxes** **4/6**
Balanced Twin Feeder per yd., **6d.** 80Ω or 300Ω.
Twin Screened Balanced Feeder, 1/– yd., 80 ohms.
Trimmers Ceramic, 30, 50, 70pF, **9d.**; 100pF, 150pF, **1/3**; 250pF, **1/6**; 600pF, 750pF, **1/9**. Philips **1/–** each
BLACK CRACKLE PAINT. Air drying, **3/–** tin
P.V.C. CONN. WIRE, 10 colours, single or stranded, **2d.** yd. Sleeving 1, 2 mm. **2d.**, 2, 3 mm. **3d.**, 6 mm. **5d.** yd.
5" RADIO SCREWDRIVERS, 6d. each
NEON MAINS TESTER SCREWDRIVERS 5/6
MULTICORE SOLDER, 60/40, 18 s.w.g., **3d.**, 16 s.w.g., **4d.** yd., ¼ lb **2/6.**
Sentercel Rectifiers. E.H.T. Type Fly-back. Voltages: K3/25 2kV, **5/–**; K3/40 3.2kV, **7/–**; K3/45 3.6kV, **7/6**; K3/50V 4kV, **8/–**; K3/100 8kV, **14/6.**
Mains Type RM1, 125V 60mA, **5/–**; RM2 100mA, **6/–**; RM3 120mA, **8/–**; RM4 250V 275mA, **16/–** RM5 **20/–**
Miniature Contact Cooled Rectifiers. 250V 50mA, **8/6**; 250V 85mA, **9/6.**
Coils. Wearite "P" type, **3/–** each. Osmor Midget "Q" type adj. dust core, from **4/–** each. All ranges.
Teletron. L. & Med. T.R.F., with reaction, **3/6**
Ferrite Rod Aerials. M.W., **8/9**; M. & L., **12/6.**
T.R.F. Coils A/HF, **7/–** pair. **H.F. Chokes, 2/6**

RADIOMETERS
2" Twin Range 0–25V, 0–250V d.c. with leads and Leather Case, **15/–** each.

Condensers. New stock. 0.001μF 7kV T.C.C., **5/6**; ditto 20kV, **9/6**; 100pF to 500pF Micas, **6d.**; Tubular 500V 0.001 to 0.01μF, **9d.**; 0.05, 0.1, **1/–**; 0.25, **1/6**; 0.5, **1/9**; 0.1/350V, **9d.**; 0.1/600V, **1/3**; 0.1/2,000V, **4/–**
Ceramic Conds. 500V 0.3pF to 0.01μF, **10d.**
Silver Mica Condensers. 10% 5pF to 500pF, **1/–**; 600pF to 3,000pF, **1/3**; ditto 1% 1.5pF to 500pF, **1/9**; 515pF to 5,000pF, **2/–**.

NEW ELECTROLYTICS. FAMOUS MAKES

TUBULAR		TUBULAR		CAN TYPES	
1/350V	2/–	100/25V	3/–	8+16/450V	5/–
2/450V	2/3	8+8/500V	6/–	16+16/500V	6/–
4/450V	2/–	16+16/500V	6/–	6,000μF 6V	6/6
8/450V	2/3	**CAN TYPES**		32+32/350V	4/6
8/500V	2/9	Clips	3d.	32+32/450V	6/6
16/450V	3/6	16/450V	3/6	64+120/275V	7/6
16/500V	4/–	32/350V	4/–	60+100/350V	11/6
32/450V	5/6	64/350V	5/6	100+200/275V	
25/25V	1/9	100/275V	5/6		10/6
50/25V	1/9	50+50/350V	7/–	1,000+1,000/6V	
50/50V	2/–	500/12V	3/–		6/6

Full Wave Bridge Selenium Rectifiers. 2, 6 or 12V 1½A, **8/9**; 2A, **11/3**; 4A, **17/6**
Charger Transformers. Tapped Input 200/250V for charging at 2, 6 or 12V 1½A, **15/6**; 2A, **17/6**; 4A, **22/6**

12/6 PURETONE RECORDING TAPE
1,200ft. on standard 7" Plastic reels. Spools 5" metal, **1/6**; 7" metal, **2/3**
FERROVOICE 1,200ft. Plastic Tape, **25/–**

CHAMPION (VHF) FM TUNER

88 to 96 Mc/s.

5 MULLARD VALVES and SUPERHET TUNING HEART

Maroon and cream receiver styled cabinet 6" x 12" x 6". Features: This is a self-powered 200/250V a.c. VHF (F.M.) Adaptor with operating and servicing data, and a screened lead for connection to pick-up sockets of any radio, radiogram or amplifier.

Brand new with 12 months guarantee. List price **16 gns. Our price 10 gns., carr. 4/6.**

JASON F.M. TUNER COIL SET, 26/–. H.F. coil, aerial coil, oscillator coil, two i.f. transformers 10.7 Mc/s, detector transformer and heater choke. Circuit and component book using four 6AM6, **2/–**. J.B. Chassis and dial, **19/6**. Complete kit, **£5.18.6.** With Jason superior calibrated dial, **£6.15.0.**

Wavechange Switches. 2 p 2-way, 3 p. 2-way, short spindle, **2/6**; 5 p 4-way 2 wafer, long spindle, **6/6**; 2 p 6-way, 4 p 2-way, 4 p 3-way, long spindle, **3/6**; 3 p 4-way, 1 p 12-way, long spindle, **3/6**; Wave change "MAKITS," 1 wafer, **8/6**; 2 wafer, **12/6**; 3 wafer, **16/–**; 4 wafer, **19/6**; 5 wafer, **23/–**; 6 wafer, **26/6.**
Toggle Switches. s.p. **2/–**, d.p. **3/6**, d.p.d.t. **4/–**.
Morse Keys, good quality, **2/6.**

Knobs Gold Engraved. Walnut or Ivory. 1⅛" diam., **1/6** each. 'Focus,' 'Contrast,' 'Brilliance,' 'Brilliance-On/Off,' 'On-Off,' 'Volume,' 'Volt-On/Off,' 'Tone,' 'Tuning,' 'Treble,' 'Bass,' 'Wave-change,' 'Radio-Gram,' 'S.M.L.-Gram,' 'Record-Play,' 'Brightness.' Ditto, not engraved, **1/–**

Valveholders. Pax. int. oct, **4d.** EF50, EA50, **6d.** B12A, CRT, **1/3**. Eng. and Amer. 4, 5, 6, 7 and 9 pin, **1/–**. MOULDED Mazda and int. oct, **6d.**, B7G, B8A, B8G, B9A, **9d.** B7G with can, **1/6.** VCR97, **2/6.** B9A with can, **2/6.** **Ceramic,** EF50, B7G, B9A int. oct., **1/–**. B7G with can, **1/9**; B9A with can, **2/6.**
Speaker Fret. Gold cloth, 18" x 25", **5/–**; 25" x 36", **10/–**. Expanded metal, silver, 15¾" x 9½", **2/–** each; 14½" x 12", **3/–** each.
Tygan. 4' 6" wide, **10/–** ft.; 2' 3" wide, **5/–** ft.

All Boxed VALVES New & Guaranteed

1R5	8/6	6K8	8/6	EABC80	8/6	EZ81	11/6
1S5	8/6	6L6	10/6	EB91	6/6	EI148	1/6
1T4	8/6	6Q7	10/6	EBC33	8/6	HABC80	12/6
3S4	8/6	6SA7	7/6	EBC41	10/6	HVR2A	7/6
3V4	8/6	6SN7	8/6	EBF80	8/6	MU14	10/6
5U4	8/6	6V6G	7/6	ECC84	12/6	PCC84	12/6
5Y3	8/6	6V6GT	8/6	ECF80	10/6	PCF80	10/6
5Z4	10/6	6X4	7/6	ECF82	10/6	PCF82	10/6
6AM6	8/6	6X5	7/6	ECH42	10/6	PCL82	10/6
6B8	5/6	7S7	8/6	ECL80	8/6	PEN25	6/6
6BE6	7/6	12A6	7/6	ECL82	12/6	PL82	10/6
6BH6	10/6	12AH8	10/6	EF39	7/6	PY80	10/6
6BW6	8/6	12AT7	10/6	EF41	10/6	PY81	10/6
6BW7	8/6	12AU7	10/6	EF50	5/6	PY82	10/6
6CH6	10/6	12AX7	10/6	Equip.		SP61	5/6
6D6	7/6	12BE6	10/6	EF50	8/6	UBC41	8/6
6F6	7/6	12BH7	10/6	Sylv.		UCH42	8/6
6H6	3/6	12K7	8/6	EF80	10/6	UF41	8/6
6J5	6/6	12Q7	8/6	EF92	5/6	UL41	8/6
6J6	7/6	35Z4	10/6	EL32	5/6	UY41	8/6
6J7	8/6	80	8/6	EL84	10/6	U22	10/6
6K6	6/6	954	1/6	EY51	11/6	U25	11/6
6K7	5/6	EA50	1/6	EZ40	10/6	X79	10/6

Written guarantee with every purchase — **Please address all Mail Orders correctly as below**

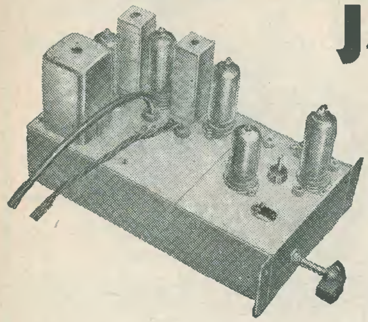
RADIO COMPONENT SPECIALISTS

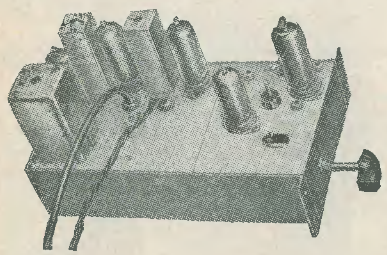
337 WHITEHORSE ROAD WEST CROYDON

Tel. THO 1665 — *Catalogue 6d.*

OPEN ALL DAY (Wed. 1 p.m.)

Buses 133 or 68 pass door. S.R.Stn. Selhurst. **48-hour Postal Service.** *P.&P. 1/–, £2 orders post free (Export extra) C.O.D. 1/6*





The

Radio Constructor

incorporating THE RADIO AMATEUR

CONTENTS FOR OCTOBER

VOL. 11. NO. 3

OCTOBER 1957

ANNUAL SUBSCRIPTION 25/– including postage

Editorial and Advertising Offices
57 MAIDA VALE LONDON W9

Telephone
CUNningham 6141 (2 lines)

Telegrams
DATABUX, LONDON

Editor
C. W. C. OVERLAND, G2ATV

Advertising Manager
F. A. BALDWIN, AMIPRE

Opinions expressed by contributors are not necessarily those of the Editor or proprietors.

NOTICES

THE EDITOR invites original contributions on construction of radio subjects. All material used will be paid for. Articles should preferably be typewritten, and photographs should be clear and sharp. Diagrams need not be large or perfectly drawn, as our draughtsmen will redraw in most cases, but all relevant information should be included.

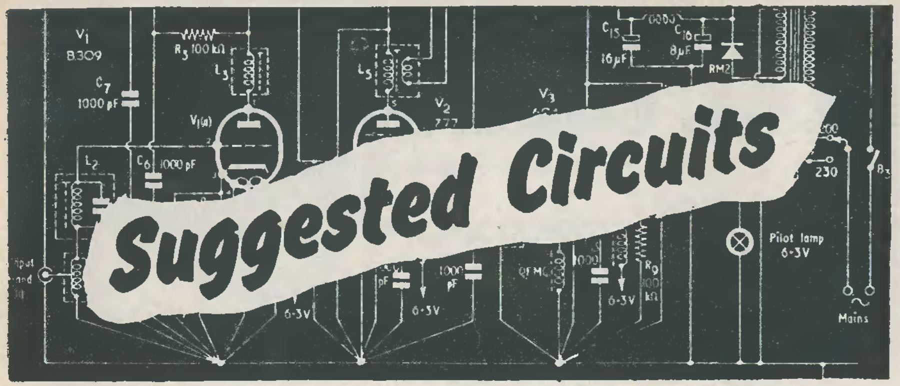
All MSS must be accompanied by a stamped addressed envelope for reply or return. Each item must bear the sender's name and address.

TRADE NEWS. Manufacturers, publishers, etc., are invited to submit samples or information of new products for review in this section.

QUERIES. We regret that we are unable to answer queries, other than those arising from articles appearing in this magazine; nor can we advise on modifications to the equipment described in these articles.

ALL CORRESPONDENCE should be addressed to THE RADIO CONSTRUCTOR 57 Maida Vale London W9

REMITTANCES should be made payable to "DATA PUBLICATIONS LTD."



The circuits presented in this series have been designed by G. A. FRENCH, *specially for the enthusiast who needs only the circuit and essential relevant data*

No. 83. A SINGLE VALVE FM TUNER

IT FREQUENTLY HAPPENS, IN THE ALTERING scene which is inevitable in a rapidly advancing science such as that of electronics, that individual developments are liable to become relegated to the background even when they deserve especial attention on their own merits. The circuit which is described this month tends to fall within this class, insofar that it represents an f.m. tuner which caused some noticeable interest in the United States in 1947 to 1949, but which, so far as the writer is aware, has since occasioned very little comment. It is, of course, possible that the particular time when the circuit appeared may have some bearing on the fact that it is now so little-known. In this period, f.m. broadcasting in the States was becoming uneconomic under the conditions of commercial broadcasting which were then applicable. Public interest was swinging towards television, and the demand for high fidelity reproduction—which could have given a fillip to the f.m. medium—was limited. At the same time, f.m. broadcasting in Europe was practically non-existent, and the design received scant publicity outside the States.

Because of these facts, it seems that the one-valve f.m. tuner circuit which forms the basis of this month's contribution has been given an undeserved lack of attention. To the writer's mind, the tuner employs such ingenious circuitry that it deserves recognition on this score alone, and the fact that it also provides an intriguing field of investigation for the more serious experimenter makes its inclusion in this series all the more desirable.

The Circuit

Before proceeding to a description of the circuit itself, some details of its source should be given. The circuit is due to B. D. Loughlin, and was produced by the Hazeltine Corporation as the FreModyne receiver. The circuit employs a single ECC81 (12AT7) and provides an *audio frequency* output at a level normally associated with superhet tuners. There are two references to the design which may be available to readers, and these are quoted at the end of this article.

The circuit accompanying this article is that of the Hazeltine FreModyne receiver in full; with the single exception that the original 300Ω input circuit has been changed to one more suitable for 75Ω operation. In the 300Ω version the coupling coil, L_1, is not employed. One conductor of the 300Ω aerial feeder connects directly to chassis (at the bottom end of L_2), whilst the other connects to the top end of L_2 via a 2pF condenser.

The operation of the circuit is complex, insofar that a number of components perform several functions simultaneously. Unfortunately, the material available to the writer offers no detailed description at all of circuit operation, and he is unable to give quite as much design information as he normally likes to do. *He feels also that he should stress, at this stage, that this particular circuit is intended for the advanced and experienced constructor rather than for the beginner.* Since the circuit is that of a tuner which has been commercially produced, the major difficulty liable to be encountered is that of layout. Apart from coils and chokes, which are discussed later, all the components are standard.

It is advisable to commence an examination of the circuit by first considering the oscillator, $V_{1(b)}$. This triode, which is half of the ECC81, functions as a superhet local oscillator and runs at 22 Mc/s above the input signal frequency. If the oscillator circuit is analysed it will be found that it is basically a v.h.f. Colpitts, the only difference to the version normally encountered in such things as television tuners being that the anode of the valve is at chassis potential so far as r.f. is concerned, and not the cathode. Provided that it covered the frequencies required and developed sufficient oscillator amplitude, any other oscillator circuit could be employed in place of that shown. The oscillator voltage is fed to the grid of $V_{1(a)}$ via the 2pF condenser C_3.

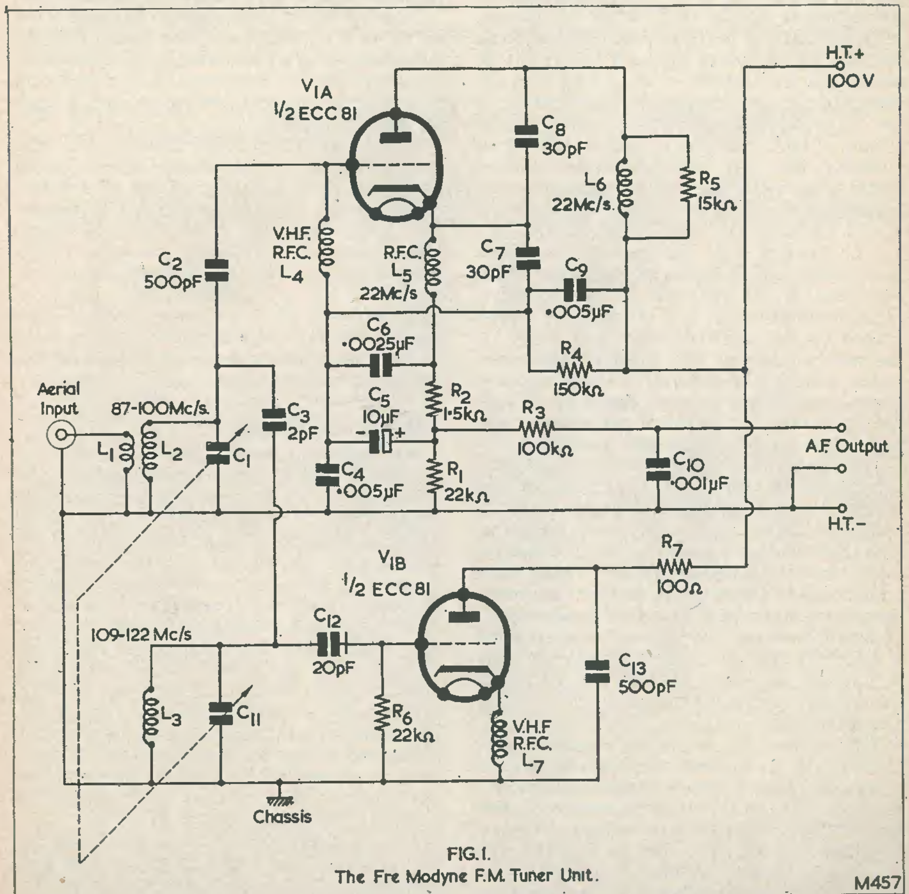


FIG. 1.
The Fre Modyne F.M. Tuner Unit.

A signal voltage, built up across the tuned circuit, L_2–C_1, is applied to the grid of $V_{1(a)}$ in addition to the oscillator voltage. As will be seen shortly, $V_{1(a)}$ is switched on and off at a supersonic frequency, with the result that, for part of the time, the valve operates in a non-linear fashion and mixing between the oscillator and signal frequencies takes place. The oscillator is off-set from the signal frequency by 22 Mc/s, with the result that an i.f. of this value appears at the anode of $V_{1(a)}$.

$V_{1(a)}$ also functions as a self-quenched super-regenerative detector running at 22 Mc/s, and with a quench frequency around 30 kc/s. In this mode of operation the valve employs L_6 and C_7, C_8 to form an oscillatory tuned circuit, one end of which connects directly to the anode, whilst the other is applied to the grid via the choke L_4. This choke offers a high impedance to v.h.f. but has low impedance at 22 Mc/s. The grid of the triode is, so far as 22 Mc/s r.f. is concerned, at chassis potential, the cathode being isolated by means of choke L_5. It will be noted that the cathode of $V_{1(a)}$ taps into the centre of the capacity tuning L_6. Insofar as the super-regenerative action proper of the circuit is concerned, it is rather difficult to visualise the CR network which causes quenching, due to the various capacities connected to the grid of $V_{1(a)}$. However, it would probably be valid to consider C_9–R_4 as the quench CR, the quench frequency being considerably increased by reason of the fact that R_4 is returned to h.t. positive. (This connection to h.t. is probably necessitated by the positive cathode of $V_{1(a)}$. If R_4 were returned to chassis the super-regenerator would not start.) Working as a super-regenerative detector tuned to 22 kc/s. the i.f. circuit is capable of achieving a very high degree of selectivity and sensitivity.

Discrimination of the 22 Mc/s frequency modulated i.f. signal is achieved by its conversion to a.m. on the side skirts of the i.f. response curve and subsequent detection. The response curve given by the FreModyne circuit has skirts which are very linear when considered in terms of db against frequency deviation, and which have a steepness of the order of 20 db per 100 kc/s. In consequence, a relatively high level of amplitude modulation may be obtained for the frequency deviations normally encountered in v.h.f. transmissions.

The a.f. output of the super-regenerative detector is taken from the cathode of the triode, it being built up across the detector load R_1. This a.f. is then filtered by R_3 and C_{10}, and is finally passed on to the subsequent amplifier. A 0.01μF condenser in series with the feed to the a.f. amplifier is desirable if the latter is likely to be affected by the small d.c. component present.

Further Details

There are one or two points concerning the circuit which require a little further discussion at this stage. First of all, it will have been noted that conversion to a.m. is achieved by applying the f.m. signal to the side skirts of an i.f. response curve, and this infers that two tuning positions would be given for each station received. However, in reference 2 it is stated that the double tuning effect is hardly apparent, and that it is possible to miss it without prior knowledge. So far as non-linearity in the conversion of f.m. to a.m. is concerned, it has to be pointed out that a response curve which is linear when considered from the point of view of db versus frequency is not quite the same thing as one which is linear for voltage against frequency. Nevertheless, the fidelity given by the device appears to be of an acceptable nature.

Another factor which has to be considered is that of a.m. rejection. It is stated that the circuit provides a useful degree of rejection to impulsive interference insofar that, employing a super-regenerative detector, it is only "on" for part of the time.

A final point is concerned with sensitivity; and a minimum sensitivity figure would appear to be of the order of 200μV across a 300Ω input. The limiting factor to sensitivity is the necessity of obtaining an audio signal which satisfactorily overrides background noise. The 200μV input figure corresponds to a signal-to-noise ratio of approximately 30 db. An input level of 70μV (across 300Ω) gives a signal-to-noise ratio of 20db, a figure which would be just acceptable for entertainment value.

Experimental Details

As was mentioned at the beginning, the Hazeltine FreModyne circuit offers considerable scope for the more experienced constructor. At first sight the coils would appear to present some difficulties, but closer examination shows that this may not be so. Examining the aerial input circuit, it will be noted that all that is required of L_1 and L_2 is that they allow a signal voltage of good amplitude to be built up across the tuned circuit. The input coils could, therefore, very probably consist of reasonably high-grade types already available in the home-constructor market. As was stated above, it is not necessary for the oscillator $V_{1(b)}$ to take up the exact form shown in the diagram, and alternative oscillators may enable the choke L_7 to be dispensed with.

L_6, the super-regenerator coil, is also not as "awkward" as might be thought at first, this being due to the fact that it is damped in the FreModyne circuit by the fairly low value resistance (for 22 Mc/s) of 15kΩ. This point infers that the constructor could employ any reasonably high-Q coil at this position, altering the value of R_5, if necessary, to sharpen up or flatten off the 22 Mc/s response curve.

The two chokes L_4 and L_5 may require a little experiment. The purpose of L_5 is that of offering a high impedance at 22 Mc/s, and a conventional commercial component should cope here. L_4 is intended to offer a high impedance to v.h.f. and a low impedance to 22 Mc/s, and may require some development work before it is finally satisfactory.

It would probably be advisable, when initially putting the circuit into working order, to concentrate primarily on the 22 Mc/s super-regenerator section. To get this part of the circuit functioning correctly, the local oscillator, $V_{1(b)}$, may be ignored, the 2pF condenser C_3 being left temporarily out of circuit. In addition, L_2 could be temporarily replaced by a resistor of some 75Ω, and the output of an amplitude modulated signal generator set to 22 Mc/s connected across it. When the super-regenerative circuit was satisfactorily tuned to 22 Mc/s and gave a sufficiently sharp response, the v.h.f. section could then be brought into operation.

References

1. *Radio Engineering Handbook*, fourth edition, p. 868. McGraw-Hill.
2. *Radio News*, Feb. 1948. Ziff Davis Publishing Co.

TUBELESS TYRES — TUBELESS RADIO

Our acting-unpaid but otherwise temporarily harmless private eye, who is at large on parole, reports.

Being unable to find a current-production car radio suitable for the appurtenances of the super-luxury "Eldorado Brougham," body-stylists in the Cadillac Division of General Motors, Detroit, commissioned their colleagues in the Delco Radio Division to devise a quality radio that would be in keeping with the affluent features of this lush automobile. It must, they specified, be something unusual; it must be the goods; nothing but the fantastic is good enough for this dream-car, which only the disgustingly rich shall be able to afford, for it is to be a limited-production jalopy.

The back-room boys went into hibernation, got down to it and evolved a design. True to type, they lacked nothing in imagination or lavishness. They discarded entirely the old-fashioned electron tube, and liberally sprinkled their drawing-boards with semi-conductors. Triumphantly they emerged with a *magnum opus* incorporating no fewer than 13 transistors and 4 crystal diodes. This, they declared, is tubeless radio the like of which you have never, but never, seen before.

A discerning scrutineer can detect, by the simple process of ignoring certain embellishments, a superhet circuit embodying an r.f. amplifier, separate oscillator and mixer stages, three i.f. stages at (strangely) 262 kc/s, infinite impedance detector, delayed and amplified a.v.c., an audio driver stage, and push-pull output. Negative feedback is applied to the audio driver stage, but the push-pull stage seems to be left to its own devices, except for a thermistor-controlled circuit which ensures optimum bias for the two power transistors therein. Frequency response of the receiver is said to extend to 18 kc/s, but oddly the two speakers into which it works cut off at 60 c/s and 9 kc/s, which looks rather peculiar to those who know their hi-fi.

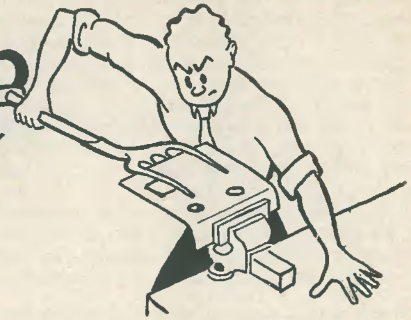
As the helmsman of the car must be given something to do radio-wise, the receiver has push-button station selection. It is here we discover the equivalent of automatic gear-shift applied to a.m. radio, for the desired button having been pushed, electronics take over; two transistors and a crystal diode then twiddle non-existent knobs by operating in a trigger amplifier and relay control circuit designated by the bright boys, "automatic search tuning." It is known to us, no doubt, simply as a.f.c.

Sensitivity, they claim, is better than 3μV, and with only 1μV of aerial signal input you can have 1 watt of audio output. If you can muster energy enough to turn the volume control round to maximum, and assuming your ears will not cave in, you can revel in 10 watts of audio. The car then becomes a small concert hall capable of being trundled round the countryside at speeds in excess of the murder margin.

The receiver has no insatiable appetite for electrical power, for it needs only the 12V car battery to operate it, and demands about 600mA total current therefrom. Of this more than half is consumed by the two pilot lamps.

We have reported on this receiver rather facetiously, but it is really no leg-pull. You can read all about it on pages 60 and 61 in the August issue of the American magazine, *Radio and TV News*. However, we did not notice any particular mention of how 10 watts of audio is derived from a d.c. input to the receiver of about 3 watts. One wonders how it is done. (Ask a silly question like that, and you might get a stupid answer.—ED.)

IN YOUR WORKSHOP



Aided by his able assistant, Dick, Smithy the Serviceman continues to run the Workshop

"I THINK," REMARKED DICK, AS HE TOOK A receiver off the rack and placed it on the bench in front of him, ready for repair, "that I'll have to give up any ideas I had of becoming a serviceman, and become a compositor instead!"

"What's up?" grunted Smithy, looking up. The morning was half gone, and he and Dick had been working steadily through the sets which filled the "For Repair" shelf.

"It's these printed circuit sets that are coming into the shop these days," replied Dick. "I've had two this morning already. If I ever made a cold joint in one I'd feel like writing 'stet' on it!"

"Well, that's corny enough," commented Smithy. "Anyway, I'm glad you're getting some practice on printed circuits. They are getting more and more common these days."

Printed Circuits

Dick looked a little glum.

"The future of servicing doesn't seem to be very bright, then," he remarked. "The more printed circuits sets that are made the fewer snags that will occur, and the less work there will consequently be for you and me."

"What on earth makes you think that?" asked Smithy, surprised.

"Well, printed wiring is supposed to be much more reliable than ordinary wiring," said Dick, "and to my mind that means less servicing work."

"Don't you believe it," Smithy replied. "Printed circuits won't cause *us* any drop in work; in fact they may very probably bring more in. Funnily enough, you're the second person who's made a comment of that nature to me in the last few days. I don't know why it is, but there seems to be a generally exaggerated feeling that printed circuits are going to completely revolutionise the industry in the next few years. Perhaps my imagination is getting a little blunted in my old age, but I just can't see the point of such an argument. You may remember that it wasn't so long ago when I made some comments on printed circuits, as considered from the manufacturer's point of view.* At that time I discussed the considerable difficulties facing manufacturers who wanted to change over to printed production. The first thing I pointed out was that the labour cost involved in wiring up, say, a television set represented only a very small proportion of its total cost, a far greater proportion going into the cabinet, tube, valves and components. Thus, if a manufacturer changed over to printed circuits and had operators inserting components individually by hand, the saving in cost would hardly be worth the trouble. In order to get the best out of printed circuits, components would have to be inserted by machinery, and that would involve a very heavy outlay of capital. I didn't mention it at the time, but the thought has since occurred to me that, owing to the speed with which new ideas in commercial electronic production become obsolete, it should not be at all outside the bounds of possibility for a particular automatic insertion machine to fall out of date after only a few years use. The depreciation per year in value of such a machine would then become shockingly high. All these points are liable to deter the set-maker from embarking on printed circuits 100%; and they cause their introduction to the British market to be somewhat slower than you might, at first sight, expect it to be.

*In Your Workshop, May 1957

"However, once the initial slow introductory period has been overcome, I should imagine that the use of printed circuits will increase with much greater rapidity. We are probably nearing the end of the initial period at the present moment, and I wouldn't be at all surprised to see the second phase come fully into being in 1958. So, although set manufacturers are probably not making much money at present by the introduction of printed circuits, they are still pressing on with them, albeit rather slowly, in the hopes of better things to come.

"Anyway, let's forget the manufacturer for the moment and get down to the service engineer's viewpoint. Now, you have just raised the question that the introduction of printed circuitry may reduce the amount of work coming into the service shop, whilst I said that it would probably bring more in. I think it would be valuable at this point if we were to consider first of all just exactly what a present-day printed circuit *does*. An average contemporary printed circuit consists, quite simply, of an insulating board with a copper foil pattern which replaces the wiring of a conventional chassis. Because of this, the printed circuit board merely obviates conventional wiring, whereupon the only fault condition which has been deleted is that of incorrect connections. It occasionally happens that a conventionally-wired receiver leaves its factory with a component connected to a wrong tag, and yet still manages to give a fairly average performance. Printed circuit boards would prevent wiring mistakes of that type. However, manufacturing faults in this class are very few and far between, and their absence would make very little difference to the total amount of work handled by the serviceman."

"Well, that seems to be a reasonable argument," commented Dick. "What about cold joints and things like that?"

"I can't see printed circuits drastically reducing the number of cold joints in a set," replied Smithy. "And, here again, you have to face the fact that the number of cold joints in a conventionally wired chassis is not, in any event, very high these days. Don't forget that printed circuit components have to be soldered to the copper foil, and I would have thought that the risk of cold joints here is just as high as when the components are soldered to tags. Indeed, the risk may even be higher, as it is not quite as easy to solder to a flat piece of copper as it is to a tag around which the wire has been twisted. Of course, much printed circuit soldering will be done automatically, but this fact is not, to my mind, likely to reduce the number of cold joints encountered.

"So far as the overall reliability of a printed circuit set is concerned, you must also remember that it employs just the same components and valves as are used in conventionally wired chassis. It is these which cause the majority of failures; whereupon it becomes irrelevant whether any particular component is stuck to a printed board or hung between two tags."

"You said just now," reminded Dick, "that printed circuits might actually increase the work we have to do. How do you justify that?"

"Well, I may have been gazing into the crystal ball rather deeply there," admitted Smithy, "although, on the face of it, events would seem to point that way. First of all, the inevitable result of printed circuits will be an increase in production, although this may not become evident for a number of years. Increased production, when it comes, means more sets in people's homes, more sets to go wrong, and more sets to be passed on to the serviceman. Secondly, printed circuits may introduce one or two snags on their own account, such as leakiness between conductors through the board, and so on—again more jobs for us! Time alone will tell what faults may arise from the use of printed circuits, but I would be very surprised if they introduced none at all. I suppose that I am being rather pessimistic in making such a statement, but then I never have looked only on the bright side of things!"

Practical Servicing

"I'll keep my fingers crossed for the future, then," Dick said. "In the meantime, have you any hints on printed circuit servicing you could pass on?"

"Well, printed circuit servicing is all very straightforward," replied Smithy, "so long as you pay attention to several common-sense rules. The main thing to avoid is the use of brute force methods on the printed board itself. This applies particularly to soldering operations. Although the copper foil adheres very strongly to the insulated board it *can* come unstuck, and especially so if you apply too much heat. So any soldering operations which are needed have to be carried out quickly and carefully. Sometimes the copper foil is covered with a varnish, and as this may have fluxing properties it does not always need to be scraped away if you intend to make a joint. You can always check the properties of any experimental varnish you may find by making an experimental dab with the iron in the centre of a large earthing section—most boards have large areas of copper at earth potential—to see how quickly tinning occurs. This quick check may save damage to a more intricate part of the circuit elsewhere. Remember, by the way, that the service manual *should* give you information concerning the best method of soldering to the board, and this should be consulted always.

"Whenever you make a joint to a board, it is best to use a miniature iron which is well tinned. In most instances the only time you should ever have to apply an iron to the board is when you suspect a cold joint between a component lead-out wire and the copper foil.

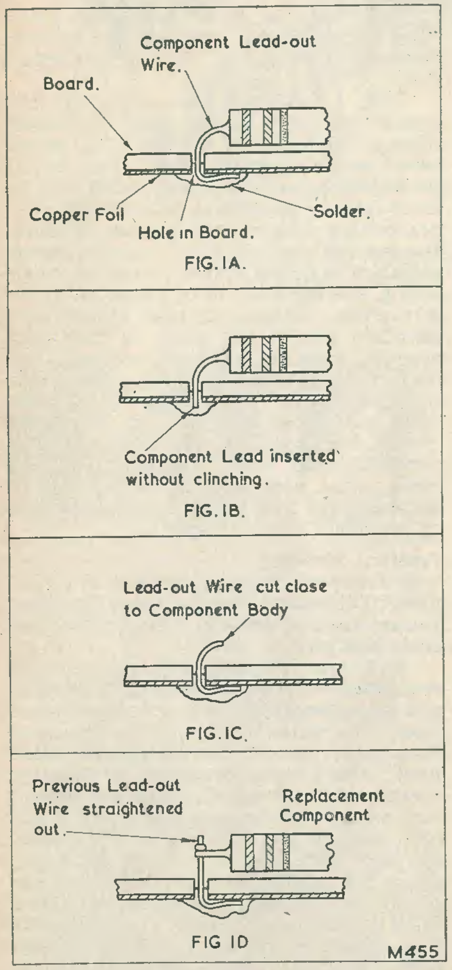


Fig. 1 (a). Cross-sectional view showing a lead-out wire from a resistor clinched to a printed circuit board before soldering

(b) A component lead-out wire inserted without clinching

(c) For replacement purposes, the lead-out wire of the faulty component should be cut, as illustrated here

(d) A replacement component secured to the previous lead-out wire

Nine times out of ten, the mere application of the iron, without any solder or flux, will be enough to make the joint serviceable. A very good idea consists of melting a little cored solder on to the tip of the iron and of shaking this off again just before applying it to the foil. This idea will ensure that the iron tinning has a minimum of oxide, and that a quick thermal connection can be made to the solder in the suspect joint. Cold joints on printed circuit boards are fairly easy to find, by the way, as they frequently have an 'obvious' look about them. Usually, you will find that the solder collects in a blob around the component wire, instead of spreading nicely over the surface of the copper foil; or that, although the solder has spread over the copper, the component lead has the unmistakable appearance of not having 'taken.' Light, repeat light, taps on the components will usually make a cold joint show up as an intermittent. It is inadvisable to check for a cold joint by moving a component bodily back and forth over any great distance unless it happens to have thin lead-out wires. Rough movement of the component can cause the copper foil on the other side of the board to be strained, whereupon it may become torn away from the board. The lead-out wires on almost all resistors and many condensers fall within the 'thick' category; and these components are those which should not be moved around too violently."

"How do you replace faulty components on a printed board?" asked Dick.

"The best way," replied Smithy, "is, whenever possible, to cut the existing lead-out wires and solder the new component to these. There is a good reason for this particular policy. In most printed boards, component leads are clinched over in manufacture before soldering. Like this (Fig. 1 (*a*)), where you can see a cross-sectional view of a lead-out wire from a resistor soldered to the copper foil. Now, if you try to replace the component by simply unsoldering it from the board, you would find that you would have to keep the iron on the joint for quite a long time before you could straighten out the wire and pull it through its hole. This may cause overheating of the board. Sometimes, the lead-out wires aren't clinched over, being merely inserted straight into the holes in the board (Fig. 1 (*b*)). Even here it is preferable to avoid trying to unsolder the wires at the board; although the risk of overheating is much less in this case, since the wires can be pulled through their holes more quickly. Don't forget that, after unsoldering at the foil, the appropriate holes in the board will be full of solder, and this can be a nuisance at times. As I said just now, therefore, in order to overcome these snags the best plan consists

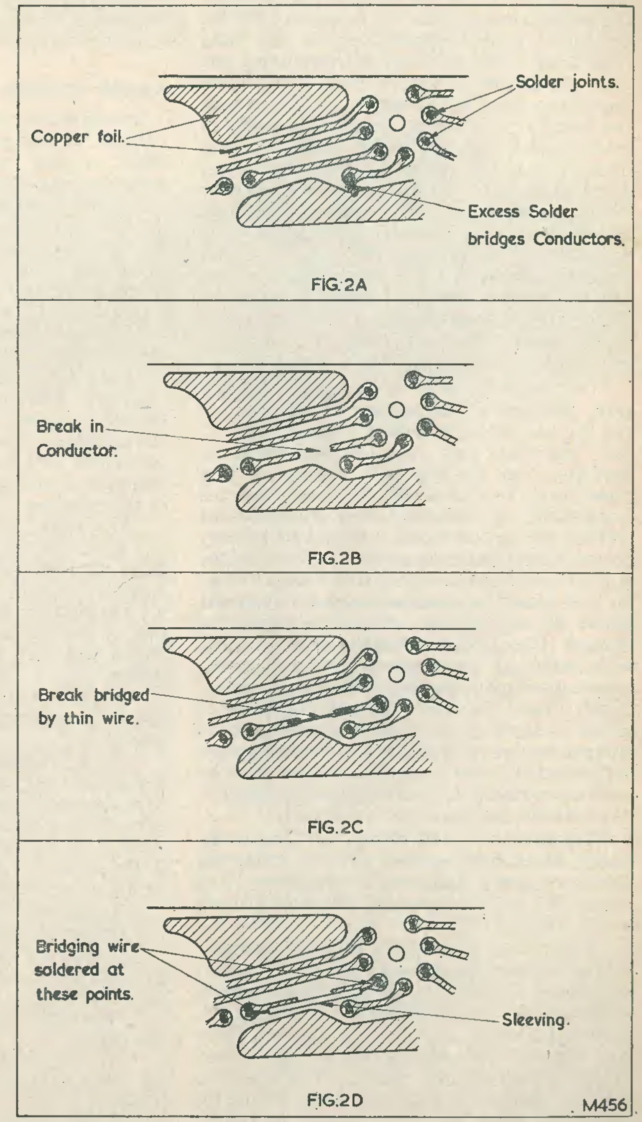
of clipping the lead-out wires of the faulty component as close to its body as you can (Fig. 1 (*c*)), and then soldering the new component to those leads (Fig. 1 (*d*)). Even here repair of this nature can be made to look quite neat, incidentally, and it gives just as good results as did the previous connections to the copper foil itself."

Fig. 2 (a) Whilst servicing printed circuits, excess solder may accidentally bridge adjacent conductors

(b) A break in a printed circuit conductor

(c) The break of (b) bridged by a thin wire

(d) An alternative, and somewhat safer, method of bridging the conductor break



you need to be fairly quick in order to prevent the heat travelling down the cut leads and loosening the joints at the copper foil. A

"It sounds to me," commented Dick, "that the thing to avoid in printed circuit servicing is the printed panel itself!"

"That's true enough," Smithy replied, "and you soon find yourself evolving new techniques for preventing damage. Sometimes, soldering directly to the copper foil becomes inevitable, of course, and there are some errors which you then have to take particular care to avoid. The worst one is that wherein the solder runs outside the boundary of one conductor and bridges over to the next (Fig. 2 (*a*)). The only way of overcoming this state of affairs, if you're ever unfortunate enough to have it happen to you, is to turn the board upside down—so that the solder is underneath—and, with the soldering iron applied, tap the board so that the excess solder falls off. You should never try to break the solder joining the two conductors by scratching at it with a pen-knife or a screwdriver. If you do this you may pull away the copper foil as well as the solder, and you are almost certain to break the skin of the insulating board as well. The latter could then become water absorbent at that point, and might later become leaky.

"Occasionally, due to careless handling plus, perhaps, a thin section of foil, part of the circuit becomes broken (Fig. 2 (*b*)). If this happens, you may be successful in bridging over the gap with a piece of thin wire (Fig. 2 (*c*)). Both the wire and the copper should be tinned before you make the joints. If the conductor happens to be very narrow at the point where the break occurs, or if the conductors on either side are very close to it, it would be more advisable to make the joints at any points where the conductor widens (Fig. 2 (*d*)). Usually such widening will occur at connections to components, whereupon you already have the copper nicely tinned for you. A further solution is given by the fact that, since the conductor is almost bound to connect to components on either side of the break, you might then be able to connect your bridging wire between their lead-out wires *above* the board."

"Up to now," said Dick, "all your comments have been concerned with soldering and component replacement problems. Are these the major troubles to expect with printed circuits?"

"They are, mainly," replied Smithy. "Most of the other snags you are likely to encounter are those of fault location, which apply equally to conventionally wired chassis. Before I finish I should point out that there are one or two precautions to take when working with printed boards. For instance, you shouldn't take a soldering iron whose bit is heavily laden with solder near the board, as you then run the risk of dropping blobs of solder on to the copper, and they may be quite difficult to get off again. Other undesirable things, such as paste flux—which you shouldn't use on printed boards in any case—between conductors may also cause a lot of trouble.

"A final point to remember about printed circuit boards is that they are liable to warp somewhat with age and heat. So, if a particular receiver employs a large board, you should keep an eye open just in case severe warping in service has caused any connection to become strained."

Another Problem

Smithy finished speaking and left Dick to ponder over the points he had just discussed. After a few moments, the Serviceman addressed his assistant once more.

"Well," he remarked, "I think we've had enough nattering for one day. Even so, though, I cannot help but be tempted to waste just a little more time before returning to the grindstone. So I'm going to set you a little problem."

"Oh no," protested Dick. "Not another 'hocus-pocus'* effort, please!"

"I'm sorry," continued Smithy mercilessly, "but my mind's made up. Our last problem proved to be very popular, and so I think we should have a repeat performance. This time the whole thing is extremely simple indeed, and you should be able to give me an answer in two minutes. Are you ready?"

"Fire away," said Dick, resignedly.

"Well, the problem concerns a friend of mine who was walking past a Government surplus radio shop one morning, when he saw a large sign in the window which said: 'Buy one of our bargain condenser parcels.' My friend was very intrigued by this and went inside.

" 'Could you tell me what condensers there are in your bargain parcels?' he asked the salesman.

" 'Well,' replied the salesman, 'each parcel is the same and each has four condensers in it. What is more, the values of all condensers are expressed in whole numbers of microfarads. That is to say, any condenser could be 1μF, 2μF, 3μF or any other number up, there being no fractions or decimals.'

" 'I see,' replied my friend; 'could you give me any more information?'

" 'Certainly, sir,' said the salesman. 'The product of the condenser values in each parcel comes to 36.'

" 'That still doesn't help me,' commented my friend.

" 'Well,' continued the salesman, 'the sum of their values is equal to the date next Tuesday.'

"My friend looked at the number indicated on the calendar by the assistant.

" 'I'm sorry, but I'm *still* not satisfied,' he said.

" 'All I can add, sir,' replied the salesman, 'is that the condenser in each parcel with the largest value is 500V wkg.'

" 'Ah, that's what I wanted to know,' said my friend, whereupon he bought a parcel of condensers and walked out of the shop."

"I should jolly well think he *would* walk out of the shop after meeting a salesman like that," said Dick feelingly. "Anyway, go on with the problem."

"That's it!" grinned Smithy. "Now you tell me the condenser values in each bargain parcel. I'll tell you the answer at our next little session if you haven't already worked it out."

*In Your Workshop, May, June 1957

Technical Forum

A Photo-Sensitive Transistor

It has been known for some considerable time that germanium possesses photo-sensitive properties, but not until very recently has any real use been found in its application. The term "photo-electric" is a familiar one and is used in describing a phenomena in which the movement pattern of electrons in a material is changed quite appreciably by the application of light to the material. Usually the amount of energy which the photo device can control is quite small, so that it has to be followed by a valve amplifier or perhaps a gas-filled trigger valve; in either case the purpose is normally to open or close a relay depending upon the intensity of the light falling on the photocell. A new type of photocell has now been introduced and is known as a "phototransistor." It does, in effect, combine the properties of the photocell with those of a transistor amplifier so that a remarkably high order of sensitivity can be achieved. In fact, the sensitivity is such that it can be made to operate a conventional type of relay without any additional form of amplification. Like most types of semi-conductor diodes and transistors on the market today, the phototransistor employs a germanium element which has been found to possess excellent photo-sensitive properties. This has in the past led to some rather queer results being obtained by experimenters using transistors, and it is worth digressing for a moment to describe an effect which may have already puzzled some constructors.

In a laboratory, engineers were working to test a new fully transistorised amplifier which differed from the normal run of amplifiers in that it had been developed with special care to give high fidelity reproduction. Now the results obtained were very good, but the performance was marred by a strong 100 c/s hum. It was naturally assumed that the hum was being picked up from adjacent mains wiring; but careful screening, and indeed even shorting the input terminals, did little to help. This was very disappointing, as it had been assumed that one of the advantages of employing transistors was that complete freedom could be obtained from mains hum, a defect which so often haunts the hi-fi constructor. Then one of the engineers switched off the fluorescent lighting in the laboratory and immediately the hum ceased, as it had, in fact, been caused by the photo-sensitivity of one of the transistors in the equipment. All forms of lamp, whether of the filament or discharge type, will flicker at mains frequency, and although persistence of vision renders this invisible to the eye, it does exist.

The applications of the phototransistor are very similar to those of any other form of photocell, namely automatic door opening, burglar alarms, counting and batching, machine protection, etc. For all these devices the mode of operation is basically the same—a beam of light is caused to fall on the cell, and when interrupted a relay in the cell circuit is energised. Other applications are found in sound film reproduction, but it is in the classes already mentioned that the phototransistor excels because of its much greater sensitivity. The first example of this type of

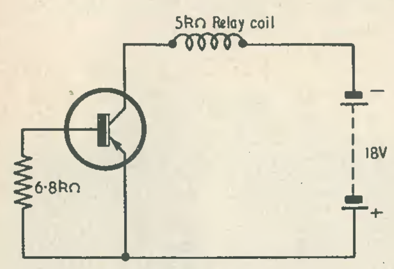


Fig.1
Complete relay circuit
E487

cell to appear in England is that made by the Mullard Company under the type number OCP71. Its physical size is extremely small by comparison with the more conventional type of cell, being only 15×5.9mm. This, coupled with a very simple circuit, enables a high degree of miniaturisation to be achieved.

A typical circuit which is suitable for most of the on/off applications which have been

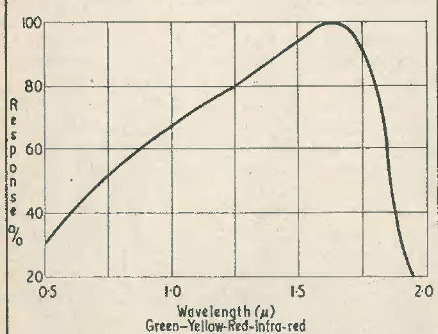


Fig.2
Spectral response of germanium phototransistor
E488

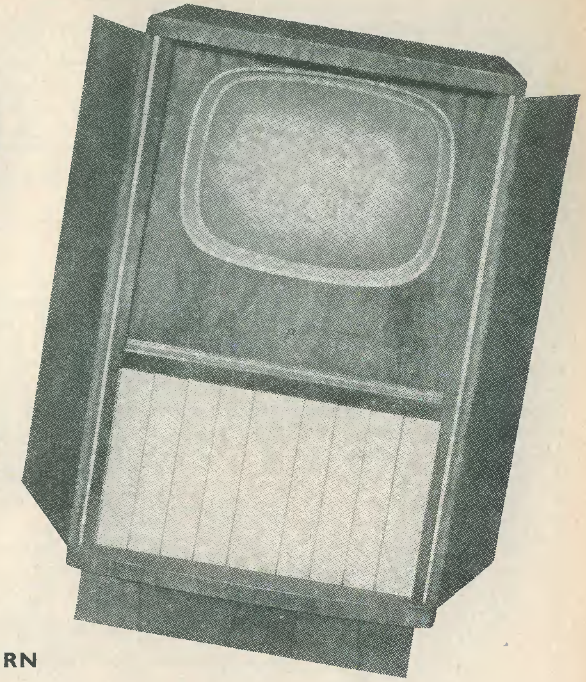
listed above is shown in Fig. 1. It will be seen that the emitter-collector circuit of the transistor is joined in series with a relay coil and battery. The current which flows in this circuit will be dependent upon the light falling on the cell and the ambient temperature in its vicinity. The inclusion of this latter factor may come as a surprise until it is remembered that all germanium devices are temperature sensitive. In the phototransistor the effect of increasing the working temperature is to increase the dark current; this has the effect of reducing the ratio of light to dark current with increasing temperature. The effect can be minimised by connecting a resistor between base and emitter as shown in the diagram, a value of 6.8kΩ being a good compromise; too low a value will reduce the sensitivity to changes in light level.

One of the advantages of the phototransistor is that its high sensitivity enables a normal type of relay to be employed. A typical 25mW 5,000 ohm relay will be quite suitable for the job, as it will have a pull-in current of some 1½ to 2mA, whereas the photocell will provide some 4mA under light saturation conditions. If the use of a relay having a coil resistance other than that recommended is contemplated, care should be taken not to exceed the maximum collector dissipation of the phototransistor. To overheat the germanium pellet can permanently ruin the characteristics of the cell. The maximum dissipation on the collector will occur when the cell is in the half-switched-on condition, that is when the current is midway between the minimum and maximum values. The collector dissipation under this condition is calculated by taking the product of half the total current and half the supply voltage, and this should not exceed 25mW.

Some knowledge of the dark current may be useful, particularly in those applications where a beam of light is used only occasionally to switch on the cell for a short period of time, as under such conditions a low capacity battery may be employed to give an almost indefinite life. At 25° C. the dark current can be expected to be in the region of 50μA.

The spectral response curve of the phototransistor is shown in Fig. 2, from which it will be seen it is most sensitive to light at the red end of the range. Knowledge of the response curve is useful in those applications where light of a given colour is used to operate the cell to reduce the interference from ambient illumination. Normally, all that is necessary in the way of a light source for normal switching applications is a small torch bulb fitted with a reflector and convex lens focusing a beam of light on to the cell. A good idea of the sensitivity of the system is obtained from the fact that if a 2.5V bulb is under-run at 1.5V, the light from the dimly glowing filament when focused on to the cell will operate it at a distance of several centimetres.

The MAYFAIR Turret Tuned Band 1-Band 3 Home Constructor TELEVISOR



PART 2

by S. WELBURN

Our popular contributor on television topics devotes the second article in this present series to the vision i.f. strip of the Mayfair television receiver

In last month's issue the writer introduced the Mayfair home-constructor television receiver, and discussed the circuit and functioning of its power pack section. He also gave step-by-step instructions for the construction of this particular unit, these instructions describing in detail the procedure needed for its complete assembly. In this month's article the vision i.f. strip is dealt with and, once again, comprehensive building instructions are given.

The Vision I.F. Strip

The circuit of the vision i.f. strip and video output stage is given in Fig. 4. As may be seen from this diagram, the circuit design is fairly conventional in character, well-tried basic principles being employed. The intermediate frequencies handled by the strip are 16 Mc/s vision, and 19.5 Mc/s sound. The coils specified are available pre-aligned, incidentally, thus obviating the necessity for adjustments after construction.

Not shown in Fig. 4 is the turret tuner, this being treated in these articles as a separate unit. The turret tuner immediately precedes the vision i.f. strip, its output at i.f. being fed directly to pin 6 of the Input Coil. Pin 1 of the Input Coil connects to the grid of the first i.f. amplifier valve V_2; whereupon the coil functions as the inductive element of a pi filter, its tuning capacities on either side being given by the C_{gk} of the first i.f. amplifier and the capacity to chassis of the lead from the turret tuner. An EF80 is employed as first i.f. amplifier in order to take advantage of the high input resistance which this valve offers.

The anode of the EF80 connects into the first I.F. Coil, thus providing a partial bandpass response by the use of a coupling winding in series with the primary. This coupling winding is fitted close to the secondary, and the overall arrangement has the advantage of providing a more closely controlled coupling factor for different core settings than is given

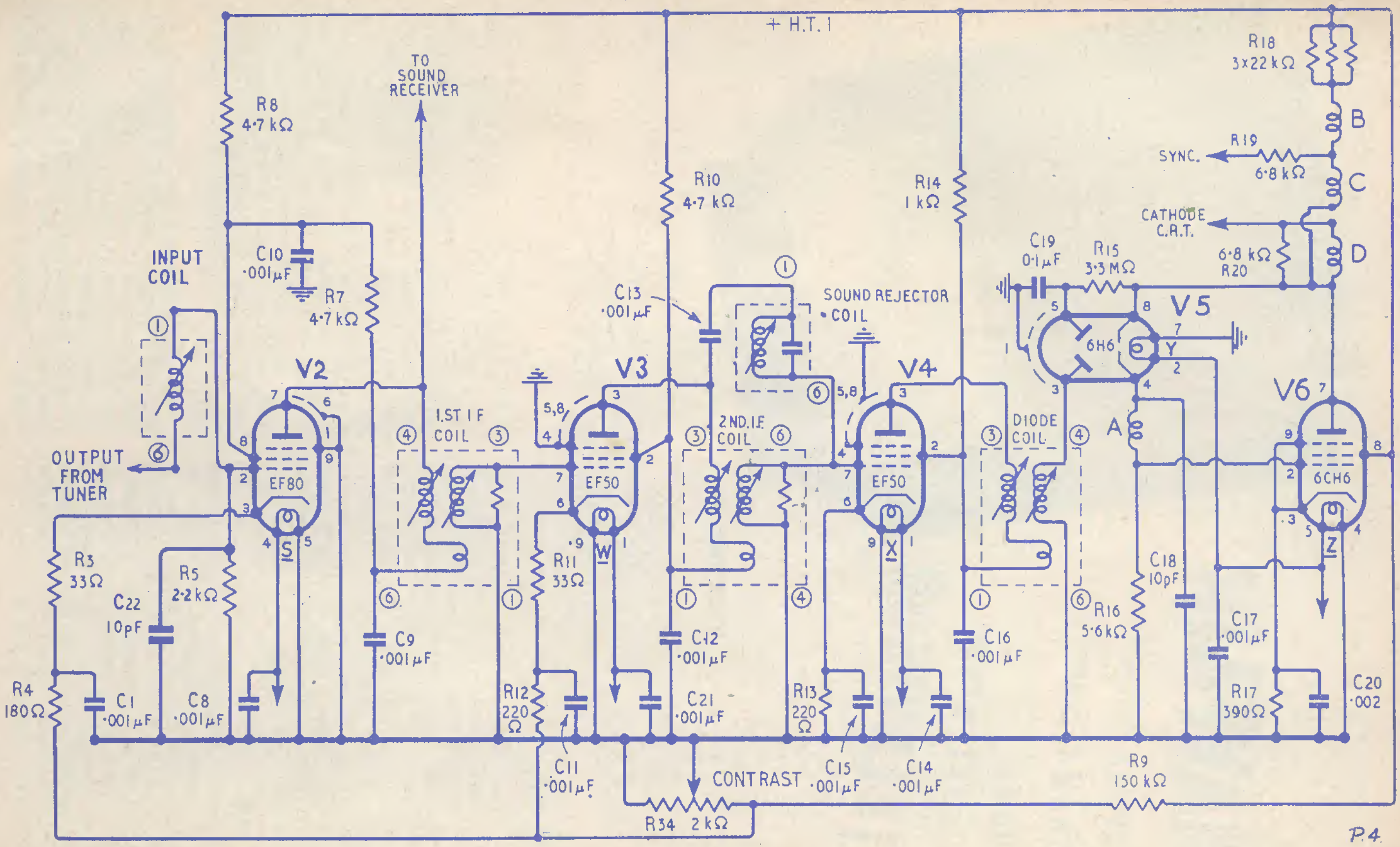


Fig. 4. The circuit of the vision i.f. strip

by the more usual transformer assembly wherein primary and secondary are separate coils spaced away from each other. Also connected to the anode of the EF80 is a take-off lead feeding into the sound i.f. strip. As will be gathered, the EF80 carries out the dual functions of sound and vision i.f. amplification, whilst the remaining valves in the strip are concerned with handling the vision i.f. signal only.

The second i.f. amplifier valve, V_3, follows the first I.F. Coil, and consists of an EF50. As was mentioned in last month's issue, the use of readily obtainable valves which are still "current," whilst also being available through ex-Government channels, is part of the policy behind the design of the Mayfair. Where such valves have no detrimental effect on performance their inclusion in the circuit confers the obvious advantage of saving in cost. An EF50 is a very good choice for the second i.f. amplifier, and, in practice, performs very well in this position.

In order to maintain a stable input capacity for V_3 during changes in bias voltage (given by adjustments to the contrast control), part of this valve's cathode bias network consists of the unbypassed 33 ohm resistor R_{11}. As the use of an unbypassed resistor at this point stabilises input capacity, it also prevents detuning of the first I.F. Coil secondary when contrast is varied. An unbypassed resistor, R_3, is included in the cathode circuit of the EF80 for the same reason.

The anode of the second i.f. amplifier couples into the second I.F. Coil, this feeding the third i.f. valve, V_4, in normal fashion. A second EF50 is employed here and, since this valve has a fixed bias potential, its cathode bias resistor is by-passed by the 0.001 μF condenser C_{15}. Also connected between the second and third i.f. amplifiers is the Sound

COMPONENTS LIST SET OUT FOR EASY REFERENCE TO FIG. 4.

Vision I.F. Strip

Resistors (all ½ watt unless otherwise stated)

R_3	33Ω
R_4	180Ω
R_5	10kΩ
R_7, R_8	4.7kΩ
R_9	150kΩ
R_{10}	4.7kΩ
R_{11}	33Ω
R_{12}, R_{13}	220Ω
R_{14}	1kΩ
R_{15}	3.3MΩ
R_{16}	5.6kΩ
R_{17}	390Ω
R_{18}	3×22kΩ 1 watt in parallel
R_{19}, R_{20}	6.8kΩ
R_{34}*	2kΩ variable

Condensers

C_1, C_8 to C_{17}, C_{21}	1,000pF
C_{18}	10pF
C_{19}	0.1μF
C_{20}	2,000pF

Valves

EF50	—2
EF80	—1
6H6	—1
6CH6	—1

*R_{34} is fitted at a later stage.

Chassis and Chassis Components

1 Vision i.f. chassis, fully punched—Premier Radio
2 Valveholders, B9A
2 Valveholders, B9G
1 Valveholder, International Octal
4 3-way tag strips (end tag earthed)
2 5-way tag strips (end tag earthed)
1 5-way tag strip (centre tag earthed)
1 Co-axial plug and socket

Miscellaneous

1 Grommet
2yd 2mm sleeving
2yd tinned copper connecting wire (22 s.w.g.)
1½yd p.v.c. covered wire
Nuts, screws, solder tags, etc.

Coils

1 Input Coil—Premier Radiadio
1 First I.F. Coil—Premier Ro
1 Second I.F. Coil—Premier Radio
1 Sound Rejector Coil—Premier Radio
1 Vision Diode Coil—Premier Radio
3 Video Chokes type 604 ("B," "C" and "D")—Premier Radio
1 Video Choke type 872 ("A")—Premier Radio

Rejector Coil. This coil resonates with its parallel condenser to provide rejection at the sound i.f., giving, therefore, a "dip" in the overall response at this particular frequency. C_{13}, connected in series with the Sound Rejector Coil, has negligible impedance at the frequencies involved, and functions merely as a d.c. blocking condenser.

The third i.f. amplifier valve feeds into the Diode Coil and, thence, to the video diode itself. This diode consists of one-half of the 6H6, V_5, and it functions in a simple series-connected circuit. The rectified video signal provided by the diode appears across R_{16}, the choke between this component and the cathode of the diode functioning as an i.f. filter. The video appearing across R_{16} is then applied directly to the control grid of the 6CH6 video amplifier. Since the video at its grid is positive-going, the 6CH6 may be biased well back, thereby preventing excessive cathode current in the absence of signal voltage. The video at the anode of the 6CH6 is negative-going and is applied to the cathode of the c.r.t. As will be seen, no a.c. couplings at all are employed in the video amplifier section of the Mayfair, this representing a very desirable design feature. Three peaking chokes appear in the 6CH6 anode circuit, these ensuring that the higher video frequencies are applied to the c.r.t. cathode without undue attenuation. Also connected to the anode of the video amplifier is a simple noise limiter circuit which includes the remaining diode of the 6H6. The noise limiter circuit operates in the following manner. In the absence of interference the condenser C_{19} remains charged at a value corresponding to the peak negative voltage level in the picture. Interference pulses causing greater negative excursions in video amplifier anode voltage are not normally of sufficient duration to alter the voltage across C_{19}, with the result that the diode then prevents them from rising to levels noticeably higher than the peak picture level.

Layout and Construction

The layout of the vision i.f. strip is shown in Figs. 5 and 6. As occurred in the layout illustrations given in last month's article, all components in these two diagrams are designated either with their circuit reference or with a separate letter or number reference. These references are then used in the step-by-step instructions which describe the assembly. Valves, incidentally, are identified here by their reference letters, viz. "S" to "Z." It may be noted that one tag on each of the tag-strips is shown black. This tag is that which is used for mounting and which is, consequently, at chassis potential. All the i.f. coils have four tags, tag No. 1 being indicated on the coil itself by a red spot. The remaining tags are then numbered 3, 4 and 6 in a clockwise direction looking down at the bottom of the coil. Coil tag numbers are clearly illustrated in Fig. 6.

Construction commences by fitting the major components to the chassis. The first of these are valveholders S and Z, both being mounted above the chassis. Care should be taken to ensure that correct orientation is observed. One of the mounting screws of valveholder Z secures 5-way tag-strip H, whilst the other mounting screw secures earthing tag T2. One of the fixing screws of valveholder S secures 3-way tag-strip K. Valveholders W, X and Y are next fitted, these being on the underside of the chassis. As with the two previous valveholders, care should be taken to ensure that correct orientation occurs. Next come the three 3-way tag-strips B, D and F; the two 5-way tag-strips E and L; earthing tag T1; and grommet G1. The positions of all these components are clearly shown in Figs. 5 and 6. They are followed by the input socket, under one fixing bolt of which is secured earthing tag T3. Finally, the coils are fitted, taking care once again to ensure that the pins take up their appropriate positions as shown in the diagram.

It should be stated at this point that it is possible that constructors making the vision i.f. strip may be supplied with a chassis which is punched for one valveholder and two coils in excess of those required by the Mayfair circuit. The additional holes in such chassis appear at the input socket end, and should be ignored.

Wiring up now commences. It is important to see that the components fitted take up the positions illustrated in the layout diagrams and that connections are kept short. The first components to wire up are the i.f. coils. Commence by connecting tag 1 of the Input Coil to pin 2 of valveholder S. Connect tag 1 of the first I.F. Coil to tag 3 of tag-strip E; tag 3 of this coil to pin 7 of valveholder W; tag 4 of this coil to pin 7 of valveholder S; and tag 6 of this coil to tag 2 of strip K. Next connect tag 1 of the second I.F. Coil to pin 2 of valveholder W; tag 3 to pin 3 of valveholder W; tag 4 to earthing tag T1; and tag 6 to pin 7 of valveholder X. The Sound Rejector Coil follows, tag 6 of this coil being connected to pin 7 of valveholder X. Tag 1 of the Sound Rejector Coil is connected later. Finally make the following connections to the Diode Coil: tag 1 to pin 2 of valveholder X; tag 3 to pin 3 of valveholder X; tag 4 to pin 3 of valveholder Y; and tag 6 to tag 3 of strip F.

We now carry on to the general wiring of the strip. The heater wiring is first of all completed by connecting together pin 4 of valveholder S, pin 1 of valveholder W, pin 1 of valveholder X, pin 2 of valveholder Y and

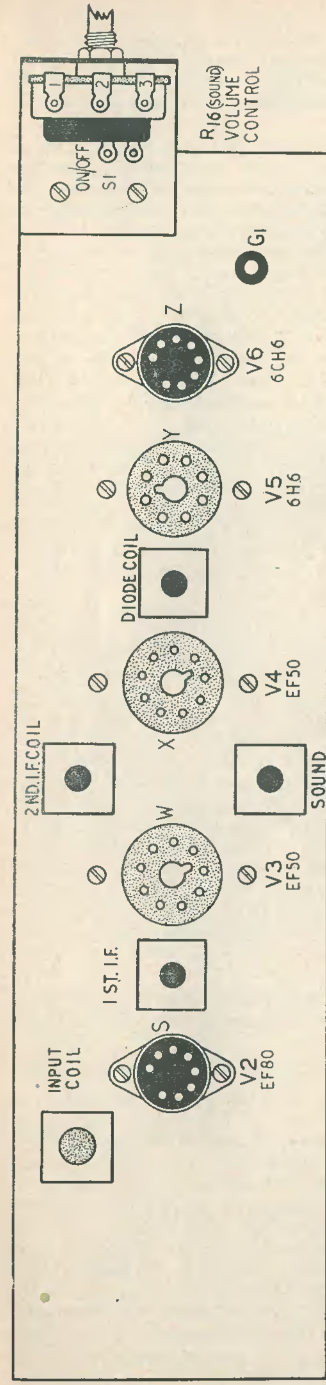


FIG. 5

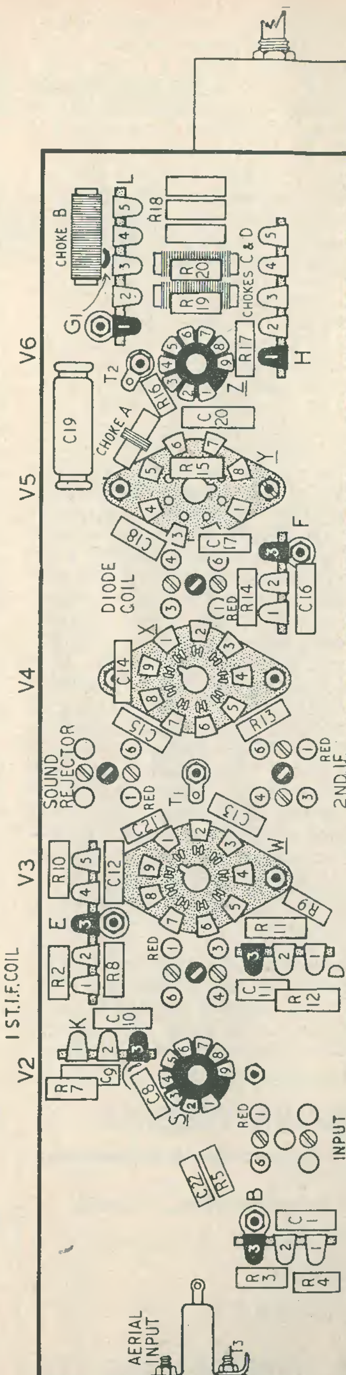


FIG. 6

Fig. 5. Layout of the vision i.f. strip above the chassis. Although illustrated in this diagram, the volume control with its bracket, need not be mounted at this stage. Fig. 6. Under-chassis layout of the vision i.f. strip

pin 5 of valveholder Z. The condensers are tackled next, in the following manner. C_1 connects between tags 2 and 3 of strip B; C_8 between pin 4 of valveholder S and tag 3 of strip K; C_9 between tags 2 and 3 of strip K; and C_{10} between tags 1 and 3 of strip K. These are followed by C_{11} between tags 2 and 3 of strip D; C_{12} between tags 3 and 5 of strip E; C_{13} between pin 3 of valveholder W and tag 1 of the Sound Rejector Coil; C_{14} between pins 1 and 8 of valveholder X; and C_{15} between pins 6 and 8 of valveholder X. Wiring up of the condensers is completed by connecting C_{16} between tags 1 and 3 of strip F; C_{17} between tag 3 of strip F and pin 2 of valveholder Y; C_{18} between tag 3 of strip F and pin 4 of valveholder Y; C_{19} between pin 5 of valveholder Y and earthing tag T2; C_{20} between pin 3 of valveholder Z and tag 1 of strip H; and C_{21} between pins 1 and 8 of valveholder W.

The condensers are succeeded by the resistors. First of all connect R_3 between pin 3 of valveholder S and tag 2 of strip B; R_4 between tags 1 and 2 of strip B; R_5 between pin 2 of valveholder S and tag 3 of strip B; R_7 between tags 1 and 2 of strip K; R_8 between tags 2 and 4 of strip E; R_9 between tag 4 of strip E and tag 1 of strip D; and R_{10} between tags 4 and 5 of strip E. R_{11} next connects between pin 6 of valveholder W and tag 2 of strip D; R_{12} between tags 1 and 2 of strip D; R_{13} between pins 4 and 6 of valveholder X; R_{14} between tags 1 and 2 of strip F; and R_{15} between pins 5 and 8 of valveholder Y. The resistors are completed by connecting R_{16} between pin 2 of valveholder Z and earthing tag T2; R_{17} between pin 9 of valveholder Z and tag 1 of strip H; R_{18} between tag 5 of strip H and tag 4 of strip L; R_{19} between tag 2 of strip L and tag 2 of strip H; and R_{20} between tag 3 of strip L and tag 3 of strip H. This completes the resistors.

The four chokes have next to be connected. These components should be handled with some care in order to avoid damage to their windings. Choke A (the diode filter choke, type 872) connects between pin 4 of valveholder Y and pin 2 of valveholder Z. Choke B connects between tags 2 and 5 of strip L; and choke C connects between tag 2 of strip L and tag 3 of strip H. Choke D connects between tag 3 of strip L and tag 3 of strip H.

All that now remains is the completion of the interstage and valveholder wiring. Chassis connections to valveholder S are first made, this being done by connecting together pins 5, 6, 9 and the centre spigot of this valveholder and earthing these to tag 3 of strip K. Similarly connect together pins 4, 5, 8, 9 and the centre spigot of valveholder W, earthing to tag 3 of strip E. Also connect together pins 4, 5, 8, 9 and the centre spigot of valveholder X, connecting to chassis via earthing tag T1. Pins 1 and 7 of valveholder Y are next wired together, these connecting to chassis via earthing tag T2. Also connected to tag T2 are pin 4 and the centre spigot of valveholder Z. Follow these operations by connecting together tag 4 of strip E, tag 2 of strip F, tags 4 and 5 of strip H, and pin 8 of valveholder Z. Connect together tag 1 of strip K and pin 8 of valveholder S. Also connect together pins 1 and 3 of valveholder S.

The vision strip is completed by carrying out the following final wiring. Connect together pin 8 of valveholder Y, pin 7 of valveholder Z and tag 3 of strip H. Next connect together the following pairs of circuit points: tag 1 of strip K to tag 2 of strip E; tag 5 of strip E to pin 2 of valveholder W; tags 4 and 5 of strip L; tag 1 of strip F to pin 2 of valveholder X; pins 3 and 9 of valveholder Z; and tag 1 of strip B to tag 1 of strip D. Connect an 11-in lead to tag 1 of strip D. This lead will be later connected to the contrast control. Finally connect a 24-in lead to tag 3 of strip L. This lead later connects to the cathode of the c.r.t.

The vision i.f. strip is now complete.

Next Month

In next month's issue the assembly and wiring of the timebase section will be dealt with.

ELIMINATING HUM

by **J. G. WARD**

THE ELIMINATION OF HUM IS A PROBLEM that sooner or later confronts every designer or builder of high quality amplifiers. It becomes increasingly difficult as the input signal level decreases and when high gain is necessary. Some recognition of the characteristic types of hum from different sources and how it enters into the system is necessary to enable practical methods to be devised to get rid of it. Shielding, layout, planning of earth leads and filtering all form part of the problem, and although instruments—an oscilloscope and a valve voltmeter—are helpful, these are not generally available to the average home constructor, and moreover, a very satisfactory job can be done without them.

It should be clearly understood that high fidelity reproduction demands a much lower relative hum level than does ordinary radio quality. In a good amplifier, the hum level should be 50 to 60 db below average listening level. The low level inputs available from tape playback heads, microphones and some pick-ups, together with the bass boost required, tend to aggravate the situation and good quality reproduction requires more care when dealing with this problem.

Anode supply ripple, due to insufficient filtering, is always a 100 cycle note, and can readily be located by connecting extra condensers across the h.t. supply. The power supply filter should contain components, chokes and condensers adequate for the equipment it is intended to operate; a single section filter, using a good choke and, if possible, paper condensers, is generally adequate for any power stage, and with additional decoupling for each preceding voltage amplifier stage will generally ensure freedom from ripple. Where negative smoothing is employed, it is as well to have some series impedance in the positive line to get rid of ripple, which may be coupled through the mains transformer capacitance.

The filtering action of any given section is better the lower the d.c. current drain, so that an R-C filter section, supplying only one or two milliamps to a resistance-coupled stage, will provide much more filtering than a similar stage drawing a heavy current. Push-Pull stages require less filtering and decoupling than do single-ended stages; power pentodes and tetrodes are more tolerant of anode supply ripple than are triodes, because of their higher anode resistance, i.e., a volt of ripple produces less anode current swing. Negative feedback over the output stage will reduce hum originating in that stage, but will not reduce hum originating in the earlier stages which may be included in the feedback loop.

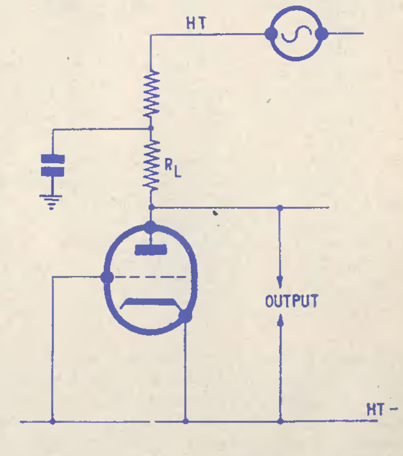


FIG. 1

The a.c. ripple voltage actually appearing at the anode of a valve is less than that at the h.t. connection by the ratio

$$\frac{R_a}{R_L+R_a}$$

where R_L is the anode load resistance and R_a the anode resistance of the valve. In Fig. 1, if the valve is an L63, operating with an anode load of 100,000Ω and an anode impedance of 10,000Ω, only 1/11 of the h.t. supply ripple will appear at the anode.

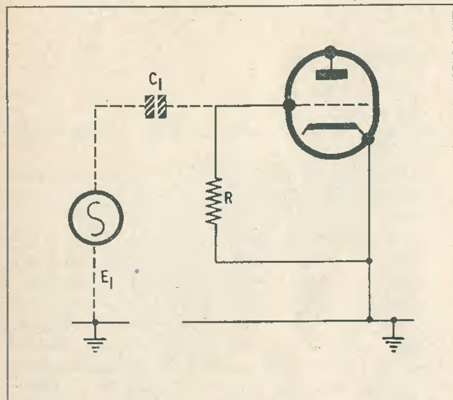


FIG. 2

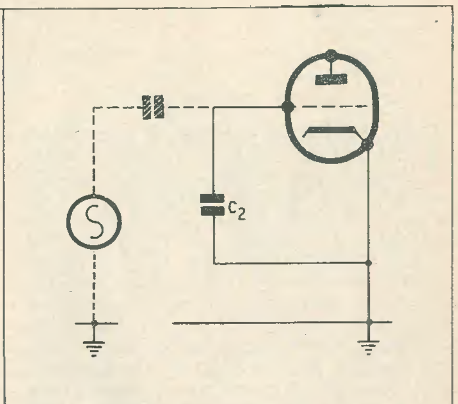


FIG. 3

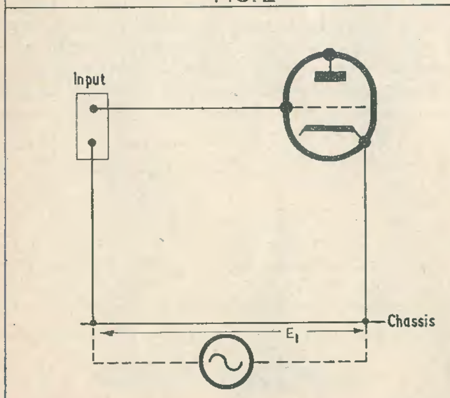


FIG. 4

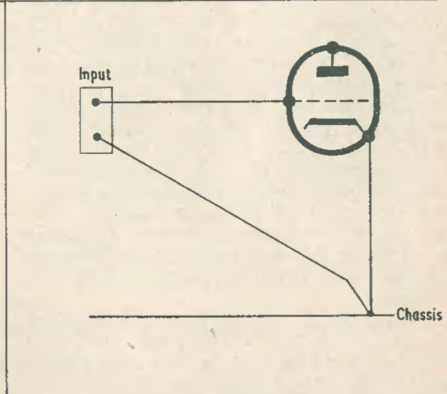


FIG. 5

C 377

In high fidelity low level amplifiers with a.c. heater supply, it is advisable to use a hum-balancing potentiometer of about 200 ohms across the heater supply, with the movable arm earthed. This arrangement will generally reduce the hum in the input stage 10 db over the level apparent when the transformer centre tap is used; in cases where one side of the heater supply is earthed, it is from 20 to 30 db. The optimum point is best determined by trial and error, and is less critical the lower the impedance of the grid circuit. In the event of it being necessary to replace a valve at some future date, the adjustment may need varying.

It is not obvious why the heater supply should be tied to earth. If this were not done, the heater winding would assume a high a.c. potential, obtained through its capacitance to the high voltage winding of the mains transformer. Through capacitance and leakage from heater to grid and other paths, this high a.c. potential couples large hum voltages into the signal circuits; it may even break down the heater-cathode insulation inside the valve. When one side of the heater supply is earthed, the a.c. potential for such stray coupling is reduced to the nominal rating of the heater supply voltage, i.e., with most modern valves, 6V instead of about 300V. When the centre tap of the heater supply is earthed, two a.c. potentials of about 3V each can couple hum into the grid circuit; these two 3V potentials are 180 degrees out of phase and their effects more or less cancel each other. It may be thought that an exact centre tap would be all that is necessary for the hum to be neutralised; but the stray impedances from each side of the heater to the grid are rarely equal; it is for this reason that the hum balancing potentiometer adjustment generally effects an improvement.

Wiring Techniques

Capacitance from any a.c. wiring to a low level signal circuit introduces a 50 cycle voltage therein in direct proportion to the a.c. voltage present, the stray capacitance and the impedance of the affected circuit. In Fig. 2 is depicted a grid circuit with a resistance R of 1MΩ coupled to a stray capacitance of 1pF shown as C_1. If the hum voltage E_1 is 1 volt there will appear at the grid 1/3,200 of a volt, about 1/3 millivolt, since the reactance of 1pF at 50 c/s is about 3,200MΩ; if C_1 should be coupled to a 300 volt mains transformer lead the grid circuit would receive 300/3,200 volt, about 0.10 volt. 1pF is about the capacitance between two pieces of push-back wire, an inch long, loosely twisted together. Fig. 3 shows the same situation where the signal source C_2 is capacitance, as from crystal microphones and pick-ups. The stray hum capacitance and the signal source act as a capacitative voltage divider.

This does not mean that all low-level input wiring should be located feet away from everything else or that everything should be elaborately screened; rather it is necessary to be aware of the problem and the extent of the effects. Extravagant use of screened wire is rarely necessary; if it is, it indicates a poorly planned chassis layout. The capacitance between two wires can be kept very low, (*a*) if they are about 2in apart, (*b*) if they are kept close to the chassis and not up in the air, (*c*) if the layout is planned so that bypass condensers and other components not associated with the "hot" grid circuits assist in the shielding. Twisting heater leads together helps, although not absolutely necessary, providing they are close together and grid leads are kept away. It is as well to use screened braid on the grid lead to a top cap grid and to use a grid cap shield as well. The hole where such leads pass through the chassis should have a rubber grommet in it to avoid an earth loop. It is not wise to use a blank tag on a black phenolic valveholder as an anchor point for top cap grid leads, as there can be an unbalanced leak across the valveholder tags.

Earth Loops

Currents of half a millivolt per foot often exist across a chassis on which a mains transformer is mounted; the transformer winding induces a 50 cycle voltage, causing a current to circulate in the chassis. It is asking for trouble to include a section of chassis in series with a low-level input circuit. Fig. 4 shows what happens when the cathode and grid are returned to different points. E_1 is a hum voltage distributed along the chassis; this voltage is included with the signal; the remedy is to return the grid and cathode to the same point, as in Fig. 5.

When wiring from a diagram it pays to study the purpose of each lead, to avoid a situation shown at Fig. 6 from developing. In this example too many earth leads have been used, forming a shorted turn or earth loop. Stray magnetic fields will induce an a.c. voltage in such a loop and the voltage across the loop is included in the grid circuit. If the grid lead and grid return lead are too widely separated, as in Fig. 7, another one-turn coil is created, ready for the induction of a 50 c/s voltage. As the voltage induced in a loop is proportional to its area, the remedy is to keep the grid return lead and the grid lead close together.

Fig. 8 shows how the pick-up lead can innocently cause hum to be introduced into the input circuit. This shows the screened pick-up lead earthed to the gramophone motor frame at one end, and to the amplifier chassis at the other. The motor frame has a capacitance to the mains line, as has the amplifier chassis; these capacitances are shown as C_1 and C_2 in the sketch with the mains voltage in between. A hum voltage is thus applied across the ends of the pick-up lead screening. The remedy, shown at Fig. 9, is to use the screening only for the signal voltage and to use a separate wire to connect the motor frame to the amplifier chassis; better still is to use twin screened lead. In this way loop pick-up effects can be avoided.

Sometimes an otherwise perfect amplifier when used with a radio tuner unit will produce modulation hum, when the tuner is tuned to a powerful carrier wave. This is due to rectification of r.f. picked up by the house wiring, the rectified signal being modulated by a.c. The remedy is to eliminate the r.f. signals by preventing them from

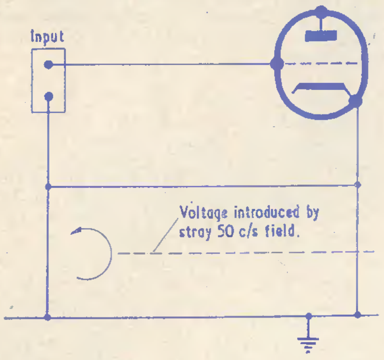


FIG. 6

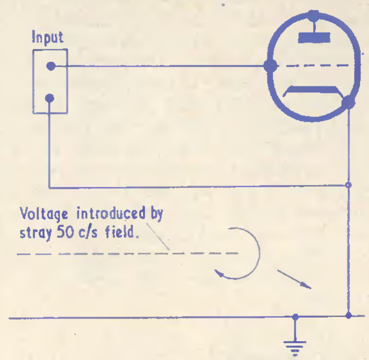


FIG. 7

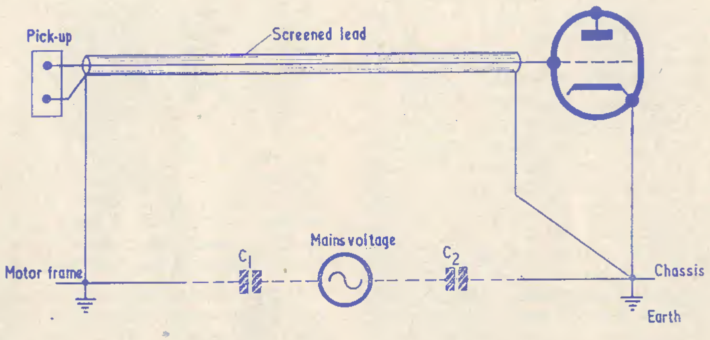


FIG. 8

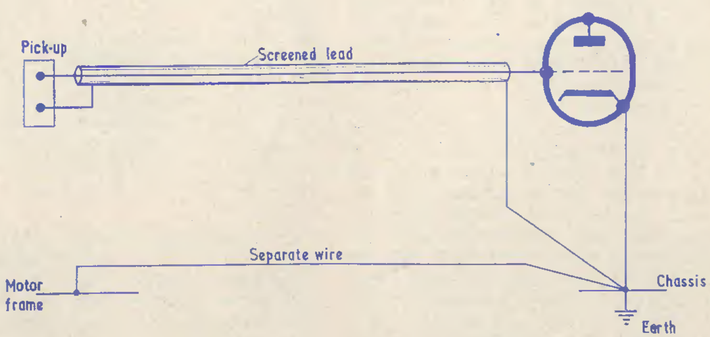


FIG. 9

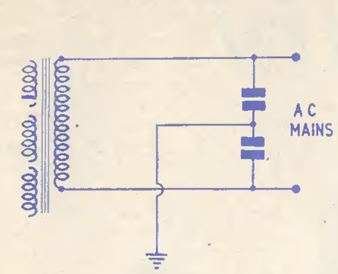


FIG. 10

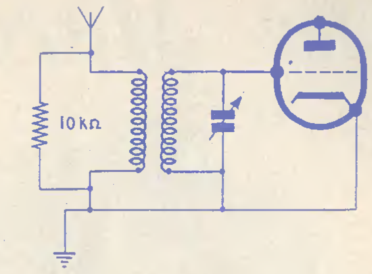


FIG. 11

getting into the amplifier from the a.c. line; this can be done by earthing both sides of the mains through condensers of about 0.005 to 0.01μF; see Fig. 10. If the hum persists, a 10,000Ω resistor connected between the earth and aerial terminals of the tuner will generally clear the trouble; see Fig. 11.

Can Anyone Help?

Requests for information are inserted in this section free of charge; subject to space being available

B. N. Hopkins, ZL1DJ, c/o 145 Euston Road, Morecambe, Lancs., would like to purchase the manual, or circuit, of the Hallicrafters SX28A communications receiver.

* * *

J. R. Norris, 98 Wickham Hill, Hassocks, Sussex, wishes to obtain an aerial coil for a pre-war Pye Model PS/B, and wishes to know is anyone has such a component to dispose of.

* * *

S/Sgt. Southby, 23 Para FD AMB, Parsons Barracks, Aldershot, wishes to purchase or borrow for payment the circuit and/or instruction manual for the ex-AM Test Set No. 31. All correspondence answered.

* * *

D. Gibson, G3JDG, 5 Edward Close, St. Albans, Herts, is praying some kind angel will lend a circuit diagram of the Premier 6in televisor. Would return same unmarked by return of post.

* * *

W. Kay, 66 Kirk Street, Bolton, Lancs., wishes to borrow or purchase information, service data, etc., for the American u.h.f. receiver type R-3A/ARR-ZX (also type numbered: Receiver R1584—possibly British Services number).

* * *

G. Hedley, 4 Furze Road, Tadley, Basingstoke, Hants., wishes to obtain circuit details, valve types and conversion data for the Unit No. LU244.

C. E. Ward, 280 Deansgate, Manchester 3, Lancs, wishes to obtain circuit diagram or any relevant information on the R.1355 for conversion to inexpensive television (or a copy of Data Book 4, "Inexpensive Television").

* * *

A. F. Smith, 61 Westfield Road, Dagenham, Essex, wishes to borrow or purchase any information on, or the circuit of, the 12in Defiant T.V. Model TR1246, drawings No. 2817 and 2818.

* * *

J. H. Bachelor, 36 Hadley Way, Winchmore Hill, London, N.21, wishes to obtain information on, or uses for, the Raytheon valves JRP5676, JRP5672, JRP5678 and JRP2621 (2G21 ?).

* * *

C. G. Pratt, 1 Ridley Street, Kettering, Northants, wonders if any reader can supply information and circuits of transistorised hearing aids.

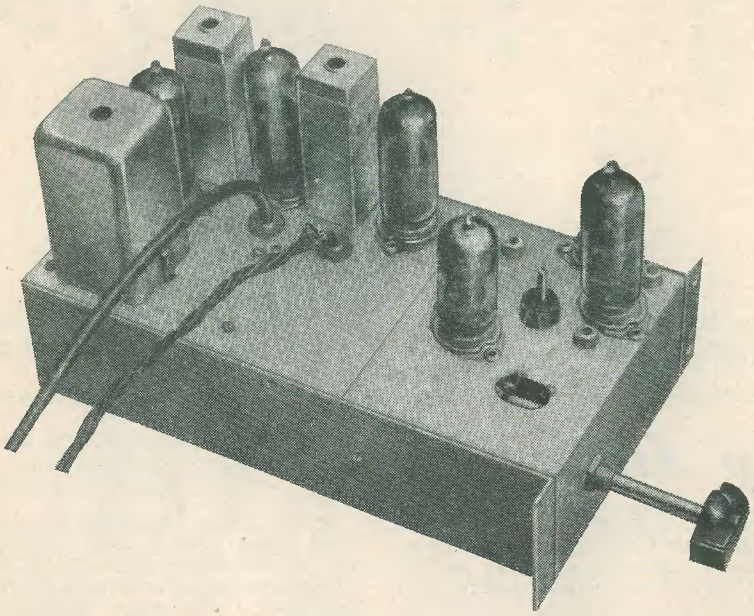
* * *

R. Leng, 12 Poplar Street, Failsworth, Lancs, wishes to borrow or purchase servicing data and the circuit of the Baird model T165 televisor. He has a number of old copies of *The Radio Constructor* and various radio books for disposal; please state wants.

* * *

F. G. Morgan, 68 Arnfield Road, Withington, Manchester 20, would like to buy or borrow a copy of *The Radio Constructor* for May 1952.

The Mercury



SWITCHED F.M. TUNER

Part 1 *A new Jason kit described by* **G. BLUNDELL**

THE V.H.F.-F.M. METHOD OF TRANSMISSION has now been in use for a number of years and covers a considerable part of the country. The quality and freedom from interference is something which the man in the street has now come to accept and expect. The woman in the street, though, finds the tuning a little more complex and is not prepared to tune for maximum reduction of interference. She will not really accept f.m. until all tuners are as simple to use as the switched tuner described in this article.

Why V.H.F.?

The medium waves are, of course, already overcrowded, and even with a limited audio range a whistle filter must be used to intercept the carrier of the adjacent stations. Also, the sidebands of the adjacent stations will be heard and the background can never be really quiet except under very favourable conditions. V.H.F. was, therefore, the only choice, and this has the advantage that the range of transmissions is not much greater than line of sight, and so stations spaced 200 miles apart can use the same frequency with no danger of interference. This does not mean that the service area of the v.h.f. station is less than that of a M.W. one, since the latter will not give a first class service area much greater than that covered by line of sight, although, of course, poorer signals can be obtained at much greater distances.

Why F.M.?

The decision to use f.m. was nearly unanimous by the committee set up to study the problem. One point made against f.m. was that it was more complex and difficult to align, and to ensure the life stability necessary to achieve the best results. This, surely, is a challenge which will be met by manufacturers, and is met in the tuner described in this article.

Pre-war life-stability of 465 kc/s i.f.'s was something of a problem when almost universal use was made of compression condensers for tuning, but with the advent of dust iron cores this problem has nearly vanished. The simplest possible f.m. set is more complex than the equivalent a.m. set, but when the latter is fitted with the necessary impulse limiting circuits, there is not much difference.

A simple listening test, though, at almost any position except, perhaps, within a couple of miles of the station, shows the superiority of the f.m. signal as regards freedom from impulsive interference and far lower background noise. Complex limiters on the a.m. receiver could, of course, improve the rejection of the impulsive interference, but there is nothing that can be done about the background noise. This test could only be made when the B.B.C. were radiating the same programme on both f.m. and a.m.

It might be expected that the a.m. transmission would require a narrower bandwidth receiver, and that there could be more transmitters in the same band. Unfortunately, though, the complex limiters used rely, for optimum working, on having a wide bandwidth in the receiver in order to produce interference pulses with a sharply rising wave shape. When this is taken into account, and it is also remembered that the stability of v.h.f. oscillators is not so good as lower frequency types, one realises that the spacing could not be less than 0.2 Mc/s between stations. This is, in fact, the spacing chosen for f.m. transmissions.

F.M. transmission can use any nominal bandwidth; the choice of the B.B.C. has been that ±75 kc/s deviation of the v.h.f. carrier represents full modulation, and this happens at maximum audio amplitude at the frequencies normally encountered.

As Band I transmissions have approximately the same service area as Band II t.v. transmissions, it is of interest to note that most of the new t.v. aerials are fitted with slot aerials, which are capable of radiating three f.m. programmes simultaneously.

As reception is limited to line of sight, a switched f.m. tuner need only receive the three programmes once the novelty of listening to the police (an offence!—ED.) and commercial transmissions has worn off. This does so rapidly, as the "programmes" radiated, while interesting, do not have much variety.

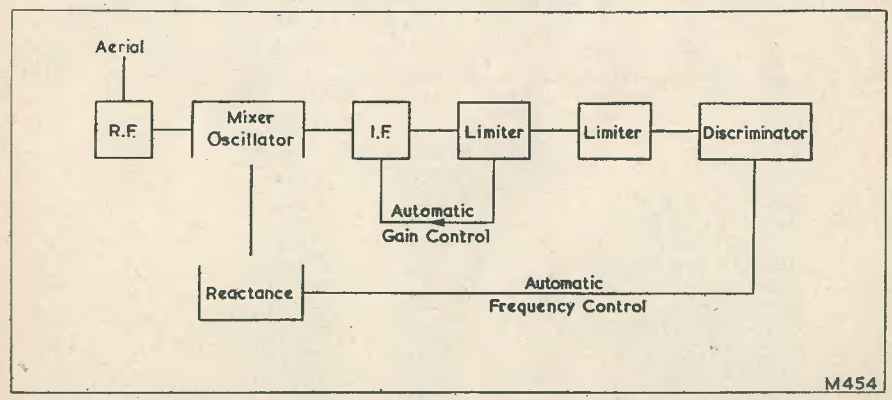
Choice of Frequency of F.M. Stations

In any one area the three programme frequencies will be found to be spaced 2.2 Mc/s apart. The only limitation on choice is that adjacent channels should be about 2–300 miles away. This leads to the simplified method of switching used in this tuner. On the medium waves, frequencies have to be chosen to avoid after-dark interference. Interference may be expected from stations in Russia, Germany, Italy, etc., and, therefore, there is no simple relationship of frequencies of programmes in any one area.

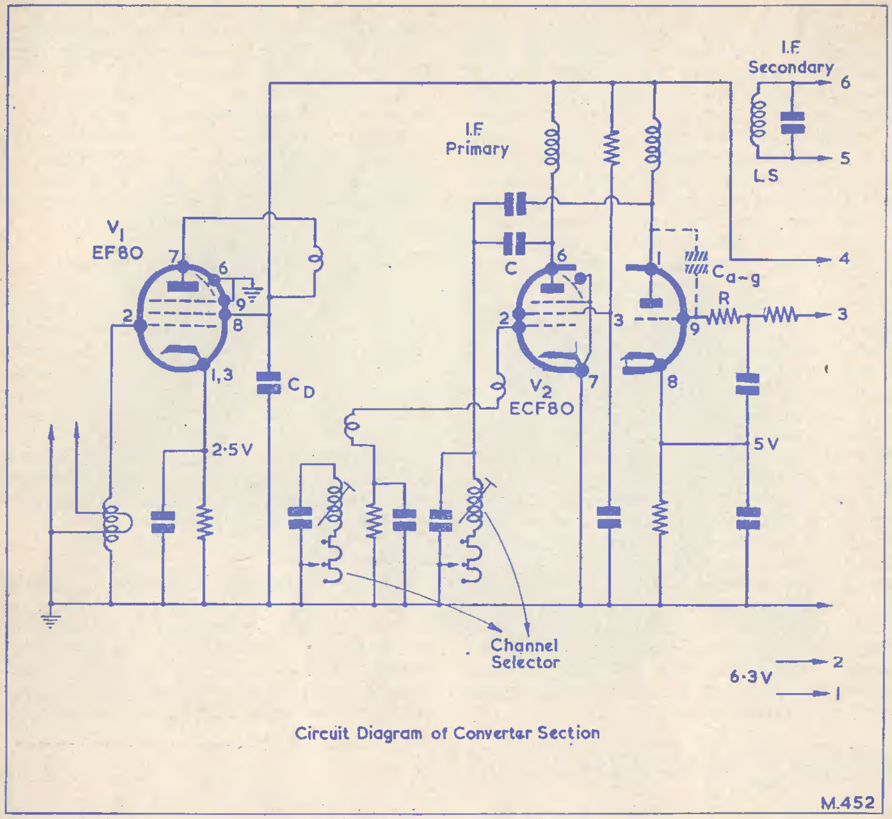
Wiring

In order to produce a successful design of tuner it is necessary to take into account all the variations of wiring which are possible. For example, all the exhortations about short wiring still does not make the average constructor forget his audio experience. Neat wiring is not necessarily the best from the v.h.f. point of view. Tag strips carrying components in the v.h.f. side are an impossibility.

The f.m. tuner described in Radio Reprint No. 2 has proved very tolerant of variations in wiring, and has thus been very successful. Long wiring in the r.f. stages produces instability, but elsewhere appears to have very little effect. The *Argonaut* A.M./F.M. Tuner,



Block diagram showing arrangement of stages in the "Mercury" tuner



Circuit Diagram of Converter Section

COMPONENT LIST

C_1	0.005μF ceramic
C_2	0.01μF ceramic
C_3	0.005μF ceramic
C_4	0.001μF ceramic
C_5	0.001μF ceramic
C_6	0.005μF ceramic
C_7	47pF silvered mica
C_8	47pF silvered mica
C_9	0.005μF ceramic
C_{10}	0.005μF ceramic
C_{11}	200pF ceramic
C_{12}	0.05μF paper
C_{13}	0.05μF paper
C_{14}	500pF ±10% ceramic

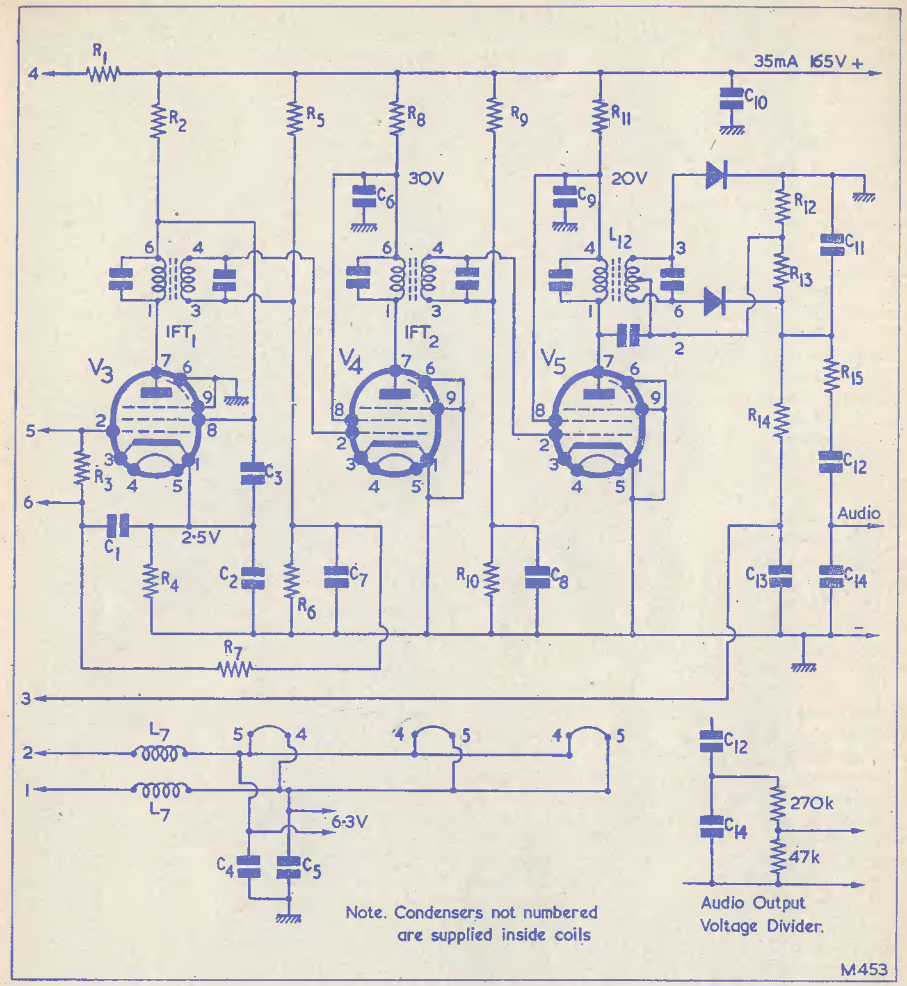
V_1	EF80 } supplied with converter
V_2	ECF80 } supplied with converter
V_3	EF80
V_4	EF80
V_5	EF80

Crystal Diodes, GEX34

R_1	270Ω
R_2	1kΩ
R_3	47kΩ
R_4	270Ω
R_5	10MΩ
R_6	100kΩ
R_7	100kΩ
R_8	47kΩ ¾W
R_9	2.2MΩ
R_{10}	47kΩ
R_{11}	47kΩ ¾W
R_{12}	100kΩ
R_{13}	100kΩ
R_{14}	2.2MΩ
R_{15}	100kΩ

Chassis, ready punched, Jason Motor & Electronic Co.

Side panels (2), Jason Motor & Electronic Co.



The converter section (Drawing M452) is supplied ready-built and tested, hence the absence of values
The I.F., limiter and discriminator stages (Drawing M453) are assembled and wired by the constructor—the values of components are given in the list herewith

IFT_1, IFT_2 Type L4, Jason Motor & Electronic Co.
IFT_3 Type L12, Jason Motor & Electronic Co.
Heater chokes Jason Motor & Electronic Co.
Valveholders (3), Nylon loaded B9A, McMurdo
Tag strips, one 2-way, one 6-way, one 3-way less earth.

Grommets (2)
4-way power supplies lead
Single screened audio lead
Pointer knob
Front end unit with name plate, completely wired and tested, Jason Motor & Electronic Co.

though, is more complex and, therefore, proved more troublesome. In fact, if the unit is built as described in the instructions (R.R. 3), no trouble results. There is, however, a great temptation to "tidy it up"; alternatively, if all condenser leads are carefully covered with systoflex, it is almost impossible to keep the wiring short enough.

Because of these points it has been decided to produce this design in two parts—converter and i.f. strip, and to supply the converter only as a ready-built unit in the same way as some Continental tuning units are available here. This decision was made because the frequency changer and reactance circuits have proved to be intolerant of alterations of layout and lead lengths.

The circuit, therefore, consists of the following stages as shown in the block diagrams: R.F.—F.C. and Oscillator—Reactance Section—I.F. Stage—Limiter—Limiter—Discriminator. The function of each stage will now be described.

The Converter

This unit, which is supplied ready-tuned, consists of the first three stages: R.F.—Frequency Changer—and Reactance Section.

The r.f. stage is an EF80 with the aerial/grid circuit pretuned to the middle of the band. In the anode circuit is a coil which is switch-tuned to each frequency.

The second valve is an ECF80 with the pentode section operating as a self-oscillating frequency changer, while the triode section acts as the variable reactance.

Various types of frequency changer circuit were tried to find one which would give a reasonable gain in the presence of the damping imposed by the reactance valve. This is a type which, in addition to acting as a pentode mixer, also oscillates between anode and grid No. 1. The i.f. tuning condenser is marked C in the circuit diagram of the converter. It will be seen that the oscillator coil is in series with this condenser, but at i.f. the impedance of the oscillator coil can be ignored. The impedance of the decoupling condenser C_D is also low and, therefore, the condenser C is effectively across the coil at i.f. At oscillator frequency the circuit behaves quite differently. The condenser C now acts as a coupling condenser from anode to the oscillator coil, and the i.f. coil acts merely as a choke supplying h.t. to the anode, and otherwise may be ignored. A coupling coil is taken to the grid of the pentode and the circuit, therefore, oscillates. In series with this coupling coil is a second coil which injects programme signal from the r.f. stage to complete the frequency changing process.

Reactance Section

In order to keep the oscillator in tune there must be a variable reactance to correct any mistuning, and appropriate circuitry makes the triode section of the ECF80 look like a capacity from the point of view of the oscillator circuit.

A reactance may be recognised in a circuit solely by the phase angle between the voltage across the circuit and the current in the circuit. If the voltage and current cycles are in step, maximum voltage and current occurring simultaneously, then the circuit is, in effect, a pure resistance. If the current cycle is 90° ahead of the voltage cycle, then the circuit is effectively a pure capacitance. Therefore, if a valve can be made to take current 90° ahead of the a.c. voltage (in this case the oscillator frequency), then the valve will look like a capacitance. This is done by feeding voltage to the grid of the valve through the internal capacity of the valve marked C_{ag} on the circuit. The phase of this voltage is altered by the resistance R in the grid circuit.

This results in a reactance whose actual capacity may be varied by altering the gain of the valve. Because the current and voltage are not exactly 90° apart, there is also a resistive component which does damp the oscillator section of the frequency changer circuit, hence the previous remarks about choice of suitable mixing circuit to work well in the presence of this damping.

A varying voltage is fed from the discriminator which is positive on one side of correct tune and negative on the other, and corrects any mistuning of the oscillator.

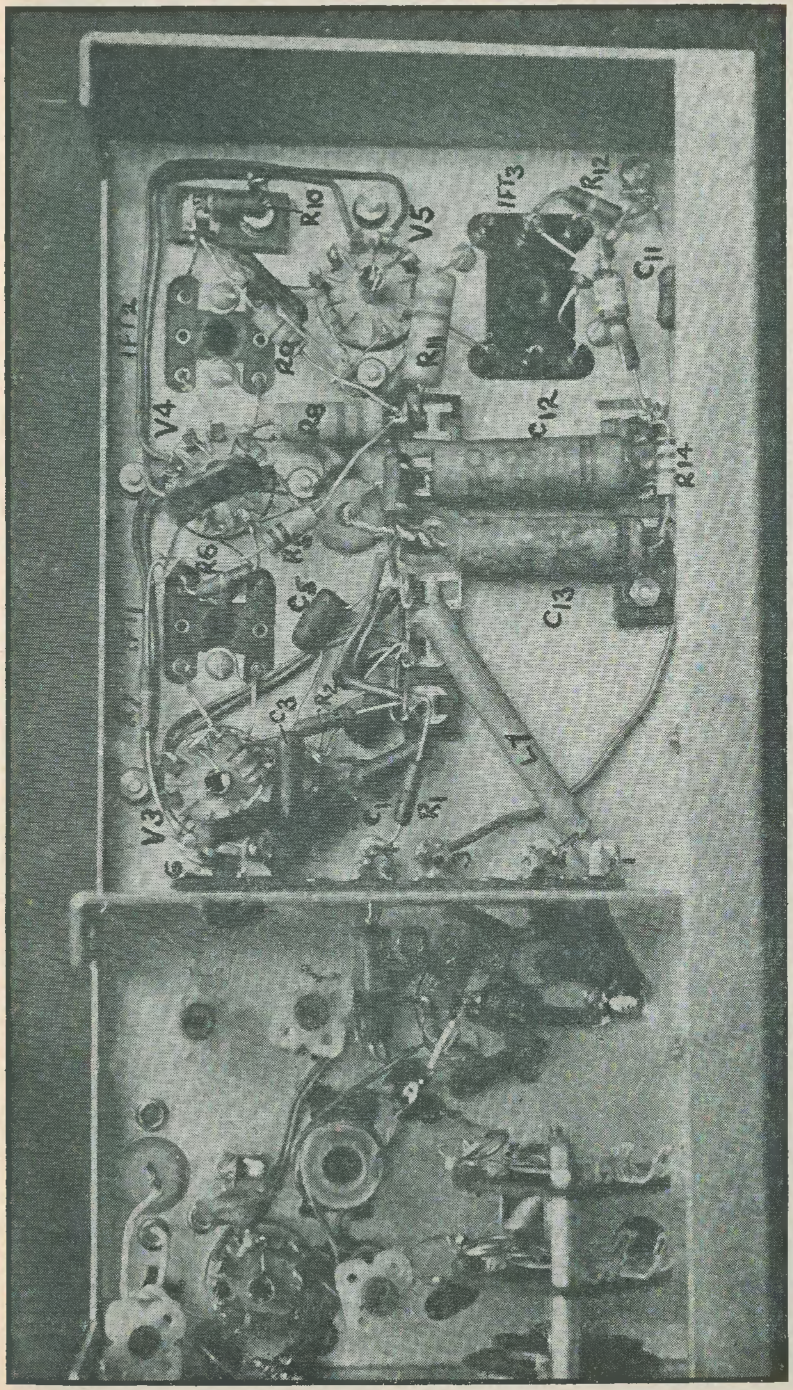
I.F. Stage

This is quite conventional, automatic gain control being fed back from the limiter to the grid of this valve.

Twin limiters are used. Without the second limiter the gain of the set is such that 100 microvolts of aerial signal produces 1 volt at the grid of the limiter. This is adequate to cover the average signal area of any of the stations. Unfortunately, considerable variations from the average signal may be found due to, for example, the receiving site being in a valley, or behind a gasholder. Alternatively, near an airport considerable variations of signal are found due to the strong signal reflected from the plane, which may momentarily cancel the normal signal. Twin limiters help to combat this, and result in an aerial sensitivity of better than 10μV. A positive bias is applied to the grids through resistors R_5 and R_9 to improve the limiting action.

The Foster-Seeley Discriminator is the part of the set which differs most from the normal a.m. set. This circuit was chosen because of the greater output which results in a bigger correction voltage being applied to the reactance valve, and is the simplest circuit for normal use.

(to be continued)



Layout showing, on right, the location of main components of the I.F., limiter and discriminator section. This should be compared with the point-to-point wiring diagram to be given next month. Note that only one heater choke (L7) can be seen in this view, though there are actually two

Radio Miscellany

JUDGING BY THE REQUESTS I HAVE RECEIVED in recent weeks from those who wish to be recommended an "ideal test-piece" record, there has been quite a revival in gramophone interest. Maybe this recent outburst is due to the fact that a wide range of 3 and 4-speed electric motors has recently been available at attractive prices. Or, of course, it may be that even in the matter of hi-fi, in order to keep up with the Jones's one's hi-fi has to be just that bit hi-fi-er than one's neighbours!

The latest enquiry comes from an Aberdeen reader who asks for a recommendation for a 45 r.p.m. (extended play) record of *permanent* interest. Seeing that these records are far from cheap he, with native thrift, wants one which can also be played for enjoyment. For the same reason he is not particularly interested in 33 r.p.m. (long play) records. He wants a recording of a good standard work which will be as satisfying to listen to in ten years time as it is today. Something which has solo passages, as well as the full crash of the whole orchestra in order to check for overloading. His ideal would have strings, brass and wind instruments all thrown in, with plenty of top and bags of bottom.

I am a little diffident about making a recommendation. So many saxpences will go bang if it fails to please. However, I have made a couple of modest suggestions by post, but I dare not put them forward publicly. There must be lots of records that meet such a demand more adequately than my limited knowledge of the record world covers. Every time I look at a catalogue of standard recordings I become deeply conscious of the shortcomings of my musical education!

Among the 33 r.p.m. long play types there are a couple of recognised favourites. The Petrouchka Ballet Suite (Stravinsky) has been used for years by Decca to demonstrate and popularise modern long-play record reproduction—a role it serves very effectively. That, however, is an expensive record—39/7½, or seventy-nine and a quarter saxpences. Another (at the same price) which might prove of interest is Britten's "Young Person's Guide to the Orchestra." The value of the latter as a test record lies in the fact that solo parts are provided for practically every instrument. However, our reader wants a 7in extended play, so these two scarcely fill the bill.

Can any reader who has alighted (by accident or recommendation) on an extended play record which goes most of the way to satisfying the demands of a careful Aberdonian, both for test and entertainment purposes, please quote the make and number —and I will prepare a list (with any comments of interest) of those that get several votes.

Like Topsy, it just Growed

My reference to the use of the CQ call last month has raised a query as to its origin. A reader enquires whether it started simply because the letters seemed to be the most appropriate to use as a general call or an invitation to anyone to reply, or as part of a planned code. Its origin, of course, goes right back to the days before telephony, when with other abbreviations it quickly became general usage. It was readily recognised that sending common phrases in full was a shocking waste of time and effort. Hence the Q-code came into use—groups of three symbols all of which could be readily understood either as a request or confirmation. QSY, for instance, means either "Please change frequency" or "I will change frequency; and QRA, "What is your position?" or "My position is——"

As the most frequent use of radio communications was by the English-speaking peoples, "Seek-you" would undoubtedly be readily accepted as a most logical general call. Up to about 1912 the letters CQD (CQ-Distress) were used to mean exactly the same thing as the more modern SOS call. At the time of the *Titanic* disaster it was the CQD call which was used in the early transmissions asking for help. Later it was changed to SOS —a signal which had been agreed upon only a little earlier by an International Convention. It was felt that an unskilled operator could more easily send it, being a simple group of three dots and three dashes, and the humblest amateur picking it up would more readily recognise it. Some people, oddly enough, still harbour the belief that the letters stand for *Save Our Souls*, although obviously it would be meaningless to anyone who did not speak English.

CENTRE TAP *talks about* *Items of General Interest*

Apart from all other considerations, the letters C and Q when linked in Morse possess a lovely natural rhythm. If you are not a code user, just sing to yourself the words "Charlie, Charlie. Here comes the Queen." There you have the perfect CQ call, the long syllables being the dashes and the short ones the dots. It also has the virtue that it is easily remembered as the dominant initial letters are C and Q.

Chassis Bashing

I am beginning to wonder if this heading is not the most appropriate I have ever chosen. Recently I have seen so many chassis that were literally bashed out, rather than fashioned to shape by gentle persuasion, that it almost suggested itself.

I hate to feel that this column, which is supposed to be chatty, is in danger of developing into a lecture, but having ruined more good aluminium than anyone else in the United Kingdom, perhaps I can speak with some authority on the subject.

If you want the finished job to look like an exhibition piece—and who starting off with a sheet of virgin polished aluminium doesn't? —cover the bench with a pile of opened newspapers. As the work proceeds, keep peeling the top sheet off. This way you will remove all the swarf which causes the horrible scratches which no amount of subsequent polishing will erase. In bending, scribe deeply and form the bends on angle iron by light, evenly spaced blows with a leather covered mallet. It is also important to keep hand pressure on the free end and so prevent it springing and whipping.

So far these points are usually observed by the intelligent constructor, but only too often the aluminium doesn't readily bend. Hence the blows get heavier until it does, and the finished chassis is covered with small scars and bruises which permanently mar its appearance. Worse still, cracks often appear along the bent edge. The reason for this is that the aluminium is "old." Too much force used on old aluminium is almost certain to result in cracking.

What is not generally realised among beginners is that old aluminium can be rejuvenated, making it easier to work and avoiding cracking. Incidentally, pure aluminium is softer and does not age or become brittle like duralumin, etc. Aluminium alloys all appear to suffer from age hardening. The pliability of duralumin can be restored by rubbing both surfaces with soap and warming over a gas-ring. Immediately the soap becomes dark brown the metal should be plunged into cold water. After it has been thus annealed it can be worked without fear of cracks developing. Preferably the bending or shaping should be done as soon as possible after the annealing treatment, as age hardening again sets in rapidly. Although this is an old dodge among metal workers, when I recently asked a half a dozen do-it-yourself constructors, not one of them knew about it.

Short Ends

Several more letters have come to hand from readers who would like to see a "Described—but not forgotten" column as a regular feature. To remind those with short memories, such a column was for constructors to air their views on the success (or otherwise) they met with in building sets described in these pages, or to share with others ideas for successful modifications they had tried. Judging by the correspondence on this subject, the Jason FM Unit was the most widely constructed item described in recent times. Incidentally, for Jason fans there is a new model full details of which are to be found in this issue. The second most popular item was the Mullard "3–3" Quality Amplifier described in our April, 1956, issue. This, no doubt, would have proved even more popular if it had not required buying the more recently introduced valves!

Mr. A. J. Felstead of St. Luke's Road, Maidenhead, suggests a modification to the Rambler Portable, which he has used with excellent results in hotel bedrooms from Kent to Cornwall. When he tried to use it in his caravan which has an aluminium roof and body, the screening was so effective that the otherwise strong signals obtained were completely lost. He then arranged for a short throw-out wire aerial to be quickly attachable as an optional addition. A length of 15 feet was found to give full volume. It is connected via a 100pF capacitor to the grid of the first valve, the aerial being plugged into a neat socket brought out to the upper edge of the panel.

An interesting point is raised by a "3–3" amplifier builder, J. R. of Bristol. His model greatly impressed a neighbour, who persuaded him to build him one like it. When he built

(*continued on page 202*)

Sand Filling the W.B. Senior Bass Reflex Corner Console

by E. G. WILSON

THIS ARTICLE DETAILS A SIMPLE METHOD of sand filling a commercial cabinet normally supplied in kit form. The materials required are easily obtainable, and the total cost of conversion does not exceed thirty shillings.

A sand-filled cabinet similar to the one described has been used for over two months in the writer's home, and in his opinion it represents a considerable improvement over the non-sandfilled version. This is due to the increased clarity of the bass response and a general reduction in resonances even on heavy orchestral passages and sustained organ notes.

The technique of construction is quite simple. By the use of 1in × ⅜in strip and hardboard, cavities are added to each of the walls of the cabinet. These cavities are filled with dry sand.

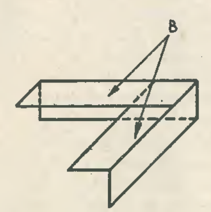


Fig.2
Cardboard corner piece

E449

Materials required are listed below. It is advisable to check dimensions and quantities before ordering to avoid waste.

⅛in hardboard	18 square ft.
1in × ⅜in softwood ..	40ft
Builder's sand	2 bucketsfull
1in and ½in panel pins ..	as required
"Casco" glue	or similar
"Croid" glue	or similar
¼in carpet underfelt ..	1 square yd.
Drawing pins	as required

Cut and fix lengths of 1in × ⅜in strip to the top, bottom, sides and backs to form recesses as shown in Fig. 1. In dimensioning the strips remember that the whole cabinet has to be fitted together, and due allowance must be made for any extra thickness of hardboard introduced. For example, the struts already fitted to the backs (A in Fig. 1) will need to be shortened to allow for the hardboard fitted on the top and bottom cabinet walls. The writer found no difficulty in working with the cabinet assembled and the backs removed. If, however, an unassembled cabinet is being converted, it will probably be easier to do all the constructional work before assembly. Butt joints are adequate for the corners, and Casco glue and panel pins make solid and sandtight joints. The cardboard corner pieces make additionally sure that no sand leaks occur at the corners. These are made from cigarette packets and are secured with Croid (Casco is unsuitable as it requires considerable pressure to obtain good adhesion). The flaps marked "B" in Fig. 2 should be at the top of the cavity to engage with the hardboard top when it is fitted.

When the glue on the strips and corner pieces has hardened, fill the cavities with *dry* sand packed fairly tightly. Cover the tops of the cavities with hardboard cut to size and secured with Casco glue and panel pins. Remember to put Croid on the flaps B of Fig. 2 before fitting the hardboard. This ensures a good sandtight joint on the finished job.

Fit the ¼in carpet felt to the two backs, covering to within 1in of the edges. This is most easily done using Croid and drawing pins.

When all the joints are dry, assemble the cabinet—bearing in mind that all panels are now considerably heavier than the designer originally intended, and therefore additional care is necessary to make sure that no damage is done to the cabinet as a whole. The same care should be exercised when the cabinet is moved to its working position, which should, if possible, be such that it does not have to be changed very often for cleaning or other domestic reasons.

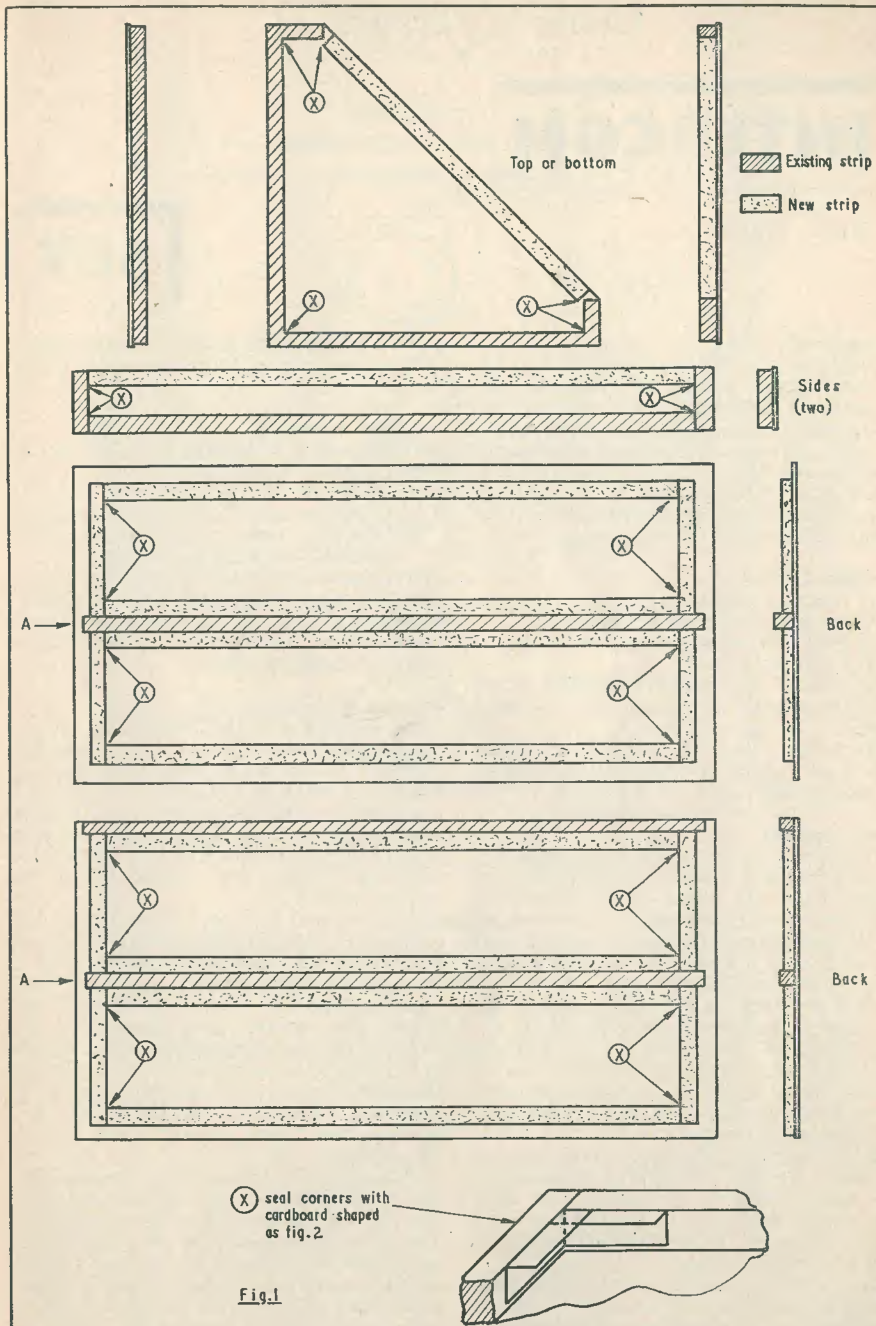


Fig.1

E448

General Purpose . .

INTERCOM SET

by R. H. SMART

Introduction

THIS UNIT WAS PRIMARILY DESIGNED AS AN amplifying intercom between the author's workshop and the house. It was thought that an amplifier used exclusively for this purpose would be unnecessarily wasteful, and so a number of features were included to enable the unit to be used for general experimental work without detracting in any way from its original purpose.

Facilities Offered

(1) Intercom between two stations with complete secrecy at both if required.
(2) High and low gain amplifier inputs.
(3) Mixing of inputs.
(4) "Slave" may be disconnected when amplifier is used for experimental work if desired.
(5) Should "slave" be disconnected under item 4 an audible or visual alarm is incorporated should "slave" wish to speak.

Main Amplifier

The circuit is shown in Fig. 1, and it will be seen that it is a conventional three-stage design with the following modifications. Provision is made to switch the intercom input transformer T_3 out of circuit and replace it with a socket and volume control VR_1 to provide a high gain input. A low gain input is provided via VR_3 to the grid of V_2. This may be mixed with the output from V_1. VR_2 should be adjusted for normal intercom working, but as it is likely to be altered during testing, etc., it would be just as well to mark the amplifier panel and VR_2 knob to facilitate quick return to intercom.

It will be noted that the coupling between V_1 and V_2, condenser C_2, is of an unusually low value. This is to decrease the bass response on intercom, and it may be lowered further if desired. It does, however, affect the bass response of "Input 1."

The power supplies incorporate full-wave rectification and are well smoothed to avoid hum troubles. Modifications may be made to suit components available, but it is *not* recommended that the mains be connected to chassis, as this could result in the full mains voltage appearing on the remote wiring to the "slave."

Amplifier Switching

This function is performed by S_2. It has three positions, viz.:
(1) Intercom
(2) Amplifier only, "slave" disconnected
(3) Amplifier only, "slave" connected in parallel with main loudspeaker

When switched to (2) or (3) and the "slave" wishes to speak, operation of relay CO (Fig. 2) completes a circuit via S_{2c} for the audible or visual alarm. Switching to (1) immediately restores intercom facilities.

Intercom Switching

Fig. 2 shows a comprehensive system requiring a three-wire connection between the stations. K_1 and K_2 are Post Office type key switches, it being an advantage if K_1 is of the non-locking type, i.e. to return to normal when finger pressure is removed. CO is a relay of the well-known 3000 type. The relay and key switches are obtainable on the surplus market.

With K_1 and K_2 "up," both stations are connected to the amplifier output. If K_2 is depressed, the negative (chassis) line is extended via K_1 to operate relay CO. CO_1 then connects the "slave" to "input" and "slave" may speak. Operation of K_1 disconnects CO, returning the "slave" to output and connects the master to input. Note that the master may speak whether or not K_2 is depressed. Should K_2 be left in the "on" position, the "slave calling" alarm can be disconnected at S_3.

The positive potential to operate the relay and buzzer (if used) may be obtained from the HT line via suitable dropping resistors. The value of these resistors will vary with the resistances of relay and buzzer used. Alternatively, a battery may be used and an extra pole added to S_1 (Fig. 1) to switch it out of circuit when the unit is turned off.

$3\frac{1}{2}$in or 5in loudspeakers perform well as microphones and can be used to good

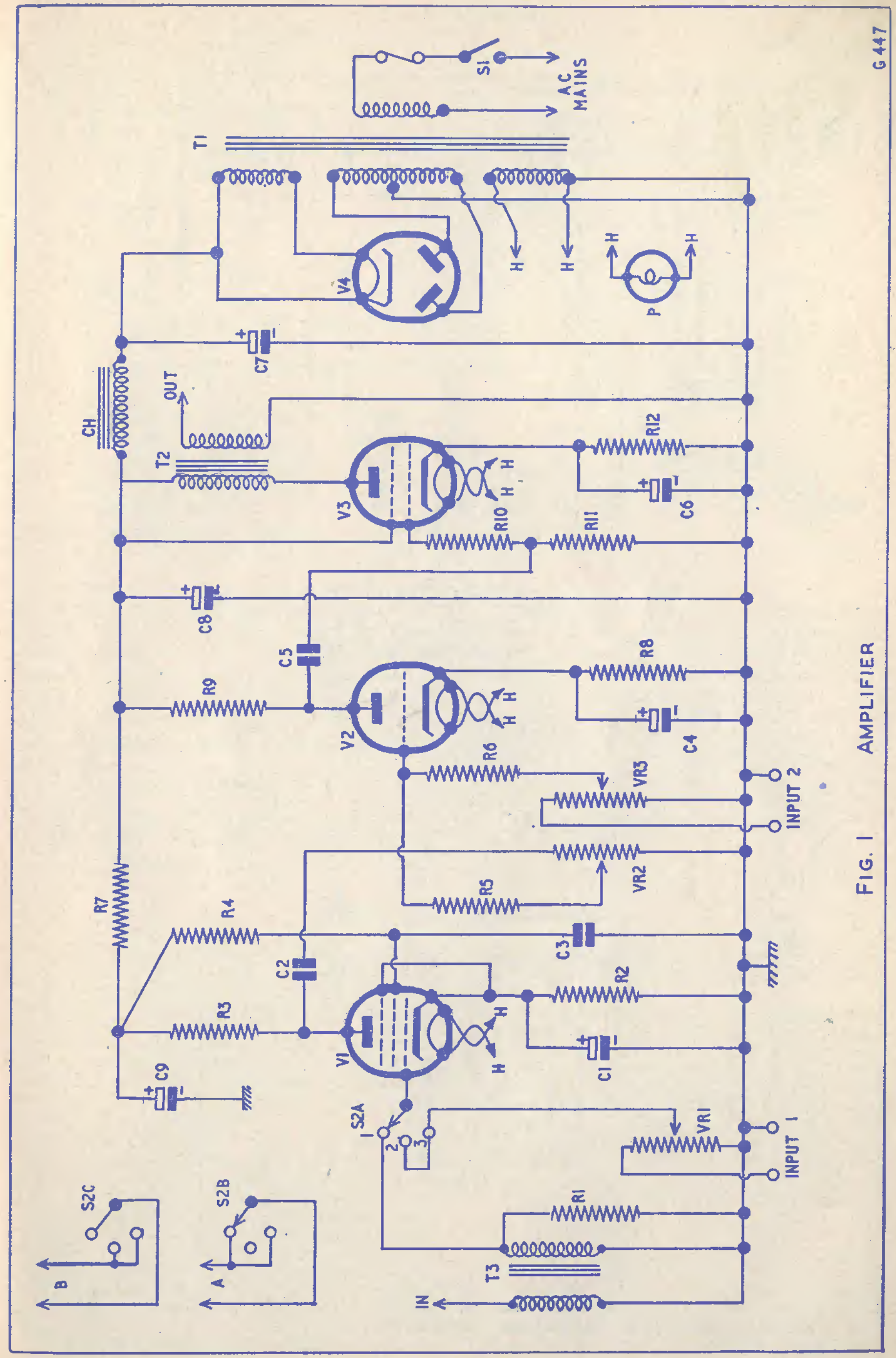


FIG. 1 AMPLIFIER

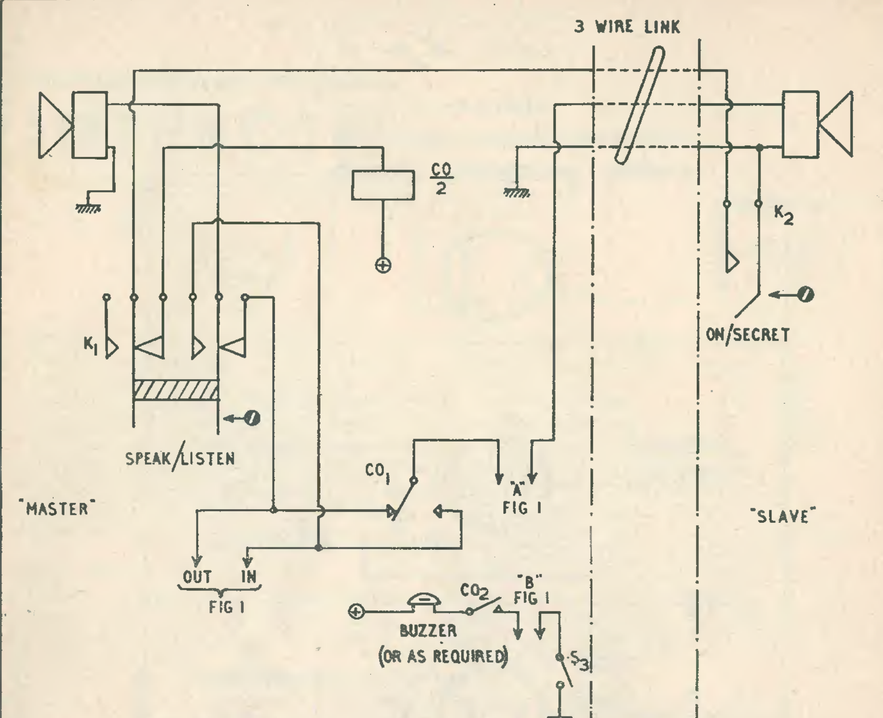


FIG. 2 INTERCOM SWITCHING

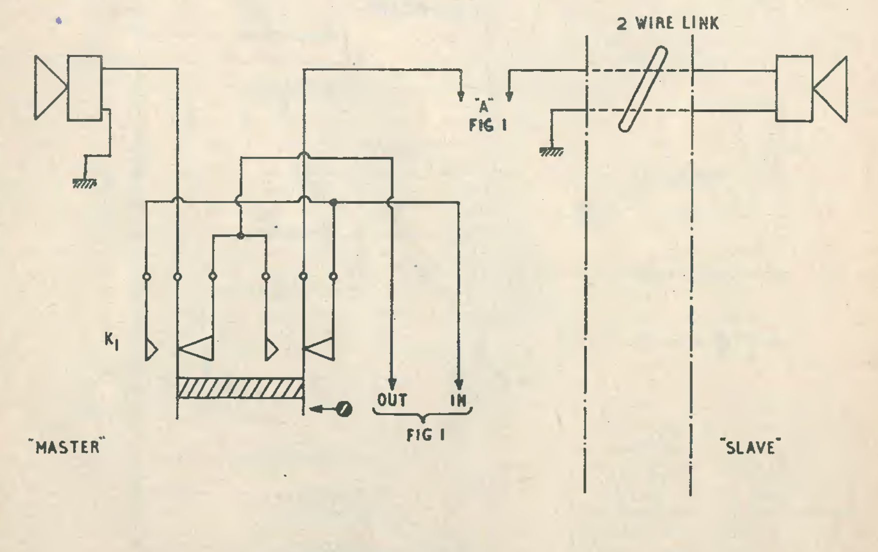


FIG. 3 SIMPLIFIED INTERCOM SWITCHING

G.448

List of Components

C_1	25μF 25V electrolytic	R_1	100kΩ
C_2	0.001μF 350V paper	R_2	2.2kΩ
C_3	0.1μF 350V paper	R_3	470kΩ
C_4	25μF 25V electrolytic	R_4	1MΩ
C_5	0.05μF 350V paper	R_5	470kΩ
C_6	25μF 25V electrolytic	R_6	470kΩ
C_7	16μF 450V electrolytic	R_7	10kΩ
C_8	32μF 450V electrolytic	R_8	1kΩ
C_9	8μF 450V electrolytic	R_9	47kΩ
V_1	6J7, etc., plus base	R_{10}	4.7kΩ
V_2	6J5, etc., plus base	R_{11}	470kΩ
V_3	6V6, etc., plus base	R_{12}	240Ω w/w ±10% (for 6V6 only)
V_4	5Z4, etc., plus base	VR_1	1MΩ pot
T_1	Output: 250–0–250V, 60mA; 6.3V, 1.5A; 5V, 2A.	VR_2	1MΩ pot
		VR_3	500kΩ pot
T_2	Output transformer to suit o/p valve and loudspeakers	CO,	Relay P.O. "3000" type, 1 make, 1 changeover contacts
T_3	Microphone type input transformer	K_1	Key type, 2 changeover contacts "non-locking"
S_1	250V 1A toggle		
S_2	3-pole 3-way Yaxley type	K_5	Key type, 1 make contact
S_3	(if required) on/off toggle	Two loudspeakers, 3½in or 5in P.M. (see text)	
P	6.3V Pilot lamp	Smoothing choke (CH) 10–20H, 60mA	
Buzzer or Indicator as preferred		Chassis, Sockets, Case and sundries as required.	

advantage in the unit. For general work, however, a larger unit is generally required, and the author has used a 6½in energised speaker successfully in the past with the amplifier. At the present time a 9in speaker is in use in the workshop in conjunction with a 3½in at the house. Naturally, one has to speak closer into a larger speaker, but at the controlling end this is no disadvantage.

Figure 3 shows a much simplified system of switching when secrecy at the "slave" is not required, and no calling alarm is incorporated.

General

As stated previously, the amplifier is of the conventional type, so existing amplifiers that may be in use or available should be easily modified. No constructional details are given, as the unit may quite easily be built from the junk box, and layouts could vary considerably with different components and valves to those specified. It is recommended, however, that the input transformer T_3 be placed as far as possible from the mains transformer T_1, and that all wiring associated with the grids of V_1 and V_2 be screened.

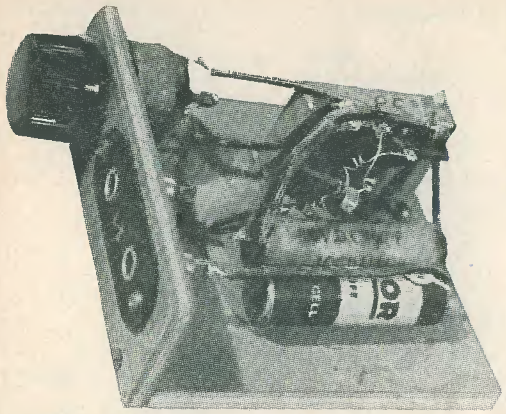
LITERATURE RECEIVED

From Clyne Radio Ltd., 18 Tottenham Court Road, London, W.1, we have received the new *Comprehensive Catalogue* 1957 of over 100 pages packed with radio and television components, kits, cabinets and all manner of other items of interest to the home constructor. One of the most comprehensive that we have seen, it is available from the above address, price 2s. post free. A monthly Newsletter—well worth receiving, is also available.

Standard Telephones and Cables Ltd., Footscray, Sidcup, Kent, have now produced and released the latest in their manual series, the *Brimar Radio Valve and Teletube Manual No.* 7. Complete details of all the Brimar range of valves, t.v. tubes, transistors, Brimistors, metal rectifiers, etc., together with base connections, data, and characteristic curves are included. In addition to the foregoing, other items include contact-cooled rectifiers, germanium diodes, abacs, formulae and a complete section of circuits of amplifiers, receivers, f.m. tuner unit, radio tuner unit and various transistor circuits. The Manual is available from radio dealers, etc., price 6s.

The Wireless Institute of Australia have forwarded the latest edition of the *Australian Radio Amateur Call Book* (June 1957). The VK callsigns listed are complete as at 15th May, 1957, and stations in Antarctica are listed for the first time under the new VKO prefix, VK1 now being alotted to Australian Capital Territory. Of 136 pages, with an attractive art board cover, it costs 5s., postage extra. The address is The Wireless Institute of Australia, C.O.R. House, 191 Queen Street, Melbourne, C.1, Victoria.

Correction. In the circuit of the Sensitive Signal Tracer, page 119 of the September issue, the electrolytic condensers C10, C13, C14, C15 and C16 were inadvertently shown as being connected in reverse, i.e. positive connections to chassis. These connections should, of course, be reversed.



TRANSISTOR MORSE OSCILLATOR

by **F. G. RAYER**

When practising Morse, it is soon found that the note from a buzzer is not very satisfactory, as it does not resemble the tone heard from Morse transmitters. A valve oscillator is frequently employed to overcome this, the signal being heard in phones, or listened to with a speaker. The usual type of simple valve oscillator is shown in Fig. 1, and it is vastly superior to the buzzer.

Though such an oscillator had been used on and off for many years, it was felt that a transistor circuit would be preferable, primarily because of the considerable economy in current consumption. No h.t. would be necessary, and even a single small dry cell should have a very long life.

With this in view, it was found that the circuit in Fig. 2 was satisfactory. Multivibrator circuits using two transistors were well known, but it was felt that a worthwhile saving would arise from having one transistor only, a transformer being used exactly as in Fig. 1. The circuit in Fig. 2 was, therefore, used. It is a ready oscillator, and gives ample volume for two sets of phones with a $1\frac{1}{2}$V battery. The current drain is only around 1mA.

The 100kΩ potentiometer was provided to vary the audio tone, as this was felt desirable. As resistance is reduced, the tone rises until the transistor goes out of oscillation. The lowest audio frequency will depend upon transformer, transistor, and room temperature. The characteristics of the phones also vary it somewhat.

Transformer

This item requires special mention, because a component suitable for the valve circuit may not function well with a transistor. The latter is a current-operated device, whereas a valve is voltage-operated. The transformer thus needs to have windings of fairly low resistance. It is also helpful if its inductance is a little low, so that it would not be a very good component by a.f. coupling standards.

When the circuit has been connected up, the results to expect will soon become apparent. If no oscillation arises, it may be necessary to reverse connections to one winding. The effect of exchanging the circuit positions of primary and secondary can also be tried.

If the transformer will not give satisfactory results, another component of different type must be tried. If several old or ex-service transformers are to hand, one is likely to suffice. The ratio is not important, but may best be around 1 : 5 to 1 : 15.

A component with low inductance, which gives a very high-pitched note, may have a condenser of about 0.05μF upwards wired in parallel with the primary.

Constructional Points

The wiring plan is shown in Fig. 3; dimensions are of no importance. Of the various possible methods, that of wiring phones and key in series with the battery has been selected, as this avoids the need for any on/off switch, and means that the oscillator is always out of action when the key is open, or phones removed. The components are so few that in some cases it may be possible to assemble the oscillator on an old Morse key, complete, to form a single unit.

When wiring up, the polarity of the battery must on no account be incorrect, the inner carbon rod being positive. The cell is soldered directly into position, as its normal life is several months.

The transistor must on no account be heated, or permanent damage is likely. It is best, for this reason, to leave its wire ends full length. The soldered joints should be made with reasonable speed, the transistor lead being held by flat-nosed pliers to conduct heat away.

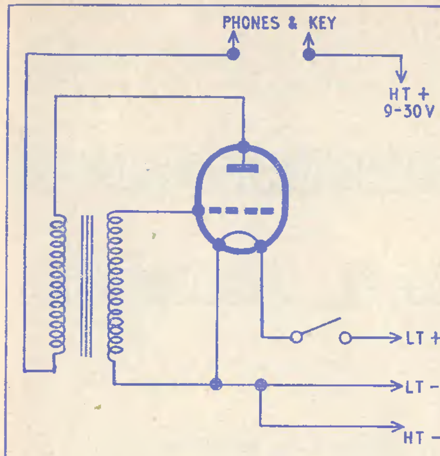


FIG. 1 THE ORIGINAL VALVE CIRCUIT

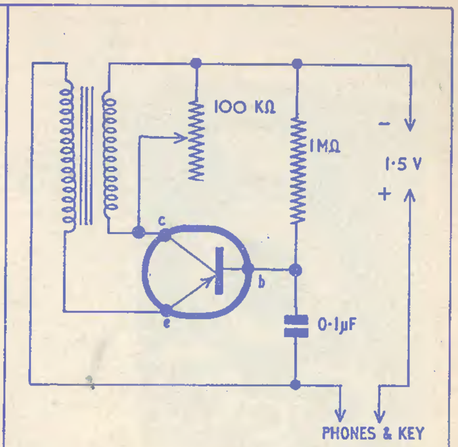


FIG. 2 TRANSISTOR OSCILLATOR

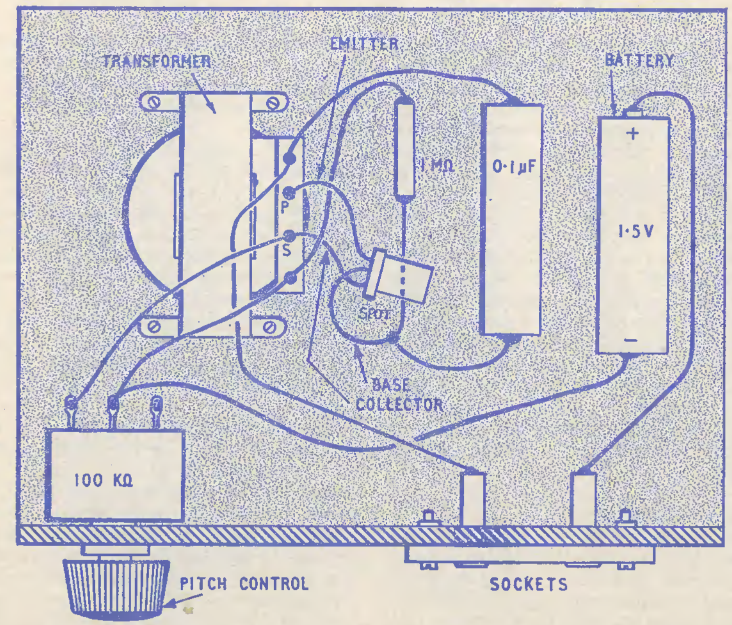
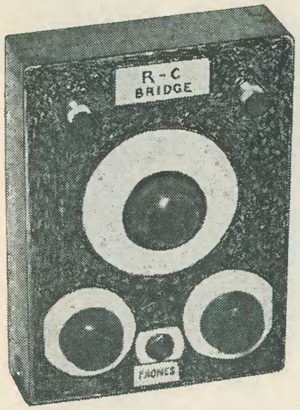


FIG. 3 WIRING PLAN

G 449



TRANSISTORISED R.-C. BRIDGE

by **S. A. MONEY**

SOME FORM OF RESISTANCE-CAPACITANCE bridge is a valuable asset to the experimenter's workshop, since with its aid the value of any capacitor or resistor can be measured quite accurately. In the instrument to be described an accuracy of $\pm 5\%$ or better may be obtained, depending upon the accuracy of the components used.

A disadvantage of many R-C bridges is that they require the use of a mains supply to operate them. By using a transistor in the circuit it is possible to make the bridge work from a $1\frac{1}{2}$ volt torch battery, thus making the instrument both portable and economical.

The instrument comprises a bridge network, in which the unknown component is measured, and an audio frequency oscillator which provides an a.c. supply for the bridge network. Since only a small amount of power is required from the audio oscillator, a transistor may be used.

The Audio Oscillator

One of the small p-n-p type junction transistors which are now obtainable is used for the oscillator. It is connected in the common emitter arrangement, with transformer feedback from the collector to the base. As with a valve oscillator, there is a phase reversal in the transistor and the transformer is connected to give a further phase reversal, so that a positive feedback is obtained.

The transformer should have a ratio of about three to one, with the larger winding in the collector circuit. Some valve type transformers are unsuitable because they have windings with high d.c. resistances which cause large voltage drops and may prevent oscillation.

A suitable transformer may easily be wound on the core of an old audio transformer using, say, 200 turns of 30 s.w.g. wire for the primary and 60 turns for the secondary. Alternatively, a suitable transformer specially made for transistor work may be obtained. A small heater isolating transformer was also found to be suitable for this circuit.

The windings must be connected up the right way round for oscillation. If the transformer is not marked and the circuit does not oscillate, then one of the windings should be reversed.

Any of the small junction transistors now available will work in this circuit, although it may be necessary to alter the circuit constants to suit the differing characteristics of various makes of transistor. With some transistors it is found that a rough note is produced. This appears to be due to excessive feedback and may be cured by damping the primary of the transformer with a shunt resistor. The value required will vary from about 2.2kΩ to 10kΩ, depending on the transistor used. For convenience a variable resistance is used here, the value being adjusted to give a clean note with the transistor in use.

The primary of the transformer is tuned by a shunt capacitor to give an audio note of about 1,000 c/s. The actual value of this capacitor will depend upon the inductance of the transformer used. A value of from 1,000pF to 5,000pF will usually be required.

In the base circuit, the transformer secondary is connected in series with a bias resistor to the negative side of the supply. This resistor provides a current bias of about 75 microamps for the base circuit and is decoupled by a capacitor. The use of this bias helps to produce a clean note.

The Bridge Network

In this instrument the bridge network has been arranged to give six ranges with a linear scale on both resistance and capacitance measurement. This makes the scale easy to draw and allows good accuracy to be obtained.

For measurement of resistances a Wheatstone bridge is used with a pair of headphones as the detector. In the measurement of capacitance a DeSauty type bridge is used. This is a Wheatstone bridge in which two of the resistors are replaced by capacitors.

For the Wheatstone bridge shown in Fig. 1, the value of R_1 when the bridge is balanced is

$$R_1 = R_4\frac{R_2}{R_3}$$

In the case of the DeSauty bridge shown in Fig. 2, we get

$$C_4 = C_1\frac{R_2}{R_3}$$

It will be noted that the ratio $\frac{R_2}{R_3}$ is common to both circuits and, in fact, the resistors R_2 and R_3 are known as the ratio arms of the bridge. It will be convenient to make R_1 and C_4 the unknown components, so that R_4 and C_1 become the standards against which the unknowns are compared. By making R_2 variable, and calibrating it, the ratio of R_2 to R_3 may be varied to balance the bridge, and the value of the unknown component read off from the scale fitted to R_2. For both resistance and capacitance this scale will be linear since the unknown is directly proportional to R_2.

The usual practice for changing the range of the bridge is to change the value of the standard component R_4 or C_1. For six ranges this means that twelve high tolerance components are needed, six of them being capacitors. An alternative method is to switch the value of R_3 so that the ratio of R_2 to R_3 is changed. With this arrangement only two standard components are needed, one for resistance and one for capacitance.

If R_2 is a 10kΩ potentiometer, then the scale fitted to it would read from 0 to 10kΩ and multiples of this. This arrangement places the 1kΩ, 10kΩ, 100kΩ values at the ends of the scale, so that it may be difficult to obtain accurate readings for these values. To overcome this, the scale is made to read from 1kΩ to 11kΩ, thus bringing the 10 values in at the upper, and more accurate, end of the scale. This result is easily obtained by adding a 1kΩ fixed resistor in series with the 10kΩ potentiometer, thus making the range of values of R_2 1kΩ to 11kΩ.

When switching from resistance to capacitance measurement, it is necessary to transpose the standard and unknown components in order to make the capacitance scale linear. Thus C_4 becomes the unknown capacitor. The switch used for this is a three-way type, the third position being used to switch off the battery supply to the oscillator when the instrument is not in use.

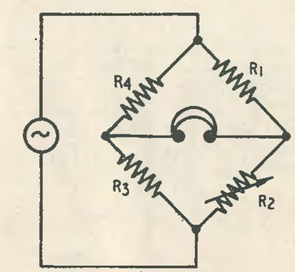
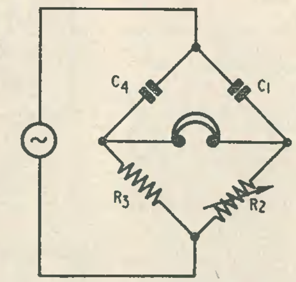


Fig. 1
The Wheatstone Bridge



E490 Fig. 2
The DeSauty Bridge

Construction

The complete circuit diagram of the instrument is shown in Fig. 3. No specific details will be given of the construction of the unit, since these will vary according to the components used and the requirements of the constructor himself. It is an advantage to mount all of the components upon the front panel since the completed unit can then be simply dropped into its case and fixed with screws. When a battery has to be replaced, it will then be a simple matter to make the change.

The size of the instrument is limited by the size of scale required in order to achieve reasonable accuracy and ease of reading. A panel size of about 7¼in × 5½in was found to be about the minimum usable.

The battery is a 1½ volt torch cell, type U11, or similar, and this is clamped to the panel by means of a capacitor clip, thus making the panel the negative side of the supply. The positive connection to the battery is then soldered to the top cap of the cell. Since the current drain of the transistor oscillator is only some 3 to 5mA, the cell should last for at least its shelf life, so that replacements will be very infrequent.

The transistor must be soldered into the circuit with some care by gripping the leads, with a pair of pliers, as they are soldered. This prevents damage to the transistor due to heat from the soldering iron. If a small iron is used and the joint made quickly, this precaution may be unnecessary. The collector connection is usually indicated by a coloured dot on the body, and the other connections should be obtained from the data sheet for the transistor used.

Components used for the bridge network must be of at least 5% tolerance, and if desired closer tolerance components may be used. The potentiometer must be of the linear type and about 1¼in or 1½in diameter. Smaller diameter components have a shorter track and will not be as accurate as the larger unit. No great advantage is obtained by using a miniature component here, since the size of the unit is governed by the scale dimensions. For the oscillator circuit ordinary 20% components may be used.

For convenience the phones should be connected to the circuit through a jack plug and socket. The test leads for the unknown component may be brought out to terminals, or to flying leads fitted with crocodile clips.

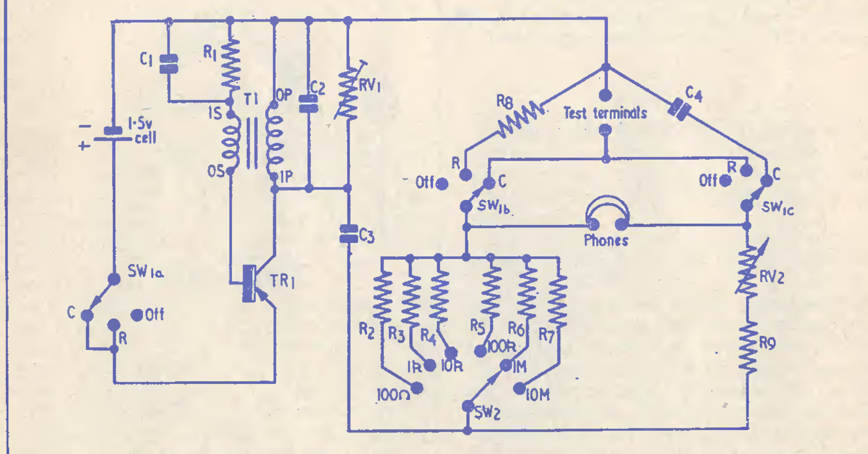


Fig. 3
The complete circuit

COMPONENT LIST

Resistors		*Condensers*	
R_1	22kΩ	C_1	0.05μF
R_2	1MΩ 5%	C_2	see text
R_3	100kΩ 5%	C_3	0.002μF
R_4	10kΩ 5%	C_4	two 5,000pF 5% silver mica
R_5	1kΩ 5%	TR_1	Red Spot, OC71, GT2, GET3 or similar
R_6	100Ω 5%	T_1	3 : 1 ratio transformer
R_7	10Ω 5%	SW_1	3-pole 3-way rotary
R_8	10kΩ 5%	SW_2	1-pole 6-way rotary
R_9	1kΩ 5%	Phones	high impedance
RV_1	10kΩ preset	Battery	1.5V cell
RV_2	10kΩ variable linear		

Calibration

When the instrument has been wired up, a scale must be drawn so that the values of the components being measured can be read off directly from the scale. The most accurate method of making the scale would be to calibrate each range separately, using an accurately calibrated variable resistance and an accurate capacitor box. Since such apparatus is unlikely to be available to the amateur constructor, a simpler method must be used. For this method the track of the potentiometer is assumed to be perfectly linear and the other components of the bridge accurate.

Most potentiometers have an angle of rotation of 300°, although there are some types which have an angle of rotation of only 270°. This angle can easily be found by fitting a knob to the potentiometer and measuring the angle of rotation with a protractor.

Having found the required scale angle, a circular scale is drawn having a diameter of about 2½in. The sector corresponding to the rotation angle of the potentiometer is then marked off and this sector is divided up into 100 divisions by using a protractor. Every tenth division is marked with a longer stroke and numbered from 1 to 11. The scale should then be marked in with indian ink, cut out and glued into position on the panel. Readings obtained on this scale will then be multiplied by a constant factor, according to the range in use, to give the value of the unknown resistor or capacitor. This method of calibration will give an accuracy of about ±5%.

Operation of the Bridge

To measure the value of an unknown resistance or capacitance, connect the component across the test terminals. Select resistance or capacitance range and set the range selector to a suitable range. The potentiometer is then rotated until the volume of the note in the phones drops to a minimum. The value of the unknown component may then be read directly from the scale. It is not usually possible to obtain zero signal in the phones because of stray capacitance and leakage resistance. The operation of the bridge should be checked by measuring a few known resistors and capacitors.

BOOK REVIEW

UNDERSTANDING HI-FI CIRCUITS. By Norman H. Crowhurst. 224 pages, 180 diagrams Published by Gernsback Library Inc., New York. Obtainable in England from The Modern Book Co. (Dept. RC), 19–23 Praed Street, London, W.2. Price 23s. 0d.

The author of this interesting book has resided in America for the past few years and has already become well established there as a writer on audio subjects in technical journals. He produced many articles in this country some time ago which were notable for their ingenious design charts, so he is well able to discourse on the aspects of hi-fi sound reproduction contained in this volume.

The text is almost wholly descriptive and conversational. Very few mathematics are used; one could almost say that a little arithmetic appears here and there just to emphasize an explanation or to give simple proof of a circuit function. On the other hand, much that could have been expressed mathematically has been made comprehensible by means of several graphs and charts. This, and the author's lucid style, makes the book absorbing to read and refreshingly easy to understand.

The ten chapters forming the major part of the book are liberally illustrated with basic circuit diagrams, each of which is discussed in detail. Component values are given only where it is necessary to discuss specific values, and their effects on a particular circuit principle. As a result, it is hardly possible to formulate a complete amplifier circuit design simply by stringing together individual circuits that catch the eye in various chapters. It may well be that they have been denuded of component values deliberately, for the author remarks quite early in the book that many "original" designs seem to have been born by such grafting methods; not without some truth, one imagines.

It is not possible in this short review to do justice to the wealth of information contained in the volume. Even a mention of all the principles, circuits and functions could take up much space. The following few aspects selected at random may serve to show how widely the subject of hi-fi has been covered: triodes, pentodes and tetrodes in ordinary, ultra-linear and cathode-follower output stages, the use of feedback; phase correction, frequency response, output impedance; transformers and chokes in driver and inverter stages, paraphase and cross-coupled inverters; thermal noise, hum, and microphony; matching of input and output stages; equalization for disc and tape recordings, passive and feedback type equalizers, triode, pentode and two-triode equalization stages; single and multiple speaker units, cross-over networks, channel separators; stepped and continuously variable loudness and volume controls; feedback-, peaking-, variable slope-, and step-by-step tone controls.

Considering the amount of useful material contained in it, the book appears to be smaller than one would expect, but the reader should not be deceived on this account. The book is really good value for its price, particularly for those who would learn from an instructive writer many things about hi-fi and audio that would be difficult to find written elsewhere.

W. E. THOMPSON

A CONSTRUCTOR VISITS THE . .

1957 NATIONAL RADIO AND TELEVISION SHOW

THE WRITER HAS ALWAYS HELD A FOND BELIEF THAT it is possible to gain entry into almost any London exhibition by the simple process of flashing a business card at the entrance and stating briskly: "Press!" If one looks scruffy enough the attendant will then let one through. This scheme has worked excellently in the past, especially at the London Audio Fair. (Would "Free Grid" of *Wireless World* please note?) Just for fun the writer tried it out this year at the Earl's Court Exhibition but the attempt was unsuccessful, and your somewhat embarrassed reporter had to rummage for his correct Press Ticket before a disdainful thumb indicated that he could pass through the turnstiles.

However, despite this rather discouraging start, the writer enjoyed his visit to the Radio Show as much as he has always done in the past. There was less "gadgetry" this year than has appeared at previous exhibitions—incidentally, the major radio and television manufacturers tending to present their wares in almost an overly dignified and staid manner. On hot days the atmosphere in Earl's Court tends sometimes towards a certain stuffiness, and it is a pity if this is added to by a stuffiness in the stand layouts.

Part of the restrained tone of this year's show may have been due to the fact that no major technical developments have recently occurred or are impending in the domestic radio and television scene. Because of this, manufacturers have had the time to consolidate their present position, and have been able to concentrate more on cabinet design and presentation.

Television

The preoccupation with cabinet styling was very apparent on the stands devoted to television. One technical development in conventional t.v. receivers consisted of the introduction in some models of 90 degree tubes but, even here, the results given are more apparent in the form of shallower cabinets than in any improved picture response. There is a strong tendency towards making the tube face occupy a large area of the front of the cabinet. The "push-through" type of tube mounting, wherein the whole of the front of the tube is visible instead of being partly masked, is becoming more and more popular.

Possibly the biggest change in television production was the introduction by almost every manufacturer of transportable receivers. Most of the models shown employed 14in tubes and were housed in cabinets of the same style as are used by portable radios, viz., cloth-covered plywood, or moulded plastic.

The chassis inside such housings employ conventional circuitry, of course, and it is possible that, since the cabinets conform to the design idiom to which portable radio has accustomed the public taste, they not only become acceptable in the home but also incur a noticeable saving in cost. A particularly interesting transportable model was the Ferguson 14in receiver (type 45), insofar that it had a very comprehensive inbuilt telescopic aerial system, this being capable of a considerable range of adjustment. The two telescopic aerial rods employed with this receiver could be drawn out of the cabinet and set to any length and at any angle to each other. Thus, it was possible to extend both rods to form a pair of "rabbit's ears" or extend one vertically to act as a quarter-wave aerial, the other being left in the cabinet or laid horizontally outside to act as a partial reflector. Since the aerial rods may be moved in any direction it is not necessary to orientate the receiver itself to receive any particular signal.

A large number of firms exhibited televisors which were also capable of reception of v.h.f. signals in Band II. Reception of v.h.f. with these sets is obtained by rotation of the tuner to the desired f.m. channel, this automatically changing the detector circuit in the sound i.f. strip from a.m. to f.m. and putting the purely television circuits out of action. F.M. reception is then achieved via the tuner, the sound i.f. strip, and the a.f. stages of the set. Technically, the introduction of f.m. represents an interesting departure, because it creates quite a number of engineering problems. Probably the most difficult of these are involved in the switching circuits themselves, as it is not only necessary to alter the method of working at the sound strip detector but also to change the power supply circuits. In many f.m./t.v. receivers the power supply problems are solved by switching off the heaters of the tube and the valves not required when the tuner is set to f.m.

An interesting device exhibited by G.E.C. is worthy of mention at this stage. This consisted of a small 6in cathode ray tube (type 1668 VMH) which could be fitted into any television receiver in place of its regular tube in order to facilitate servicing and manufacturing processes. In most modern televisors the deflector coils are mounted to the chassis metal-work, with the result that the 6in tube may remain in position merely by inserting it into the deflection yoke and fitting the base socket and e.h.t. clip. The tube gives a normal and, of course, smaller picture under these conditions, and obviates the awkward problems involved when chassis with large tubes have to be handled. The writer understands that the 6in tube works with the same e.h.t. voltage as is employed by the much larger one it temporarily replaces.

Sound

So far as sound reproduction was concerned, the major change evident at the Show was the greatly increased number of record players on display. There is a very thriving market for this type of instrument just now, and the range available extends from portable models priced below £15 to hi-fi units (at £40 up), having two or more loudspeakers and carefully designed cabinets/enclosures. Pye exhibited a transistorised record player.

Transistors are slowly entering the portable radio market, but the high prices of transistorised receivers preclude large sales as yet. There is, nevertheless, considerable interest in transistor equipment when advantage is taken of their small size, and a popular exhibit was the Perdio PR-1 transistor receiver, whose outside dimensions are $3\frac{1}{4}$in by $5\frac{3}{4}$in by 1in. The PR-1 covers 185 to 565 metres and is powered by six small torch-batteries. A do-it-yourself transistor receiver built into a 20 cigarette packet was to be seen on the Siemens Edison Swan stand.

Readers may remember the new Periphonic speaker system introduced by G.E.C. at this year's Audio Fair. These speakers were employed in a most impressive demonstration of stereophonic reproduction at Earl's Court. Other high fidelity equipment was much in evidence, and it would appear that prices are becoming more and more competitive. The trend towards producing "unit" hi-fi systems is very strong and, here again, much work has been put into providing attractively styled cabinets or housings for equipments which have undergone no dramatic technical changes.

Careers

If the more technical details were soft-pedalled in the "domestic" part of the Show, the same statement could not be made for the exhibits on the stands in the Careers and Services area on the first floor. A particularly well designed and well presented exhibit was devoted to television fault finding. Inside a glass case a working television chassis was seen alongside a c.r.o. displaying the waveform at its video output stage. By means of press-buttons on the outside of the case it was possible to "select" typical faults, such as loss of sync, etc., whereupon these were at once exhibited by the receiver and the oscilloscope. A similar exhibit utilised a Murphy receiver switched to one of the programmes piped through Earl's Court. This receiver exhibited faults which were selected sequentially by an automatic control box.

The Radio Society of Great Britain laid emphasis on home-construction at their stand, items shown ranging from a complete transmitter to a simple one-valve receiver. An interesting exhibit here was a three-stage do-it-yourself short wave receiver for the beginner. The first unit to be built consisted of a single valve detector stage which, on its own, formed a complete receiver. R.F. and a.f. add-on units could then be added later as and when required. Also to be seen on the R.S.G.B. stand were two 10 metre walkie-talkies which gave evidence of considerable attention to mechanical as well as electrical detail.

An interesting device, also in the Careers area, consisted of a crystal-controlled clock which required only a small frequency control unit (some eight or nine inches cube), and whose cost should be low relative to its timekeeping accuracy. The crystal was a 100 kc/s unit, four successive binary stages dividing this frequency down to 50 c/s. The 50 c/s frequency was then amplified and applied, push-pull, to the motor windings of a synchronous clock. The clock itself was a standard Smith's model intended for operation from synchronous a.c. mains, the only modification carried out being that the motor had been rewound to accept the low voltage output of the crystal control unit. The binary stages and amplifier in the control unit were transistorised, the transistors employed being twelve Mullard OC71's and two Mullard OC72's.

Another item of transistorised equipment was a three-stage a.f. amplifier employed on one of the G.P.O. stands for the purpose of locating a particular "pair" in a multi-conductor telephone cable. The stand was made up as a replica of the familiar "hole in the road" scene wherein G.P.O. engineers may be seen sorting their way through large numbers of wires; and visitors were invited to try their skill at finding a particular pair themselves. The procedure involved consisted of first hooking a portable telephone on to any pair in the bunch being checked and of dialling a code number. This number connected the engineer to an oscillator at the exchange which put a continually repeated squegging oscillation on the line. The engineer then dialled the number corresponding to the pair he wished to trace, whereupon the squegging signal was fed to that pair as well. The next job consisted of switching on the transistorised a.f. amplifier and, with the aid of a probe connected to it via screened cable, locating the desired pair. It was necessary only to hold the probe near the cable in order to pick up the squegging tone, this becoming loudest when the probe was held on the pair being traced. The same transistor amplifier could be used to locate pairs even when they were completely screened inside lead sheathed cables. In this case a more sensitive probe was plugged into the amplifier and held against the lead sheathings of the cables being checked. The first probe, incidentally, was merely a test prod whose inner "hot" conductor was completely screened except for the tip.

Gadgetry

Both Standard Telephones and Cables, and Mullard, exhibited ingenious devices which fall into the category of "gadgetry" and which helped to make the Show more interesting for the technically-minded visitor or, indeed, for the non-technical person who is merely prepared to stand and stare.

The S.T.C. exhibit consisted of a machine on which a game of electronic snakes and ladders could be played. "Shaking the dice" for each move was carried out by pressing a button, whereupon a system of relays and uniselectors selected a figure which was shown as a number of illuminated spots corresponding to the spots on a dice. The appropriate move on the "board" was then carried out, also by illuminated spots. Ascent up ladders and descent down snakes was handled automatically by the uniselector circuits.

The Mullard exhibit included quite a few gadgets, one of these consisting of what was called "The Gambler's Dice." With this device a dice was made to jump in the air at the sound of a hand-clap near a microphone. The impulse causing the dice to be thrown was provided by an electromagnet under its platform, this being energised momentarily by the hand-clap. It was possible for "sixes" to be thrown to order, these being controlled by a stand attendant carrying a transistorised pocket transmitter. By means of this transmitter the attendant could cause the electromagnet to be continually energised. The dice, incidentally, was a cube of Magnadur magnetised so that the poles occurred at the "one" and "six" faces.

A more ambitious Mullard display was provided by a number of electronic "beetles" whose movement on a glass platform could be controlled by means of lights placed above them. Each beetle consisted of a small framework on wheels driven by a motor which received its power from a 6 volt battery. Also supplied by this battery was a phototransistor circuit. The phototransistor was mounted at the top of a rotating neck coupled to the steering mechanism of the beetle. When the phototransistor became energised by a light source a clutch mechanism stopped further rotation, with the result that the beetle moved towards the light. By moving the angular relationship between the neck holding the phototransistor and the steering mechanism through 180 degrees the reverse effect could be obtained, the beetle this time moving away from the light source. A setting between these two extremes would cause the beetle to approach a light source with a sideways movement and then circle around it. In the Mullard exhibit a number of lamps were suspended above the platform on which the beetles moved, these being switched on or off individually at intervals.

Test Gear Kits

Mention should be made in this report of the fact that the Cossor Instruments range of home-constructor test gear kits now includes a double-beam oscilloscope. Labgear have also entered this field and have kits available for an oscilloscope using printed circuits, a 1,000 ohms-per-volt multi-range testmeter and an a.f. power output meter.

A final point which is worthy of emphasis is that home-constructors wishing to meet fellow-devotees of the hobby could do so at the Mullard Home Constructor Centre, where examples of equipment built to Mullard design were to be seen and where questions were answered quickly and comprehensively. This latter fact was demonstrated very forcibly to the writer who spent quite a lot of time at this stand, and who heard some of the really difficult posers that were raised by visitors!

SOUND ONLY

A suggestion for those who depend on batteries

by **A. S. CARPENTER**

A FAIRLY LARGE PERCENTAGE OF BRITAIN'S population still rely on dry (and sometimes wet) batteries to provide them with radio entertainment and, generally speaking, for them television is out of the question. There seems no reason, however, why they should not enjoy t.v. sound at any rate, and to assist them the circuit shown in Fig. 1 is offered merely as a suggestion.

The valves required are in cheap and plentiful supply, and the fact that they have 2V filaments presents no difficulty if they are connected series-fashion and fed from a 4.5-volt two-terminal battery via a limiting resistor.

A super-regenerative detector can be successfully employed as its poor selectivity characteristic is of no consequence, rather an advantage, as a fairly wide bandwidth is desirable. Nor does the quality of the output matter particularly, as few existing battery receivers give undistorted output.

An undesirable feature of this kind of detector is its ability to radiate, and on no account must an aerial be connected to its input direct. Radiation can, indeed, take place even when no aerial is connected, and adequate screening is a *must*.

A layout is suggested in Fig. 2—an under-chassis diagram. It will be noted that all components capable of radiating are effectively screened by the chassis box. V_2 is mounted horizontally, and as a further precaution a plate of 16 swg aluminium should be firmly bonded across the bottom of the chassis on completion, so that a closed-in construction results. Holes drilled in the chassis sides will ensure ventilation. A top-of-chassis diagram is not shown, as only V_1 and L_1 (shown dotted) will be visible. While V_1 does contribute to the gain, its main purpose is to act as a buffer between the aerial and V_2, and it should not be omitted.

Coils may be wound on $\frac{3}{8}$in Aladdin formers, iron dust cored, using 22 swg enamelled copper wire, the turns spaced from each other slightly. Six turns were found suitable for Channel 5, but variations in wiring, etc., may possibly necessitate some deviation from this figure. Initially 7–8 turns should be wound on, and turns removed one at a time until the desired transmission is heard. The primary of L_1 consists of 2 turns of P.V.C. covered wire wound over the earthy end of the secondary winding. Alternatively, ready-made coils may be used and suitable types are obtainable from Osmor, Denco, Teletron, etc.

The chokes are easily made by winding a length of fine wire on a $\frac{1}{4}$in mandrel. The length is readily calculated in the case of a quarter-wave choke by multiplying the quarter wavelength by ten and winding on this number of inches. For example, if 1 metre = 40 inches (actually 39.37in) and the working wavelength is 5 metres, then

$$\text{Length} = \frac{40}{4} \times 5 = 50 \text{ turns.}$$

Component List

Capacitors	
C_1, C_2, C_7	1,000pF
C_3	10pF
C_4	100pF
C_5	500pF
C_6	0.5–2μF
Resistors	
R_1, R_2	10kΩ
R_3	270kΩ
R_4	27kΩ
R_5	100kΩ potentiometer
R_6	10Ω
Valves	
V_1	VP23 = ARP 12
V_2	VP23
Coils (see text)	
Miscellaneous	

Valve bases: Mazda Octal (2). Chassis 6in × 5in × 2$\frac{1}{2}$in plus base panel. Chokes (see text). Co-axial plugs and sockets (2) Belling-Lee. S_1: on/off toggle switch. H.T. Battery 90V. L.T. Battery 4.5V. One control knob. Nuts, bolts, etc.

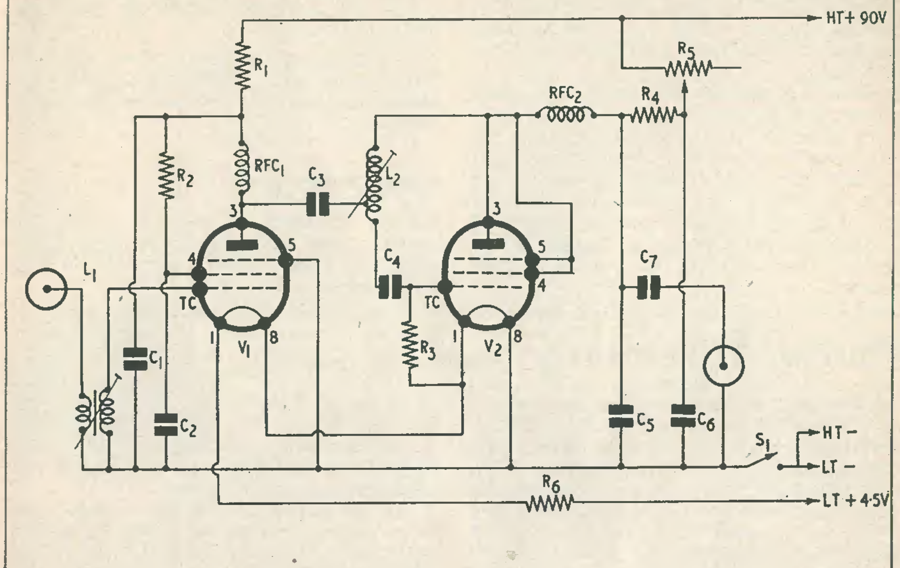


FIG. 1.

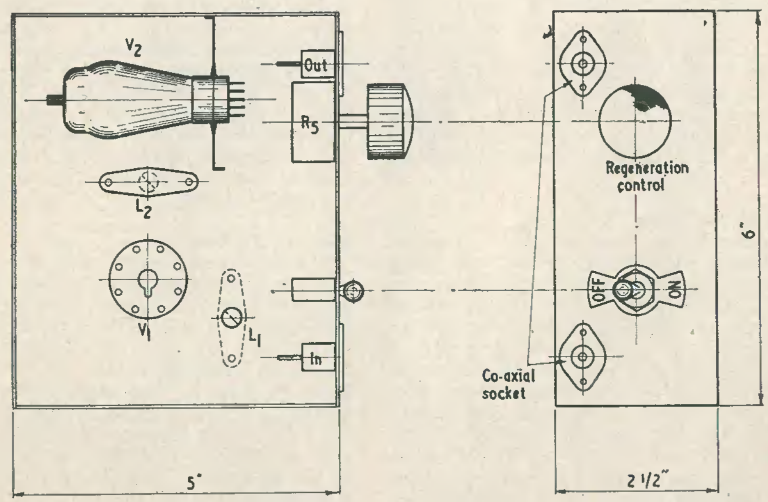


FIG. 2.

The approximation is near enough for practical purposes.

Output is available via a co-axial socket and may be fed into the gram sockets of an existing receiver. If no such sockets exist, connection can be made to the grid pin of the l.f. valve.

Initial adjustments are best made using phones, and in areas of good signal strength 7–8ft of aerial wire connected directly to the top cap of V_1 will suffice. A loud hiss should be heard when the receiver is switched on, the strength of which is adjustable by means of R_5. This hiss disappears entirely when the transmission is received, the strength of the signal being sufficient to render it non-existent.

L_2 should receive attention first. Should no signal be heard at any core setting, a reduction in the number of turns is necessary—this will only apply when the coils have been self-wound.

Once the signal has been resolved, attention can be turned to L_1, and with a proper dipole aerial connected, this coil may be adjusted to resonance.

Constructional Note

Keep all leads as short and direct as possible, and use also only high grade capacitors—paper types are useless at high frequencies.

Radio Miscellany *(continued from page 185)*

the second he used a 10-way tagboard to hold all the resistors and capacitors in a neat row, thinking it would make the under-chassis look really ship-shape and Bristol fashion. His original model had these small components wired-in point to point. He says it took him over twice as long to wire up, and many of the leads were lengthened by several inches! Actually this often happens in amateur assembly. The great virtue of tagboards is that, in mass production, sub-assemblies can be completed *before* they are fitted to the chassis. Wiring them after they are mounted in a small chassis can often be a tricky business. From the point of view of the constructor who is habitually rebuilding, they possess a very solid virtue—resistors, etc., which have been stripped from something else and have only a quarter of an inch of their original wiring left can be used again without having a lot of knobbly joints all over the place!

On with the Show

Another Radio Show has come—and gone—but as in recent years it was once again, from a constructors' point of view, little more than a furniture exhibition. Older readers will well remember the time when Radiolympia was an exciting event with lots of interesting things to see and a number of samples to collect—perhaps even a couple of cardboard valves! When home construction was at its peak and the Mullard Master Three, the Cossor Melody Maker, the Osram Four, etc. were all the vogue, interested enquirers were given packets containing the wire needed to complete them, each piece cut to length with neatly hooked ends to fasten to the terminals as per pictorial plan. Whether you used them for that particular purpose was a matter for your conscience. Even the complicated receivers of that period could be wired in an hour or so, and keen types stripped down and re-wired with slight variations a couple of times a week. Nicely tinned wire was thus very acceptable, and consciences are easily salved.

For the constructor the R.E.C.M.F., a far more recently introduced affair, has greater attraction. This, however, comes in the spring when interest is less keen than in the autumn, and is primarily for the trade, so it has never achieved great importance in the radio amateurs' calendar. The major event for us has been the R.S.G.B. Exhibition, although there has always been a widespread feeling that this was for the very advanced constructor or the transmitting amateur. It is a pity that this impression has been allowed to grow so firmly entrenched. True, the R.S.G.B. has pointed out several times that their exhibition was not concerned solely with the transmitting fraternity, but it seems that nothing but a vigorous campaign could obliterate the idea.

Showing the Flag

The constructor again comes into his own with the Radio Hobbies Exhibition, which is being held at the Royal Horticultural Old Hall from 23rd to 26th October, when home construction is the *main* theme. This exhibition takes the place of the Annual R.S.G.B. event. The significance is not merely the change of name. Rather, the name more accurately describes its widened scope and, although it is under the management of a well-known transmitting amateur, the Amateur Transmitter side of it is, rightly, just one of the important aspects.

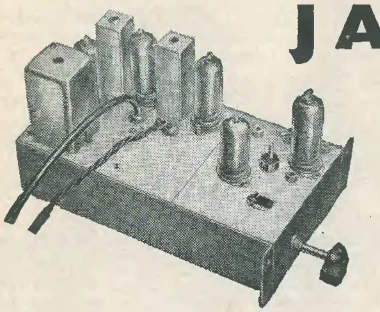
Phil Thorogood, G4KD, who is managing it, has had great experience in exhibition work, and apart from his keen v.h.f. activities he has been prominently connected with local club affairs and the radio world generally.

CLYNE RADIO LTD.

All correspondence to
162 HOLLOWAY ROAD
LONDON · · N7
NORth 6295/6/7

18 TOTTENHAM COURT ROAD LONDON W1
(50 yards only from Tottenham Court Road Tube)
MUSeum 5929/0095

Monday-Friday 9-6 p.m.
Saturday 9-1 p.m.



JASON
SWITCH TUNED FM FEEDER KIT

(AS DESCRIBED IN THIS ISSUE)
Designer approved kit

This excellent unit enables the selection of Home, Light or Third programme at the touch of a switch. Complete freedom from drift is ensured by the incorporation of Automatic Frequency Control. When used in conjunction with a suitable amplifier superb quality is obtainable. The highest standards of efficiency and reliability that are the well-known features of the Jason Standard and Fringe Model FM Tuners have been maintained.

Up to the time of going to press a special price for the complete kit has not been finalised. However, as usual, we shall be offering this kit at a most competitive price. Send 2/- for our itemised price list and the instruction book.

STOP PRESS—Price just announced — Complete kit £9 . 19 . 6 P. and p. 2/6

IMPORTANT ANNOUNCEMENT

Our **NEW BRANCH** is **NOW OPEN** at
162 HOLLOWAY ROAD LONDON N7 Telephone NORth 6295/6/7

Situated approximately half-way between "Nags Head" and Highbury Corner. One minute from HOLLOWAY ROAD and DRAYTON PARK Tube stations. Two doors from the NORTHERN POLYTECHNIC. Early closing Thursday at 1 p.m. Open all day Saturday until 5.30 p.m. The service that we are noted for at Tottenham Court Road is available! Old and new friends welcome.

ALL MAIL ORDERS and **CORRESPONDENCE** in future to **HOLLOWAY ROAD** please.

JUST ARRIVED! Further limited quantity of Acos HGP37 crystal pick-up inserts complete with sapphire stylii, suitable for B.S.R. Monarch, etc. Brand new, only 18/6 and 9d. post and packing.

We carry the most up-to-date and comprehensive valve stocks in London at most competitive prices. Send stamp for list.

Our new 109 page comprehensive catalogue is now available at 2/- post free. Containing invaluable information on our kits of parts, chassis, components, transistors, loudspeakers, cabinets, etc., etc. This book is a "must" for all constructors ! ! !

The sign assuring you of IMMEDIATE and CAREFUL attention

The Bennett College can make you an expert TV technician
—IN YOUR OWN HOME!

Here's your big chance! The Bennett College, famous the world over for its first-class postal tuition, now offers you a course in Television Servicing. Right away you can start adding to your knowledge of television repairs and maintenance, increasing your technical ability—and making a sound investment for your future.

Studying with The Bennett College is a pleasure. You work in your own home, as quickly—or as slowly—as you like. Your personal tutor at the College sends you your lessons—and gives you his friendly help based on years of teaching experience. The College guarantees to continue teaching you until you reach the standard you wish—and all your text-books are provided free of charge.

Send for a free prospectus to-day! *Just fill in the coupon opposite and post it off—The Bennett College will send you a prospectus free of charge and without obligation.*

To THE BENNETT COLLEGE (Dept. J.162), SHEFFIELD

Please send me free of charge and without obligation, a copy of your prospectus on

SUBJECT/S ....

NAME ....

ADDRESS ....

....

AGE (if under 21).......... *Please write in block letters*

EXCELLENT COURSES in the following subjects are also offered by The Bennett College. Write on your coupon the course that interests you.

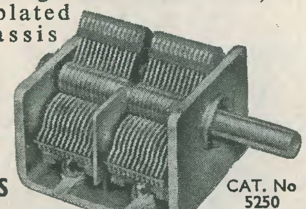
ELECTRICAL ENGINEERING — **RADIO ENGINEERING**
ELECTRICAL WIRING — **TELECOMMUNICATIONS**
POWER STATION ENGINEERING

PRECISION-BUILT COMPONENTS

JACKSON
'O' GANG CONDENSER

Miniature model in 1 or 2 gang, capacities up to 365pF swing, front area $1\frac{3}{8}$" x $1\frac{17}{32}$" including sweep of vanes, length 1 gang 1", 2 gang $1\frac{3}{4}$", spindle $\frac{1}{4}$" dia. x $\frac{5}{8}$" long. Aluminium vanes, cadmium plated steel chassis

1 gang 7/6
2 gang 11/6



CAT. No 5250

It's Reliable If It's Made By JACKSONS

Please write for illustrated catalogue

JACKSON BROS. (London) Ltd.
Kingsway . Waddon . Surrey *Phone* CROydon 2754/5

No Resistance with ERSIN MULTICORE SOLDER

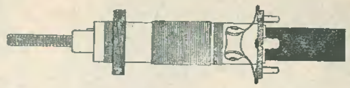
One imperfectly soldered joint can ruin reception and frustrate hours spent in assembly work. Be sure you use Ersin Multicore Solder on all connections in your equipment. Five cores of extra-active, non-corrosive Ersin flux, prevent oxidation, *clean* surface oxides and eliminate 'dry' and H.R. joints. The Size One Carton gives you waste-free, trouble-free soldering without the need for extra flux. Get a carton today—and ensure good reception.

SIZE 1 CARTONS 5/- RETAIL

Catalogue Ref. No.	Alloy Tin Lead	S.W.G.	App. l'gth per carton
C 16014	60/40	14	19 feet
C 16018	60/40	18	51 feet
C 14013	40/60	13	17 feet
C 14016	40/60	16	36 feet

MULTICORE SOLDERS LTD., MULTICORE WORKS, HEMEL HEMPSTEAD, HERTS (BOXMOOR 3636).

TELETRON Type FX.25



Self-tuned, dual wave Ferrite rod aerial. **15/– each**

Specified for the "Companion" 3 Transistor regenerative pocket receiver.
Type 24 Inductor ... ... **3/6** each

TRANSISTOR I.F. TRANSFORMERS

High Q "potted" construction, with Ferrite screw cores. Mounted in screening cans 1" x $\frac{3}{4}$" dia., **6/6** each. Oscillator coil, **6/6**. Transistor type Ferrite rod aerial for MW band, **10/–**. Selective crystal diode coil type HAX, **3/–** each. Type HAX.L (for LW band), **3/6**. Dual wave TRF coils, type A/HF, matched pair, **7/–**, with adjustable iron dust cores.

FERRITE ROD AERIALS

Wound on high permeability Ferroxcube rod. No external aerial required. Full sensitivity. Ideal for battery portable receivers. Medium wave, type FRM 4" x $\frac{5}{16}$", **8/9**. Dual wave type FRD, 8" x $\frac{5}{16}$", **12/9**. Miniature R.F. Chokes, wound on iron dust cores, with wire end terminations. 2.5 and 5mH, **3/–** each; 10mH, **3/6**. 200mH top lift Inductors, **6/6** each. Bias rejector coils, **4/6** each. Tape oscillator coils for push-pull operation, **8/6** each.

Send 5d. in stamps for complete data and circuits. All types available from advertisers in this Magazine and local component stockists.

THE TELETRON COMPANY LIMITED
266 Nightingale Road . London N9
Telephone HOW 2527

Trade enquiries to sole distributor
S. Mozer Ltd 288 Hedge Lane N13 *Telephone* PAL 1748 *or* EDM 7707

DB5 TV FAULT FINDING

Profusely illustrated with photographs taken from a televisor screen depicting the faults under discussion, and containing a wealth of technical information, with circuits, enabling those faults to be eradicated. Both B.B.C. and I.T.A. transmissions are covered.

PRICE 5/- Postage 5d. **Data Publications 57 Maida Vale London W9**

Get your new Test Set by return of post on the easiest of terms. Write for descriptive literature.

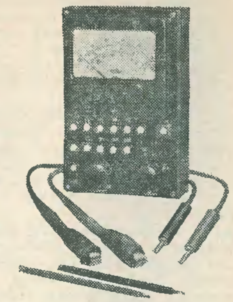
PULLIN MULTI-RANGE TEST SETS

MINIATURE

19 ranges a.c./d.c., from 200 microamps to 1,000 volts. Sensitivity 5,000 ohms per volt.

£2.0.0 deposit and nine monthly payments of 19/6

Cash price £9.15.0 complete

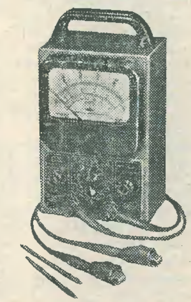


SERIES 100

21 ranges a.c./d.c., from 100 microamps to 1,000 volts. Sensitivity 10,000 ohms per volt.

£2.10.0 deposit and nine monthly payments of £1.4.6.

Cash price £12.7.6 complete



HOME RADIO (Mitcham) LTD.
187 London Rd Mitcham Surrey
Telephone MITcham 3282

TRANSISTORWISE

"RECO" TRANSISTOR ONE

Make this simple little set up in about 30 minutes. Complete kit including transistor, diode, super sensitive phone and neat plastic case, 27/6, post and packing 2/–; nothing else to buy. Parts price list, etc., 9d. plus S.A.E.

"RECO" EXPERIMENTER'S KIT

All parts, transistors, diode, transformer, high-Q frame aerial mounted on metal base plate $5\frac{3}{4}$" x$3\frac{3}{4}$", set of coils for short wave listening, balanced armature output unit, etc., 47/6, post and packing 2/–. Parts price list and circuit, 9d. plus S.A.E.

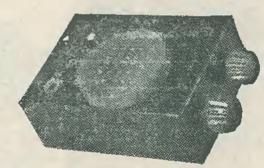
"RECO" TWO

Receives home and continental stations. Neat plastic case $4\frac{1}{2}$" x $4\frac{1}{2}$" x $1\frac{1}{2}$". Complete with balanced armature output unit. Parts price list, etc., 9d., plus S.A.E.

The RADIO EXCHANGE CO
(Dept. RC)
NEWPORT PLACE LEICESTER SQUARE
LONDON WC2 GER 2613
CLOSED SATURDAY

The Teletron "COMPANION"

Three transistor pocket receiver

★  ★

COMPLETE KIT (as spec.) **£4.15.0**
(See our advert September issue)

List of components, circuit diagram, etc. **9d.**

Bridisco crystal sets in attractive bakelite cases (various colours)	19/6
Headphones for above, 125 ohms resistance	12/6
2 pairs for	24/–
Suitable all purposes (worth treble)	

Teletron ferrite aerials:	
Medium wave, type FRM	8/9
Dual wave, type FRD	12/9
Teletron I.F. Transistor Transformers each	6/6
(Complete range of Teletron coils in stock)	
Postage and packing on above items,	1/–

ELEC-RADIO
172a BLACKSTOCK ROAD HIGHBURY
LONDON N5 *Telephone* CANonbury 1672
Callers Welcome

A.C. Superhet 5-valve Chassis, Medium and two short, unused, but less valves and mains transformer. Uses standard Octal range. **27/6.** (Again, coil pack worth much more.) Non-callers add 6/6

A.C. Superhet 7V 5-Waveband Chassis. H.F. stage. Unused. Less valves and power pack. Slightly soiled. Coil pack worth twice as much, circuit diagram supplied. **£2.15.0,** carriage and insurance 7/6

A.C. 4-valve Superhet, complete with valves, but less scale and pointer, unused. Circuit diagram supplied. **39/6** plus. *Note that the above three chassis, although unused, will need checking. On account of low price, no guarantee is given. Nor, we regret, can technical assistance be given*

0.1μF 350V Small Tubular Metal cased Condensers. Made by Dubilier. **2/6** per dozen.

Germanium Diodes. B.T.H. with wire ends. **10d.** each or **9/–** dozen

Midget I.F. Coils. Dust cored, size 1¾" x 1", 465 kc/s. **4/6** pair

Standard Size. I.F. Coil. Dust cored, 465 Mc/s. **4/6** pair

Coil Pack for Superhet. 465 kc/s. I.F. Medium and 2 Short waves. **9/6**

Cathode-Ray Tube. VCR97. Instrument type. New **7/6** each, carriage 3/6

Bakelite 5 amp Electric Wall Switch. "Hicraft," **9d.** each, or **8/–** per dozen

Series, parallel and off-electric wall switch made by Crabtree. Price **1/3** each, or **13/6** per doz. *NOTE: Additional technical data is not available on these bargain items.*

Amplifier, ex-Government unit 1134 contains one double triode and one triode. **6/6,** post and ins. 2/6

Connecting Wire, P.V.C. covered 24 s.w.g. copper. **2/6** per 100ft, or 5 coils, different colours for 10/–

Scanning Coils by very good maker New and unused. **4/6** complete

10 v. Superhet, 1½ metre. Ex-Govt. but unused. Complete with valves. Easily converted for Band III. **39/6,** carriage and packing 7/6

Cathode-Ray Tube, VCR517. **8/6** each, carriage 2/6

Mains Lead. Metal screened to stop interference, **9d.** yard

Midget Push-pull Input Transformer and push-pull output transformer to match. **8/–** pair. *NOTE: Orders for small components over £2 are post free, otherwise please add sufficient.*

AUTO-CHANGER 30/- DEPOSIT

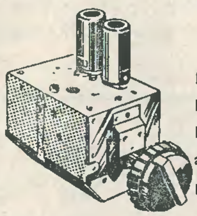
3-SPEED & 4-SPEED GRAMOPHONE AUTO-CHANGER

Latest types by all famous makers are invariably in stock at competitive prices. B.S.R. Monarch, Garrard, etc. Latest models from **£8.10.0,** or deposit **£1.10.0** and 8 payments of **£1** plus 5/– carriage and insurance.

THIS MONTH'S SNIP

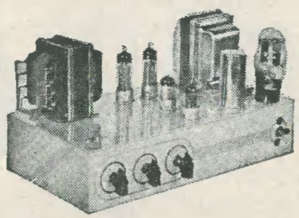
Tape Deck—Made by the famous Truvox Company. This contains exactly the same essentials as the current model. Only the styling is different. It also takes the stereophonic head.

Specification: 3 B.T.H. shaded pole motors with silent friction drive eliminating wow and flutter. Push-button controls, electrically and mechanically interlocked. Patented electric type push-button controlled brake. Tape loading on the drop-in principle, accommodation for reels of 7" diameter. Tracking sense to British and American standards. Playing time: up to 3 hours with L.P. Tape or 2 hours with L.P. Tape or 2 hours with Standard Tapes. Two tracks side by side with safety gap. Positive Azimuth adjustment of Record/Player head. High impedance heads. Overall size 14½" x 12¾" x 5" approx. 120 only of these fine decks offered at non-repeatable price of **£17.10.0 or £3.10.0** down and eight monthly payments of **£3.** Non-callers add 10/– carriage and insurance.



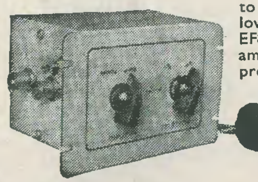
TURRET TUNER

Brand new stock, not surplus, with coils for Band I and III, complete with valves PCC84 and PCF80—I.F. Output 33/38 Mc/s with instructions and circuit diagram **79/6.** With knobs **3/6** extra, post and insurance 2/6



MULLARD AMPLIFIER

A Quality Amplifier designed by Mullard. Power output exceeds 10 watts. Frequency response almost flat from 10 to 20,000 c.p.s. For use with the Acos "Hi G" and other good pick-ups. Made up and ready to work is **£12.10.0** or **£1.10.0** down and 8 payments of **£1.10.0,** plus **10/–** carriage and insurance.



MULLARD PRE-AMP. We are pleased to offer as a ready-made unit. It uses the low hum/noise high gain pentode type EF86. It takes its power supply from the amplifier and incorporates 2 switches to provide immediate compensation, for radio, microphone, L.P. and 78 records. The price of this unit is **£4** post and insurance 3/6 extra. Or **10/–** down and 9 payments of **10/–.** If purchased with above, combined price is **£16** or **30/–** down and 8 payments of **£2.**

ELECTRONIC PRECISION EQUIPMENT LTD

POST ORDERS SHOULD BE ADDRESSED TO DEPT. 34, 66 GROVE ROAD, EASTBOURNE

Personal shoppers, however, can call at:

266 LONDON ROAD CROYDON
Telephone CROydon 6558 Half-day Wednesday

42/46 Windmill Hill Ruislip Middlesex
Telephone RUIslip 5780 Half-day Wednesday

152/3 FLEET STREET EC4
Telephone FLEet 2833 Half-day Saturday

29 Stroud Green Road Finsbury Park N14
Telephone ARChway 1049 Half-day Thursday

High "Q" Coils

4/– EACH

Iron dust cores. Clip in fixing. EXTREMELY SMALL

AMAZING EFFICIENCY

For Superhet T.R.F. or Transistor operation.

OSMOR

(Frequency Controlled) F.M.

Switch-tuned Feeder

With special quick-build chassis

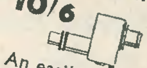
A completely stable drift-free unit for adding to existing radio or Hi-Fi amplifier

EASY TO BUILD Size 4¼in x 5¼in

Wiring diagram and circuit on request.

STOP!

T.V. Patterning 10/6



An easily fitted—Simple Remedy

OSMOR COILS AND COMPONENTS AVAILABLE FOR THE FOLLOWING PUBLISHED CIRCUITS

Wireless World	*Practical Wireless*	*The Radio Constructor*
F.M. Tuner (Amos)	High Quality B'cast Rx.	TRF Tuner
Economical Rx.	Alternative Superhet	3 plus 1 Superhet
Reflex Push-pull Rx.	Modern Battery Superhet	Hi Q Pre-set push-pull
2-v Superhet	7-5 Push-pull Superhet	Transistorette
Car Radio	Car Radio	Progressive Rx.
Transistor Portable (Amos)	Crystal Tuner	Whistle Filter
Bedside Rx.	Autoradiogram	S.W. Rx.
Sensitive TRF Rx.		Band III Converter

WE HAVE A FULL RANGE OF COILS FOR TRANSISTOR CIRCUITS

OSMOR COILS FOR HIGH "Q"
SELECTIVITY & PERFORMANCE

OSMOR

FREE! Send 10d. (stamps) for fully descriptive literature including OSMOR DESIGNS—5-Valve Superhet, Miniature ditto, Battery and Battery/Mains Receiver, Mains T.R.F. Superhet and T.R.F. Feeders. Band 3 Converters, Wiring Diagrams, Chassis Templates, Coil and Coilpack information and price lists and information on circuits in *Wireless World, Practical Wireless, The Radio Constructor*

(Dept. RC15) 418 BRIGHTON ROAD
SOUTH CROYDON · SURREY
Telephone CROydon 5148/9

ENTIRELY NEW RANGE SUB-MINIATURE CAPACITORS

Available for the first time in this country, these are the product of a famous manufacturer. The following values are now in stock:

25μF 6V	8μF 6V
16μF 12.5V	5μF 12.5V
8μF 25V	1.6μF 6V

All at 4/– each

Trade enquiries invited

T.C.C. Sub-miniatures. 32μF 1.5V, 6μF 3V, 10μF 3V, 2μF 12V, 4μF 12V, 8μF 15V **all 4/9 each**

TRANSISTORS

Red Spot (equiv. OC71) **10/–,** R.F. Blue Spot (1.6 Mc/s) **15/–. Superior type** (packeted with data): Audio **11/–** each, R.F. (2.8 Mc/s) **21/–** each

THREE DEE KIT ... ... (Instructions 1/–)	**£5.2.6**
COMPANION KIT ... ... (Instructions 6d.)	**£5.6.6**
RADIOSETTE KIT	**£2.3.0**
All parts sold separately	*Price lists available*

TRANSISTOR HOLDERS. Enable transistors to be plugged in and out like valves, without danger from heat of soldering iron. For any type of transistor. Recommended by R.C. (June). **1/–** each, **6** for **5/6, 12** for **10/9**

CHASSIS CONSTRUCTION KIT IDEAL FOR THE EXPERIMENTER

Consisting of 11 pairs of aluminium channels, which can be put together to make chassis of almost any size. Can be used over and over again. Complete in stout box **30/–**

TYGAN—the non-creasing, fadeless, washable speaker fabric in 6 distinctive patterns. Approx. **3/9** square foot. Send **1/–** for samples and quotation for size you require (credited on return). See page 840 of July issue.

LITESOLD SOLDERING IRON. The smallest made, 6" long, weighs ½oz. With ⅛" permanent non-wearing bit. Ideal for transistor assemblies, **21/6** (state voltage). Available for mains or 6 volts.

MULTICORE SOLDER, 4d. per yard (50/50)* 20ft reels (60/40 high tin), **2/6**

*This is the new "SAVBIT" solder, which prolongs the life of the bit up to ten times. Also available in 1lb reels at **14/9**

MULTIWAY CONNECTORS

A range of 5 and 7-pin plugs and sockets, capable of up to 3 amps per pin at mains voltage, and with low contact resistance.

5-pin plug and socket complete	4/–
7-pin plug and socket complete	5/–

Please state flex plug/chassis socket or chassis plug/flex socket.

ALL JASON PARTS STOCKED. SEND FOR LISTS

Send for Catalogue price 5d. *Please add postage to above prices*

R. FAGELSTON (MAIL ORDER) 46 HARDWICKE ROAD LONDON N13

HENRY'S
(RADIO) LTD

5 Harrow Road Edgware Road
Paddington London W2

Opposite Edgware Road Station

PADdington 1008/9

OPEN MONDAY to SAT. 9–6 THURS. 1 o'clock

SEND 3d. FOR 28-PAGE CATALOGUE

TRANSISTORS
JUNCTION TYPE P-N-P
(British Manufacture)

RED-SPOT 800 kc/s Audio Frequency ...	10/–
BLUE SPOT 1.6 Mc/s Mixer and Frequency Changer	15/–
WHITE-SPOT 2.5 Mc/s R.F. and I.F. Amp.	20/–

All Transistors are Tested and Guaranteed

N.B.—The Red-Spot is similar to Mullard OC71

Transistor Bases **9d.** each

TRANSISTOR PUSH-PULL AUDIO AMPLIFIER
(200 Milliwatts Output)

Build this Push-Pull Amplifier which is ideal for Crystal or Magnetic Pick-up Amplification, Baby Alarm, Microphone Amplifier, etc. Powered by 6-volt Dry Battery lasting for months. **Complete Kit of Parts including 4 Transistors and all Components with Circuit (less Speaker), £4 . 10 . 0**

COLLARO RC456
4 speed auto-changer. Latest type with crystal turnover pick-up **£9 . 15 . 0**

TRANSISTOR SIGNAL TRACER
Complete Kit with 2 Transistors, components, phones, with circuit and plastic case **42/6**

TRANSISTOR SQUARE WAVE GENERATOR
Complete Kit with 2 Transistors, Components, Circuit and plastic case **25/–**

DIODES

B.T.H. Germanium	1/6
Mullard OA74	2/6
IN21	3/6
1N22, 1N23, 1N21A	5/–

MODEL-MAKERS' MOTORS
Two types available, 12 or 24V with ¼" spindle, **10/–** each

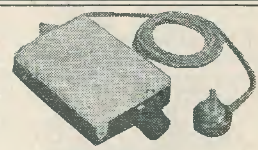
6V VIBRATOR PACKS
Output 120V 30mA. Brand new **12/6**

Valves — Valves — Valves

We have over 300 different types of British and American valves in stock. We give below new types that are available. Send for 28-page Catalogue for further details of valves, components, etc.

DK40	10/–	EF42	14/–	PL81	12/6	6AL5	9/–
DK92	9/–	EF80	9/–	PL82	10/–	6AM6	9/–
DAF96	10/–	EF85	10/–	PL83	12/6	6AQ5	10/–
DF96	10/–	EF86	12/6	PY81	10/–	6AU6	8/6
DK96	10/–	EF89	10/–	PY82	10/–	6BA6	8/6
DL96	10/–	EF92	9/–	PY83	12/6	6BE6	10/–
DM70	9/–	EL41	10/–	U25	14/–	6BW6	10/–
EABC80	10/–	EL42	10/–	UABC80	11/–	6C4	6/6
EAF42	12/–	EL84	11/–	UAF42	11/–	6U4	12/6
EBF80	11/–	EM34	10/–	UBC41	10/–	6X4	7/6
EBF89	11/–	EM80	10/–	UBF89	11/–	7C6	10/–
EBC41	10/–	EM81	11/–	UCC85	11/–	7Y4	9/–
ECF80	14/–	EM85	11/–	UCL82	15/–	12AH8	12/6
ECF82	12/6	EY51	10/–	UCH42	12/6	12AT6	8/–
ECC40	14/–	EY86	12/6	UCH81	12/6	12AT7	9/–
ECC81	9/–	EY91	10/–	UF41	10/–	12AU6	9/–
ECC82	9/–	EZ40	8/–	UF80	12/–	12AU7	9/–
ECC83	9/–	EZ80	10/–	UF85	12/–	12AX7	9/–
ECC84	11/6	EZ81	10/–	UF89	11/–	12BA6	9/–
ECC85	10/–	PABC80	15/–	UL41	10/–	12BE6	10/–
ECH42	11/–	N78	12/6	UL84	11/–	14S7	14/–
ECH81	11/–	PCF80	12/6	UY41	9/–	19AQ5	11/–
ECL80	10/6	PCC84	11/–	UY85	9/6	20L1	14/–
ECL82	14/–	PCF82	11/–	3A5	10/–	35W4	8/–
EF40	12/6	PCL82	12/6	3Q4	9/–	50B5	10/–
EF41	10/–	PCL83	15/–	6L18	12/6	50C5	10/–
						117Z3	8/6

All Valves Tested and Guaranteed



MINI-TWO
2-TRANSISTOR MINIATURE POCKET RADIO
(No Aerial or Earth)

The smallest transistor set offered on the market. Variable tuning. Drilled chassis, plastic case size 3" x 2" x ⅞", miniature hearing aid, 2 transistors and all components including 1½ volt battery, circuits and full practical layout diagrams.

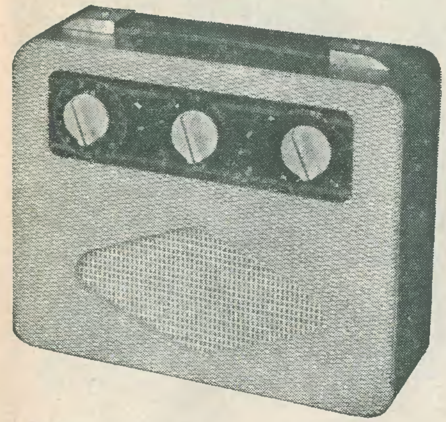
Total cost **49/6** complete

"HOMELIGHT"
2-TRANSISTOR PERSONAL PORTABLE
No Aerial or Earth required
Variable Tuning

We can supply all components including 2 transistors, diode, resistors, condensers and miniature hearing aid and plastic case, size 4½" x 2⅞" x 1⅝", and 1½V battery, for 52/6. All items sold separately

COLLARO RC/3/554
3-speed single player with crystal turnover pick-up type "T," £6.19.6, carr. 3/6. Brand new in original carton

The NEW "TRANSISTOR - 8"
Push-Pull Portable Superhet



This Portable 8-Transistor Superhet is tunable for both Medium and Long Waves and is comparable in performance to any equivalent Commercial Transistor Set. Simplified construction enables this set to be built easily and quickly into an attractive lightweight cabinet supplied.

Can be built for £11/10/–

TEN STAR FEATURES

- ★ 8 specially selected Transistors
- ★ 250 Milliwatts output push-pull
- ★ Medium and Long Waves
- ★ Internal Ferrite Rod Aerial
- ★ 7" x 4" elliptical High Resistance Speaker
- ★ Drilled plastic Chassis 8½" x 2½"
- ★ Point to point wiring and practical layout
- ★ Economical. Powered by 7½V battery
- ★ Highly sensitive
- ★ Attractive lightweight contemporary case

We can supply all these items including cabinet for **£11.10.0** All parts sold separately

Send for circuit diagrams, assembly data illustrations and instructions, and full shopping list **1/6**

N.B.—Pair o f OC72's supplied at additional cost of **40/–** Call and hear demonstration model

As featured in August issue and described on page 28

"EAVESDROPPER"
THREE-TRANSISTOR POCKET RADIO
(No Aerial or Earth required)

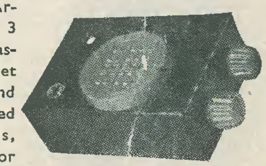
Variable tuning—medium wave. Total cost, as specified including Transistors, Transformers, Coils, Condensers and Battery, etc., with circuit, plastic case and battery.

All items sold separately **77/6** POST FREE

With miniature hearing aid	90/–
With balanced armature	82/6

THE TELETRON 'COMPANION'
THREE-TRANSISTOR POCKET RECEIVER
Medium and Long Waves No Aerial or Earth

Tuned R.F. Circuit. Ardente transformers. 3 transistors. Drilled plastic chassis and cabinet size 4½" x 3" x 1" and all components. Balanced armature, batteries, knobs and transistor holders.



Total cost **89/6**

ALL PARTS SOLD SEPARATELY

N.B.—Transistor Holders are supplied free with all kits and we would respectfully suggest you use same, both in order to protect the Transistors and to simplify testing, and only those sets using these Holders will be accepted for inspection and testing.

HENRY'S RADIO LTD · 5 HARROW ROAD · LONDON W2

CASH OR TERMS

12 MONTHS' GUARANTEE!!

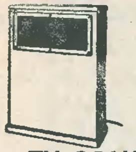
17" £7.10.0 **14" £5.10.0**

As supplied to the trade for the last seven years. Six months full replacement, six months progressive. Made possible by the high quality of our tubes. Ins. carr. 15/6.

SPECIAL OFFER of 14", 15", 16" TV tubes **£5**

CONVERT your 9", 10", 12" to above sizes. Information on how to "Do it yourself" in our FREE catalogue. Ins. carr. 15/6.

12" TV TUBES, with guarantee £6. Ins. carr. 15/6.



ELECTRIC CONVECTOR HEATER 99/6

Buy now before winter catches you on the hop! Hotter and cheaper than oil. A.C./D.C. Switched for 1 or 2 kW. Illuminated grille. Ins. carr. 10/6.

TV CONSTRUCTOR CHASSIS

SOUND AND VISION STRIPS, 25/6. Tested working, complete less valves. I.F.s 16-19.5 Mc/s. P. and p. 2/6. Drawing 2/6 or free with order.

POWER PACK, 29/6. 6-10kV R.F. E.H.T. unit included. Tested working, less valves. Drawing 2/6 or free with order. Ins. carr. 5/-.

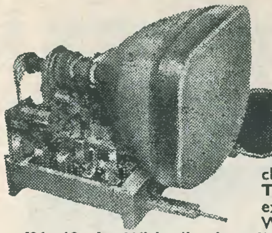
TIME BASE, 15/6. Tested working. Inc. focus unit, etc. Less valves. P. and p. 3/6.

8" P.M. SPEAKERS, 8/9. Have one in every room! With o.p. trans. 10/-. P. and p. 2/9.

Send for our free 1958 catalogue

Open Saturday all day

TV CHASSIS BARGAIN — £19.19.6



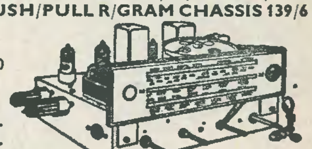
Latest improved circuits. Higher e.h.t. (brilliant picture). Improved sensitivity (for greater range). Chassis easily adapted to any cabinet. 17" rectangular tube on adapted chassis. All channels. **Turret Tuner 50/-** extra. Less valves. With five valves **£21.19.6**. With all valves **£25.19.6**. Valve line-up (5 valves): 2 6D2, SN7G, 6P25, EL38. Others: 7 6F1's, EL38, 6L18. **12 months' guarantee** on tube, 3 months' guarantee on valves and chassis. Ins. carr. 25/- (incl. tube). State B.B.C. channel (and I.T.A. if turret required).

14" TV CHASSIS, TUBE & SPEAKER £13.19.6

As above with 14" round tube. Less valves. Guaranteed 3 months. With 5 valves **£15.19.6**. With all valves **£19.19.6**. Ins. carr. 25/- (incl. tube).

ARGOSY PUSH/PULL R/GRAM CHASSIS 139/6

8-valve
EBC41
ECH81, EZ80
2-EBF80, 2
EL42, EM34.
Latest models.
3 gram.
switched.

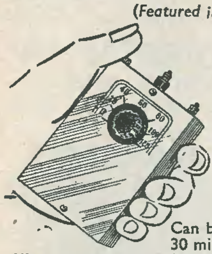


Full tone range, 4 knob control. Less valves. Ins. carr. 5/6.

DUKE & CO. (Dept. 1) 621/3 ROMFORD ROAD, MANOR PARK E12 *Telephone* ILF 6001-3

RADIOSETTE & NURSERYETTE

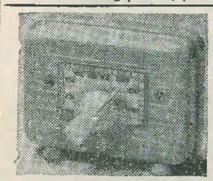
(Featured in June Issue)



The ideal low cost transistor pocket radio for the beginner. The circuit utilises the new R.C.S. VARILOOPSTICK transistor coil. A specially designed miniature .0004 tuning condenser permits the set to be in a case which fits the palm of your hand.

Can be built in 30 minutes **30/-**

All components are sold separately, full construction data including plan of parts, 2/-



The Nurseryette has been specially produced for those who require an attractive but inexpensive receiver for the children. It is safe to handle and will give months of service from the small battery included. The design includes the R.C.S. VARILOOPSTICK transistor coil and a miniature .0004 tuning condenser.

All components are sold separately, full construction data including plan of parts, 2/-

Postage: Under 10/-, 9d. Under 40/-, 1/6. Over 40/-, post free **30/-**

R.C.S. PRODUCTS (RADIO) LTD.
11 Oliver Road London E17 *Mail Order only*

G2ACC offers you . .

Quality Components for the **Radio Constructor**

EDDYSTONE – J.B. – DENCO
BELLING-LEE – REPANCO
WODEN – RAYMART
McMURDO – BULGIN – T.C.C.
RADIOSPARES – MULLARD
OSRAM – MAZDA – WESTING-HOUSE – AVO – AERIALITE
TELCON – HUNTS – ALADDIN
Q-MAX – ACOS – ROTHERMEL
CLIX – ACRU – COLVERN
SORAD – ETC.

All goods new and Guaranteed

For a square deal and prompt service remember

SOUTHERN RADIO and ELECTRICAL SUPPLIES
SORAD WORKS REDLYNCH SALISBURY
Telephone Downton 207

SMALL ADVERTISEMENTS

Readers' small advertisements will be accepted at 3d. per word, including address, minimum charge 2/-. Trade advertisements will be accepted at 9d. per word, minimum charge 6/-. If a Box Number is required, an additional charge of 2/- will be made. Terms: Cash with order. All copy must be in hand by the 8th of the month for insertion in the following month's issue.

PRIVATE

NEW SWITCH-TUNED FM unit with a.f.c. Gold Hammer front panel engraved Home, Light, Third. Selection by three-position switch. £10.10.0. Jason. FM unit with Jason dial, £8.10.0. Write for details Box No. E137.

AMATEURS! Four element beam aerial, cover four frequencies, £4. 5 Broadfield Avenue, Sheffield 8.

BARGAIN. Viewmaster 12in television, I.T.A. converter, attractive console cabinet, working order, £12 complete, or would separate. 202 Bexley Lane, Sidcup, Kent.

BC348. Good condition, fitted internal a.c. power pack, "S" meter and noise limiter, £12.10.0. J. J. Hollington, 1 Templeton Avenue, Chingford, E.4.

MINIFON Pocket Wire Recorder, not push button, microphone stethoscope, £22. R1155 with power pack and speaker, £4.10.0. AVO Signal Generator, £4. Write first, Treherne, 12 Lessar Avenue, Clapham, S.W.4.

CUTTER HEAD, as new. What offers? 8 Grafton Road, Cheltenham, Glos.

TAYLOR 65B Signal Generator, £5. Ultra service oscilloscope, £8. Both c/w manuals, etc. VCR139, new, boxed, £1. Walker, 19 Burleigh Avenue, Wallington, Surrey. WALL 5183.

"THE RADIO CONSTRUCTOR." Offers: part of Vol. 6; one short Vols. 7; 8 and 9 complete, also *Practical Wireless* bound Vols. 26, 28, 29 and Vol. 30 not bound; also odd copies of *Practical Wireless*. 36 Lindale Avenue, Royton, Lancs.

WANTED *The Radio Constructor* Vol. 6, No. 4, 1952. Prowse, 5 Tresluggan Road, Plymouth, Devon.

WANTED Standard textbooks on radio and mathematics. Terman, Zepler, etc., and telecommunications generally. Crawford, c/o Postmaster, Scotton Village, Catterick Camp, Yorks.

WANTED *Monitor* since August 1955. 95 Ramsden Road, London, S.W.12.

TRADE

BEGINNER'S MORSE RECORDS (L.P. 33⅓), complete course with booklet, designed to pass G.P.O. test at 12 w.p.m. easily. Only 45/-. Send P.O. now, course by return. 45 Green Lane, Purley, Surrey. UPL 2896.

TRANSISTOR P.P. Amplifier, 4 transistors, complete kit 75/-. Transistor 8 Superhet Portable, latest. circuit, etc., 1/6. Lists. Osmabet Ltd., 14 Hillside Road, Tottenham, London, N.15.

continued on page 215

NEW SURPLUS . . .

1A3	2/6	6Q7GT	9/6	830B	15/-	EM80	10/-
1LN5	4/-	6SA7M	7/6	866A	12/6	EY51	11/6
2A3	8/6	6SG7M	7/6	1616	7/6	EZ40	8/-
2X2	3/6	6SJ7M	7/6	1629	4/-	EZ80	8/-
3A4	7/-	6SK7M	6/6	DAF96	9/6	GZ32	10/6
3A5	9/6	6SL7GT	7/6	DF96	9/6	HK24G	25/-
3B7	6/-	6SN7GT	6/6	DK96	9/6	EY86	12/6
3D6	5/-	6SQ7M	7/6	DL96	9/6	KT33C	9/6
3Q5GT	9/6	6V6GT	8/6	DL33	9/6	PCC84	10/6
3Q4	8/6	6U4GT	12/6	EA50	1/6	PCF80	12/6
5B/254M	21/-	6X4	6/6	EABC80	10/-	PCF82	11/-
5R4GY	10/6	6X5GT	7/6	EAF42	10/6	PL82	9/6
5U4G	8/6	7B7	9/-	EB34	2/6	PL83	10/6
5Y4G	6/6	7C5	9/-	EB91	7/-	PCL83	12/6
6AC7M	5/-	7C6	9/-	EBC33	7/6	PY80	9/6
6AG5	3/6	7S7	10/-	EBC41	10/6	PY81	9/6
6AG7M	10/-	7Y4	8/6	EBF80	10/-	PY82	9/6
6AK5	5/-	12A6M	7/6	EBF89	10/-	R19	12/6
6AL5	7/-	12AT6	8/-	ECC82	9/6	SP61	3/-
6AM6	7/6	12AU6	9/-	ECC83	9/6	TT11	4/-
6AQ5	8/6	12AU7	8/6	ECC84	11/-	U25	12/6
6AT6	8/-	12BE6	8/6	ECC85	10/6	UAF42	10/6
6AU6	8/6	12C8M	7/6	ECF80	13/6	UBC41	10/6
6B8G	4/6	12J7GT	9/6	ECF82	11/6	UBF89	10/6
6BA6	8/6	12Q7GT	9/-	ECH42	10/6	UCC85	10/-
6BE6	7/6	12K7GT	9/-	ECH81	10/-	UCH42	10/6
6BR7	11/6	12SC7M	2/6	ECL80	10/-	UF41	10/6
6C4	5/-	12SK7M	7/6	EF36	4/-	UF89	10/6
6C5M	5/6	12SQ7M	8/6	EF37A	8/6	UL41	10/6
6F6M	6/6	12SR7M	7/6	EF39	5/-	UY41	8/-
6F8G	4/6	35L6GT	9/6	EF41	10/6	UY85	10/-
6G6G	4/6	35Z4GT	8/6	EF50(S)	5/6	UABC80	10/6
6J5GT	5/-	35Z5GT	8/6	EF55	7/6	VU39	9/6
6J5M	6/-	42	7/6	EF80	9/-	VR105/30	8/6
6J6	4/-	50L6GT	9/6	EF85	10/-	VR150/30	7/6
6K7G	5/6	80	8/6	EF89	10/-	VR116	4/-
6K8G	9/6	446A	12/6	EF91	7/6	VS70	3/-
6K8M	10/6	801A	10/6	EL32	4/-	XP1.5	3/-
6H6M	3/6	803	20/-	EL41	10/-	Z77	7/6
6L7M	7/6	805	30/-	EL84	10/6		
		808	25/-				

SPECIAL OFFER

Performance Meters No. 2. Comprising 230V 50 c/s mains trans. 250-0-250V 30mA 6.3V 1½A 5V 2A (60mA h.t. may safely be drawn), 20H choke, 5Z4, Y65 magic eye, 2 XEF50, 1 EC52, 1 EA50, dozens of components all in smart grey louvred case 10" x 9" x 9". Made by Parmeko. Brand new and boxed. Unrepeatable component value at only **37/6** each plus 5/- carriage (U.K. only).

Special Valve Offer. 6J6, 6AG5, EL32, TT11, EF39, 6G6G, 6B8G, EF50, **37/6** doz. 12SC7M, **21/-** doz.

Command Receivers BC454B. 3-6 Mc/s. Brand new in maker's cartons with 6 valves, **45/-** each, Few only used, good condition, 1.5-3 Mc/s, **55/-** each.

RF24 Units, 20-30 Mc/s. New with 3 SP61, **12/6** each, post paid.

Resistance Unit Type 231 with 12 heavy duty (10" long) 80 ohm carbon non-inductive resistors. Just right for the antenna match. **32/6** each, carr. paid.

M.C. Meters. 3¼" rd. fl. mtd. (2½" dial), 0-1mA, **26/-**; ditto but with very lightly damped movement and scaled 0-10, **18/6** each; 0-30mA, 0-250mA, 0-500mA, 0-2A, **13/6** each; 0-150V a.c. (1mA Basic with Rect.), **28/6**; 2½" rd. fl. (2" dial), 0-500µA, **17/6** each. All post paid.

Midget Mains Transformers (same size as std. spkr. o/p). Input 230/250V, o/p 220V 20mA, 6.3V 0.6A. Ditto but 175V 25mA, both types **11/9** each, post paid.

Whip Aerials, 4 section screw-in, 12' 6" long (part of BC610 whip), **15/6** each.

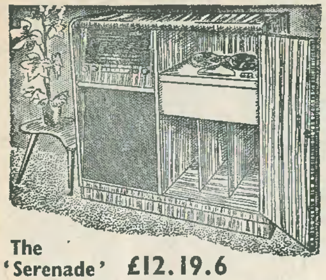
"PANL" Crackle Paint, 3/6 tin, post paid.

Jason FM Feeder Unit Kits (Local). All components, chassis, dial, instruction book, etc. **£5.5.0**, or with 4 valves, **£6.12.6**. Fringe version, **£6**, or with 5 valves, **£7.15.0**

Post 6d. *Free over £1 except where stated*

JOHN ANGLIN
385 CLEETHORPE ROAD GRIMSBY LINCS
Telephone 56315

CABINETS & HI-FI EQUIPMENT



The 'Serenade' £12.19.6

We can supply any Cabinet to your own specification

Veneered with finest selected walnut, beautifully polished to a medium shade; this attractive cabinet has generous storage space, with motor board sliding out smoothly on metal rollers.
We can also supply and fit this or any cabinet with the latest Hi-Fi amplifiers, tuners, transcription units, record changers, speakers, etc.

Send for comprehensive illustrated catalogue of cabinets, auto-changers, speakers, etc., all available on easy H.P. terms.

LEWIS RADIO COMPANY
120 (RC11) Green Lanes · Palmers Green · London N13
Telephone BOWes Park 1155/6

Radio Control Mechanisms by Raymond F. Stock

A new publication—and the first devoted entirely to the subject of radio control linkage mechanisms. Complementary to *Radio Control for Model Ships, Boats and Aircraft* and to other books on radio control.

64 PAGES — ART BOARD COVER — 70 ILLUSTRATIONS

First Edition . . . 4/6 plus 4d. postage

DATA PUBLICATIONS LTD
57 MAIDA VALE LONDON W9

QUALITY COMPONENTS

in stock for the
MULLARD 3 VALVE AMPLIFIER
MERCURY SWITCHED FM TUNER
and

510 AMPLIFIERS, FM TUNER circuits 3/6
912 AMPLIFIER, FM TUNER „ 4/–
RADIO CONSTRUCTOR FM „ 2/–
DENCO FM TUNER „ 1/6
G.E.C. "FM PLUS" TUNER „ 2/6
Price Lists available on request

J. T. FILMER
82 DARTFORD ROAD DARTFORD KENT
Telephone DARTFORD 4057

★ VALVES NEW TESTED AND GUARANTEED ★

1R5	8/6	6Q7GT	9/6	DK91	8/6	EF92	4/9
1S5	7/6	6SA7	8/–	DK92	9/–	EK32	8/6
1T4	7/6	6SL7GT	8/–	DK96	9/–	EL32	7/6
3S4	7/6	6SN7GT	8/6	DL92	7/6	EL41	10/–
3V4	8/6	6SS7	6/6	DL94	8/6	EL84	10/6
5U4G	8/6	6V6G	7/6	DL96	9/–	EL91	7/6
5Y4G	7/–	6V6GT	7/6	EA50	1/6	EY51	11/6
5Z4G	9/6	6X4	7/6	EB91	6/6	EZ35	8/–
6AG5	6/9	6X5GT	7/6	EBC41	9/6	EZ40	8/–
6AM6	8/6	12AT7	9/–	EBC33	8/6	KT33C	7/6
6AL5	6/6	12AU7	9/–	EBF80	10/–	KT66	11/6
6AT6	8/–	12AX7	9/–	ECC81	10/6	PCF82	11/–
6B8	7/6	12K8GT	10/6	ECC84	11/6	PL81	10/6
6B8G	7/6	12K7GT	8/6	ECF82	11/–	PL82	10/6
6BA6	8/6	12Q7GT	8/6	ECH81	10/6	PY81	10/6
6BE6	7/6	35Z4GT	8/6	ECH42	10/–	PCC84	11/6
6BR7	10/6	35L6GT	9/6	ECL80	10/6	U76	8/6
6BW6	8/6	807	6/9	EF36	7/6	UBC41	10/–
6G6G	4/9	5763	10/6	EF37A	14/6	UCH42	10/–
6J5G	5/6	DAF91	7/6	EF39	5/6	UF41	10/–
6J5GT	6/6	DAF96	9/–	EF41	10/–	UL41	10/–
6K7G	5/6	DF91	7/6	EF80	9/6	UY41	8/–
6K8G	9/6	DF96	9/–	EF85	10/6	W76	8/6
6L6G	9/6	DH76	8/6	EF91	8/6	X65	10/6

Matched Pairs. EL84, **23/–**; 6V6G & GT, **17/–**; 6BW6, **18/–**; KT33C, **19/6**; KT66, **27/6**; 807 **14/6** pair

P.P. Op. Transformers. Mr 3-15 ohms for EL84, 6V6, 6BW6, etc., **18/6**; Op. Pen. 50mA, **5/6**; 30mA, **4/6**
Volume Controls. All values, long spindle. L/S **3/–**, s.p. **4/–**, d.p. **4/9**, ext. spkr. control, **3/–**
W.W. Pots. Pre-set **3/–**; 3W long spindle **5/6**, s.p. **6/6**
P.M. Speakers. 3 ohm. 5" **16/6**, 6½" **17/6**, 8" **21/–**, 10" **25/–**, 12" **30/–**
Coaxial Cable. 75 ohm ¼" stranded, **8d.** yd; semi-air spaced, **9d.** yd; screen cable single and twin, **9d.** yd
Coaxial Plugs 1/– each; **Sockets 1/–** each

C.R.T. Isolation Transformers with 25% boost. Low capacity, a.c. mains 200-240V. For 2V, 4V, 6.3V and 13V tubes. All **12/6** each; 1-1 for H.C. shorts **10/6**

Valveholders. 4, 5, 7 pin English and U.S.A. B7G, B9A, 1.0 Mc. B8G, **9d.** each; B7G, B9A with screening can, **1/6**; B12A, **1/3** Aladdin formers ¼" with core, **8d.** each
Scotch Boy Recording Tape, 1,200ft reels, **27/–**
Jack Plugs, miniature standard **3/–**; **Sockets 3/–**
2-Gang Condensers, .0005 small size, **7/6**
I.F. Transformers, 465 kc/s, small size, **7/6** pair
Capacitors, small mica, 5% 1pF to 100pF, **8d.**; 120pF to 1,000pF, **9d.**; 1,000V wkg· .01, .0015, .0025, .004, .005, **1/–** each.
Crystal Diodes, G.E.C., **1/6** each
Headphones, lightweight, 4,000 ohm, **16/6** pair
Ceramic Capacitors, close tol. 500V for V.H.F., **9d.**
Paper Capacitors, tubular, .01, 1,000V, **1/–**; 0.1 to 0.5 500V, **10d.**
Paper Blocks, 4 mfd, 1,000V wkg., **3/6**
Rectifiers, contact cooled, 250V 50mA, **7/6**; 85mA, **9/6**
Reaction Condensers. .0001, .0003, .0005, **4/6** each
Heater Trans. 200/240V, 6.3V, 1.5A, **7/6**
Resistors, ¼ and ½W, insulated, **4d.** and **6d.**; 1W, **8d.** 6W W.W., **1/–**; 10W, **2/–**
Electrolytics. Wire ends. 25/25V, **1/6**; 50/50V, **2/–**; 12/50V, **9d.**; 8/450V, **2/–**; 16/450V, **2/9**; 16/500V, **3/6**; 32/450V, **4/–**; 8+8/450V, **4/6**; 8+16/450V, **4/6**; can types: 16/450V, **3/6**; 16+16/500V, **6/–**; 32/500V, **6/6**; 32/450V, **6/6**; 20+20/450V, **4/6**; 64+120/275V, **7/6**
Wavechange Switches, midget: 1p 12W, 2p 6W, 3p 4W, 4p 3W, 4p 2W, long spindles, **4/6**
Toggle Switches. QMB, s.p.s.t., **2/–**; s.p.d.t., **3/3**; d.p.s.t., **3/6**; d.p.d.t., **4/–**
Chokes, 80mA, 15H, **8/6**; 100mA 10H, **10/6**; 150mA 10H, **14/6**
Solder, Multicore, 4d. yd; Sleeving 2mm, **3d** yd.

P. and p. 9d to £1; 1/6 to £2; over £2 post free. C.O.D. 2/6

R. COOPER G8BX 32 SOUTH END CROYDON SURREY — CROYDON 9186

SMALL ADVERTISEMENTS

continued from page 213

TRADE—*continued*

PANL, recognised for many years as the unique one-coat black crackle finish. Brush applied, no baking. Available by post in ⅛th pint cans at 3/6 from G. A. Miller, 255 Nether Street, London, N.3.

ILLUSTRATED CATALOGUE No. 13 containing over 450 items of Government Surplus and Model Radio Control Equipment, 2/2. Refunded on purchase of goods, 2/6 overseas seamail—Arthur Sallis Radio Control Ltd., Department R.C. 93 North Road, Brighton. *Telephone* 25806.

LEARN as you do it—we provide practical equipment combined with instructions in Radio, Television, Electricity, Mechanics, Chemistry, Photography, etc. Write for full details to E.M.I. Institutes, Dept RC47, London, W.4.

INCORPORATED Practical Radio Engineers' home study courses of radio and t.v. engineering are recognised by the trade as outstanding and authoritative. Moderate fee to a limited number of students only. Syllabus of Instructional Text is free. *The Practical Radio Engineer* journal, sample copy 2/–. 6,000 Alignment Peaks for Superhets, 5/–. Membership and Entry Conditions booklet, 1/–, all post free from the Secretary, I.P.R.E., 20 Fairfield Road, London, N.8.

JOIN THE INTERNATIONAL S.W. LEAGUE Free Services to members including Q.S.L. Bureau Translation, Technical and Identification Depts.—both Broadcast and Fixed Stations, DX Certificates contests and activities for the SWL and Transmitting members. Monthly magazine, "MONITOR," containing articles of general interest to Broadcast and Amateur SWL's. Transmitter page and League affairs, etc. League supplies such as badges, headed notepaper and envelopes. QSL cards, etc., are available at reasonable cost. Send for League particulars. Membership, including monthly magazine, etc., 15/– per annum.—Secretary, ISWL, 86 Barrenger Road, London, N.10.

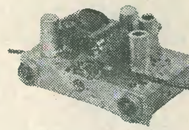
COILS, COILS, COILS. We can supply coils for all frequencies, r.f. chokes, etc. Send s.a.e. for circuits and data.—The Teletron Co., 266 Nightingale Road, London, N.9.

MORSE CODE TRAINING. Special course for Beginners. Full details from (Dept. RC), Candler System Company, 52 Abingdon Road, London, W.8.

FREE. Brochure giving details in Home Study Training in Radio, Television, and all branches of Electronics. Courses for the hobby enthusiast or for those aiming at the A.M.Brit.I.R.E., City and Guilds, R.T.E.B., with other Professional examinations. Train with the college operated by Britain's largest Electronics organisation. Moderate fees. Write to E.M.I. Institutes, Dept. RC28, London ,W.4.

SPECIAL OFFER
I.T.A. CONVERTERS

70/- to clear
Post 2/6 C.O.D. 1/6



Only a few dozen. London and Winter Hill areas I.T.A. converter in chassis form. Made by famous manufacturer. Valves PCC84 and ECC81; with power supply. Working and ready for use. Direct switching I.T.A. to B.B.C.; cabinet (walnut) to fit, 10/–

DROP-THROUGH MAINS TRANSFORMERS. Brand new, 250-0-250V at 60mA; 6.3V at 2½A and 6.3V at ½A. Price 12/6 plus 2/6 post; 1/6 C.O.D.

BAND 3 CONVERTER available for Philips' receivers; complete with power pack. Bakelite case, 8½" x 4½" x 6" high. PCC84 and PCF80. Post 2/6, C.O.D. 1/6. Price £5 . 5 . 0

Posted orders to Camberley please

Gladstone Radio
3 CHURCH ROAD REDFIELD BRISTOL
(next door to Lawrence Hill station) and
82B HIGH STREET CAMBERLEY SURREY

ARTHURS HAVE IT !

Large Stocks of Valves and C.R.T.s
Full Range of Meters available
Avo, Taylor, Cossor, Advance, etc.
Particulars on Request

FM Kit of Parts £5, less valves
(Ref. *Radio Constructor* July 1954)
Amplifier Tape Recorders and Loudspeakers

Jason FM Tuner Unit	£15 17 0
Jason Power Pack	£3 10 0

Radios and Television always in stock

VALVE MANUALS
Mullard, 10/6; Brimar No. 6, Osram, Part 1 5/–; Osram, Part II, 10/–
Postage 9d. each extra
Publications "Lodestar" Tape Recorder 3/6

Goods offered subject to price alteration and being unsold

Arthurs *first* — Est. 1919

Proprietors ARTHUR GRAY LTD

OUR ONLY ADDRESS **Gray House**
150-52 Charing Cross Road
London WC2
TEMple Bar 5833/34 *and* 4765

LINE E.H.T. TRANSFORMERS REWOUND PROMPTLY

Our 30 years' experience of winding and wave-winding enables us to provide the finest service for all types of **television components.** We repair or manufacture all types of transformers singly or in quantity; enquiries welcomed. *Catalogue on request.*

H. W. FORREST (TRANSFORMERS) LTD.
349 HASLUCKS GREEN ROAD SHIRLEY
SOLIHULL WARWICKS *Telephone* SHI 2483

GUARANTEED VALVES — Over 3,000 in Stock

EF92, EAC91, 6J6, 6C4, **4/6**; 6K7, EC91, **5/6**; 6AL5, 6SK7, R10, 3A4, 807, **6/–**; 6AM6, EL91, 6X4, **6/6**; 6BE6, 6CH6, 6F17, 6F33, **7/6**; 12AT7, 12AX7, 12AU7, 6BA6, 6BW6, **8/–**; 6BR7, 12E1, 85A2, 2D21, **10/–**; EF86, 6L6M, 5B/225M, 5B/251M, **11/6**

A. A. W. SKILLMAN
79A FRANCHISE STREET WEYMOUTH

BRASS, COPPER, DURAL ALUMINIUM, BRONZE

ROD, BAR, SHEET, TUBE, STRIP, WIRE
3,000 STANDARD STOCK SIZES
No Quantity too Small *List on application*

H. ROLLET & CO. LTD
6 Chesham Place SW1 *Telephone* SLOane 3463
Also at **Liverpool Birmingham Manchester Leeds**

H.A.C. THE ORIGINAL SUPPLIERS OF SHORT-WAVE KITS

One-valve Kit, price **25/–**. Two-valve Kit, price **50/–**. Improved designs with Denco coils. All kits complete with all components, accessories and full instructions. Before ordering, all and inspect a demonstration receiver, or send stamped envelope for catalogue.

H.A.C. SHORT-WAVE PRODUCTS (DEPT. R)
11 OLD BOND STREET LONDON W1

OPPORTUNITY FOR

AMATEURS — HOME CONSTRUCTORS

GENERAL RADIO CO.

invite you to visit their new Showrooms at

9/10 NOEL STREET LONDON W1
(2 minutes from Oxford Circus)
Telegrams and Cables GENRAD LONDON

Considerable Quantities of AMERICAN RADIO, RADAR EQUIPMENT, SPARES, etc. can be purchased from our Warehouse Counter

IMMEDIATE DELIVERY OF COMPONENTS

Transformers (Mains, Constant Voltage, Auto, etc.), Chokes, Rectifiers, Valveholders, Power Supply Units, Rotary Converters, Vibrators, Plugs and Sockets, Remote Control Units, Resistors, Condensers—variable and fixed, Trimmers, Relays, Crystals, Valves, C.R. Tubes, P.P.I. Units, Coils, Waveguides, Solenoids, Meters, Test Meters, Signal Generators, Frequency Meters, Pulse Generators, Amplifiers, Transmitters and Receivers.

PAY US A VISIT
IT WILL BE WORTH YOUR WHILE
WE HAVE WHAT YOU WANT
AT THE RIGHT PRICE

Open daily 11 a.m. till 3 p.m.
and ALL DAY SATURDAY

The Walk-around Shop

ALL ARE WELCOME TO INSPECT OUR WIDE RANGE OF "FULL VALUE FOR MONEY" BARGAINS. COME ALONG AND MAKE YOURSELF AT HOME. ADVICE AND ASSISTANCE GIVEN IF REQUESTED.

R1155 RECEIVER. In used condition but working order. **£6.5.0.** Plus 10/– pkg. and carr.

ELECTROLYTIC CONDENSERS

8 Mfd. 450v wkg. 525 surge	1/9
16 Mfd. 450v wkg. 525 surge	2/9
8+8 Mfd. 450v wkg. 525 surge	3/3
16+16 Mfd. 450v wkg. 525 surge	4/–
32+32 Mfd. 450v wkg. 525 surge	4/3
25 Mfd. 25v wkg.	1/9

All post paid

RECTIFIERS. Full wave 12 volt 1 amp., **5/6** post paid
4 amp., **12/6** post paid

VALVES

VU111	2/–	6SH7	3/3	12SC7	6/–
VR54	2/–	VR91	4/–	3Q5	6/6
6H6	2/–	APT4	3/6	6SL7	6/6
12H6	2/–	1625	5/–	6SN7	6/6
VT501	2/6	12A6	5/–	2D21	7/6
VT52	2/6	OZ4	5/–	6V6 m.	8/6
12SH7	2/9	6L7	5/6	VR53	5/–
6K7G	3/–	6CQ6	6/–		

PROOPS BROS. LTD. *Open all day Saturday*
Dept. R, 52 Tottenham Court Rd. W1
Hours 9-6 p.m. *Thursday to 1 p.m.* LANgham 0141

THREE DEE

Build this amazing new transistor radio featured in the September issue

SIMPLE TO BUILD
FULL SPEAKER VOLUME
LOW RUNNING COST

Components as specified by the designers

Repanco drilled chassis		3/–
Repanco coils type DRR2	each	4/–
Repanco transformer type TT5		8/–
Variable 500pF condensers	each	3/10
Red Spot transistors	each	10/–
Resistor kit		2/6
Condenser kit		7/3
3-pole 3-way switch		3/9
8-way tag board		1/6
Socket panels	each	6d.
Set of dial plates		2/3
Set of pointer knobs		2/3
Battery plug		8d.
Loudspeaker		22/6
7½ volt battery		2/–
Crystal diode		2/6
Hardware kit (nuts, bolts and wire)		1/6

RADIO EXPERIMENTAL PRODUCTS
LIMITED
33 MUCH PARK STREET COVENTRY

SCOTTISH INSURANCE CORPORATION LTD
62-63 Cheapside London EC2

TELEVISION SETS, RECEIVERS AND TRANSMITTERS

Television Sets, Receivers and Short Wave Transmitters are expensive to acquire and you no doubt highly prize your installation. Apart from the value of your Set, you might be held responsible should injury be caused by a fault in the Set, or injury or damage by your Aerial collapsing.

A "Scottish" special policy for Television Sets, Receivers and Short Wave Transmitters provides the following cover:

(*a*) Loss or damage to installation (including in the case of Television Sets the Cathode Ray Tube) by Fire, Explosion, Lightning, Theft or Accidental External Means at any private dwelling-house.

(*b*) (i) Legal Liability for bodily injury to Third Parties or damage to their property arising out of the breakage or collapse of the Aerial Fittings or Mast, or through any defect in the Set. Indemnity £10,000 any one accident.

(ii) Damage to your property or that of your landlord arising out of the breakage or collapse of the Aerial Fittings or Mast, but not exceeding £500.

The cost of Cover (*a*) is 5/– a year for Sets worth £50 or less, and for Sets valued at more than £50 the cost is in proportion. Cover (*b*) and (ii) costs only 2/6 a year if taken with Cover (*a*), or 5/– if taken alone.

Why not BE PRUDENT AND INSURE your installation—it is well worth while AT THE VERY LOW COST INVOLVED. If you will complete and return this form to the Corporation's Office at the above address, a proposal will be submitted for completion.

NAME (Block Letters)..
If Lady, state Mrs. or Miss
ADDRESS (Block Letters)..
.... /JB

YOU CAN RELY ON US

We specialise ONLY in radio and electronic components, a comprehensive stock of which are held by us, to supply Government, educational and commercial laboratories. Can we be of some help to you, the experimenter and constructor? ?

QUALITY AMPLIFIER KITS

IN STOCK **ALL SPECIFIED PARTS FOR**

MULLARD 3 WATT QUALITY AMPLIFIER
INCLUDING WYNALL TRANSFORMERS
MULLARD 510, FM UNIT, PRE-AMP
20 WATT AMPLIFIER
OSRAM 912, PASSIVE UNIT, PRE-AMP, FM UNIT

TRANSFORMERS FROM STOCK—
WYNALL, PARTRIDGE, GILSON, W.B., ELLISON

Detailed Price List Available on Request *New Catalogue No. 14 on Request*

Next to South Ealing Tube Station 65 Bus

82 SOUTH EALING ROAD
LONDON W5 *Telephone* **EAL 5737**

RADIO SERVICING CO