Radio Control Models & ELECTRONICS

JUNE - - - - - - 1961

FREE INSIDE

Coil Can Data Chart

★ ★ ★

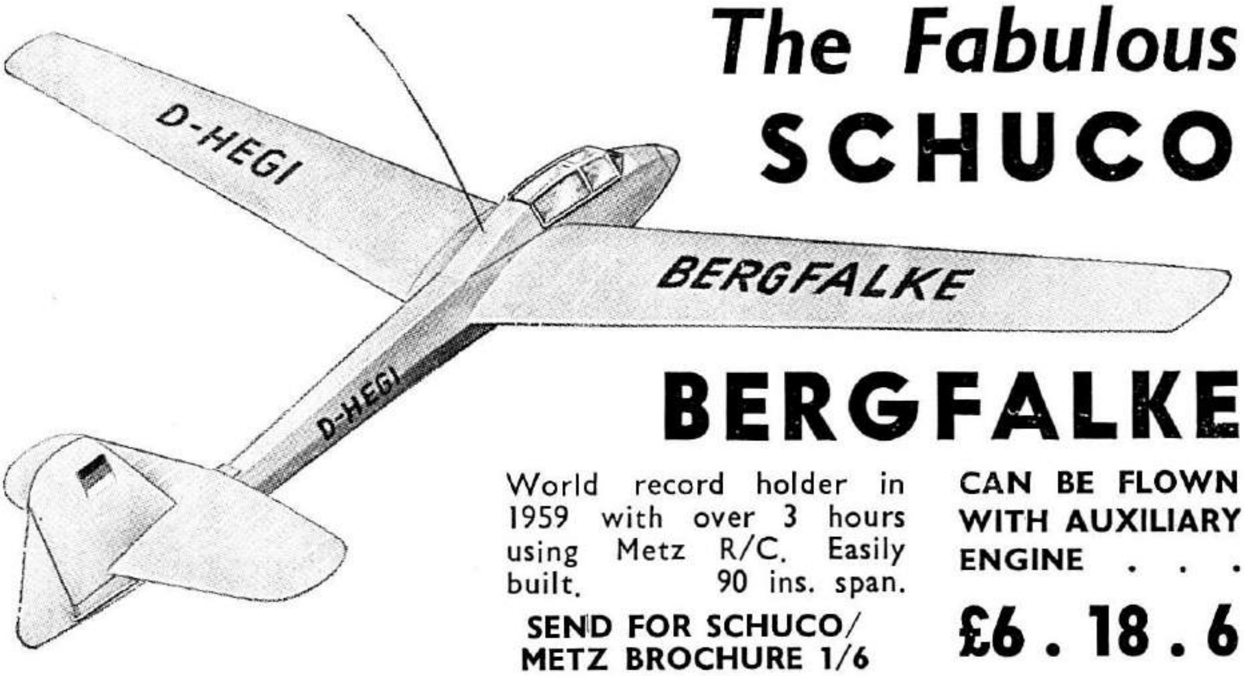
Compact Tone Receiver

★ ★ ★

Servo Motor Performance

PRICE - - TWO SHILLINGS

The Fabulous SCHUCO



BERGFALKE

World record holder in 1959 with over 3 hours using Metz R/C. Easily built. 90 ins. span.

SEND FOR SCHUCO/ METZ BROCHURE 1/6

CAN BE FLOWN WITH AUXILIARY ENGINE . . .

£6 . 18 . 6

★ DEAC CELLS ★

225 DK 1.2v. Button	4/6
225 DK 3.6v. Pack	15/6
225 DK 4.8v. Pack	21/–
225 DK 6v. Pack	26/–
225 DK 7.2v. Pack	31/–
450 DK 1.2v. Button	6/10
450 DK 7.2 Pack	50/–
225 DK Charger	20/–
450 DK Charger	25/–

★ ACTUATORS ★

"Quadtrol" Selective for Rudder Elevator & Engine.	118/6
"Code-a-matic" Control Box Manual Operation, pos.	99/–
"Sage" Actuator, especially suitable for Gliders.	99/–
"Transmite" Relayless.	225/–
"Transmite" Trim.	220/–
Cobb "Ouncer", multi.	95/–
"Duramite", multi.	100/–
Metz "Blip".	33/10
F.R. Lightweight.	25/3
F.R. Compound.	49/11
F.R. 4 Pawl Clock.	44/3
R.M.A. Mactuator.	23/7
Kinematic (Boats).	52/–
E.D. Multi Servo	70/10
Hillcrest Motor Servo	59/6
Aristo Selective.	65/–
Aristo Motor Control.	38/–
"Powertrol" Transistor.	170/–

GRAUPNER "ULTRA-TON" RX. Latest type of this popular receiver now in stock. £11.19.0

'CHANNEL MASTER' TX. Hand held crystal controlled for tone receivers. £13.5.0.

★ BRITISH R/C ★

Reptone (Boats).	£15.8.0
Reptone (Aircraft).	£16.16.0
Unitone.	£16.10.6
Quadratone.	£29
Sextone.	£31.17.3
Octone.	£50.0.0
Dekatone.	£90.0.0
Black Prince/Arrow 1.	373/–
Black Prince/Arrow 4.	575/6
Black Prince/Arrow 6.	649/4
E.D. PC1. Tx.	118/–
E.D. Airtrol Rx.	144/–
Black Knight Tx.	138/9
Aeromodeller Rx. Kit.	64/–
P.C. Tx. Kit.	20/6

★ RELAYS ★

Siemens 100 ohm.	26/–
Siemens 300 ohm.	26/–
Siemens 5000 ohm.	26/–
Gruner 957 300 ohm.	25/–
E.D. Polarised.	30/–
E.D. P 100 ,,	31/–
E.D. Bleep.	24/–
R.E.P. ½ oz.	24/–
E.D. Oct. Reed Bank.	60/-

★ R/C ENGINES ★

Merco 35 Multi 6c.c.	152/–
Veco 19 Multi 3.2c.c.	135/–
Tornado Twin 5c.c.	232/–
Taplin Twin 7c.c.	170/–
A.M. 15 Multi 1.5c.c.	70/8
A.M. 10 Multi 1c.c.	69/8
K & B Torp 45 7.5c.c.	230/–
Enya 19 multi.	114/9

ALL STANDARD ENGINES AVAILABLE FROM STOCK

★ R/C PLANE KITS ★

Orion Multi 5-10cc.	230/–
White Cloud 3-5cc.	125/–
Schuco Auster 1-2.5c.c.	67/6
Snapdragon 44 1-1.5c.c.	75/–
T. 100 2.5-5cc.	109/6
S-10-W Ranger 3-5c.c.	109/6
Viscount 2.5-5c.c.	112/6
Junior 60 2.5-5cc.	58/–
Super 60 2.5-5cc.	97/6
Galahad 1.5-2.5cc.	36/–
Matador 1.5-2.5cc.	25/3
Buster Pylon Racer.	99/–
Comanche Scale.	109/–
Pursuit 66" Multi.	160/–
Rearwin Speedster 38".	59/–
Sterling PT 19 48".	73/9
Wizard Bipe.	124/3
Explorer 56" 3-5cc.	150/–
Mambo 48" 2.5cc.	73/9

HIRE PURCHASE TERMS

We can accommodate you on any order over £8. One-fifth deposit, balance in six to twelve months. Write for quotation today.

★ R/C ACCESSORIES ★

Tornado 12" x 5" props.	11/3
Tail Wheel Brackets.	4/3
Nylon in Orange, Blue and Yellow, 1½ sq. yds.	7/6
Jap Silk, per sq. yd.	6/–
Oryx Irons 6-12 v.	25/–
Oryx Irons mains.	32/6
Telescopic Aerials 36".	12/6
Telescopic Aerials 60".	25/–

PHONE, WRITE OR CALL . . . THE SERVICE IS THE SAME FOR ALL

ROLAND SCOTT LTD.

RADIO CONTROL SPECIALISTS

147 DERBY ST., BOLTON
('Phone : 27097)

97 RAILWAY RD., LEIGH
('Phone : 72673)

SERVISTORS

- HAVE MADE RELAYS OUT-OF-DATE.
- FULL 12 MONTHS GUARANTEE.
- VIRTUALLY CRASH PROOF.
- FULLY ENCASED.

Are the only transistor amplifiers with the built-in safety circuit which obviates damage when two reeds are operated together.

Type	Use	Input required	Output	Approx. Weight	Size	Price
31 2 transistors	Single channel (Actuator)	Less than 0.2 m/A change	0.5 amp steady 1.0 amp peak	0.3 oz.	$1\frac{1}{16}$" x $\frac{27}{32}$" x $\frac{17}{32}$"	£1/19/6
21 4 transistors	Single channel (Pulse)	As type 31	As Type 31 with current reversal as above	0.33 oz.		£2/19/6

TYPE 1213

★ **Price £6.10.0.**

★ **Size $1\frac{1}{16}$" x $\frac{27}{32}$" x $\frac{17}{32}$".**

★ **Fits inside the 'Bonner' Servo.**

★ **Will work with all servos we have tried, incl. REP : ED : CLEVELAND** (plus home constructed types).

★ **Seven Mullard Transistors.**

★ **Weight less than ½ oz.**

★ **12 months GUARANTEE.**

★ **Prang Repair Service.** (although it's virtually crash-proof).

★ **The ONLY Transistor Amplifier with the SAFETY CIRCUIT**

(If both reeds operate together NO DAMAGE WILL RESULT)

PATENT APPLIED FOR

We have in stock 250 mw. 27 m/c transistors at £2 17s. 6d.

Sole manufacturers:

Mannings Sales & Service Ltd.

17a SILVER STREET · WELLINGBOROUGH

Telephone: Wellingborough 3496/7

Sales enquiries: NORTHAMPTONSHIRE WAREHOUSE CO. LTD., HIGH STREET, WELLINGBOROUGH, NORTHANTS.

equipment is recommended for the KeilKraft 'Super 60' Kit for Radio Control

E.D. provide the perfect combination to power and control the new **SUPER 60.** The New **BLACK PRINCE/1** Radio Control Unit is the most advanced equipment obtainable and is capable of delivering high power with minimum battery consumption. Engines recommended are the 2.46 c.c. **RACER** and 3.46 c.c. **HUNTER.**

The BLACK PRINCE/1

Single Channel Tone Transmitter (Standard or Crystal controlled) is the ideal beginners unit and may be used with any receiver operating on a tone of 300 to 600 cycles per second. Normally supplied as a companion to the **BLACK ARROW/1 RECEIVER.** Transmitter Size : $9\frac{3}{4}$" long x $6\frac{1}{2}$" wide x $3\frac{1}{8}$" deep. Weight including batteries: 5 lbs. Receiver Size : $2\frac{1}{2}$" x $1\frac{1}{2}$" x $1\frac{5}{8}$". Weight only 3 oz.

Ask for full technical details from your Model Shop or write to :

ELECTRONIC DEVELOPMENTS (SURREY) LTD.

Island Farm Rd., West Molesey, Surrey, Eng.

CATALOGUE No. 14
500 items Government surplus electrical and radio equipment, **2/6d.** post free. Cost refunded on purchase orders £2 or over.

SIGMA RELAYS
5,000 ohms coil, single pole change-over contacts. Weight $3\frac{1}{4}$ ozs. Price **15/-**, postage 1/-.

SIEMENS HIGH-SPEED RELAYS
3,400 ohms, single pole change-over contacts. Price **17/6d.**, postage 1/-. Miniature sealed type, **21/-**, postage 1/-. 12 volt miniature relays 300 ohms SPCO, **4/6;** ditto 100 ohms, 6-8 volt, **5/6d.**, postage 1/-.

VALVES
3A5 (DCC90), **12/6d.;** 3S4, **9/-;** 1T4, **9/-;** 3Q4, **10/-;** 3V4, **10/-.** Postage 1/-.

RECEIVERS
Radio control built to our specification and incorporating a 3S4 valve and special high resistance relay. Weight $4\frac{1}{2}$ ozs.; O.A. size 3 x $2\frac{1}{4}$ x $2\frac{1}{4}$. With 4-way battery plug, **59/6d.**, postage 1/9d. Battery to suit B.114 Ever Ready, **8/-.**, postage 1/3d.

CONTROL UNITS
12-24 Magnetic type rotating cams, operating 5 sets of contacts in sequence. Used in radio controlled boats will give 3 rudder and 2 motor positions. Price **10/6d.**, postage 1/9d.

RADIO CONTROL — Phone BRIGHTON 25306 — ARTHUR SALLIS RADIO CONTROL LTD. — 93 NORTH ROAD BRIGHTON SUSSEX — EX-GOVT. ELECTRICAL SURPLUS

NEW COMPONENTS

"RADIO SPARES" & MULLARD ELECTROLYTICS SUBMINIATURE
5, 8, 10, 25, 50, 100, 250, 500, 1,000 mf. 15 volt working. **2/6d.** each, p.p. 6d.

RESISTANCES
All values in stock, 10 ohms to 5m. ohms, $\frac{1}{2}$ watt, miniature **6d.** each, p.p. 6d.

CONDENSERS
Miniature Ceramic 4.7, 6.8, 8.2, 10, 15, 22, 30, 33, 47, 82, 100, pf. 8d. each, 180, 220, 270, 330, 390, 470, pf. 10d. each, .0005, .001, .01. **11d.** each, p.p. 6d.

PLUGS AND SOCKETS
Miniature 7 and 9-pin plugs and sockets, **2/9d.** each; 2 and 4-pin ditto, **1/-** each, p.p. 6d.

WIRE
Fine stranded flexible P.V.C. in colours, red, black, white, blue, green, yellow, brown, orange. **2d.** yard or two yards each colour, **2/6d.**, p.p. 6d.

"LITESOLD" SOLDERING IRONS
Miniature Type 230-250v. A.C. 10 watts, **21/6.** Ditto, 12 v. types, **25/-.** Resin cored solder **5/-** per carton, p.p. 1/-

MULLARD POT CORES
Type L.A.I., **21/-** each. Miniature Vinkor pot cores, type 2505, **15/6d.** each. As used in tone generators and filter circuits, p.p. 6d.

TRANSISTORS
OC 170, **30/-;** OC 71, **14/-;** OC 72, **16/-;** OC 76, **15/-**, p.p. 6d.

METERS
5 M.A. 2 in. square flange, **17/6d.;** 50 M.A. ditto, **15/-;** pp. 1/3d. New and boxed.

RADIO AND ELECTRONIC PRODUCTS

G. HONNEST-REDLICH LTD., 44 SHEEN LANE, MORTLAKE, S.W.14

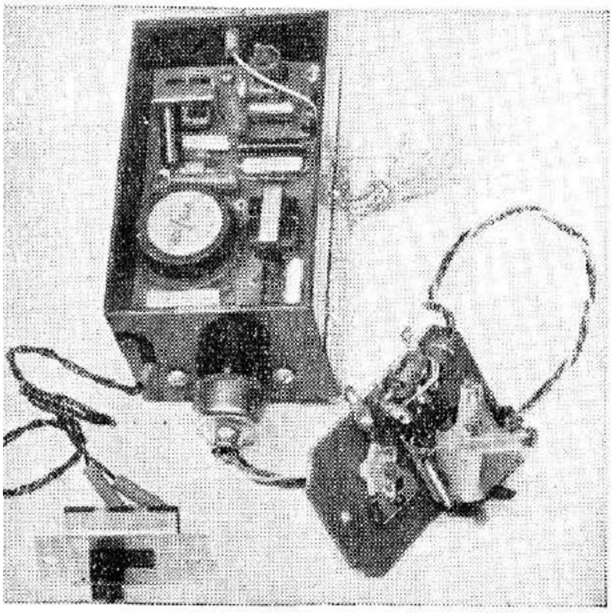
Telephone : PROSPECT 9375

THE COMPLETE RANGE OF RADIO CONTROL EQUIPMENT

★ **From components to complete kits of parts there is R.E.P. equipment to satisfy novice or champion, for aircraft or boats designed and produced by practical experts.**

MINI-REPTONE

RELAYLESS TONE RELIABILITY



Fully transistorised, relayless, special compound escapement with provision for an extra control. Receiver/Battery box unit. $2\frac{7}{8} \times 1\frac{3}{4} \times 1\frac{1}{2}$. All up flying weight of Receiver, Batteries and Escapement only $5\frac{1}{4}$ oz. Three U12 pencells provide total battery requirements. No soldering, plug-in batteries and escapement cable. Low consumption hand held transmitter with fully telescopic aerial.

Complete transmitter, Receiver/battery box and compound escapement. **£16/16/0**
Receiver/battery box separate. **£9/6/0**

COMPLETE EQUIPMENT

combining **range, reliability, durability,** achieved by up-to-date "Tone Systems".

Full 12 months' guarantee

"REPTONE"

SINGLE CHANNEL

Unit construction with Plug-in batteries and Motorised Compound actuator, complete. **£15/8/0.**

"UNITONE single channel tone. Hand held transmitter **£9/3/0.** $2\frac{1}{2}$ oz. Receiver **£7/7/6.**

"TRITONE" 3 channel reeds. Hand held transmitter **£9/6/6.** 5 oz. Receiver **£11/6/6.**

"QUADRATONE" 4 channel crystal controlled Transmitter, 7 oz. Receiver **£29/0/0.**

"SEXTONE" 6-channel reeds. Crystal controlled transmitter with "Joystick". 8-oz. Receiver **£31/17/3.**

"OCTANE" 8-channel reeds. Simultaneous operation. Crystal controlled Transmitter and matched 10-oz. Receiver **£50.**

A FULL RANGE OF ACCESSORIES

R.E.P. $\frac{1}{2}$ oz. Relay ...	**24/–**
3-Reed unit	**35/–**
6-Reed unit	**50/–**
8-Reed unit	**60/–**
10-Reed unit	**80/–**

ACTUATORS

"MINI UNIAC" motorised **52/-.** "OMNIAC" motorised for single or multi **60/-.** OLSEN / REMTROL multi-actuator **70/-.**

TRANSMITTER POWER CONVERTER, 135v. at 25 m.A. From 6v. accumulator. **£8/10/0**

KITS

"AEROTONE" Receiver. Single or multi-channel "tone" **83/-.** "AEROMODELLER" Receiver. Single channel "carrier" **64/-.** "PRINTED CIRCUIT" Carrier transmitter pre-tuned **20/6.** "MODULATOR" tone generator **38/8.** "P.C." and "Modulator" combined are suitable for the "Aerotone". All kits are pre-assembled.

DEKATONE

10 CHANNEL RELAYLESS.

Tone and frequency stable crystal controlled transmitter in duotone chrome and red case, with angled telescopic aerial and carrying handle.

Receiver with integral power convertor. Size, $2\frac{7}{8} \times 2\frac{1}{8} \times 1\frac{1}{2}$, 6 oz. Receiver output cables plug direct into the five **powertrol** transistor amplified servos. $2\frac{7}{8} \times 1\frac{3}{8} \times 1$, $2\frac{1}{2}$ oz.

Only power supply required from actuator battery pack, 6v. All up weight (receiver, 5 servos, battery pack and cables), 23 oz. Ready to plug in, ready to operate. **£90** (P.T. inc.)

"POWERTROL"

Transistor servos to operate from split reed units. (All R.E.P. 6, 8 and 10). **£8/.**

NOTE. — Unitone and Tritone Transmitters are available crystal controlled at extra cost of £2/7/0 & £2/14/0.

★ R.E.P. STAR POINTS ★

★ "Tone stability" achieved by use of tuned high Q chokes in all transmitters.

★ "Receivers" totally enclosed. Protected from dust and exhaust fumes.

★ "Temperature" stability ensured by choice of high stability components.

★ "Sextone and Octone" fitted with original "neon flasher" battery voltage indicator.

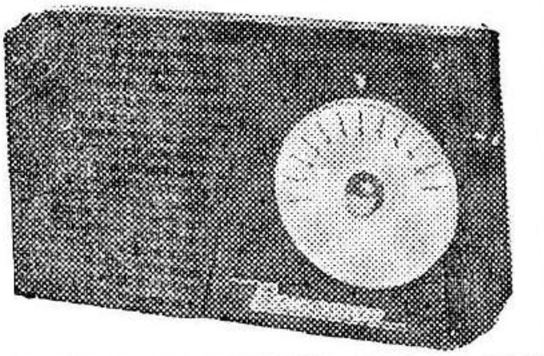
★ Gold Plated Reeds. Require no maintenance.

★ "Pretuned", no adjustments or tuning required.

★ **EXTENDED PAYMENTS** available on equipment from £15 ★ You can order R.E.P. equipment from your local model shop ★ S.A.E. for Price Lists and Information. Trade enquiries invited.

TRANSISTOR POCKET RADIOS

MOST EFFICIENT R.F. CIRCUIT



Circuit comprises 2 h.f. transistors reflexed to equal 4 stages. Permanent germanium diode and high gain a.f. output stage, fitted with miniature speaker, proper tuning condenser, volume control and in case (less monogram), completely portable. No aerial or earth required. Pocket 3 uses 2 transistors and 1 diode, **27/6.** Pocket 4 uses 3 transistors, and 1 diode, **42/6.** Pocket 5 uses 4 transistors, diode and feedback, **55/-,** post and ins. **2/6.**

★ **Results proved in all areas. Components guaranteed for 12 months.**

★ **Plans free with parts, or separately 1/6.**

More details S.A.E.

Transistors for R.F., F.M., T.V. and U.H.F.

Frequencies quoted are approx cut-off

SB 078 15-20 Mc/s	8/6
SB 305 20-30 Mc/s	9/-
SB 231R 40-50 Mc/s	15/-
AMERICAN 2N1727 100-150 Mc/s	15/-
AMERICAN 2N1728 100-150 Mc/s	12/6
AMERICAN T1832 1000-1300 Mc/s	25/-
AMERICAN T1833 1000-1300 Mc/s	25/-

Read these testimonials

THE ORIGINALS MAY BE SEEN AT THIS OFFICE

Mr. S. Rigby-Jones, South Molton, N. Devon. — "I was delighted to receive my Pocket 4 Transistor set. After I assembled and tested it I was amazed such a small receiver had such good reception".

Mr. E. Balcombe, Manchester.—"I have constructed your Pocket 4 Loudspeaker radio and am delighted with its performance and appearance. For the cost I consider it excellent".

Mr. R. Belt, Newcastle-on-Tyne.—"I have built your Pocket 5 Transistor set. I am very pleased with it".

Mr. A. J. Simmonds, Welling, Kent.—"I purchased from you a week ago the Pocket 4 Transistor Kit. I put it together last night in $1\frac{1}{2}$ hrs. On switching on the set, I was right on Radio Luxembourg. I must say thank you, because not only has the set a very attractive appearance, it also behaves fantastically".

ELECTRONIC PRECISION EQUIPMENT LTD.

★ Orders received by post are despatched from our warehouse, **Dept. T, 66 Grove Road, Eastbourne,** and to save time, please post your order to this address. Please include enough for postage. Callers, however, should use one of the following addresses:

266 London Road, Croydon.	**29 Stroud Gr. Rd., Finsbury Pk., N.4.**	**520 High St. Nth., Manor Park, E.12.**	**42-46 Windmill H., Ruislip, Middx.**	**246 HighSt., Harlesden, N.W.10.**
Phone: CRO 6558	Phone: ARChway 1049	Phone: ILFord 1011	Phone: RUIslip 5780	Phone: ELGar 4444
Half day Wed.	Half day Thur.	Half day Thur.	Half day Wed.	Half day Thur.

INTRODUCING THE RANGE OF

BLACKWELL

★ PROVEN PERFORMANCE ★

RADIO CONTROLLED FLYING MODEL KITS

Snapdragon 44. Shoulder wing 44" span; Wing area 330 sq. in.; Power .074-.099, rudder only. Designed with the beginner in mind. **63/6**

T—100. High wing cabin 54" span; Wing area 535 sq. in.; Power .15-.19, rudder, intermediate, proportional control. **87/6**

S-10-W. Shoulder wing, 63" span; Wing area 600 sq. in.; Power .19-.35, rudder, intermediate, multi-chan. Comp. design. **103/6**

Hurricane 600. Low wing, 62" span; Wing area 600 sq. in.; Power .19-.35, intermediate, multi-channel. Fully aerobatic. **127/6**

ALL KITS FEATURE

All parts machine cut for rapid, easy assembly. Pre-shaped block pieces. Plywood fuselage doublers and full depth wing spars. Wire landing gear pre-formed. Full scale detailed drawings. Separate power and glide trim sheet explaining how to test, fly and adjust for optimum performance.

★ PROVEN PERFORMANCE ★

In 1959 T-100's swept the board at the Mirror Meet. In 1960 T-100 and S-10-W models won five out of six trophies in rudder and intermediate at the Denver Mile-Hi Contest; an S-10-W came fourth in intermediate at the U.S. Nationals; an S-10-W came second in multi at the N.Z. Nationals.

S.a.e. for illustrated details of these kits.

MALCOLM DOUGLASS

Radio Control Equipment and Accessories
19 Byron Drive, Rawcliffe Lane, York

LONDON

BURLEIGH'S

Min. M/Coil Relay 110 and 47 ohms, **17/6;** Small Relay suitable for Transistors, **5/-;** Potting Compound, **19/6** ($\frac{1}{4}$ pint tin); S.B.305 Transistor, now only **10/-;** Henry's Transistor Manual and Price List, **3/6** (post paid). Parts for all published circuits, ask us to quote you.

All parts for following sets:

Printed Circuit C.W. Transmitter, compl. made with 3A5 valve, for own box.	**31/-**
Add on Modulator	**32/6**
3 Transistor	**50/-**
Monitor	**63/-**
Aeromodeller	**64/-**
4 Transistor Direct to Actuator	**89/6**

All above plus 1/- postage.

REPTONE Outfit, as available. All ED. R.E.P., F.R., ED. and other equipment in stock.

BOOKS AND MAGAZINES ON RADIO CONTROL ALWAYS IN STOCK.

RETAIL ONLY

Please add postage for return when ordering or for reply.

303 Edgware Road, London, W.2.

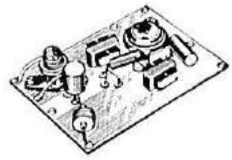
Tel.: PAD 8827-8-9

Open all day Saturdays 9 a.m.-6 p.m.

RELAYLESS RECEIVER

"SUPERTONE RR4"

- **4-Transistors.**
- **300 m.A. Current Rise.**
- **4 to 5 volt Opera.**
- **Output to Servo or Actuator, etc.**
- **Size 2¾ x 2 x ¾ in.**



A new sensitive 4-Transistor 27 mc/s model control tone Receiver. Uses OC169/OC71/OC72/V15/201P transistors, transformer coupled. Only 1st grade components used throughout,

Total cost of all parts. p.p. 1/6. **89/6**

- Stable Design.
- **¼ mile range.**
- **Fully guaranteed**

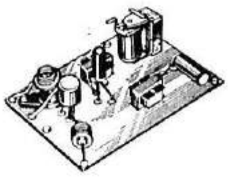
● Ideal for Aircraft or Boats ●

● Pictorial diagrams FREE on request.

SINGLE CHANNEL RECEIVER

"SUPERTONE—IC"

- **Output to miniature relay.**
- **18m.A. Current Rise.**
- **3-Transistors.**
- **Size 2¾ x 2 x 1 in.**



A 3-transistor transformer coupled tone receiver of high stability and sensitive performance, uses OC 169/OC71/OC72 transistors. Range about ¼ mile. Suitable relay in stock. 24/-.

Total cost of all parts, with battery. p.p. 1/6. **69/6**

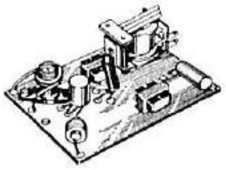
- **Fully guaranteed**

● Pictorial diag./prices FREE on request.

3-CHANNEL RECEIVER

"SUPERTONE—3C"

- **3-Transistor, Transformer coupled.**
- **Output to 3 or more standard tone reed unit.**
- **Size 2¾ x 2 x 1 in.**



A multi-channel 3-transistor design for radio control of models. Output is to vibrating reeds. Uses OC 169/OC71/OC72 transistors. Suitable 3-reed unit. 35/-.

Total cost of all parts, with battery. p.p. 1/6. **69/6**

- **Fully guaranteed**

● Pictorial diag./prices FREE on request.

● **Gruner 957 Relay for Transistor Receivers.** Min. op. 4½ volts, 8 m.A. 300 ohm. 1 pole 2-way contacts up to ½ amp. Size 28 18x9mm. **24/-** each.

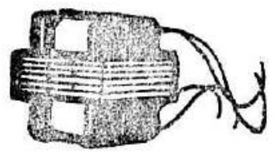
● **Siemens High Speed Sealed Miniature Relays.** 1 pole 2-way contacts. 1700x1700 ohms. **15/-** each.

● **Miniature Differential Relay,** two coils. 350 ohms each. Min. 140 microamps, max. 10 m.A. 1 pole, 2-way or centre stable. Contacts 100 m.A. up to 50 volts. Size 1¾ x ⅝ x ¾ in. **19/6** each.

● REP 3-reed unit. 35/-

★ TRANSISTORS, STANDARD and MINIATURE COMPONENTS

We stock the largest range of components in the country for the home constructor.



WE HAVE YOUR ITEM IN STOCK. **Just ask and we will quote competitive prices.**

★ 27 Mc/s Quartz Crystals for RADIO CONTROL

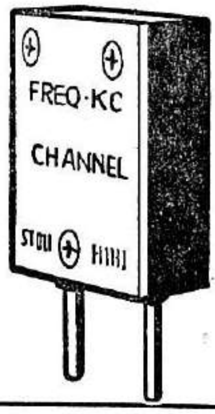
9.065 mc/s third overtone for all 27 mc/s radio control valve transmitters.

12/6d.

Sockets 1/3d.

Fully Guaranteed

Sub-miniature versions for valve or transistor transmitters. **30/–**



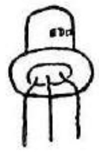
Transistors

FROM

3/6d. EACH

All 1st Grade

Fully Guaranteed



★ High Frequency for 27 Mc/s Front End

SB305, **10/-** SB231, **15/-** OC169, **18/-**, OC170, **25/-** OC171, **50/-** XA131, **35/-** 2N502, **55/-**.

★ Low Frequency Types

OC71, **10/-**. OC76, **15/-**. OC72, **15/-**. XB102, **7/6**. XB103, **10/-**. XC121, **15/-**. Red Spot, **3/6**. Green/Yellow, **7/6**. OC75, **15/-**. Others in stock.

★ Power Output Transistors

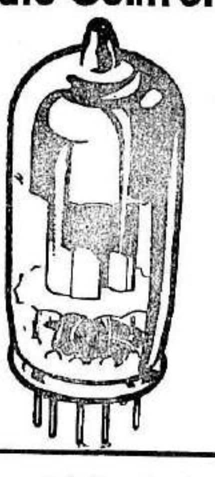
V15/10P, **15/-**. XC141, **25/-**. OC16, **25/-**. OC29, **35/-**. OC28, **30/-**. V15/201P, **20/-**. Others in stock.

FREE LIST of 60 types with data on request. Also equivalents for U.S.A. and Continental types available.

★ VALVES for Radio Control

DK96 8/– 6C4 5/–
3S4 (DL92) 7/–
3A5 (DCC90) 9/–
1S4 (DL91) 8/–
3V4 (DL94) 7/6
3D6 (1299A) 4/6

Valve Holders for above types 9d. each. Others available.



SEND FOR NEW FREE LIST OF OVER 800 TYPES FOR DOMESTIC AND COMMERCIAL USES.

Henry's Radio Ltd.

Miniature Component Specialists **Dept E, 5 Harrow Rd, London W.2**
Open Mon to Sat, 9-6, Thurs 1 o'clock. Tel.: PADdington 1008/9

Radio Control Models & Electronics

VOLUME 2 NUMBER 6 JUNE 1961

Editorial Director: D. J. Laidlaw - Dickson.
CONSULTING EDITOR: T. H. IVES.
Assistant Editor: W. P. HOLLAND.
Advertisement Director: C. S. Rushbrooke.
Editorial and Advertisement Offices:
38 CLARENDON ROAD : WATFORD : HERTS
Telephone: WATFORD 32351/2 (Monday to Friday).

Here, There & Everywhere

Getting Out Our Census!

A FAVOURITE dictum of the first Lord Northcliffe was, "Never mind what they say about you so long as they say something!" For that reason, if no other, we are glad to see a mention of *R.C.M. & E.* in *Model Airplane News,* leading U.S. model aviation publication (Certified net sales 1960 of 74,115 copies monthly, so rather out of our league!).

But, alas, they either have wishful thinking informants, or are, perish the thought, only occasional readers of this and our associated publications, to make the error of construing the continued appearance of R/C articles in *Aeromodeller* as only limited success for *R.C.M. & E.* Way back in 1959, when our creation was no more than a beautiful thought, *Aeromodeller* made it clear that general R/C articles would continue to appear therein; the same applies to *Model Maker.* That undertaking has been implemented, for, indeed, we must first have a desire to try R/C aroused, before readers can possibly be interested in these columns.

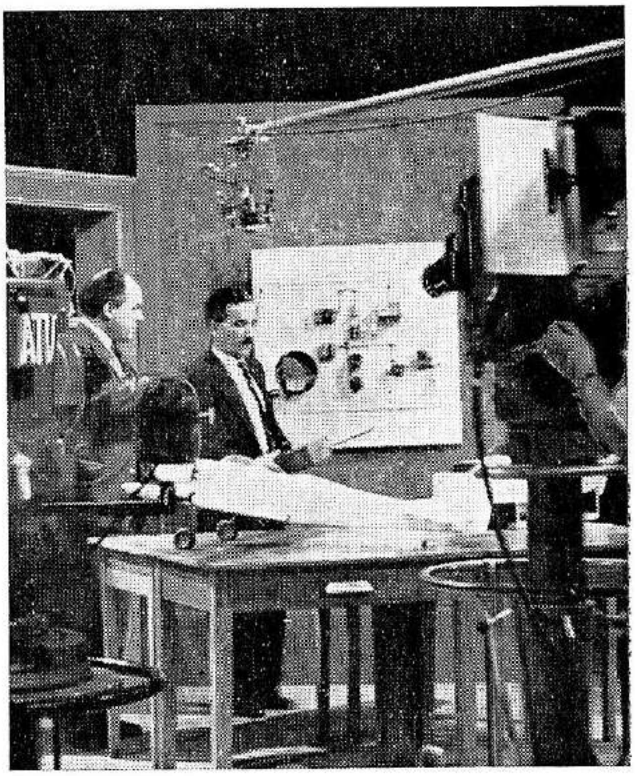
We are happy to thank our readers for their wide—worldwide in fact—support. It has exceeded our expectations by a little less than 100%; we would never admit to being satisfied with it, but are certainly highly delighted. Now in this issue we are enclosing a loose questionnaire sheet so that your copy need not be multilated by answering and returning it to us. Please help us to provide the mixture you most desire by sending in simply thousands of sheets; you have had over a year to decide the sort of contents that you want; we have had ample opportunity of meeting many of you on the flying field and pondside; hundreds have already expressed their views. In spite of this, we have touched only a mere fringe of our readership, and so could be led statistically astray by too small a sample. Our readership survey is of immense value to us, and equally to you, in putting over a point of view, so fill it in, right now, this very minute. If clubs and other groups care to send in collective opinions so much the better—but do send in something. We shall not simply file these reports, they are intended for active use, so vote for your favourite features, lest more aggressive readers sweep the poll with their wishes! Thank you, everybody!

"That well-known TV personality . . ."

George Honnest-Redlich has been at it again! This time he co-starred with the famous Fordson tractor in Arthur

CONTENTS

Subscription Rates: 12 months (home), 28/6; (overseas) 27/6; U.S.A. & Canada, $4.



George Honnest-Redlich with Arthur Garratt on his right, rehearse their ATV programme, "It Can Happen Tomorrow".

Garratt's ATV programme, "It Can Happen Tomorrow" on April 9th. With him were John Dumble activating Gerry Buck's famous R/C car "Old No. 1" and young Paul Rogers complete with his *Orion*. Programme went over live, following an unfortunate strike at the studio which at one time seemed likely to cause its postponement, and, praise be, was angled to an adult audience.

The value of these TV appearances is incalculable. It may all seem jolly good fun to viewers, but it involves a great deal of hard work in rehearsal, apart from providing the reliable models, disrupts a large amount of the business day if not week, and it is only proper that we should hail George as radio control's own ambassador of goodwill. His assistants, too, are deserving of praise in giving up a lot of time for the good of the cause, and above all, in providing a faultless performance bringing practical aspects of our hobby into millions of homes.

I.R.C.M.S. A.G.M.

A sad note of farewell marked the I.R.C.M.S. A.G.M. at Derby on April 15th when Dr. Dawes, who has been Chairman for the past nine years confirmed his intention of retiring from active participation in the society's affairs. Presentation of Tyneside Group's "achievement trophy" to the retiring chairman by Mr. Norman Armstrong was a fitting token of appreciation for his sterling efforts to weld the I.R.C.M.S. into a unit worthy of its fine title.

Departure of Hon. General Secretary P. T. Bellamy abroad, plus resignation of last year's Hon. Treasurer some six months ago, involved a clean sweep of principal officials. New Chairman is T. G. Carrington Wood, who will be well known for his work in developing yacht radio control. Vice-Chairman is Norman Armstrong, who doubles as Pamphlets Secretary (and took the opportunity of announcing latest additions in shape of a five-valve superhet and a simple boat hull drawing). Hon. Treasurer is P. de H. Champion, who took over in mid-season last year; Hon. General Secretary is E. Abbey, who again doubles as new secretary of London Group. Roy Martin continues as P.R.O.

In common with so many clubs, I.R.C.M.S. suffers from meagre finance. Model aircraft meetings can be made to pay their way handsomely with sufficient effort (Coventry Group made a nice contribution to the coffers last year for the Wellesbourne rally) but boat meetings, usually on public water, whilst excellent as spectacles, must frequently run at a loss, unless subsidised by a local authority or other interested party. For that reason it is difficult to see how the society can continue to justify their "International" title unless radical changes in the constitution are made, and officers keen enough and strong enough in control can guide their affairs. Under the present set up, we can see their future most clearly as a group of regional R/C clubs, loosely bound together by common interests, with "Headquarters" responsible for co-ordinating efforts of the various clubs, and representing collective interests at G.P.O. and government department levels. Link with overseas members is mainly through the Bulletin, but its regular appearance depends on much voluntary unpaid effort and a degree of financial strength which is problematical. However, in its limited way, a good job is done, not least of membership advantages being a massive group third party insurance cover.

For would-be members Secretary's address is: 10 Devon Rise, Finchley, London, N.2; Pamphlets Secretary: 3 Lilburn Gardens, Newcastle-upon-Tyne 3; P.R.O.: 45 The Furrows, Walton-on-Thames, Surrey.

I.R.C.M.S. Activities

Groups are active in promoting regattas of interest to R/C fans, and we are happy to give brief particulars of three imminent events.

First, Hull Group have a Northern Area Contest for R/C power boats and yachts over Whit Sunday and Monday, May 21st and 22nd, at East Park Model Boat Pond, Hull, in conjunction with Kingston-upon-Hull Parks Department. Non-members of I.R.C.M.S. as well as members may enter. Entry forms and details from: Reg. Drury, 495 Anlaby Road, Hull, Yorks.

Then Tyneside Group will be holding their Annual Contest at Saltwell Park, Gateshead, on Sunday, June 11th, starting at 11 a.m. Classes for R/C steering, speed and a special invitation to yachtsmen who would like to challenge the local 10-raters—R/C of course! Entry forms, details, etc. from D. L. White, 28 Elmfield Gardens, Gosforth, Newcastle-upon-Tyne 3.

Finally, another event for R/C yachts at the Rick Pond, Hampton Court in co-operation with Y.M.6m.O.A. on Saturday and Sunday, June 17th and 18th, commencing 11 a.m. Events will be run for any type of R/C sailing craft—an opportunity here for anyone with unconventional boats—and events for the established ex-A's and Q's. Comp. Secretary: E. Abbey, 10 Devon Rise, Finchley, London, N.2.

Good for DEAC

Following last month's Editorial plea for better batteries, we have received a friendly letter from Mr. K. Drury, G. A. Stanley Palmer's Technical Manager, reminding us—as if we needed reminding!—of the virtues of DEAC cells, now being manufactured in Great Britain.

Regular readers will already have studied our fairly extensive article on the care and nourishment of these useful rechargeable cells in our March issue, but it is vastly satisfying to learn from the main distributors that they are "already finding a sales outlet in the model field". This is a fact we all know very well indeed; model shop proprietors know it too; only too often, in our experience, the actual vendors are the last people to know the destination of their products, so that the "on-the-ball-ishness" of G. A. Stanley Palmer Ltd.'s sales department is a matter for hearty congratulation. We wish them a constantly ascending sales graph!

Do-it-Yourself Department

We like the introduction to *KC/RC Contacts* news letter from Kansas City: "*If* you happen to receive this by Saturday, April 1st (no fooling!) and if you *can* make it out to the Jacomo flying field in the afternoon: *Bring a rake* or something to help spread rock salt around as a grass and weed killer . . . Vast quantity at practically no expense. Sure, bring the plane too . . ."

Some of our ex-aerodrome sites would benefit from self-help like this . . . and some more sites, weedy or otherwise would not come amiss either.

Herne Bay Regatta

Once again Col. Taplin will be organising an all radio control regatta at Herne Bay. Date is Sunday, August 13th, and there will be classes for speed and steering. Notable feature of this now annual fixture is fast action, with boats on the water all the time, expert marshalling of next man in, and informed commentary. Details and entry forms from Lt. Col. H. J. Taplin, "Shrublands", St. Mildred's Avenue, Birchington, Kent.

Good News for U.S. Readers

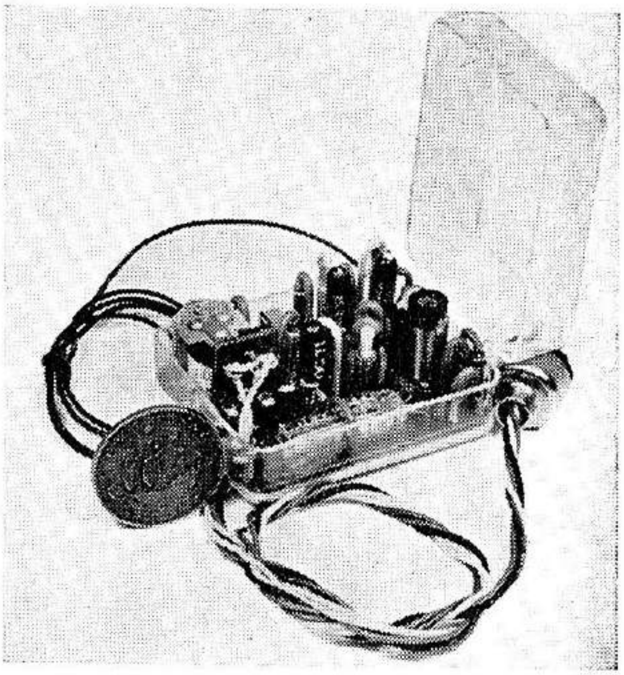
Readers and would-be readers in U.S.A. who would prefer to place their subscriptions through an agent in that country will be interested to know that Paul Runge of Ace Radio Control, Box 301, 1107 Main, Higginsville, Missouri, will take them, on our behalf. Since so many write A.R.C. anyway for equipment, a few lines and few dollars more will give them *R.C.M. & E.* in the postbox for a twelvemonth.

R/C Primer

We have a small stock of Howard McEntee's new R/C Primer (reviewed in last month's *R.C.M. & E.*). These are available, retail only, from these offices at 15/- post free, and are of particular value to those using U.S. equipment.

The U.K. Receiver

By Sqd. Ldr. V. J. CORSER, RAF



The U.K. Receiver in a standard plastic box. Whilst the components are quite widely spaced, the halfpenny gives an idea of the small size.

LET me start off by confessing that this receiver owes much to both the Kraft and Orbit 1 receivers. A look at Pat Wheeler's review of the Orbit 1 on page 229 of the May, 1959, *Aeromodeller* will show how similar the circuits are.

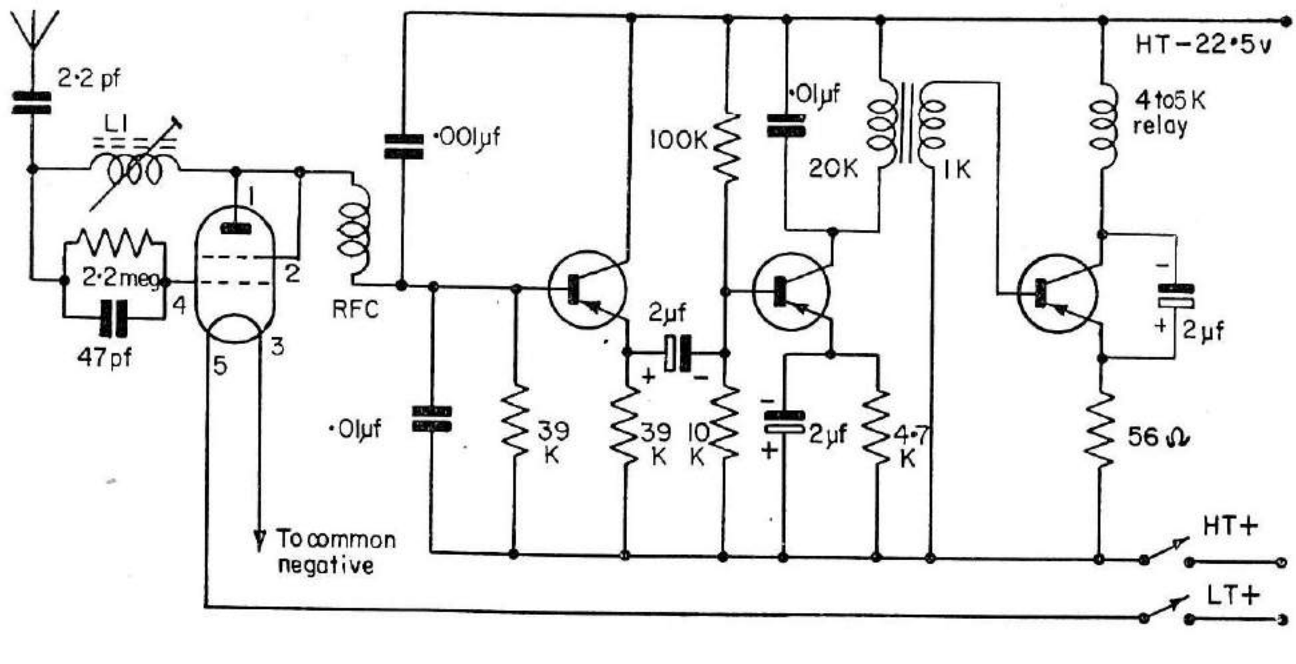
When the Kraft receiver was first published in the March, 1959, *Model Airplane News,* I thought it looked just what I wanted, so I made an "over-sized" one using normal sized components and found it to be of exceptional stability and sensitivity with much more than adequate range, so much thought and "fiddling" was used to locate and try out really small components which were available in this country.

The components specified have been thoroughly tried out and whilst others could be used (for instance, DL66 or 67 for valve, Red-spot Transistors and other makes of condensers, transformer etc.) these shown do produce the best results in this application.

If you get the specified components from a reputable dealer no trouble should be experienced although I always think it is a good idea to test relay and transformer windings for open circuit by a simple continuity test *before installation.*

Since the components are rather closely spaced it is best to work to a sequence which allows maximum room to use heat shunts at the appropriate place.

The precautions to be used when soldering Printed Circuit board have been well covered in previous issues of R.C.M. & E. My own tricks are:—



(1) Well clean the copper foil with Ajax cleanser (advert) and wash off thoroughly—dry with Kleenex (another advert).

(2) Smear a *light* coat of fluxite on the copper and tin round all holes —clear out any holes that need it with the appropriate drill.

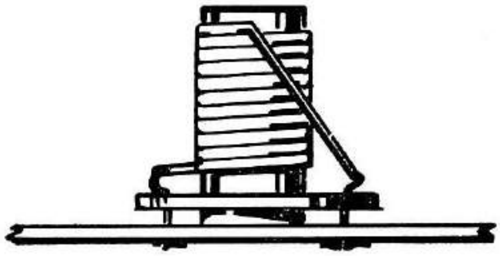
(3) Clean all component wires, leads, etc. (except transformer leads) thoroughly and *carefully* re-tin, using a heat sink where necessary.

(4) Place component in holes and apply iron and solder *together* to lead and foil to make a perfect joint with minimum chance of overheating either the component or foil.

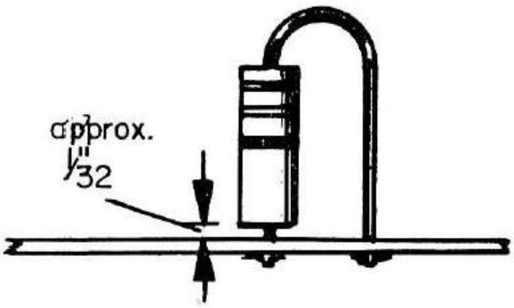
(5) Snip surplus leads off close to the solder bead and clean off board with an old toothbrush and *ONE* drop of dope thinners—dry off with tissue.

A heat sink for transistor and valve leads is, of course, essential. A small pair of tweezers with a crocodile clip over the blades, holding them in close contact to the lead, is the method I use. It also has the advantage that it leaves both hands free.

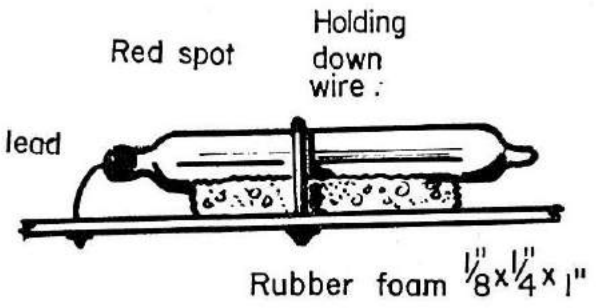
One word about the transistors—OC 71's or OC 75's in any combination may be used. An OC 75 is the same as an OC 71 but with a higher gain. I used all OC 75's in the set I made for Eric Hill, all OC 71's in Ed. Carroll's and OC 71's for T.1 and T.3 and an OC 75 for T.2 in my own set. The extra gain of the OC 75 may give a greater margin of safety but since the set with OC 71's gives a range well in excess of that visually usable (with a decent transmitter, of course) it can be considered to be a matter of personal preference.



COIL DETAILS

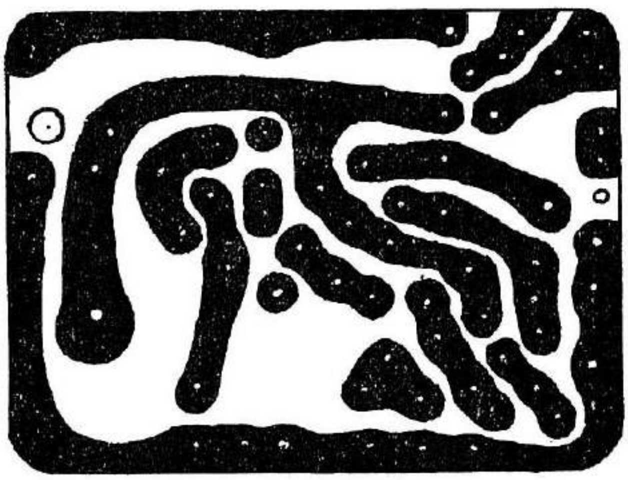


METHOD of COMPONENT PLACEMENT



VALVE FIXING

FIG. 1.



Full size Printed Circuit board.

Whichever transistors you use, they should, if possible, be checked on a gain/leakage tester (I use the one shown in the January, 1959, *Aeromodeller* using a 1 m.A. meter for leakage and a 5 m.A. meter for gain) and the lowest leakage one selected and used in T.1 position.

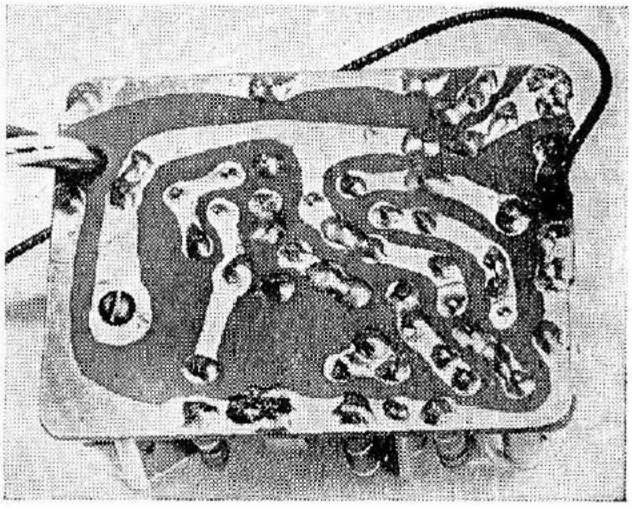
It always seems to be a point of controversy about how long to make the leads of components when using a

Printed Circuit board. In this set no components should project above the level of the relay tag board to prevent them being "squashed down" by the box used to contain the set. Figure 1 shows the approximate dimensions I use for the leads. Try to form the curve of the down lead neatly—it looks better and there is less likelihood of damage to the lead.

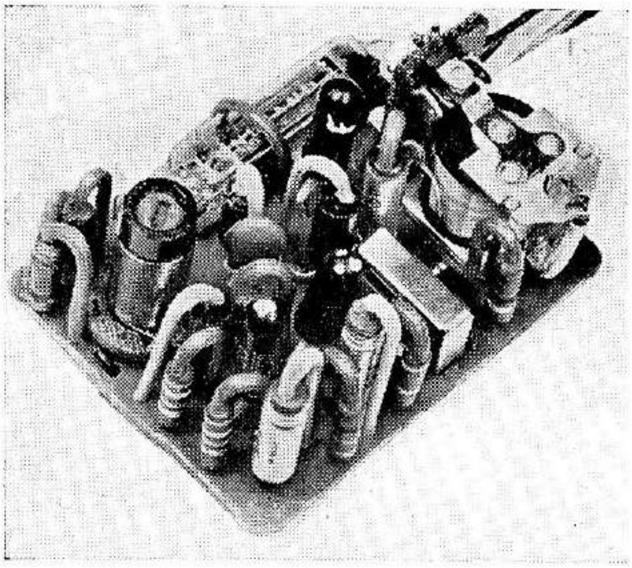
The details of the coil are shown at Figure 1, note particularly that the lead from the top of the coil goes to the aerial coupling condenser.

Testing is simplicity itself — a 0-10 meter in the H.T. plus lead—switch on —the meter reading will be between 1 m.A. and 3 m.A. with the needle quivering. Switch on transmitter carrier only and tune coil slug until the meter goes down to approximately .75 to 1 m.A.—the needle will go steady at the same time. Key tone, which should modulate the transmitter 100% in the range 500 to 1,000 c.p.s. when meter should rise to between 5.5 to 6.5 m.A.

If the slug projects above the top of the coil former when the set is tuned to the transmitter, remove a sixteenth of an inch from the bottom end of the slug with a fine saw, being careful not to damage the threads. Do *NOT* hold the slug in a vice as it can easily break. It should not be necessary to remove much more than a sixteenth of an inch even at the very end of the frequency range allowed, but if it is, file off a small amount at a time. It is, of course, equally possible to adjust the tuning by removing turns off the coil, but this tends to have other effects on the set so I prefer to shorten the slug.



Above : Make a similarly neat job of the soldering. Below : Note the sleeving and well radiused bends on the component wires.



Carry out a distance check at about 200 yards and fine tune for maximum current. Lock slug with sliver of rubber, or better still, use core locking compound. Retuning is hardly ever necessary if you use a crystal controlled transmitter (and who doesn't these days?). After all, it is no good having a stable receiver and using a transmitter whose frequence swings wildly in sympathy with the firmness of your grip on the case or proximity to the aerial!

The fixed contact "Bleep" as supplied is set a bit on the low side for this receiver in my opinion. The beauty of this type set is that the current rise does *not* fall off progressively with distance but remains at full value until the limit of range is reached. This means that the relay can be set to pull in at 3.5 m.A. and drop out at 2 m.A. *Relay Coil Current not* total H.T. current. The actual relay current is carrier on—0 m.A., tone on—5 m.A.

It is best to set the relay before installation using a 22½v. battery, a 100K pot. and a 5 m.A. meter. The fixed contact Bleep can be adjusted easily by bending down the lower spring tag and slightly raising the upper (normally closed) contact on the tag board until the required range is attained. *Be CAREFUL*—these relays are precise pieces of equipment so don't go using 9 in. pliers on them!

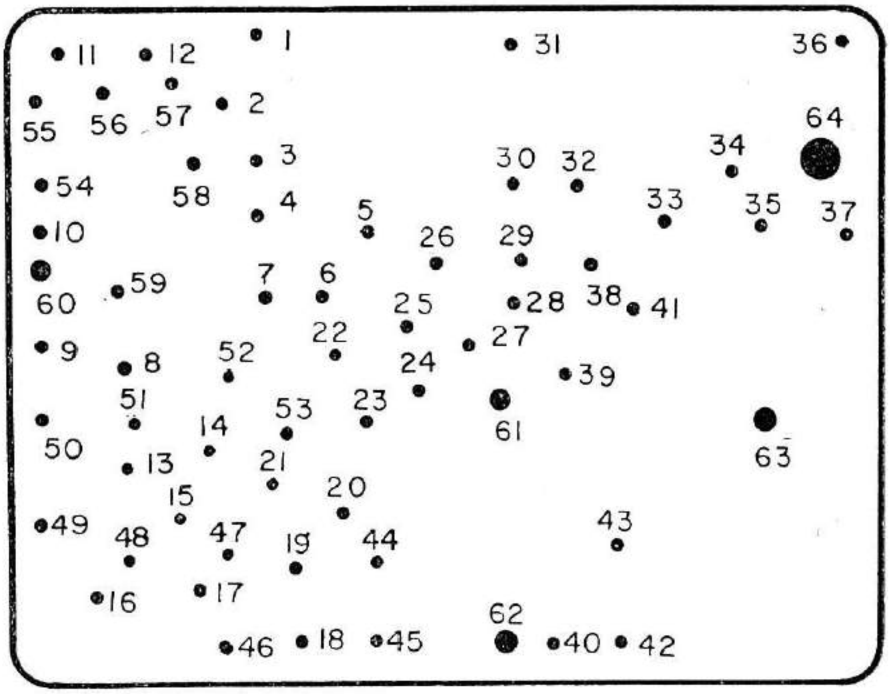
An alternative—and better (in my opinion)—method of tuning is the "Graupner" one. Having rough tuned close by, using a meter—go to 200 yards and without the meter, key tone and rotate slug clockwise until relay falls

★

Use this numbered hole diagram when wiring up. The holes should be drilled as follows :—

1 to 41	1/32″ dia.
42 to 57	No. 62
58 to 62	1/16″ dia.
63	No. 44
64	9/64″ dia.

★



out — rotate slug anticlockwise until relay falls out again — set slug slot exactly between these two points and that is it.

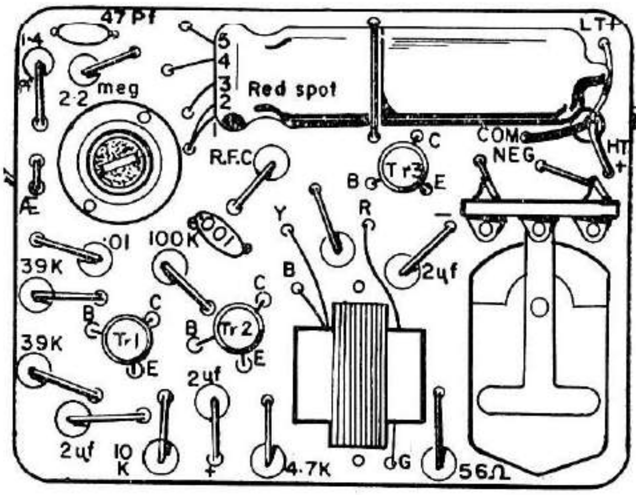
This set operates like most tone receivers—i.e. carrier is left on all the time and tone is keyed to operate the control. Fast pulsing is followed faithfully so that any type of escapement or meter may be used. I have left off spark suppression since the optimum method is different for various escapements and motors. In any case, I think the best place for suppressors is at the source of trouble—that is directly across the escapement coil or motor brushes.

With the rising compound I use the simplest possible suppressor—a 100 ohm ½ watt resistor across the actuator coil and have found it to be excellent.

Eric Hill has conducted close tests on this receiver and considers it to be one of the most sensitive and reliable receivers he has come across. The fact that he now uses one himself is a good enough recommendation.

Assembly Sequence

1. Transformer clip in holes 61 and 62.
2. Transformer Red wire in hole 28 leaving about 1 in. spare and coiling it out of the way.
3. Transformer Green wire in hole 40 —ditto above.
4. Transformer Blue wire in hole 24 —ditto above.
5. Transformer Yellow wire in hole 25 —ditto above.
6. 100 K—over hole 52—lead to hole 53.
7. 2 mf. over hole 16 — pos. lead to hole 17.
8. 10 K over hole 46—lead to hole 47.
9. 2 mf. over hole 19—pos. lead to hole 18.
10. 4.7 K over hole 45—lead to hole 44.
11. Transistor T.R.2—Base to hole 21; Collector to hole 23; Emitter to hole 20.
12. 39 K over hole 49—lead to hole 48.
13. 39 K over hole 50—lead to hole 51.
14. Transistor T.R.1—Base to hole 13; Collector to hole 14; Emitter to hole 15.
15. 2 mf. over hole 39—neg. lead to hole 41.
16. Mount Relay by screw through hole 63.
17. Relay coil tags to holes 33 and 35 by short lengths of 22 s.w.g. tinned wire.



Component layout shown full size.

18. T.R.3—Base to hole 29; Collector to hole 32; Emitter to hole 38.
19. .01 over hole 27—lead to hole 26.
20. .01 over hole 8—lead to hole 9.
21. .001 in holes 7 and 22.
22. R.F.C. over hole 5—lead to hole 6.
23. 56 ohms over hole 42—lead to hole 43.
24. 2.2 meg. over hole 56—lead to hole 57.
25. 47 p.f. in holes 11 and 12.
26. 1.4 p.f. over hole 55—lead to hole 54.
27. Coil to holes 58 and 59—top of coil to hole 58.
28. Aerial lead to hole 10—down through hole 60—Knot under.
29. Neg. lead to hole 34 and through hole 64.
30. H.T. Pos. lead to hole 36 through hole 64.
31. L.T. + lead to hole 36 through hole 64.
32. NO (yellow) and NC (white) to relay contact tags and through hole 64.
33. Valve lead 1 and 2 to hole 4; lead 3 to hole 3; lead 4 to hole 2; lead 5 to hole 1—Red dot is next to pin 1.
34. Valve retaining wire to holes 30 and 31—put sliver of rubber foam under valve first. Use fabric sleeving over all exposed component leads and use a heat-shunt on all transistor and valve leads.

Component List

Coil former—Aladdin PPF 16423/4 or 16425/4 with Slug type PP5963 Length from top of tag ring to top of former $\frac{11}{16}$ in. Two tags only on tag ring.

Coil (L)—35½ turns No. 32 s.w.g. enamelled wire wound clockwise from bottom.

Valve—Hivac XFY 34.

Transistors—Mullard OC 71 or OC 75.

Transformer—Ardente D1001 or T1079.

Radio Frequency Choke—CH1 core, fully wound with 40 s.w.g. en. wire.

2 mf. Electrolitic Condensers—TCC Type 68CE68 25 volt or Hunts SM 42 25 volts.

.01 mf. Condensers—Hunts Midget Moldseal—150 volt type W99—dimensions $\frac{7}{16}$ in. L. × $\frac{3}{16}$ in. dia.

.001 mf. Condensers—Radiospares disc ceramic or Hunts Midget Moldseal (in this case fit over hole 22—lead to hole 7).

47 p.f. Condensers—Radiospares disc ceramic.

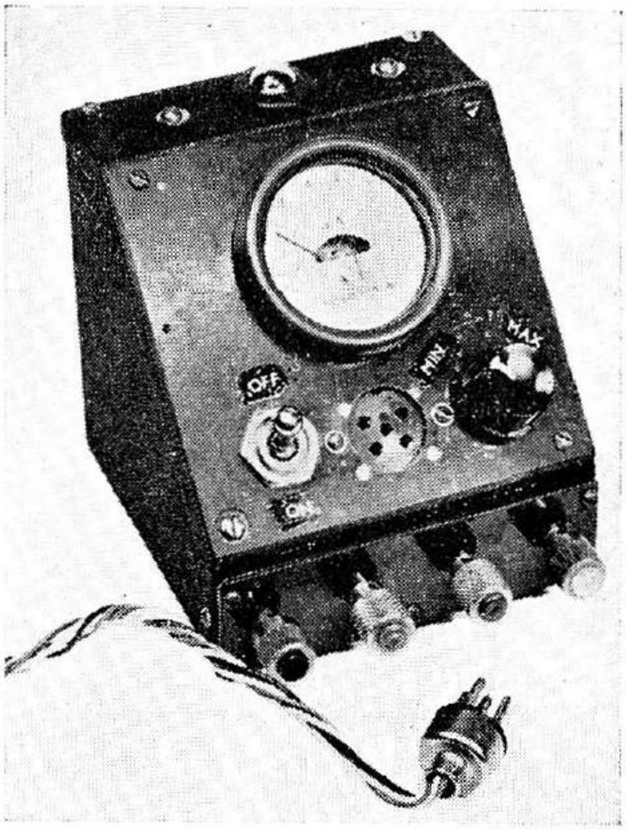
1.4 p.f. Condensers—TSL or any good quality midget equivalent in the range 1 to 2.2 p.f.

Resistors—Dubelier ½ watt BTS or Radiospares 10%.

P.C. Board—$\frac{1}{16}$ in. Epoxy glass with at least .0015 in. foil.

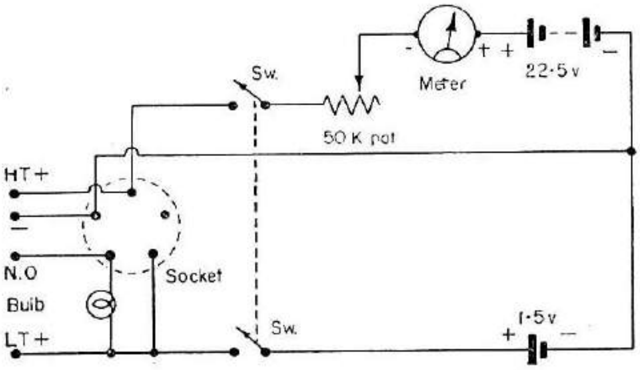
Test Meter for the U.K. Receiver

By Sqd. Ldr. V. J. CORSER, RAF



THE idea of building a special tester tailored specifically for the receiver was inspired by Eric Hill's tester for the Hill Receiver.

The socket can be which ever type is actually being used in the aircraft installation. The four connectors are in parallel with the socket tags and are



Above: Simple theoretical circuit for the test meter as illustrated. Below; Extra circuitry to enable one to monitor the test batteries. Right: Tester removed from its case showing the batteries in place.

for use when a plug is not used.

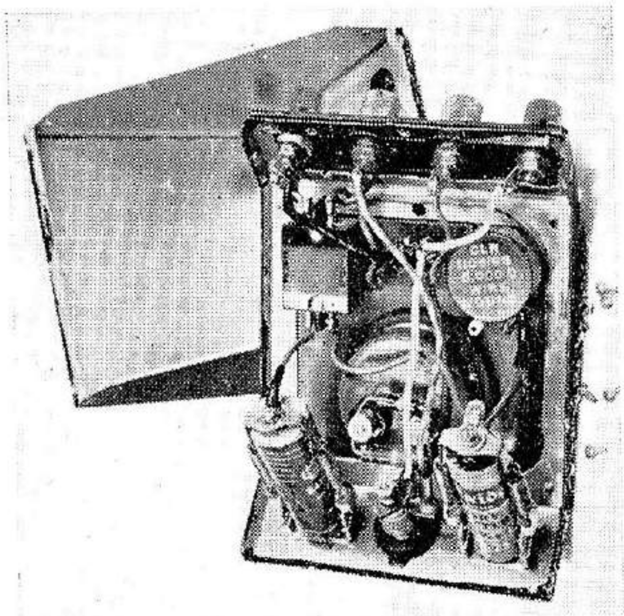
The bulb should be a 2.5v. .04 amp type and lights when the relay operates as it is wired in the relay normally open circuit. The potentiometer enables the relay operating point to be checked. NB. the complete H.T. current is shown on the meter *not* the relay only current.

The meter should be either 0.5 m.A. or preferably 0-10 m.A. as most, if not all, U.K. receivers draw at least 5.5 m.A. and most up to 6.5 m.A. on receipt of a tone signal.

The case shown is made by gluing the sides to the piece of metal forming the back and sides by Araldite or Twin Bond and baking in the oven in accordance with the manufacturers' instructions. "Panl" paint is used for the finish.

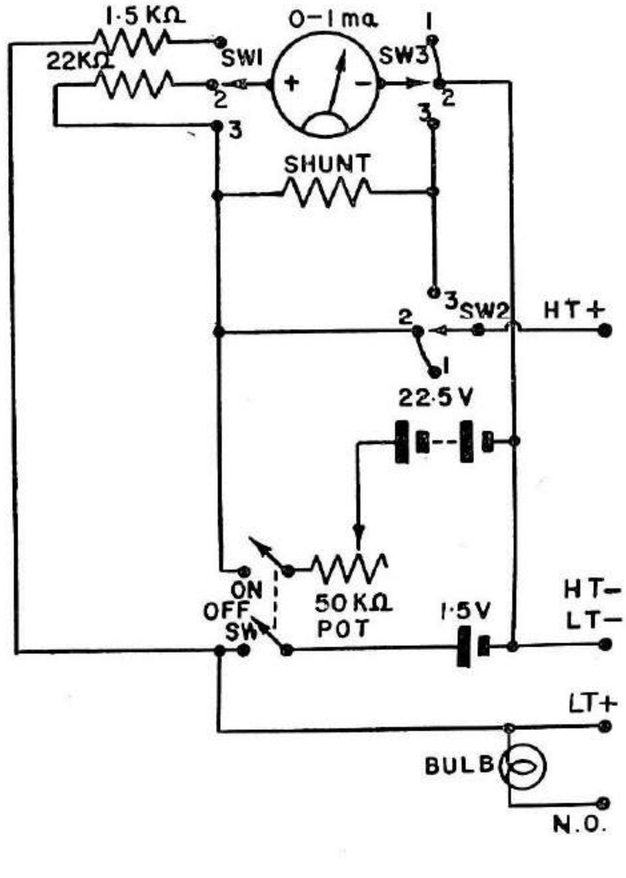
The H.T. battery is either a B122 or B155 and the L.T. is an ordinary pencell such as DL25. A double pole switch must be used to switch on and off both H.T. and L.T.

To test the batteries for voltage it is only necessary to plug in the receiver



switch on and monitor the voltages across the connectors using a high resistance voltmeter.

A more sophisticated circuit can be used to switch the existing meter as a voltmeter in which case the meter should be an 0-1 m.A. shunted in the normal current position to read 0-10 m.A. A suggested circuit is shown—the main switch should be a 3 pole—3-way and the H.T. and L.T. batteries are switched by a separate 2 pole on-off switch.



HAND HELD 8 CHANNEL TX.

The following coil winding data was omitted from last issue and should be noted when building this Transmitter.

L1 $\frac{1}{4}$ in. former, 22 turns 32 s.w.g. enamelled wire close wound anti-clockwise from bottom of the former.

L2 $\frac{3}{8}$ in. former, $9\frac{1}{2}$ turns of 22 s.w.g. enamelled wire close wound clockwise from bottom of former.

L3 12 turns of 16 s.w.g. enamelled wire close wound on $\frac{5}{8}$ in. dia. former. Former removed and coil slightly spaced to occupy $\frac{15}{16}$ in.

R.F.C. 2 amp TVI choke fully wound with 41 s.w.g. enamelled wire.

Transistor Switching Circuits

By P. T. BELLAMY, D.Tech.(Eng.)

PART II

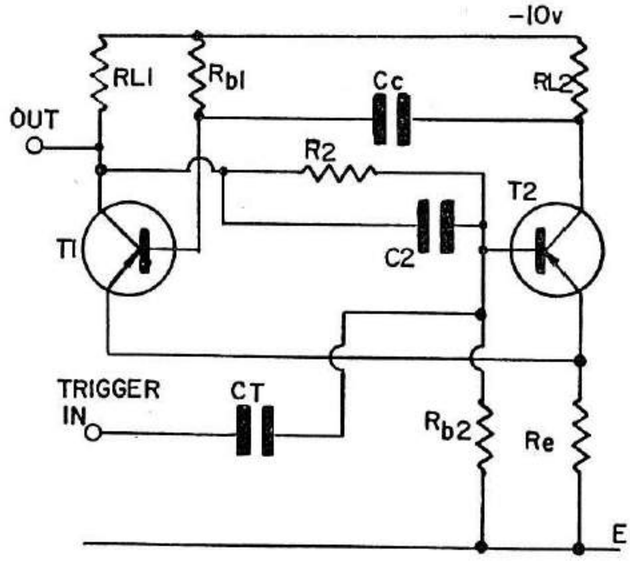
(Former Hon. Secretary, I.R.C.M.S., in whose Bulletin this feature first appeared.)

Monostable

THE monostable is a switch which requires a trigger pulse, either positive or negative, depending on where it is injected, to turn it "on", but turns itself "off" automatically after a predetermined period, depending on a resistance/capacitance time constant. In other words, it is a circuit with two positions, either stable or unstable, the latter state after a suitable trigger pulse has been injected.

The monostable has many uses in transistor circuitry connected with radio control—such as mark/space generators, frequency to mark/space converters, pulse repetition frequency selection and delay circuits.

A typical monostable circuit is shown in Fig. 1. It can be seen that it is not a symmetrical circuit like a multivibrator, the asymmetry is used to give it a steady state. In the steady state transistor T_1 is "on", i.e. conducting, so that the collector is almost at earth potential with the emitter. The reason for T_1 being on is that the base is taken to the negative line via resistor Rb_1. It is seen that the emitters are commoned and have a common resistor Re. The voltage across Re forms the bias for keeping T_2 "off" in the steady state. Owing to the nature of the circuit, only one transistor at a time is "on" and the other "off". Now if the collector loads Rc_1, and Rc_2 are equal, then in the "on" condition for each transistor, the current through each transistor will be equal and so the bias voltage across Re remains constant which ever condition the switch is in. At times it helps to put a capacitor across Re to smooth out switching transients. As T_1 is "on" in the steady state, i.e. the collector is at almost the same potential as the emitter of T_1 and likewise emitter of T_2, the voltage at the base of T_2 is sufficiently

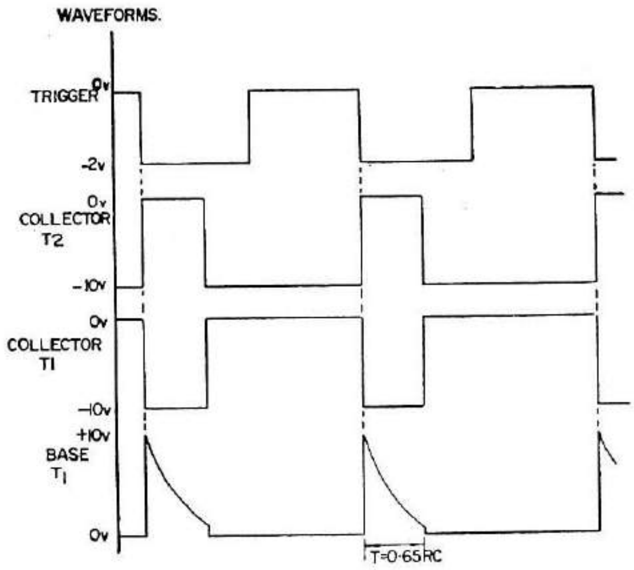


positive to switch T_2 "off", due to the potential divider consisting of R_2 and Rb_2. For faster switching between one state and the other, capacitor C_2 is sometimes included across R_2.

Now suppose a suitable negative trigger pulse is applied to the trigger input, it will cause T_2 to switch to the "on" state, i.e. the collector will go positive, this positive pulse will appear via Cc at the base of T_1 as well, and switch T_1 "off", i.e. the collector will go negative and so help the trigger pulse to drive the base of T_2 negative. Now the charge on Cc will slowly leak away through resistor Rb_1, i.e. the base of T_1 will resume a slightly negative voltage, this will cause T_1 to conduct, i.e. turn "on". A positive pulse step appears at T_1 collector, and T_2 base via R_2 C_2. This cuts T_2 "off" and a negative pulse step appears at T_2 collector and T_1 base via Cc. The monostable is now back to the steady state and will remain in this state till the next negative trigger pulse is fed into the base of T_2.

The waveforms at various points in the circuit are drawn so that a better idea of the switching actions can be obtained. Also those readers with an oscilloscope will be able to check the waveforms they obtain.

Fig. 2 shows how a variable mark/space generator can be made using a monostable circuit. RL_1 and RL_2 are the two coils of a polarised relay of the



Carpenter type. The two diodes across the coils of the relay are to suppress switching surges due to the inductance of the coils. The resistor Rb_1 is made variable in this case and has a small fixed resistor Rx. in series. The value of the fixed resistor determines the shortest time of the R/C time constant and the value of the variable resistor at maximum resistance plus the value of the fixed resistor determine the longest time. Thus by making the resistor Rx. $= 1/8\ Rb_1$ it is theoretically possible to alter the mark/space ratio between 10/90% and 90/10%. If the switching speed is fairly slow, there is little need to put a "speed up" capacitor across R_2.

The trigger circuit is taken through a capacitor—to block the D.C.—and a diode — to help prevent a pulse being fed back to the trigger source, by the switching of the monostable.

Cc is chosen so that the time constant of $(\frac{1}{2}Rb_1 + Rx.)\ Cc.\ 0.65 = T$ where T is equal to half period of the trigger source, thus giving a 50/50 mark/space ratio at centre of the total travel of the potentiometer, assuming a linear law.

There have been many circuits designed to cope with the problem of selection of frequency of pulses in mark/space systems. If the variable frequency pulses are fed into the monostable, then if the R/C time constant is correctly chosen, a second mark/space signal is obtained from the collector of T_1. The trigger pulses which are of variable frequency can also be of variable mark/space without interfering with the second proportional signal obtained from the monostable.

If two relays are put in the collector of transistor T_2 each in series with its own potentiometer and slugged with a suitable capacitor, then the circuit can be set so that if there are three pulse frequencies then either there will be none, one or two relays operating. This is because as the frequency of trigger pulses are increased so the average current flowing through T_2 increases. Conversely, if the relays were in T_1 collector, increase in the trigger pulse frequency would cause decrease in the average current flowing through T_1.

A monostable may also be used to delay a pulse and the time of delay is dependent on the R/C time constant. The delayed pulse is obtained from either T_1 or T_2 collector depending on the polarity of the output pulse required.

EXAMPLE:

Supply voltage — 10 v. Transistors OC71 ($\alpha^1 = 40$).

Period for switching 10 ms.

Let collector current be about 3 m.A. Hence collector loads are 3.3 k. Ω each (nearest preferred value to give 3 m.A. approx.).

Emitter bias can be about 300 mV, therefore Re = 100 Ω.

A slight positive bias is required on the base of T_2 relative to the emitter, thus Rb_2 can be, say, 4.7 k. and R_2 = 10 k.

From the equality $Rb_1 < \alpha^1 Rc_2$, this suggests that Rb_2 might be 100 k.

Now the value of Cc can be calculated from T = 0.65 C.R.

$$.01 = 0.65.\ C \times 10^{-6}\ .\ 10^5.$$

$$c = \frac{1}{6.5} = .15\ \mu F.$$ This can

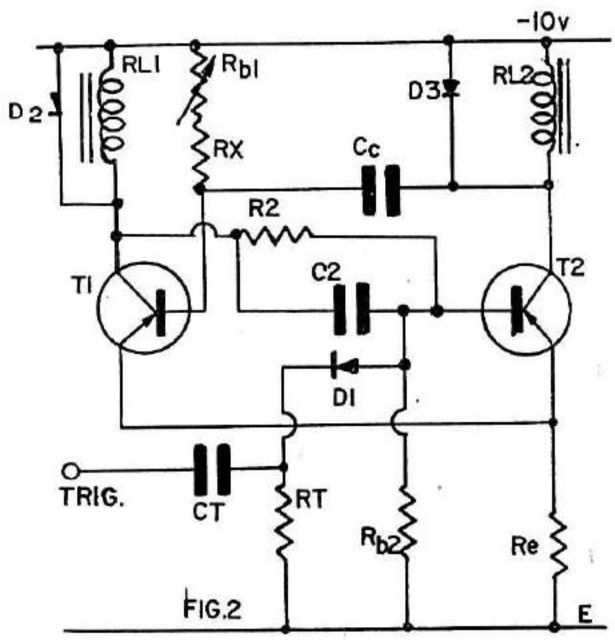


FIG.2

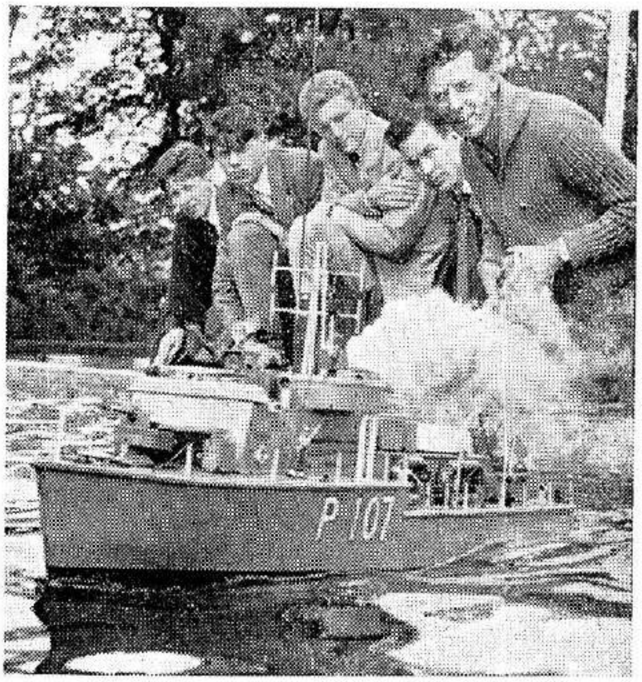
be made up with a $0.1 \mu F$ in parallel with a $0.05 \mu F$.

The value of the trigger capacitor might be $.001 \mu F$ (1000 pF) and the speed up capacitor C_2 might be 330 pF. If a diode is used in the trigger circuit, don't forget to remember that it must be connected round the correct way.

Often it will be found that the time constants do not turn out exactly as calculated, this is due, in general, to two things. The first is the leakage currents of the transistors, which can be appreciable in certain cases, and the second is that the standard components from which these circuits are usually constructed have tolerances of the order of ± 20%. Thus the total error of an R/C combination will be large if both components have similar tolerances at the maximum limits.

P.107

E. T. J. PETERS DESCRIBES HIS FREE LANCE GUNBOAT WHICH MUST HAVE A REPUTATION OF A FLOATING FIREWORK DISPLAY



Smoking heartily, the P.107 gathers speed for a "pyrotechnic patrol".

P.107 is a free lance Gunboat having a scale of ⅜" to the 1". Radio:—The reed receiver is built to a circuit by E.D. Ltd., the transmitter now being used is the crystal controlled "Hill" circuit from *R.C.M. & E.*, the only modification is in the using of the control box: Fig. 1 shows the trimming pots. enclosed in the box, access to the knobs via holes in the back—I do not like exposed knobs on equipment—small fingers like twiddling knobs!

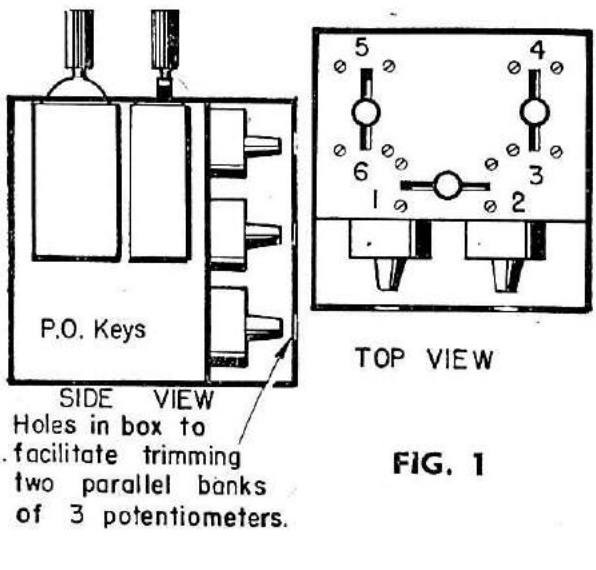
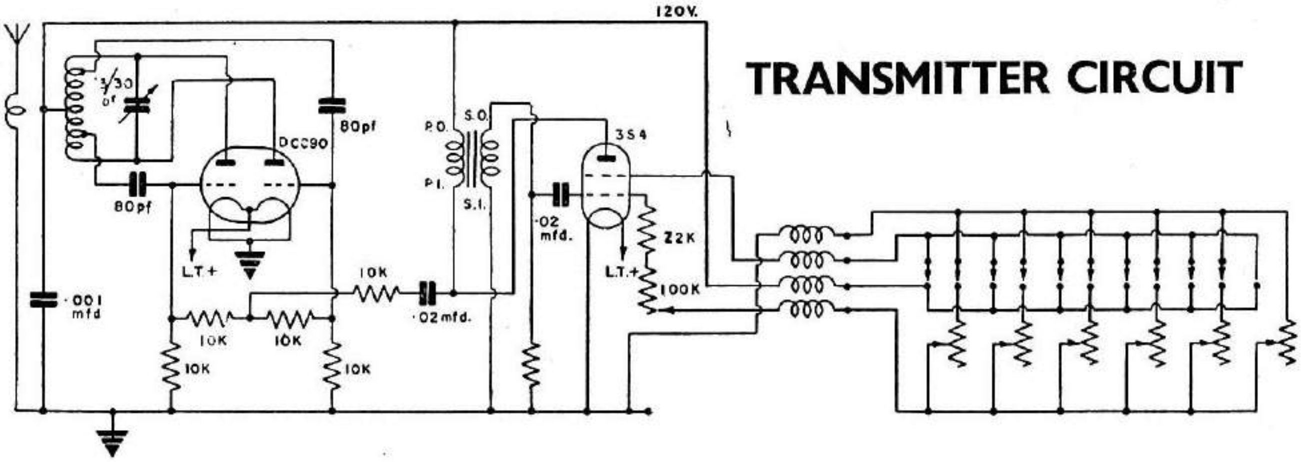


FIG. 1

The control positions numbered 1 to 6 are used as follows: 1 *and* 2. Control steering in usual manner, steering gear consists of gear box driven by electric servo motor, finally linked to a balanced rudder by chain drive and sprockets.

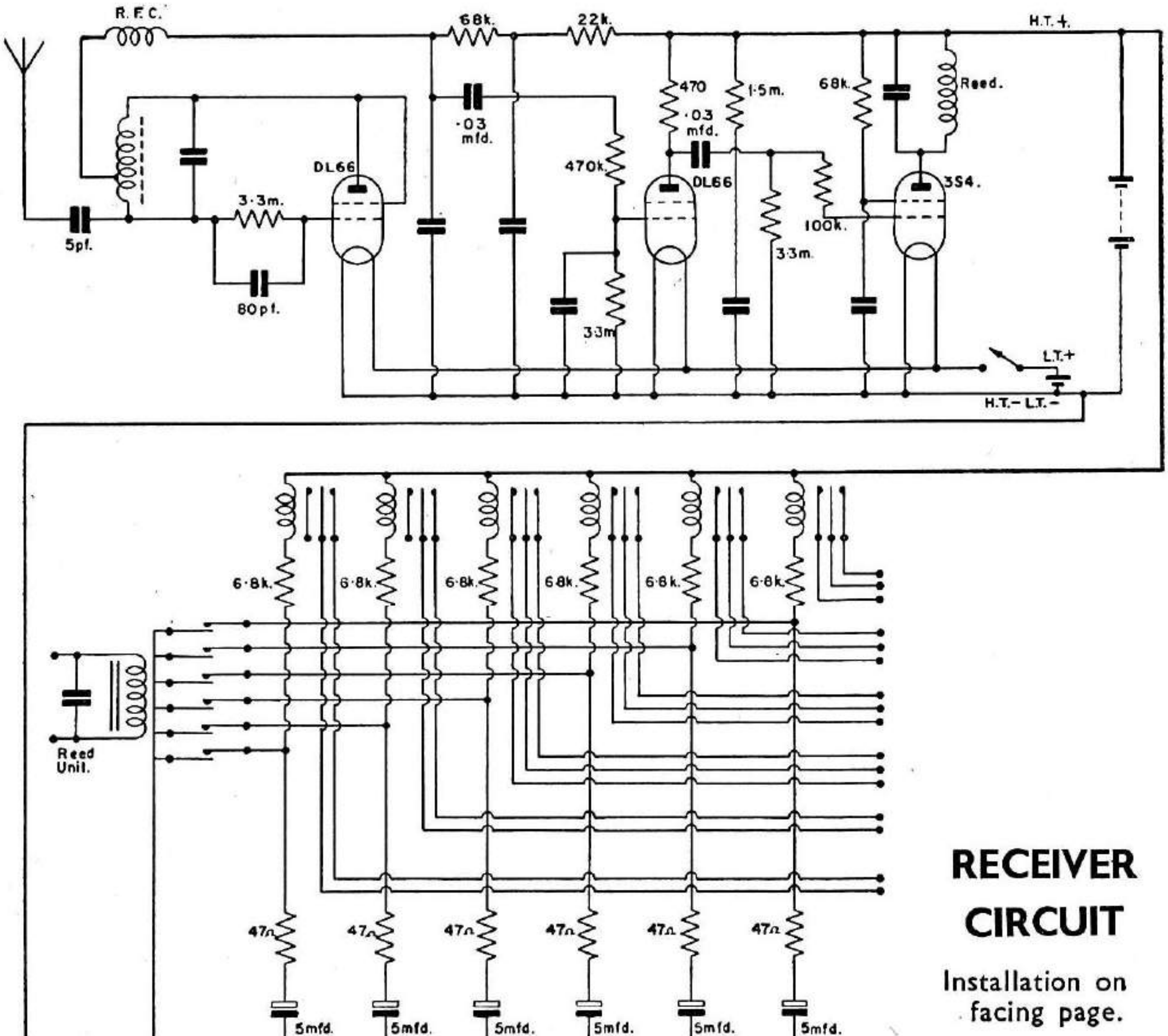
3 *and* 4. Propulsion is by a Taplin Twin cylinder diesel engine, via a variable pitch propeller, the throttle of the engine and the pitch control lever are synchronised, using one common gearbox driven again by an electric servo motor, 4 is used for throttle opening/course pitch in forward drive. 3 gives closed throttle and fine pitch progressively to reverse pitch with throttle slightly open, both directions going through a neutral position when the boat is stopped with engine ticking over.

TRANSMITTER CIRCUIT



Position 5 controls an original Mercury Cossor actuator which has been redesigned to operate a double bank eight position rotary switch, this in turn controls all the auxiliaries, as yet, only one bank is in use, the positions are as follows:—

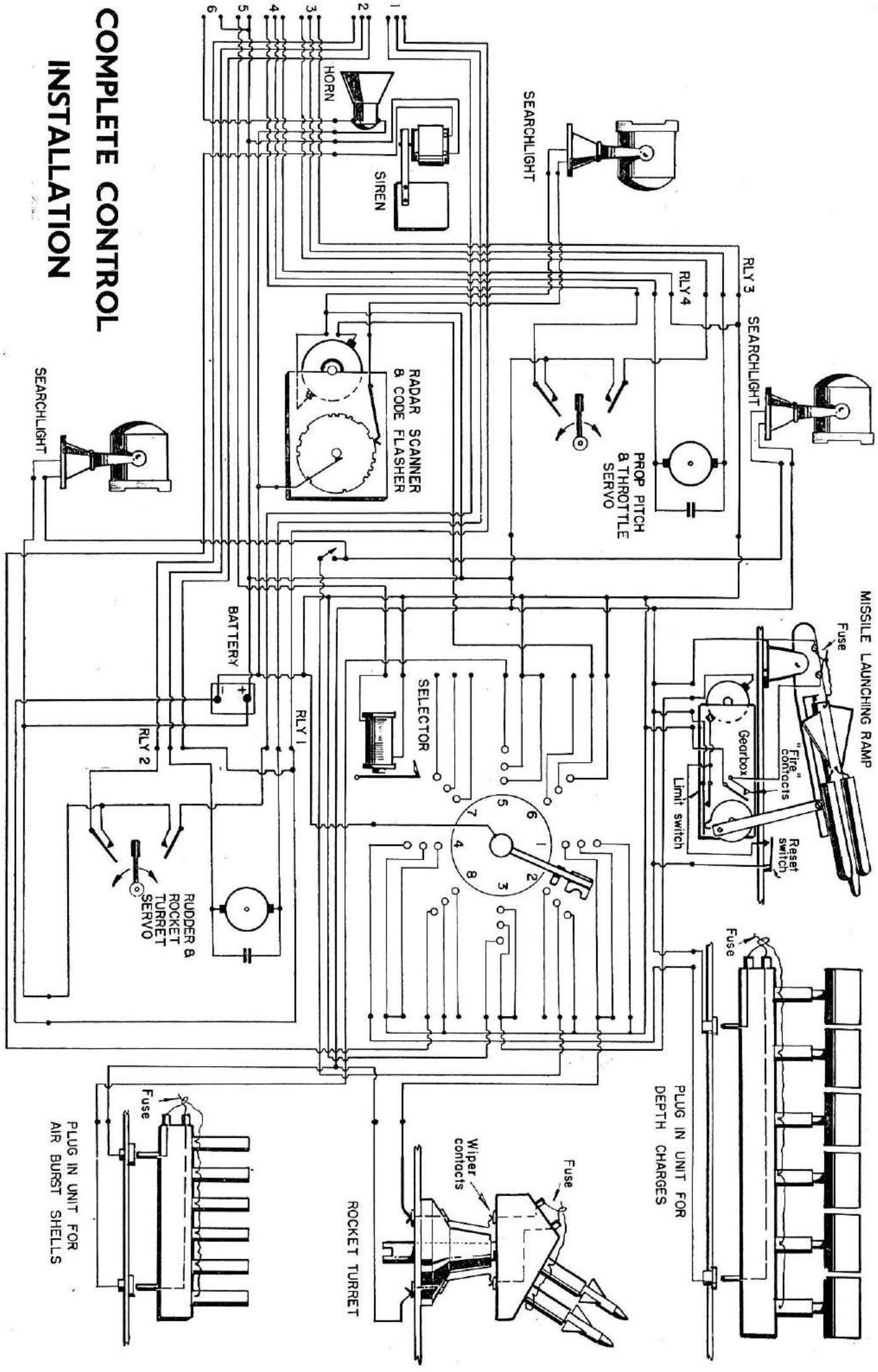
Position 1: (This position is also controlled by an overriding switch accessible when all the super structure is in position) reason for this being that position 1 is the rear port and starboard searchlights, these act as "Safe position indicator" so that when any of the armed units are plugged in I am sure that the actuator is in the correct

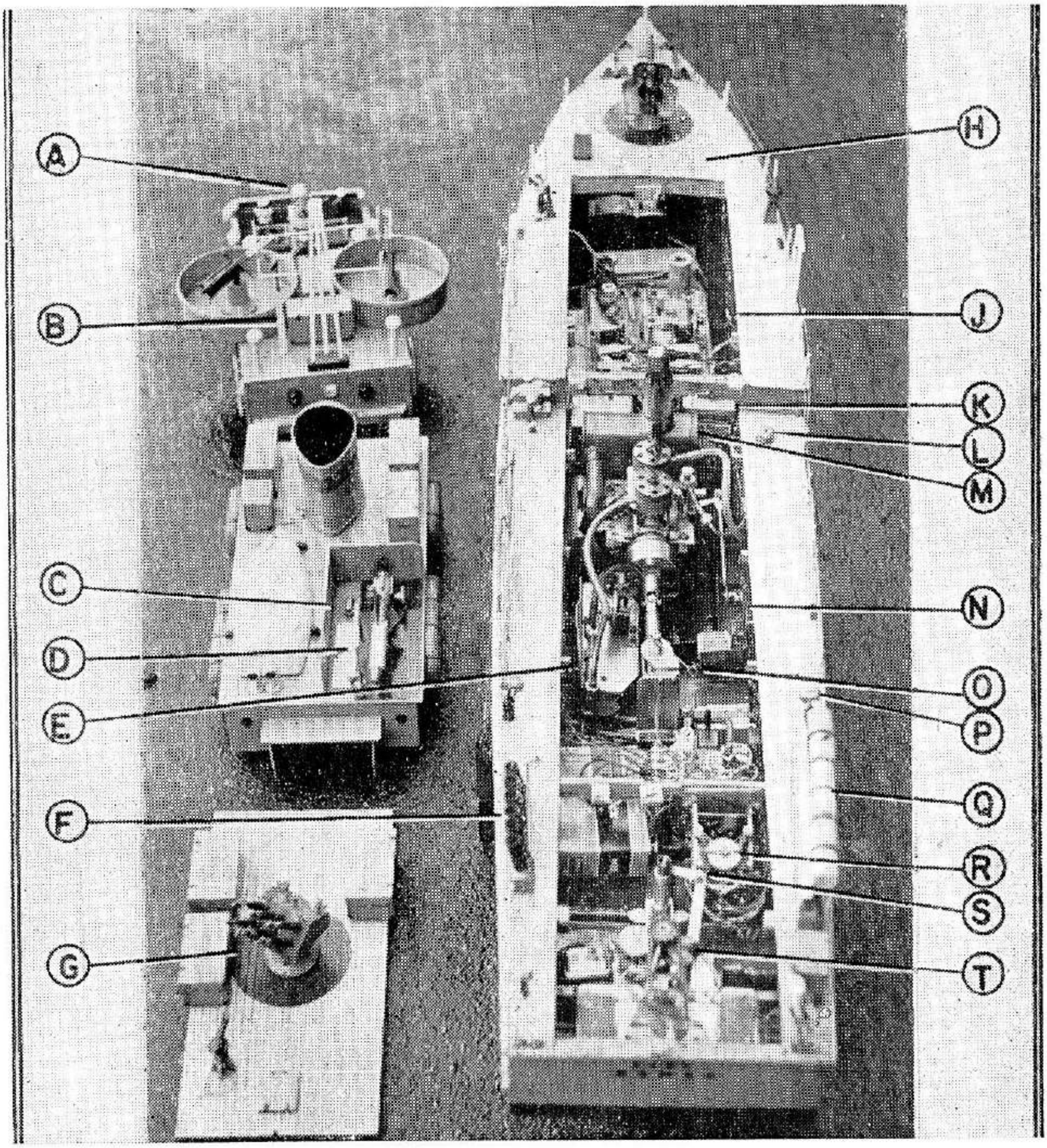


RECEIVER CIRCUIT

Installation on facing page.

COMPLETE CONTROL INSTALLATION





KEY

A. **Forward searchlight.**
B. **Radar scanner.**
C. **Reset button.**
D. **Guided missile.**
E. **Water pump.**
F. **Air burst shells.**
G. **Rear turret.**
H. **Radio switch.**
J. **Receiver (lid removed).**
K. **Radio batteries.**
L. **Fuel tank top.**
M. **Silencer.**
N. **Throttle and prop control gearbox.**
O. **Override switch.**
P. **Rear searchlight.**
Q. **Depth charges.**
R. **Rotary switch.**
S. **Rear turret drive.**
T. **Steering gear.**

position, they are also useful, one may then see them off from the shore denoting that the actuator is working.

Position 2: Plug in drive for the rear turret engages in the rudder gearbox, the turret may be used as a rudder position indicator, and fires six small rockets, the barrels being series fused

with JETEX fuse, electrically, when position 2 is selected, current is sent via the deck contacts, through the turret mounting contacts, into the split ring on the bottom of the turret, and then to the fuse holder above the fuse burns out after igniting the JETEX fuse, length of electrical fuse depends on batteries used.

Position 3: Another gearbox with a drive for the radar scanner is built into the forward section of superstructure an unevenly toothed "cōde" wheel, fitted with a contact which flashes the forward searchlight and the masthead. The navigation lights are switched on whilst the control is in this position.

Position 4: Fires the air burst shells, the unit is built to plug in to facilitate re-loading.

Position 5/7 which controls the ship's hooter, is made from an electric cycle hooter, removed from its case and fitted with a bell mouth made from the front end of a child's toy trumpet.

Position 6: Control for depth charges, also a plug-in unit, the base for which is similar to the air-burst shells at position 4.

Position 8: Guided Missile: this unit is driven from below centre section deck by an electrically driven gearbox. Position 8 merely controls the launching ramp, the rocket is fired by contacts built onto the gearbox, so that they close only when the ramp is fully elevated, this is a safety precaution which should be observed, a limit switch operates when the ramp reaches bottom, re-set button on the top of the superstructure re position the servo for its next operation.

Control Box Key 6. This key controls the ship's siren in addition to the hooter giving a very loud note, useful for "Action Stations", etc. and range testing, being audible for a considerable distance.

We presume the original model used fireworks to propel and explode the rockets, depth charges, airburst shells and guided missile.

It should be pointed out that it is illegal to modify fireworks, so readers intending to try similar experiments would be advised to use JETEX cartridges or parts thereof.

Basic Radio

By G. E. DIXEY

PART VIII

The Superheterodyne and Super-regenerative Receivers

In the last article we outlined the principles of the superhet. receiver. Now we go on to the various stages of this receiver.

The Frequency-Changer

In Fig. 1 is shown a frequency-changer circuit using a heptode valve. This is the most common frequency-changer circuit, which employs a battery valve.

The heptode can be considered as a pentode and a triode in the same glass envelope. The pentode acts as an r.f. mixer, and the triode as the local oscillator.

The pentode section which uses the three grids adjacent to the anode has its grid circuit tuned by L_2C_1; the link coil L_1 couples in the signal from the aerial. R_1, R_2, C_2 provide the screen supply. The anode load is the primary circuit of an i.f. transformer i.f.t.l.

The two grids adjacent to the filament serve as control grid and anode of a triode oscillator, which inspection shows to be of the Meissner type. L_3

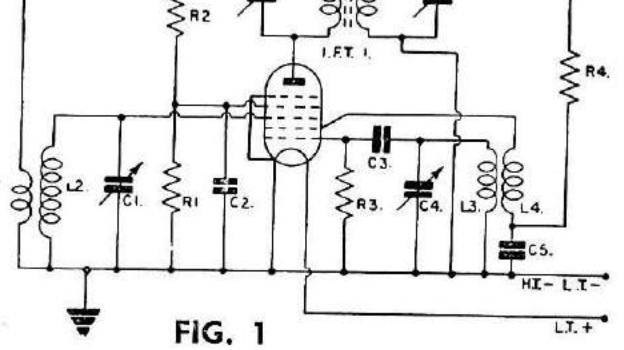


FIG. 1

C_4 form the oscillator tuned circuit; L_4 is the feed-back coil with decoupling of the H.T. provided by R_4 and C_5. Automatic bias is provided by R_3 and C_3.

The operation is as follows:—

Both the received signal and the local oscillator cause the anode current to vary. Since these frequencies are different, the anode current is caused to vary in a complex manner, there being components of anode current of frequencies fs, fo, fo-fs, etc., where fs is the signal frequency and fo the local oscillator frequency. The primary of the i.f. transformer is a tuned circuit, which responds to the i.f., i.e. fo-fs. Thus, the two signals are mixed to produce the i.f. This i.f. signal is coupled into the secondary of the i.f. transformer, which is also tuned to receive it. It is now passed to the i.f. amplifier.

The i.f. Amplifier

This is quite a conventional voltage amplifier with both input and output circuits tuned by i.f. transformers. The i.f. transformers may be tuned by a trimmer (small variable capacitor), or by a slug of iron dust, which can be screwed in or out of the coil to vary the inductance. Since the i.f. amplifier works at high frequencies, a pentode is invariably used.

A diagram of an i.f. amplifier is shown in Fig. 2. It may be coupled into a further i.f. amplifier to improve sensitivity and selectivity, or fed direct to a detector.

The Diode Detector

The diode detector is about the only type used in superhet. receivers. The diode may be a hard valve or a crystal diode. Some battery valves, e.g. DAF. 91 are a pentode with a diode contained in the same envelope. In this case the

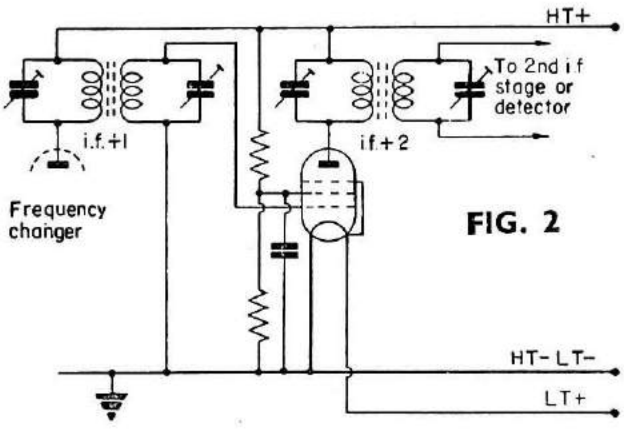


FIG. 2

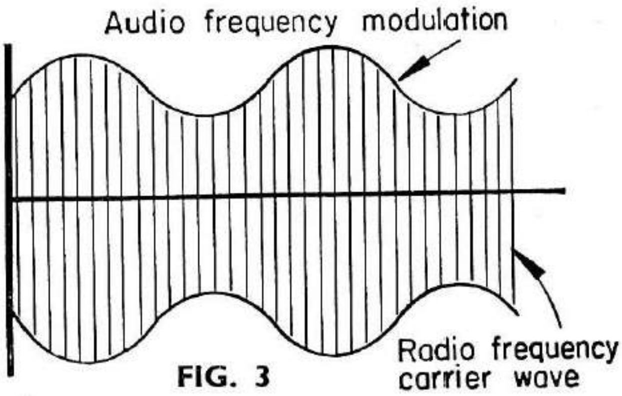


FIG. 3

diode is used as the detector, and the pentode as an a.f. amplifier.

An unmodulated carrier wave is one of constant amplitude, and constant frequency. When it is 'amplitude modulated' its amplitude is caused to vary in accordance with the audio tone with which it is modulated, this is shown in Fig. 3. The process of detection or demodulation consists of rectification of the modulated carrier and filtering out the carrier wave to leave only the audio wave. The circuit of a diode detector is shown in Fig. 4.

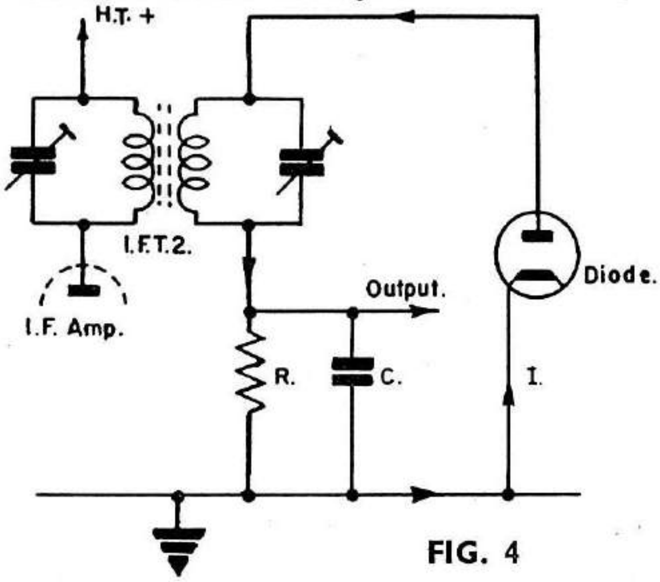


FIG. 4

It can be seen that the detector circuit consists of the secondary of the i.f. transformer with the diode and a parallel R/C combination across it. Now the modulated signal appears across the diode in series with R/C. Current only flows in the circuit (in the direction of the arrows) when the diode anode is positive with respect to its cathode (or filament). Since the wave only goes positive on alternate half-cycles the diode only conducts on these half-cycles, and the carrier is said to be rectified. This is shown in Fig. 5 (a).

The capacitor C has a large value which gives it a very low reactance to

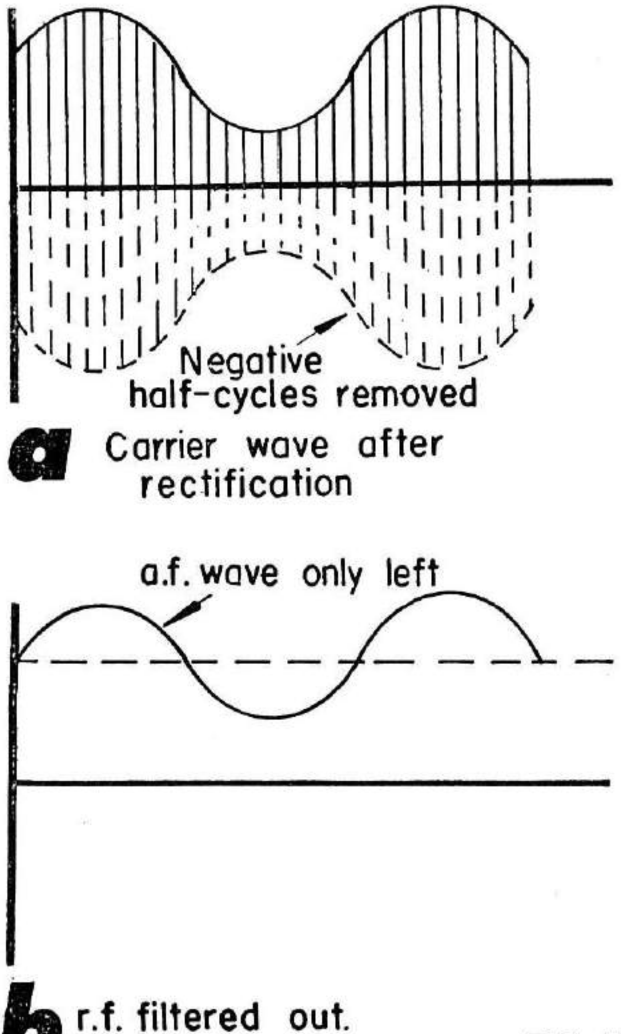


FIG. 5

the r.f., but a high reactance to the a.f. The result is that the r.f. currents flow through C to earth, and the a.f. currents flow through R developing an audio voltage across it. The output is taken from the top end of R. Typical values are R = 470 K ohms, C = 100 pF.

The a.f. Amplifier

The a.f. amplifier which follows the detector serves to amplify the a.f. produced, and is a conventional amplifier, so no special comments need be made here, since this amplifier was covered in detail in the article on 'voltage amplifiers'. However, Fig. 6 is included to show the use of a diode-pentode as a combined detector and a.f. amplifier.

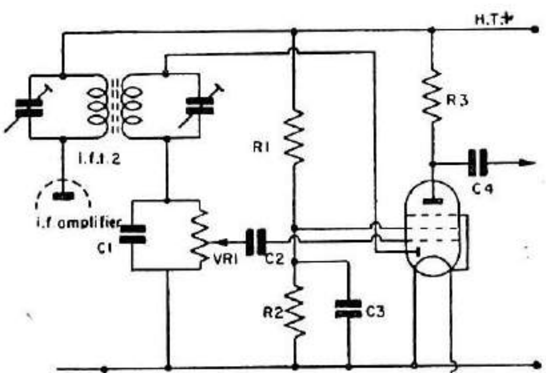


FIG. 6

The detector circuit is easily picked out. VR 1 corresponds to R in Fig. 4. In a broadcast receiver it is used as a volume control. The a.f. picked off VR 1 is coupled by C_2 into the grid circuit of the a.f. pentode amplifier. The amplifier output is taken via C_4.

This completes our study of the superhet. receiver, and we now meet a completely different type of receiver, whose operation is rarely understood well, the super-regenerative receiver.

The Super-Regenerative Receiver

The super-regen. is basically an oscillator operating at the signal frequency, whose oscillation is interrupted at a particular rate known as the 'quench frequency'. A simple super-regen. circuit is shown in Fig. 7.

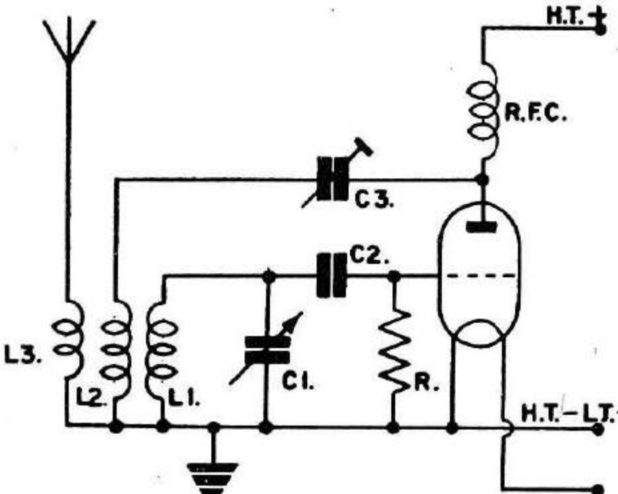


FIG. 7

That it is our old friend the Meissner oscillator with a couple of refinements is evident. The anode is an R.F.C. in parallel with L_2 and C_3 (H.T. + and H.T. — are considered to be at the same potential with respect to alternating voltages). The feed-back coil is L_2 and the amount of feed-back is controlled by C_3, a variable capacitor adjustment of which takes the circuit in or out of the oscillatory condition. An aerial is coupled in via L_3 so that received signals are injected into the tuned grid circuit L_1 C_1.

An essential difference between this oscillator and a normal oscillator is in the choice of values of R and C_2 which are so chosen that, instead of a steady bias value, which permits oscillations to be maintained, a large bias voltage

is produced, which cuts the valve off.

This bias then leaks away through R until the valve is again conducting and oscillations recommence. Again a large bias is produced which cuts off the valve, then leaks away through R, and so on. The oscillations are thus intermittent, and are cut on and off at the quench frequency. The nature of these oscillations is shown in Fig. 8.

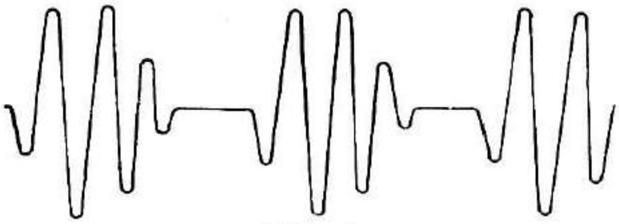


FIG. 8

The frequency at which this quenching is carried out is normally of the order of 20—50 kc/s.

The question arises, why should the circuit be allowed to oscillate? A fact which has to be accepted is that these receivers are at their most sensitive when on the verge of oscillation (readers who have dabbled with reaction T.R.F. sets will have met this phenomenon). By permitting the circuit to oscillate, and then quenching it at a much lower frequency the receiver is on the verge of oscillation for an appreciable length of time.

The super-regen. shown in Fig. 7 is of the self-quenched variety. It is possible to use a separate valve as a quench oscillator and apply this quench voltage to the grid of the super-regen. valve. Each time the quench voltage swings negatively, it cuts the super-regen. valve off, and on the positive swing allows it to oscillate. Thus, the super-regen. valve is periodically cut on and off at the quench rate.

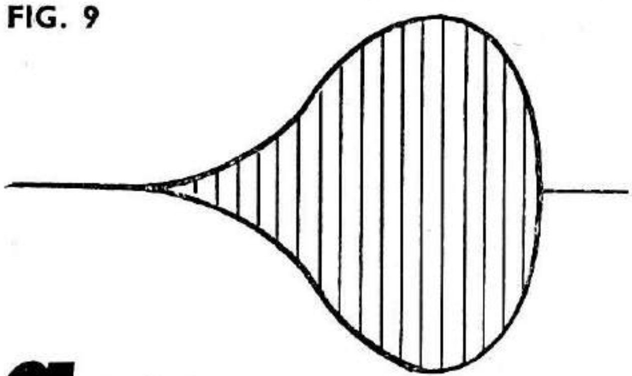
Modulated Carrier Operation

Operated in the manner described the super-regen. can be used for the reception of modulated signals. How these signals are detected can be described as follows.

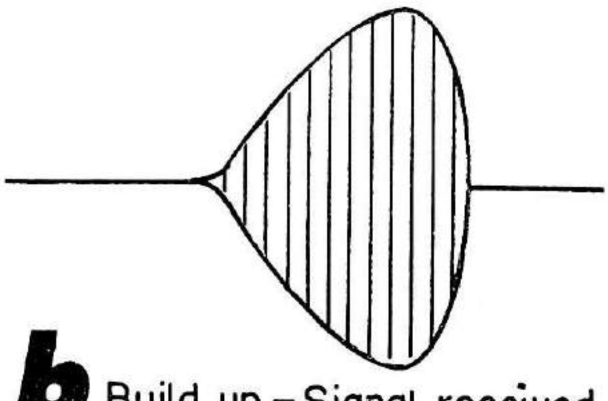
With no signal received the oscillations build up from the value of the random noise voltages in the grid circuit. Starting from such a small level, the build-up time is comparatively long. Fig. 9(a) shows this.

When a signal is received the build-up time is reduced, since the level at which the oscillation commences is that of the received signal (Fig. 9(b)).

FIG. 9



a Build up – no signal



b Build up – Signal received.

If the carrier is modulated the level of the signal varies with the modulation (Fig. 3), so the time of build-up varies with the modulation and the anode current of the valve follows the modulation waveform.

Unmodulated Carrier Operation

A lot of super-regen. receivers used for radio-control operate a relay on the change in anode current occurring on receipt of a signal. To achieve this the receiver is adjusted to be on the verge of oscillation; the control which sets this condition is termed the 'sensitivity' control. When the valve is in this condition the anode current is high, because there is little bias on the valve. When a signal is received, the valve oscillates fiercely, a large bias is developed, and the anode current drops.

There are a number of super-regen. circuits published all of which employ the same principles of operation. The main differences lie in the type of oscillator employed, and the method of generating and applying the quench voltage.

The next and final article in this series covers the principles and methods of modulation and transmission.

Servo Motor Performance

R. H. WARRING DEALS WITH THIS IMPORTANT LINK IN OUR MODEL CONTROL SYSTEMS

ALMOST without exception electric motors used for servo units are of permanent magnet type which tend to have relatively low efficiencies particularly when delivering a reasonably high torque. Gearing is thus essential to multiply the torque, with further losses through the gear train. Overall efficiency, therefore, may be as low as 10 per cent, and in many cases even less. Normally this is acceptable since the working current drain usually falls within accepted limits for servo batteries, although accumulators are to be preferred to dry cells for reliable operation where current drain exceeds about 200 milliamps due to the inherent tendency for Leclanche-type cells to polarise rapidly under heavy current drains.

The nominal 'working' current — or, as many manufacturers quote, 'no load' current—may represent only part of the story, however. With permanent magnet motors the maximum current drawn when the motor is stalled can be of the order of several amps; and the application of even moderate load can often double or treble the nominal 'no load' current rating. This is hard on the servo batteries, but can be harder still on relay contacts and cause considerable trouble in this respect. Arc suppression via a resistor or resistor and capacitor in series may still be effective in combating surges through the contacts, but the steady demand may well exceed the safe rating of the relay contacts and cause burning or even welding.

A typical current curve for a permanent magnet motor is linear (see Fig. 1). At the low speed end, near the stall, the curve will be affected by heating effects. A rise in temperature in the armature windings, due to the heavy current carried, will increase their resistance so that less current is drawn.

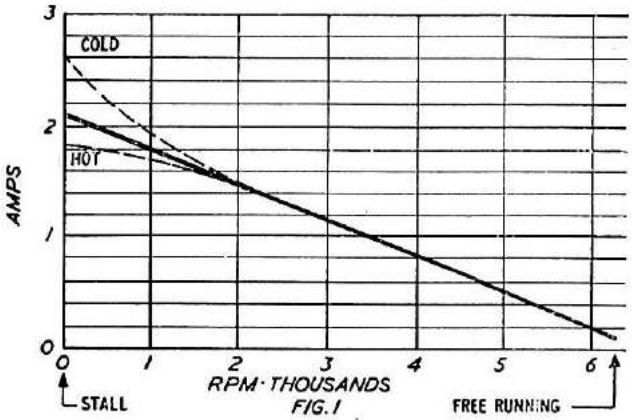


FIG. 1

Thus measured stall current will vary between a maximum (instantaneously stalled, with 'cold' windings) and a minimum (windings heated up to a steady temperature at which the motor is dissipating further heat by radiation and conduction—always provided it can take the resulting temperature without burning out). On three-pole motors, in particular, stall current will also vary with the position in which the armature is stopped — i.e. whether one or more armature windings are in circuit via the brushes, depending on how the brush has stopped on the commutator.

A very fair approximation of the current curve for a small permanent magnet motor can usually be made without taking intermediate readings by measuring stall current and free running current (i.e. with the motor running without any load) and connecting with a straight line. The free running current or 'no-load' current is no real criterion as to what the motor will draw under useful load. The most useful generalisation that can be drawn in this respect is that a motor which takes a very low free running current will likewise generate very low torque under load. Thus to get any useful work out of it it may have to drive through a high reduction ratio.

With a linear current curve torque, generated theoretically, is also linear—zero at the free running speed and a maximum at the stall. Stall torque again, however, is a variable figure, depending on how many armature windings are energised, and also considerably influenced by the heating effects of the current, as affecting the motor effi-

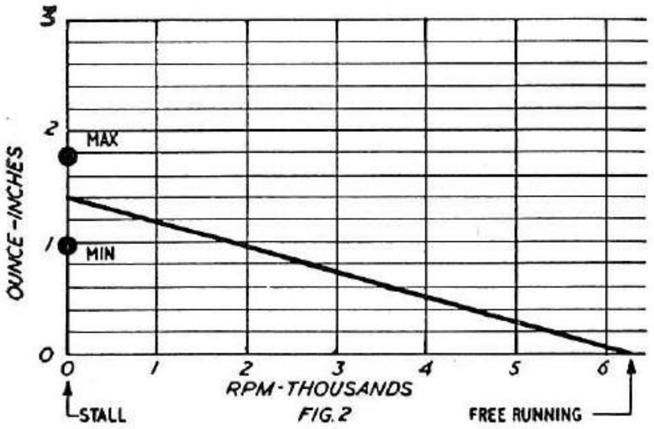


FIG. 2

ciency. On an approximate basis, however, the mean of the measured 'maximum' and 'minimum' values of torque measured at stall, joined by a straight line to zero at the free running speed, will give the torque-speed curve.

We now have a basis for computing the overall efficiency of the motor, on an approximate basis.* Performance data can be read off the constructed curves of Figs. 1 and 2 and derived data can be computed from these. A typical set of workings are given in Table I, the method of arriving at each line of working being as follows—

Line 1. Current values are read from the current speed curve constructed as in Fig. 1.

Line 2. Multiply current values in *line* 1 by the voltage used to arrive at watts input. (Note: this is not necessarily strictly accurate since voltage may vary with current drawn, according to the source of voltage used. However, we are concerned only with approximate working, so the assumption of constant voltage is acceptable).

Line 3. Enter torque, read from the constructed torque curve as in Fig. 2.

Line 4. Multiply torque by r.p.m. and divide by 1,000 to arrive at equivalent milli-horsepower, where the torque entered in *line* 3 is measured in *ounce inches.*

Line 5. Multiply milli-horsepower calculated for *line* 4 by 746 and divide by 1,000 to arrive at *watts output.*

Line 6. Divide values arrived at in *line* 5 by corresponding values for watts input in *line* 2 and multiply by 100 to arrive at overall efficiency, as a percentage.

It is then very instructive to plot milli-horsepower output (line 4), and overall efficiency (line 6) on the current consumption graph, as in Fig. 3. Such a graph will indicate (i) at what speed the motor develops maximum power output, and the corresponding current consumption; (ii) at what speed the motor develops maximum efficiency; also efficiency at maximum power, or at any intermediate speed, etc. In other words, such a graph or set of characteristic curves for the motor indicates the best working point or working range for the motor.

* More accurate results can, of course, be obtained where the measured performance characteristics of the particular motor are known—e.g. from the sets of characteristic curves published in the **Model Maker** series of Test Reports.

TABLE I

LINE	R.P.M.					
	1000	2000	3000	4000	5000	6000
1. Current Consumption (amps)	1.8	1.5	1.1	.8	.95	.1
2. Watts Input = Voltage × Current (Assume 6 volt input)	10.8	9.0	6.6	4.8	2.7	.6
3. Torque (ounce-inches)	1.2	.95	.72	.5	.3	.06
4. Milli-H.P. = $\frac{\text{Torque} \times \text{R.P.M.}}{1000}$	1.2	1.9	2.16	2.0	1.5	.36
5. Watts Output = $\frac{\text{Milli-H.P.} \times 746}{1000}$	.9	1.42	1.61	1.51	1.12	.26
6. Overall Efficiency = $\frac{\text{Watts Output}}{\text{Watts Input}}$	8.3	15.8	24.2	31.2	41.6	43

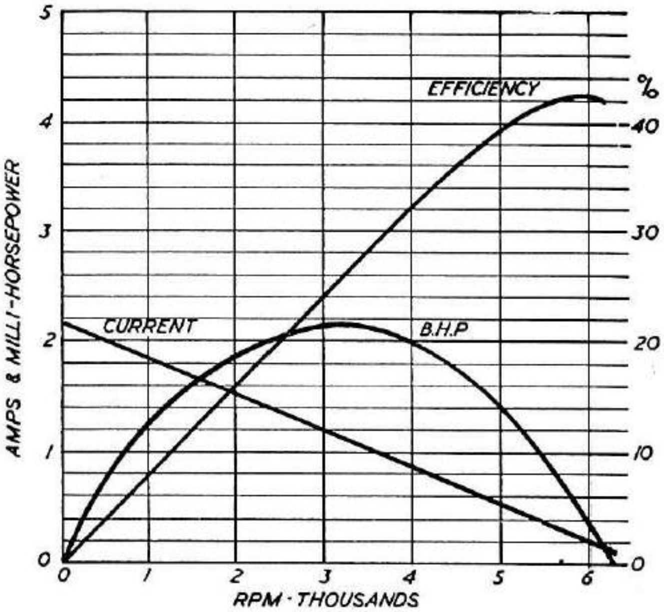


FIG.3

In any particular installation with the motor running under load it is only necessary to measure the current drawn by the motor to establish the operating point relative to these characteristic curves. It is then possible to establish whether the motor is running under good conditions—i.e. near peak power —or very economically—i.e. near maximum efficiency; or under poor conditions—e.g. at a speed corresponding to low power and high current drain.

Suppose, for example, simple measurements with the motor alone established the curves of Fig. 3 and the motor was then reassembled as a servo unit complete, driving some form of mechanical output. Measurement of the current drawn by the servo without external load will establish an operating point for the motor (see Fig. 4). This should fall to the right of the maximum power operating point (speed) so that when the servo is driving its design load—e.g. operating a control surface—the resulting operating point (again determinable by measuring the current under load conditions) should, ideally, coincide with the maximum power point.

In practice it would be better for the normal load-speed condition to fall to the *right* of the peak power point as being more efficient (and thus more economical in terms of current drain), as well as providing a reserve of power in that an overload causing the load-speed to drop slightly will result in *increased* power output from the motor to combat this condition.

The operating point of the servo under *no load* represents the load put on the motor by the servo gearing and linkage. Obviously the farther this pulls the operating point to the left the more power that is being absorbed in driving the gearing. At the same time, being reduction gearing, it is producing torque multiplication. The actual working point is established both by the actual reduction ratio achieved and the efficiency of the gearing as a gear train. If the working point is wrong —too far to the left—either the gear ratio is wrong or the gears are inefficient (mechanically poor), or there is a combination of both faults. Increasing the reduction ratio should displace the no-load working point to the right again, but will not compensate for poor mechanical efficiency. Worm gear reduction (in small sizes) does, unfortunately, tend to be very inefficient mechanically, so that nothing like the theoretical torque multiplication is achieved. On the other hand the faster the motor itself can run under load conditions the more efficient it will usually be since maximum efficiency with small permanent magnet motors nearly always occurs at the upper end of the speed range (i.e. usually about 75 to 80 per cent of the free running speed). Usually, however, it is better to accept a slightly lower efficiency and try to arrive at a *load-speed* working point near the peak power point for the motor.

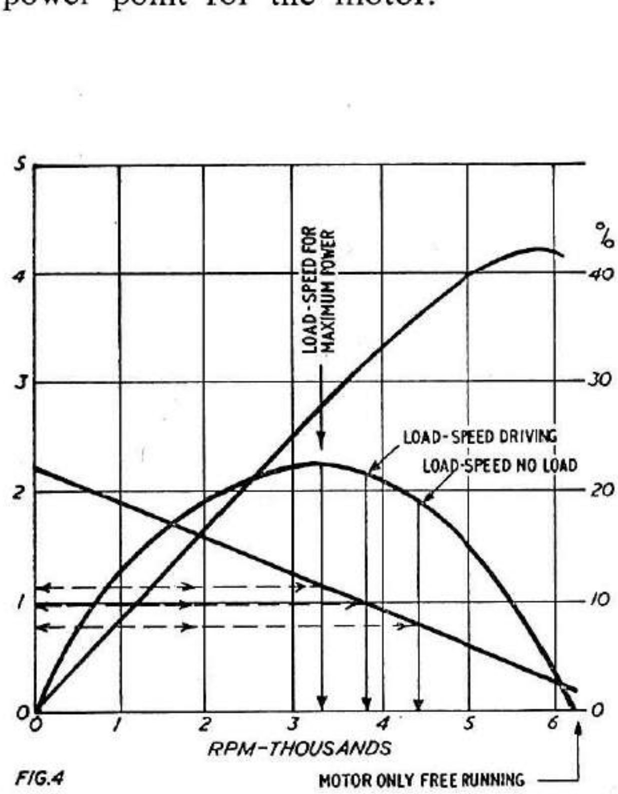


FIG.4

Transistorised Pulse Unit

By P. T. BELLAMY
D.Tech. (Eng.)

THE requirements for this pulse unit were two pulse frequencies, the lower one being 10 c/s and the higher 30 c/s, the mark space ratio was to be variable as well between limits of 10% to 90%. Also it had to provide continuous mark and continuous space.

The latter two requirements being very simple will be dealt with first. It was decided to generate the pulses with a pair of relay contacts, so the continuous mark space was obtained by using a biased off switch across the relay contacts and a biased on switch in series with the output. All contacts being suppressed with just one resistor and capacitor as shown in Fig. 1.

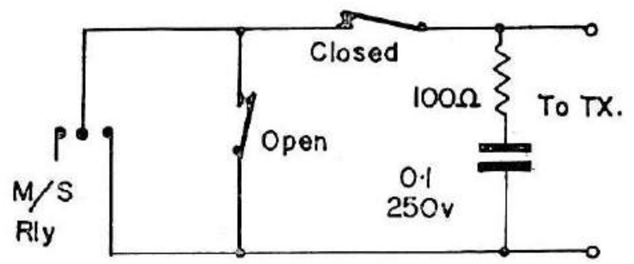


FIG. 1

It is possible to make a transistor multivibrator perform both functions of mark space generator and frequency generator. However there are various troubles, which I will briefly describe. The outcome of the faults are that variation of mark space ratio varies the frequency and sometimes vice versa. It is advisable to keep Rc $\alpha >$ Rb (Fig. 2) in order to keep the collector waveforms reasonably square. This means that Rc must be varied in conjunction with Rb—i.e. a gauged pot is desirable.

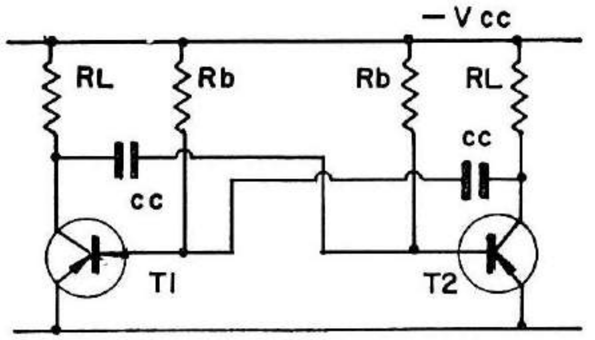


FIG. 2

However, at each extreme it is found that the frequency of the pulse rate increases. This is due partly to the fact that the decay time of the base voltage is dependent on Rb, but if Rb is large, which it will be at either extreme, then the leakage current of the transistor becomes appreciable compared with the current through Rb. Thus the decay time for the base voltage is much less than one might suppose it to be, and so the frequency rises as shown in the graph, Fig. 3. As can be seen, the

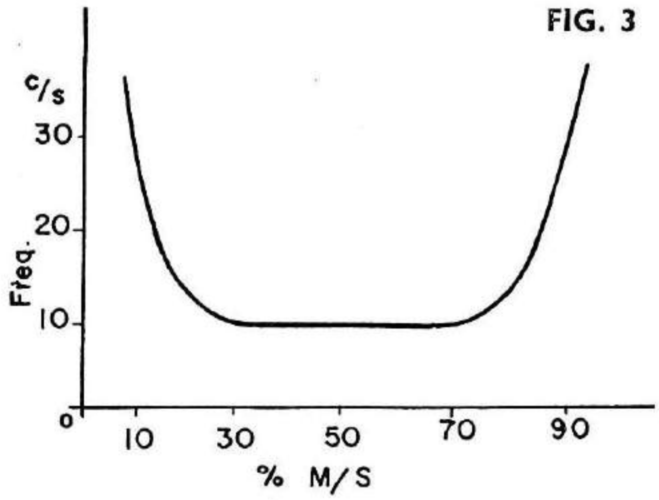


FIG. 3

usable part of the curve is between 25% and 75%. This is only a ratio of 1:3, which is not enough for a rudder to give a fast response. If the whole of the 10% to 90% is used, the frequency response is of no use, so another approach had to be used. It was decided to make the frequency and mark space independent. This is done by using a multivibrator to generate the pulse frequency and a monostable circuit to generate the mark space ratio. The circuit of the multivibrator will be taken first.

In the interest of reliability it was decided not to use electrolytic or self-sealing metalised capacitors. The reasons for this are that electrolytic capacitors have a large leakage current and this is dependent on temperature. The self-sealing metalised paper capacitors are only self-sealing when there is a voltage of say 70 volts across them—this is not much use as the transistor circuits work off 18 volts total.

The standard values of capacitor are: .1 μF, .25 μF, .5 μF, 1 μF, 2 μF. This sets the choice of capacitor that can be used to give the correct frequency. Next the frequency ratio was to be 1:3, i.e. 10 c/s and 30 c/s, and the frequency change was to be done with only one change over switch. The reason for this is shown later.

These requirements thus set definite timing relationships. No calculations were made to determine the values of the capacitors, the required waveforms were drawn out and the values of capacitors chosen to fit the required waveforms, Fig. 4.

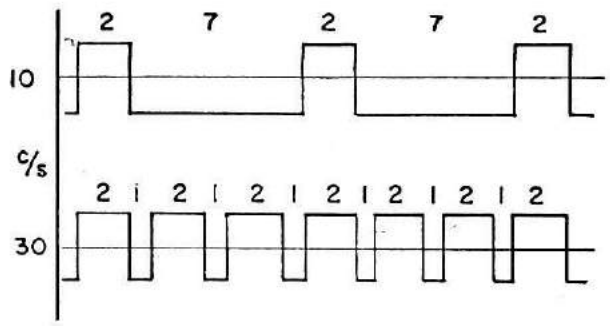


FIG. 4

It can be seen that a complete cycle at 10 c/s occupies nine units (2 + 7) of time, and one cycle at 30 c/s occupies three units (2 + 1) of time.

Now if each unit of time represents .25 μF then the capacitors required for the cross coupling of the multivibrator are a fixed 0.5 μF on one side and on the other, a fixed .25 μF, and a 1.0 μF in parallel with a 0.5 μF which can be switched in parallel with the fixed .25 μF to give 1.75 μF total equivalent to seven units of time.

To find the value of base resistor the formulae used is Period=.692 (R_{b1} C_1 + R_{b2} C_2). Let R_{b1} — R_{b2}.
= .692 R_b (C_1 + C_2) approx.

10 c/s gives a period of 100 millisecs.

$100 = .692\ R_b\ (.5 + 1.75)$

(R_b expressed in KΩ)

$= .692 \times 2.25 \times R_b$

$$\therefore R_b = \frac{100}{2.25 \times .692} = 64\ \text{k}\Omega.$$

Nearest preferred value = 68 kΩ.

From $R_b < \alpha R_c$ where α is the current gain of transistor.

R_c can be say 2.7 kΩ.

This gives the values of the multivibrator frequency determining circuit, Fig. 5.

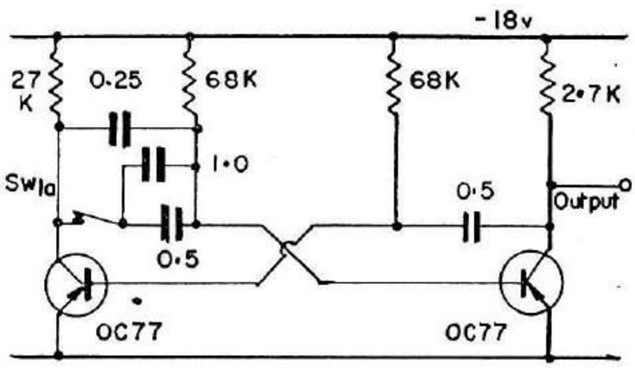


FIG. 5

Normally closed switch to give 10 C/sec., opened for 30 C/sec.

The next part of the pulse unit is that which generates the mark/space ratio. The circuit used is basically a monostable switch. The working of the circuit is explained in Transistor Circuits 2. The trigger pulses are fed in via a capacitor and diode from the multivibrator frequency generator. The trigger pulse switches the monostable into its unstable position and the C_c R_{b1} time instant determines when it will switch back to its normal rest position. By varying the value of R_{b1}, so, the time of switching back to the steady state can be altered. If the collector loads are the two coils of a carpenter polarised relay, then a variable mark/space pulse will be generated by the contacts. The end limits, i.e. maximum and minimum mark/space are adjusted by the values of the total maximum and minimum base resistance R_{b1} and Rx.

When the frequency of the timing multivibrator is increased by depressing a double pole switch and removes some timing capacitance from one side of the multivibrator, so some capacitance must also be removed from the timing circuit of the monostable so that 50/50 pulses occur at the same central setting of the potentiometer R_b at both frequencies.

It is quite simple now to make all the required calculations for designing the monostable. It will be found that if variable mark/space signals are required at 30 c/s then a suitable high speed relay must be used. This is because at 10/90% of 90/10% the relay must perform a complete cycle of making and breaking in only 3 m s. However, in the author's case only 50/50% signal was required at 30 c/s. With a transistor transmitter then it is

possible to switch directly without using a relay, and so it is not necessary to bother about the switching times because with transistors the time factor is in the order of μ secs.

The values of the components used in the monostable are to a certain extent dependent on the fact that the choice of potentiometers is limited to the standard range, i.e. 10 K, 50 K, 100 K and 250 K. Of these 100 K is the best—it should also have a linear law and not a log law as usually used for volume controls.

Two equators can now be made for the two limits of mark/space signal corresponding to the full rotations of the potentiometer spindle.

The ratios are 10% and 90%. Pulse frequency is 10 c/s, hence period is 100 μS total — 10 μS and 90 μS at limits of ratio. The values of Rx. and C_c are found thus.

$$(100k + Rx.)\ C \times 0.65 = T_1 \text{ secs.} = 90 \times 10^{-3} \quad \ldots\ldots\ldots\ldots (1)$$

$$Rx. \times C \times 0.65 = T_2 \text{ secs.} = 10 \times 10^{-3} \quad \ldots\ldots\ldots\ldots (2)$$

$$\therefore 100k + Rx. = 9\ Rx.$$

$$\therefore Rx. = 12.5k = 12k \text{ (approx.)}$$

From (2)

$$C = \frac{10 \times 10^{-3}}{12 \times 10^{3} \times 0.65} = \frac{10}{12 \times 0.65}\ \mu F. = 1.54\ \mu F.$$

Now at 30 c/s, C_c needs to be $\frac{1}{3}$ the value at 10 c/s, i.e. 0.5 μF. It can be seen then that the 0.5 μF capacitor is permanently in circuit and the 1 μF in parallel with it is switched out when the speed changes from 10 c/s to 30 c/s.

The collector loads will probably be the two coils of a balanced polarised relay but the D.C. resistance is about 1,000 Ω so another 1.8 k should be put in series with each relay coil. To stop overshoot a low hole storage diode such as an 0A.10 should be put across each relay coil. The common emitter resistor can be 100 Ω with a .25 μF in parallel. This bias resistor is included so that the base of the off transistor can have a positive bias. The bias chain consisting of R_2 R_{b2} can be 47 k and 22 k respectively.

The trigger diode D_1 can be a general purpose germanium point contact type. The trigger capacitor and resistor C_T

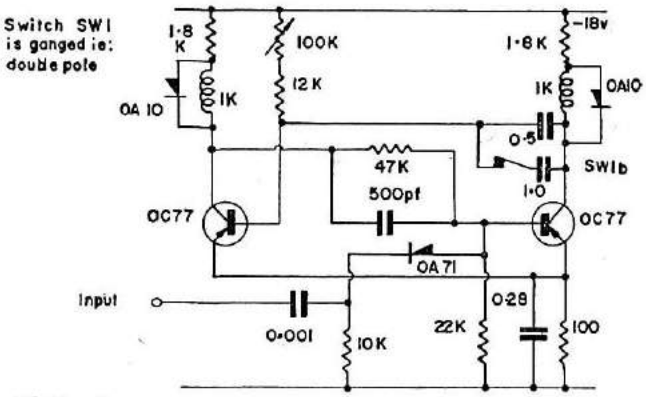


FIG. 6

and R_T can be about 1,000 p (.001 μF) and 10 k respectively. See Fig. 6.

It will be found that some adjustments will have to be made to the circuit depending on the components and transistors used. Most components have a ± 20% tolerance which can make appreciable errors in the timing frequencies and mark/space ratios. Another factor is the operating time of the relay—this may only be milliseconds but this is sufficient to upset exact end ratios being set up without a little circuit adjustment here and there.

It is not advisable to use potentiometers or variable resistors by themselves to find the correct value for a resistor, and then measuring it and inserting the correct value. This is because it is easy to turn the control to zero or almost zero ohms and so cause large currents to flow. If it is required to have a potentiometer, then the approximate resistance should be calculated and the next lower value resistor taken together with a potentiometer whose resistance should be about $\frac{1}{4}$-1/10 the value of the fixed resistor. Then the measurement should be taken of the resistor and potentiometer together in series and a suitable resistor substituted.

It is best to put the whole of the pulse circuitry inside an aluminium box and use microphone or screened cable for the wires to the transmitter. The supply voltage is obtained from two 9 v. transistor radio batteries in series.

Readers may find it helpful to refer to "Transistor Switching Circuits", Part 2, which appears on page 277. Part 1 was published last month; back issues may be obtained from these offices, price 2/4d. post paid.

O.S. 8 Channel Reed Receiver Kit

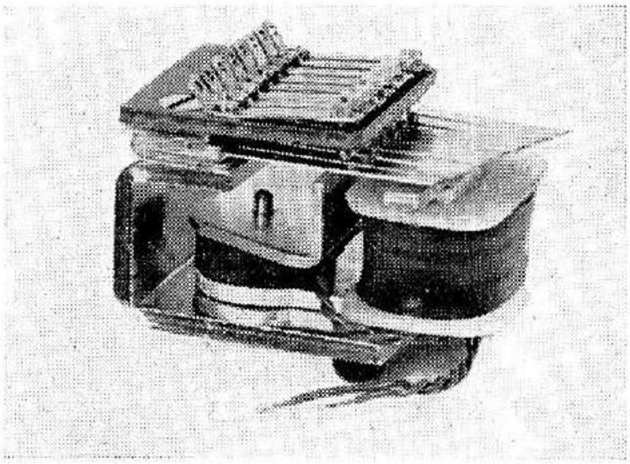
Reviewed by

T. H. IVES & G. EASTELL

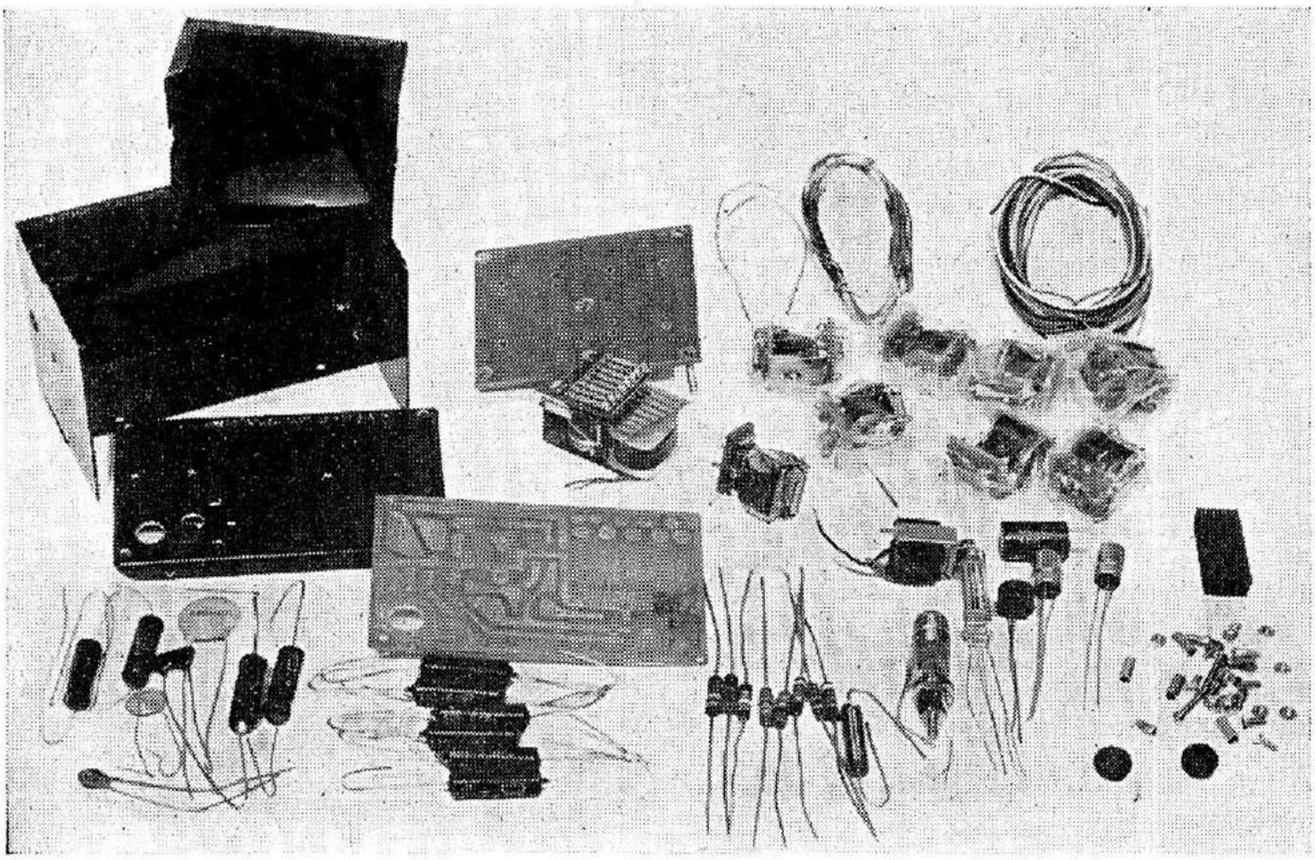
REFERENCE has been made to the standard of the equipment from Japan and the O.S. 8 Channel Receiver kit received for review from Ed. Johnson is of a very high standard indeed.

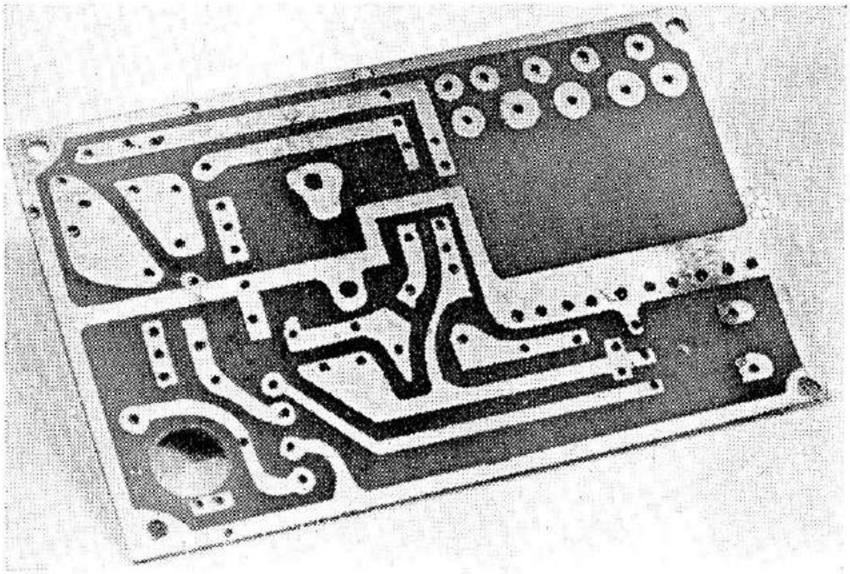
The circuit in an XFY43 valve as a super-regenerative detector of fairly conventional design followed by a three-stage transistor amplifier. H.T. voltage is 45 which seems high by modern standards but the receiver is probably less affected by falling voltage and provides greater reliability.

The receiver proper is assembled on the usual printed circuit board and reed unit and relays are a separate unit. An aluminium panel provides support for both assemblies, the Rx. being underneath and Reed unit and



Above : Small and neat, this reed unit has a circular magnet, some idea of the size of this unit and the equally small relays may be apparent from the layout of the components below.





Left: The printed circuit board approximately three-quarters full size.

Below: One of the tiny relays shown here TWICE actual size! Note the wisp of silk to secure the coil wire end. Facing page shows the theoretical circuit.

relays on top. The complete unit is housed in an attractive black polished aluminium case providing a reasonably shockproof arrangement.

The reed unit is $1\frac{1}{4}'' \times \frac{3}{4}'' \times \frac{3}{4}''$, weighs $\frac{7}{8}$ ozs. and is a really nice job. In appearance it reminds one of the Dean unit and may well have been copied from it.

The relays are the smallest we have seen and one suspects that the winding is not larger than 50g. wire. If so the current capacity is quite low, but for multi work where the signal is on for brief periods only no harm may be done. Size $\frac{3}{4}'' \times \frac{5}{8}'' \times \frac{3}{8}''$. Weight $\frac{1}{2}$ oz.

Some of the capacitors are large by comparison but as the Rx. panel is only $2'' \times 3\frac{1}{8}''$ and the total weight of the unit only $8\frac{1}{2}$ ozs. this is not important and the safety factor is greater.

With a P/C board assembly should be quite easy and the kit includes everything needed, even the correct solder which the makers stress should be used.

An interesting point is the instruction about adjusting the relays which should be done before the relay is fixed in position. Two large nails are provided as weights. The longer one (4″) is sufficient to depress the armature when resting on a point immediately above the pole piece. The other is a 4″ nail shortened to $3\frac{1}{4}''$ and is just insufficient to depress the armature. One can imagine that the settings of each relay will be precise by this method.

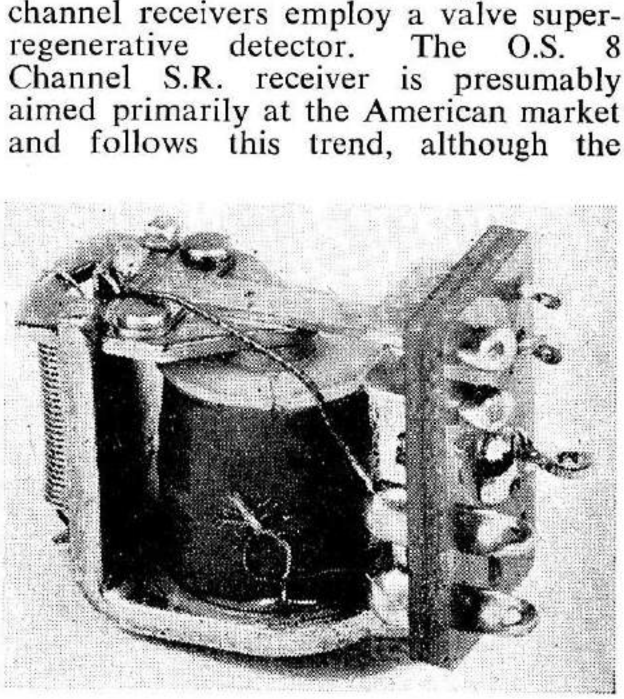
We have no hesitation in recommending the kit to the "do it yourself" fraternity. An extensive knowledge of electronics is not required but one should be able to make a sound soldered joint and have an elementary knowledge of electrics.

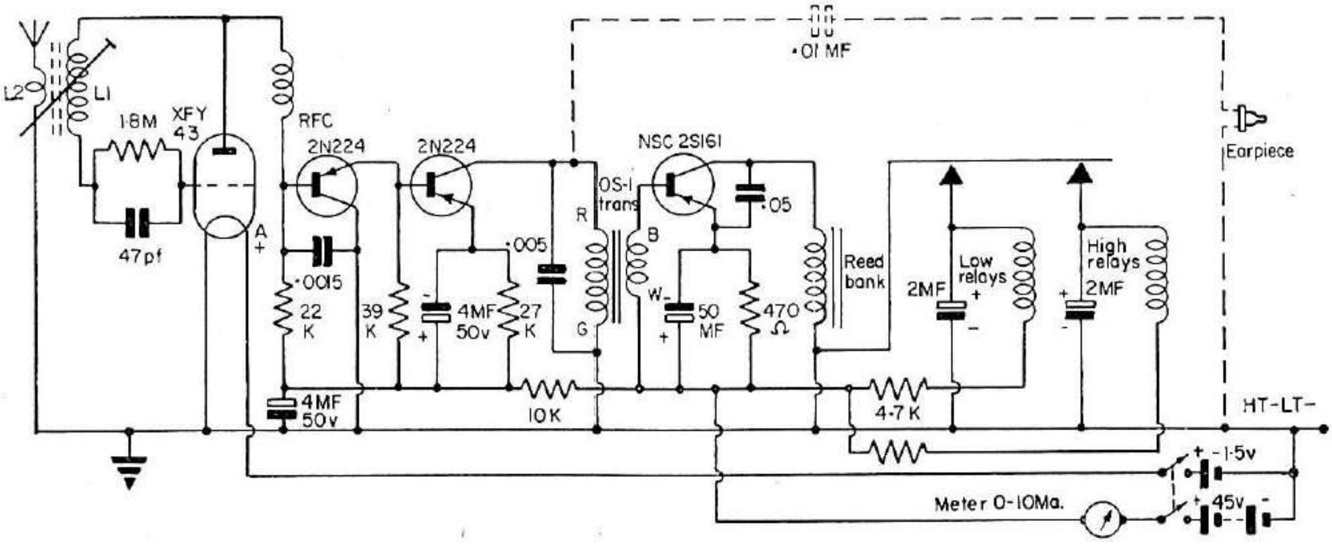
Price £22. Instruction manual giving very fully detailed instructions $2 extra (say 15/-).

* * *

Circuit Description

It would seem that the opinion of kit designers in the U.S.A. is against the use of transistors in RF stages and that they consider insufficient development has taken place to assure the average home constructor of satisfactory results from the finished product. Thus, most if not all kits for reed type multi-channel receivers employ a valve super-regenerative detector. The O.S. 8 Channel S.R. receiver is presumably aimed primarily at the American market and follows this trend, although the





PARTS LIST

1 Top and Bottom Case.
1 Relay Deck — Micarta.
1 Aluminium Chassis Mount.
1 Paper Insulator.
7 Small Nuts.
2 Small Screws.
4 Spacer Tubes.
2 Grommets.
6 Sheet Metal Screws.
8 Flat Relay Screws.
1 Printed Circuit Board.
1 XFY-43 Valve.
2 2N 224 Transistor.
1 25 161 Transistor.
1 OS-1 Transformer.
1 RF Coil Asembly (Tune).
1 RFC Choke.
1 47 mfd. Cap.
1 .0015 mfd. Cap.
1 .005 Cap.
1 .05 Cap.
2 4 mfd. at 50v. Cap.
1 50 MF Electrolytic Cap.
1 470 ohm Resistor.
8 2 mfd. at 50v. Cap.
1 1.8 meg. Resistor.
1 22 K Resistor.
1 39 K Resistor.
1 27 K Resistor.
2 4.7 K Resistor.
1 10 K Resistor.
1 8 Channel Reed Bank.
8 Relays.
24 in. Red Wire.
24 in. Black Wire.
24 in. White Wire.
12 in. Blue Wire.
12 in. Green Wire.
12 in. Yellow Wire.
12 in. Orange Wire.
12 in. Brown Wire.
12 in. Grey Wire.
30 in. Blue Antenna.
5 in. 22g. Solid Wire.
$\frac{3}{4}$ in. – $\frac{1}{8}$ in. Dia. Insulation.
1 Length of Solder.

valve used is a British Hivac XFY 43.

To ensure stability and minimise feedback due to long leads or high internal resistance batteries, the super-regen. detector and the first two (2N244) transistor stages are decoupled from the output stage by a 4 mfd. electrolytic capacitor and a 10 K resistor, the latter also acting as a voltage dropper to the first sections of the receiver.

In order to match the high impedance of the valve stage to the lower impedance of "transistory" the first 2N244 is connected as a direct coupled emitter follower, which is in turn directly coupled to the second 2N244, this drives the output transistor via an inter-stage transformer.

As a result of the high voltage used (45 volts) the resistors used in the first two stages need to be of correspondingly high values, this, together with the coupling employed, indicates that a fairly high gain could be expected.

The NEC 2S161 output transistor operates in class B and distortion should be low enough to make bi-simultaneous operation a possibility.

4.7 K resistors in series with the relays limit the current to a safe level and 2 mfd. electrolytics provide the usual smoothing and avoid any tendency for the relays to "follow" the audio tones.

Three Purpose C/W Transmitter

F. G. RAYER OFFERS THIS FLEXIBLE LITTLE TX. FOR YOUR EXPERIMENTS

THE transmitter described here will operate in three different ways, according to the position of the "function" switch. Briefly, the modes of working are as follows:—

(1) Crystal controlled.
(2) Two-valve transmitter.
(2) One-valve transmitter.

The circuit is shown in Fig. 1, and was arranged to allow these three methods of working, because it was felt each has its own advantages. The completed transmitter is thus virtually three units in one.

Referring to Fig. 1, switches are as shown, for crystal controlled operation. This type of circuit allows an economically priced 9 mc/s crystal to be used. The crystal is switched in by the set of contacts A. Switch section B brings into circuit the 9 mc/s coil, with 30 pF. pre-set tuning condenser. The first valve thus oscillates at the crystal frequency, and this is tripled into the 27 mc/s band by the second valve. With such a circuit, frequency is determined by the crystal, not by tuning. The signal thus allows a wavemeter or receiver to be tuned into the 27 mc/s band, which can otherwise be a matter of difficulty when using home-constructed equipment, and having no commercially - manufactured or calibrated transmitter or wavemeter, to allow frequency checking.

The output with a crystal oscillator and multiplier is rather small, so position 2 on the switch allows each valve to drive the other, in the usual kind of tunable transmitter circuit. The operating frequency is adjusted to that which was obtained when the crystal was in use, as will be explained. This assures that the transmitter is in the permitted band, without any need to

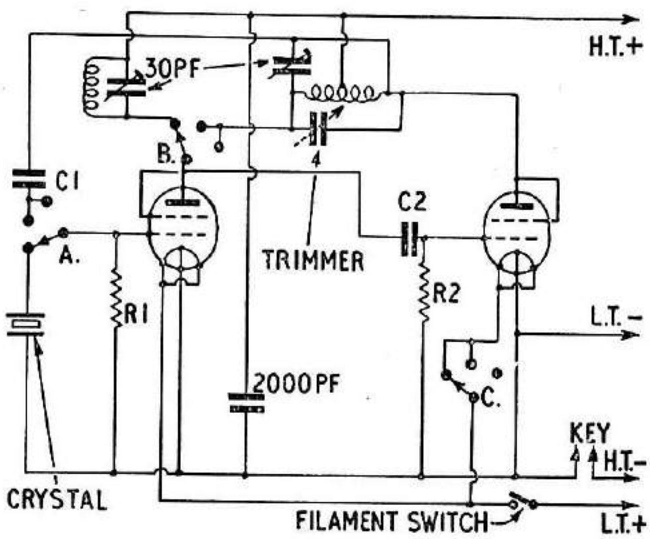
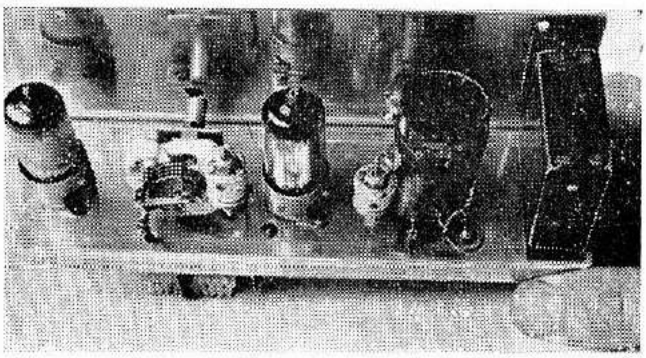


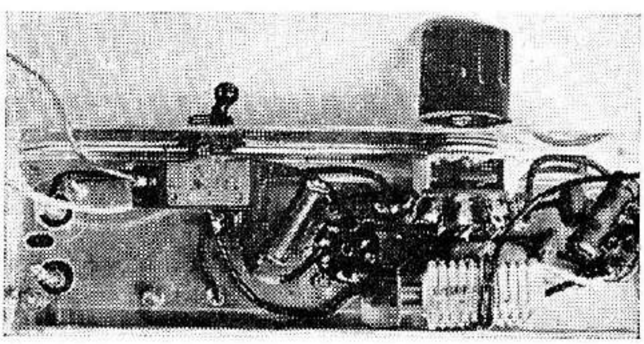
FIG. 1

borrow or obtain ready calibrated equipment for frequency checking.

In the third switch position, the second valve is switched off and the first operates as a tunable one-valve transmitter. This doubles battery life, which is a useful feature when much experimental or similar work is done at short range.



Upper and lower views of the chassis illustrate the simplicity of the layout.



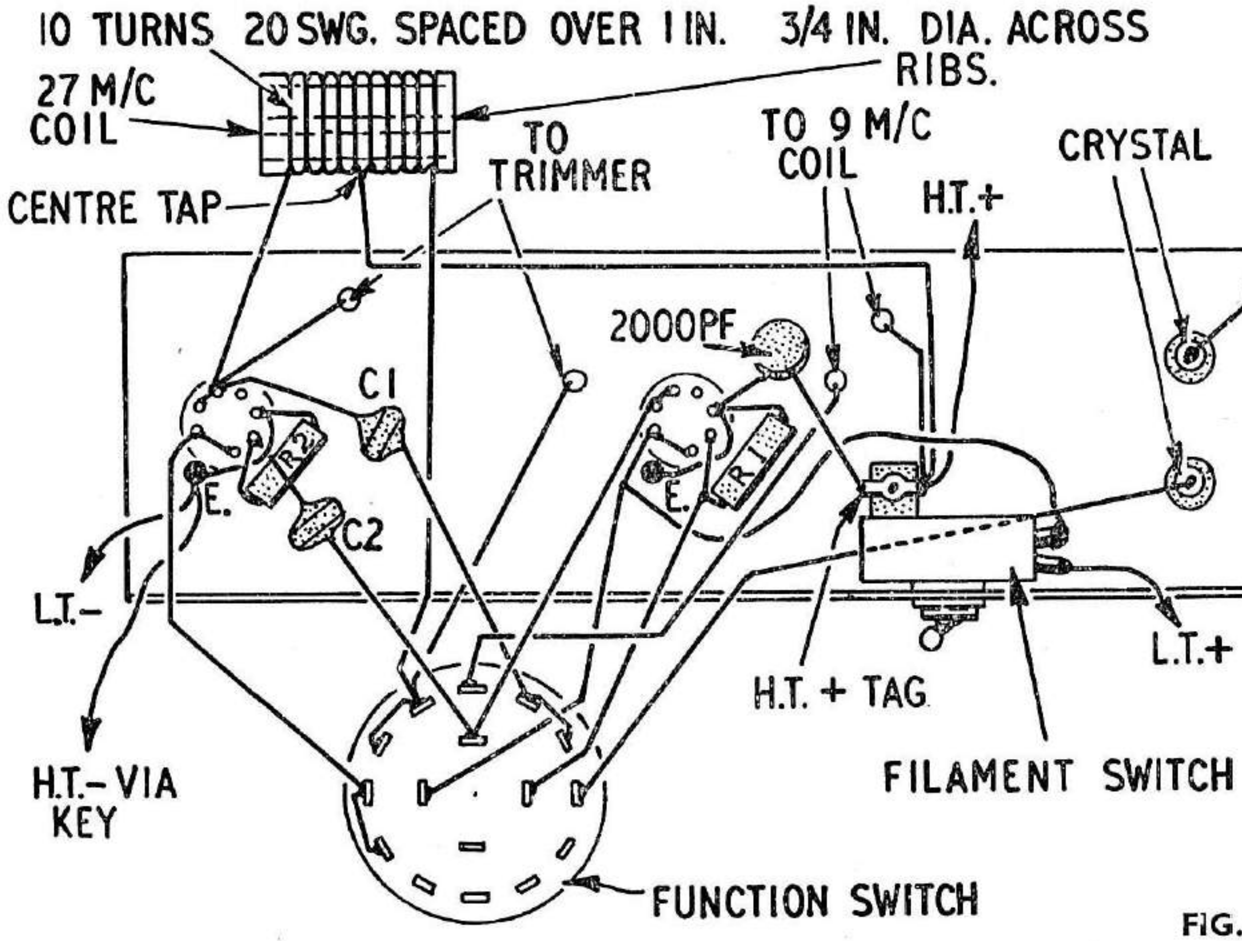


FIG. 2

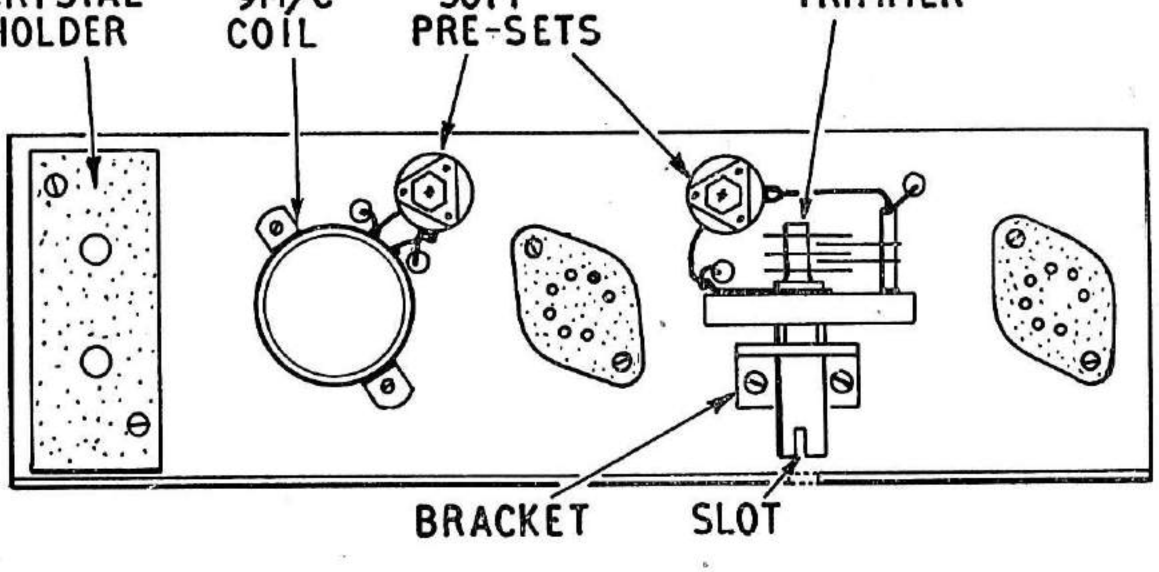
Crystal & Chassis

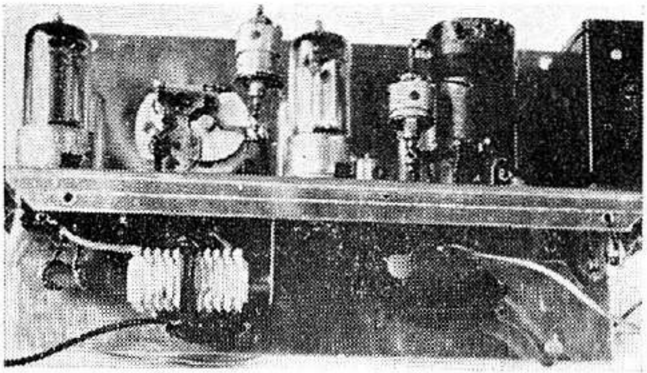
Though any crystal with a multiple falling in the 27 mc/s band can be used, it is generally best to select a frequency which comes out near the middle of the band. There will then be less chance of operating a tunable transmitter outside the permitted frequencies.

The chassis used was 7 in. × 2 in., with a 7 in. × 4 in. panel. Actual dimensions are of no importance, provided the layout of parts is somewhat similar to that in Fig. 2. After adjustment, the unit fits into a box or cabinet large enough to accommodate batteries.

Components above the chassis are shown in Fig. 2. Clearance holes are required for the crystal holder sockets, and valve-holders. The two 30pF. preset condensers are supported by short, stiff leads. The trimmer, which can be about 15pF., is mounted on a bracket, and has a slot, as shown. It can be adjusted by inserting an insulated tool through a hole in the panel. This trim-

FIG. 3





Above : Rear view. Bottom of facing page : The front, filament switch left and function switch to the right.

mer must be insulated from the chassis. If the trimmer has dead tapped bushes fitted to its insulated end plate, a metal bracket with a clearance hole for the spindle will be satisfactory. But if the condenser has a bush common to the spindle and moving plates, an insulated bracket should be made. This can be of paxolin, with a small metal bracket for mounting.

The 9 mc/s coil consists of 14 turns of 28 s.w.g. enamelled wire, on a lin. dia. former. Turns are closely side by side. There is no need to employ this gauge of wire, or size of former, provided resonance can be obtained as described later.

Solder one pre-set to short, stiff leads which are in turn soldered to the trimmer. The other pre-set will be held firmly if the 9 mc/s coil is equipped with one or two tags or small brackets, and the leads from the pre-set are soldered to these. Place insulated sleeving over leads, and be sure the pre-sets cannot touch the chassis.

Under-Chassis Wiring

Connections, etc., are shown in Fig. 3. Here, the function switch is removed from the panel, so that its tags can be shown. The 27 mc/s coil is illustrated out of position, to clarify wiring—this coil is actually mounted on a bracket near the rear edge of the chassis.

Holder connections are for 3V4 valves, but other valves will operate, socket wiring being changed to suit, if necessary. Points marked E are connected to tags bolted to the chassis. The H.T. plus tag is merely an anchor point, insulated from the chassis, and held by one of the bolts securing the 9 mc/s coil.

Condenser and resistor values are not very critical, but it was found that 100pF. for C1, and 25pF. for C2, gave suitable results. The reason for making C1 fairly large, and C2 fairly small, is to obtain a good output when the circuit is running as a one-valve transmitter. Both R1 and R2 were 20K. It is quite usual to reduce these values, if more output is wanted.

Switch and coil connections should be short and direct. If there is any doubt about switch wiring, examine the switch carefully. Or fit a knob to it, and set it in various positions, observing how contact is made, or checking the contact circuit with a battery and bulb.

The actual way in which the switch fits will be clear from the photographs.

Fit lengths of flex for battery leads. For low tension, use 1½v. only, either from a 1½v. dry battery, or from a number of 1½v. cells wired in *parallel*. For high tension, a 90v. or larger battery can be used. The transmitter is keyed in the H.T. negative lead, and the key must be closed for tuning up.

If desired, a filament circuit check can be made before inserting the valves. To do this, connect both H.T. and L.T. batteries, and connect a voltmeter between chassis and sockets 1 and 7 of the valve-holders. The meter should show 1½v. only, when the filament switch is closed. With the function switch in the 1-valve transmitter circuit, no filament voltage should be found on the second holder. A 2.5v. torch bulb, with insulated leads attached, can be used for this test, if no meter is available.

Crystal Stage Tuning

Insert the first valve, and put the switch in position 1. Add a 15 m.A. or similar meter in one H.T. lead. Rotate the 9 mc/s coil pre-set until a dip in H.T. current is encountered, showing the valve is oscillating. Wrong tuning will reduce output, or cause oscillation to cease, but will not result in operation on wrong frequencies. This is, of course, the purpose of the crystal control.

Oscillation may also be checked by bringing a lamp loop *near* the 9 mc/s coil winding. This loop may be of one turn, with its ends soldered to a 6v. .06a. bulb. A bright indication on the bulb must not be expected.

The second valve is then added, and the 9 mc/s coil tuning slightly adjusted, if necessary. For best operation, it is usual to tune a crystal stage slightly off

resonance, or oscillation may not begin immediately the unit is switched on.

The lamp loop is now placed near the 27 mc/s coil. The trimmer is set about half open, and the 30pF. pre-set in parallel with it is rotated until the lamp glows best. The pre-set is then left, as any final adjustment is made through the hole in the panel. Remember to use a fully insulated tool—a tool with insulated handle, but metal blade, is not satisfactory.

The transmitter may be used in the crystal controlled mode, if required. Output is then insufficient for controlling a model at range, however.

Wavemeter

In order that the crystal controlled signal may furnish a standard for adjusting a tunable transmitter, a wavemeter such as that shown in Fig. 4 can

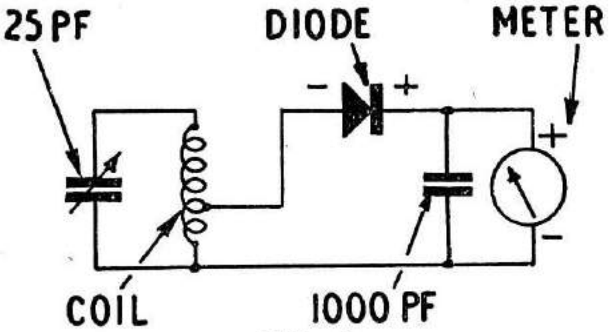
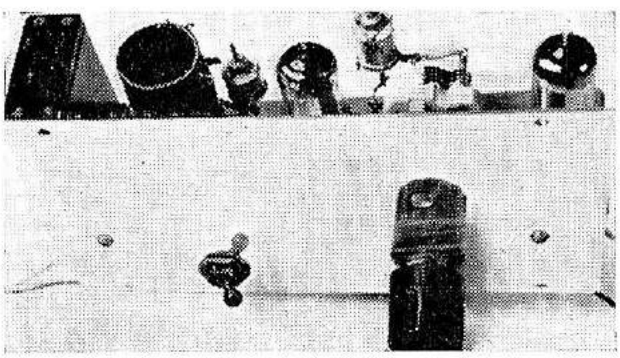


FIG. 4

be made up. The diode is tapped down the coil merely to sharpen the tuning indication. Any coil tunable to 27 mc/s will do—say about 10 turns on a 1in. dia. ribbed former. The condenser across the meter can be anything from 500pF. to 0.01μF. or so. The meter can be any 500μA, 1 m.A., or similar instrument, or a surplus item of unknown range.

Construction should be absolutely rigid in all respects, and a pointer knob or dial should be securely fixed to the tuning condenser.



To calibrate the wavemeter, switch the transmitter on, with crystal control, as explained. Then tune the wavemeter to exact resonance, as shown by maximum meter reading. Keep the wavemeter a little distance from the transmitter, to avoid excess current. The wavemeter dial or scale is then marked.

When the transmitter is used as a 1-valve or 2-valve tunable oscillator, set the wavemeter to frequency. Then adjust the transmitter for maximum indication on the meter.

Aerials

For checking most receivers at short range, no aerial is needed on the transmitter. The latter may also be switched to the economical 1-valve position.

For moderate range work with a minimum of transmitter aerial, it is in order to attach a *short* rod directly to one end of the 27 mc/s coil. Long aerials cannot be used here, as damping will prevent oscillation.

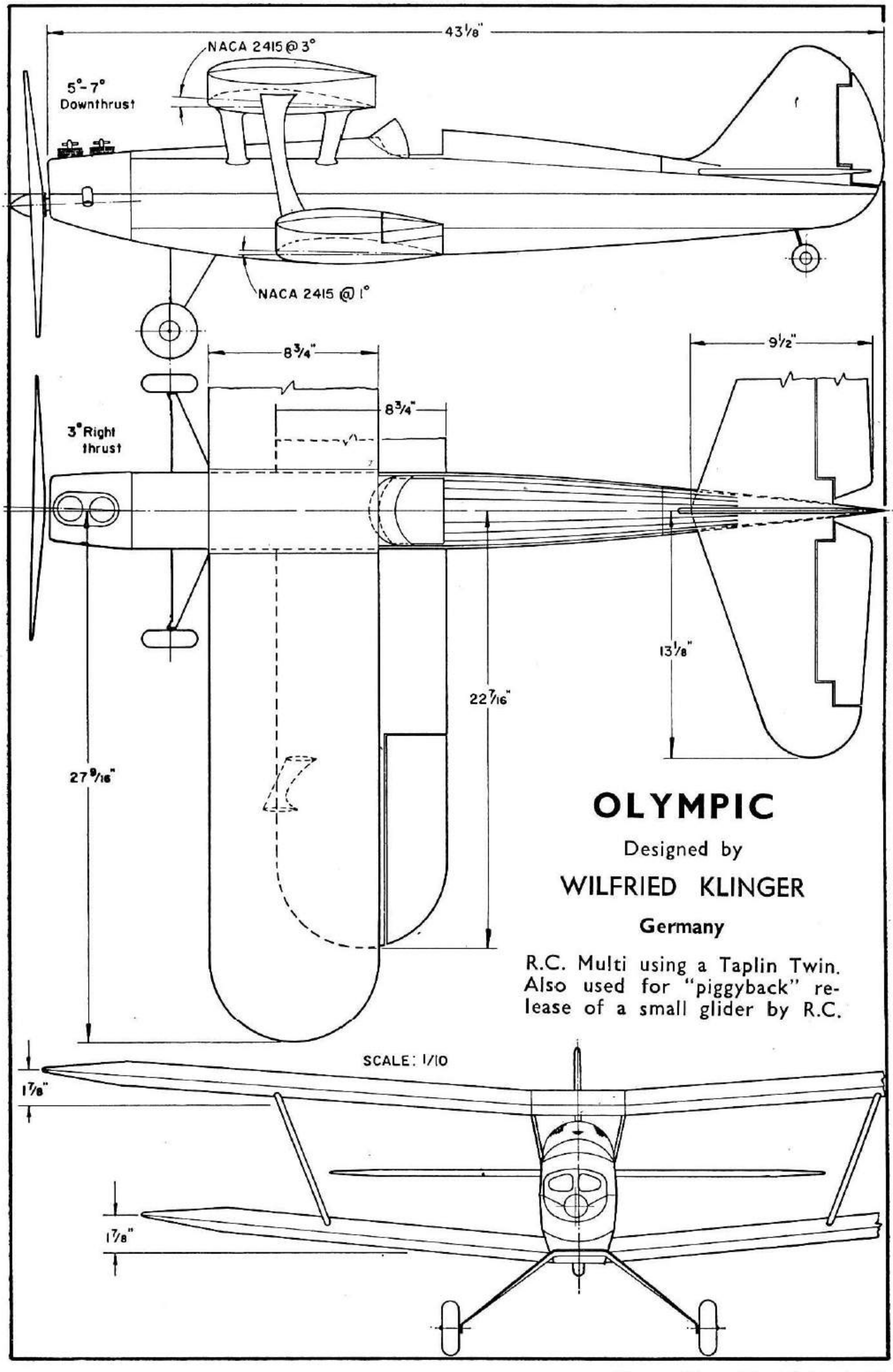
The usual type of longer aerial is best coupled by fitting a two turn or similar loop round the middle of the 27 mc/s coil. Take one end to chassis (and earth) and the other to the aerial.

Remember that changes to the aerial can influence frequency (except when the transmitter is in the crystal controlled mode) so check output with the wavemeter. This is particularly important when using an aerial directly on the coil.

The main differences of crystal controlled operation, as against tunable operation, may be summarised as follows: with crystal control, wrong tuning adjustment will reduce output, but not change frequency; but with ordinary tunable operation, wrong tuning will change frequency, while output may remain the same. With this in mind, it should soon be found quite easy to obtain proper operation with the switch in any of its three positions.

ARE YOU LICENCED ?

Just in case newcomers to Radio Control are not aware of it — you need a licence for operating remote control equipment. No tests, just fill in a form and pay £1 for five years cover. Application form and full particulars from Radio Branch, Radio & Accommodation Dept., G.P.O. Headquarters, London, E.C.1.



OLYMPIC

Designed by

WILFRIED KLINGER

Germany

R.C. Multi using a Taplin Twin. Also used for "piggyback" release of a small glider by R.C.

From Flug Model Technik.

Whirr and Click

A series for the mechanically minded and followers of switchcraft.

J. R. NEALE sent us details of a modified "Galloping Ghost" system which permits greater proportionality and less "Gallop" than the normal system.

The mighty midget and gear as original are still used, but operate rudder only. A printed circuit disc (similar to an Omniac disc) is fixed to the face of the large gear shaped as shown in sketch. Stops are fitted to the gear wheel so that it can only rotate 90° each way (180° total). Experiments have shown that a sector of 60° gives best results.

Wipers make contact through the disc as soon as the crank moves more than 30°; this energises another motor (Ever Ready or M.M.) which actuates the elevator through a flyball actuator against a rubber band holding the elevator DOWN.

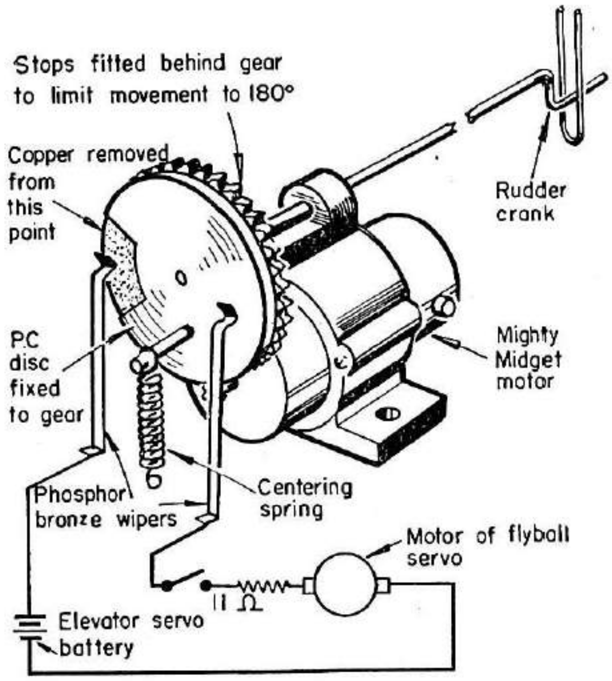
Thus, for small oscillations (fast pulse) of the crank the wipers do not make contact and the elevator remains at full down without flapping *at all.* Larger oscillations energise the elevator actuator proportionately, but, due to the inertia of the flyball actuator no flapping of elevator occurs.

As the M.M. gear has a smaller range of movement than the original, a faster pulse range is desirable, from about 3 c.p.s.—12 c.p.s., with mark-space ratio varying from 75/25 to 25/75.

The foregoing remarks do not mean the system is critical, as it is not, but important only for optimum efficiency. The only critical factor is the relay, as in normal G.G., and a good relay is worth its weight in gold. He has been using a Siemens high speed relay type 96 with great success.

The whole system, with Unitone receiver, Siemens relay, two motors, four DEAC 450s, and receiver batteries, weighs only 13 ozs.

Mr. Neal has been flying the above system in his Gasser (A.M.15) with great success (no good prangs yet!).



The advantage of the system lies in the fact that the elevator does not flap at all, and because of limited movement the rudder does not flap excessively. Also, as the surfaces have an actuator each, this system is suitable for larger planes than the ordinary G.G.

Against this is the added weight of 1 oz. of motor and increased drain on actuator batteries (nickel cadmium cells offset this disadvantage). Average drain is of the order of 500 m.A. (with resistor of 11 ohms in series with elevator motor; this could be removed for more power in the actuator but with increased drain), which gives ¾ hour flying at least on one charge, much less than on a normal afternoon's flying.

D. Youens contributed this "Swashplate" modification to escapement (shown in Fig. 2). The advantages of the system over the more orthodox crank at the rear of the tailplane are as follows:

(1) Enables rudder to extend to bottom of fin and therefore more suitable for scale types of air-

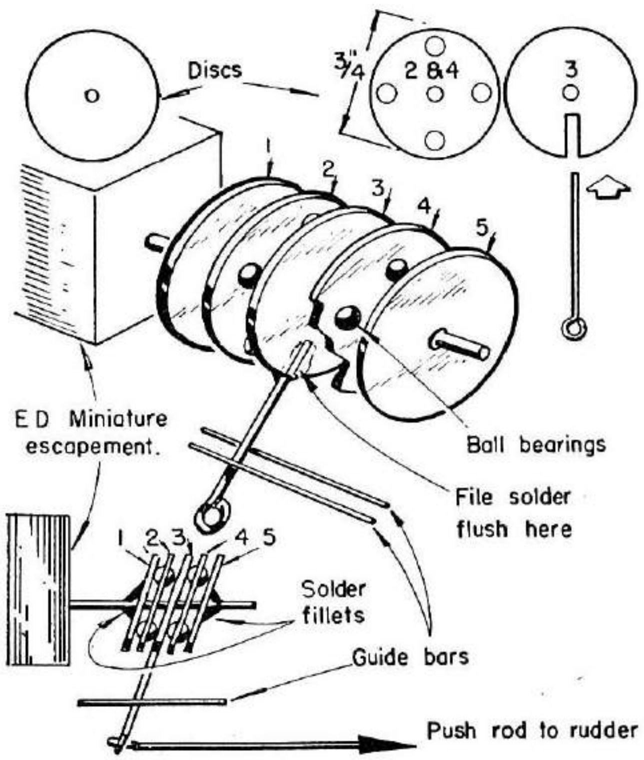


FIG. 2

craft.
(2) Neater.
(3) Not so vulnerable to rough handling.

Construction

Five brass discs ¾" diam. are needed. Numbers 1 to 5 are drilled clearance for escapement shaft. Nos. 2 and 4 are drilled to take suitable ball bearings. No. 3 is slotted to take a piano wire lever which is soldered in position, the joint is then filed flush.

Assembly: No. 1 disc. is soldered to shaft at approximately 20° angle, Nos. 2, 3 and 4 follow, making sure they are free to rock on shaft and that ball bearings installed. No. 5 is then soldered to shaft, with usual paper shim interposed to obtain free working.

Installation

Operating lever is fed through piano wire guide slot in fuselage side. Escapement is rotated on mounting bolt until both neutrals coincide and then locked in this position.

This linkage brought to mind a slightly different approach to the same problem of linkage alignment, which we developed for a clockwork escapement. This employs a cranked shaft and a brass tube lever in place of the disc and ball races. Similar lever-to-pushrod knuckle jointing has to be employed in order that the lever may rotate slightly at each NEUTRAL position (see Fig. 3).

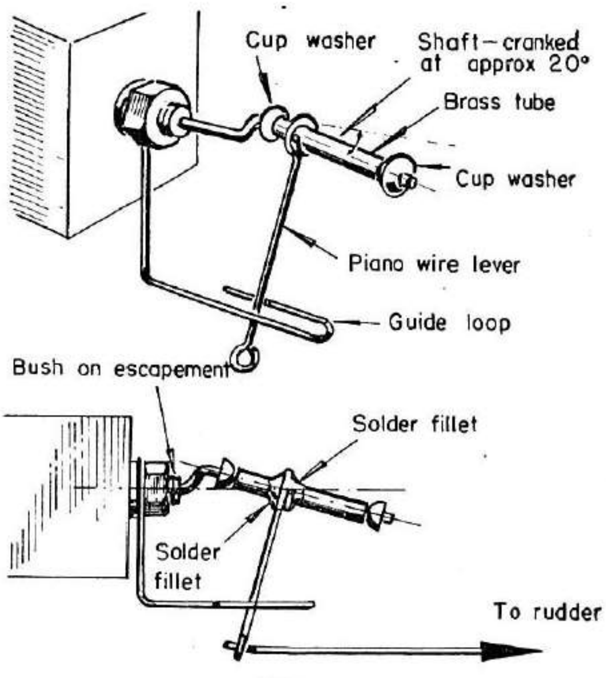


FIG. 3

Beginner's Report . . .

W. Lister gives a factual report on his entry into the radio field with an O.D. model known as the "Flap Jack".

The "Flap-Jack" flies extremely well. The only alteration from the original model has been to increase both down and right side thrust. The glide is fast and quite flat and penetration is good, likewise under power. The loops are still very good and easily managed; one can practically be done on the glide after only three turns of spiral. The rudder movement has been somewhat reduced, and turns to the left are quite safe due to the gyroscopic effect of the 9 × 4½ propeller on the Enya 19. If turn is held on too long to the left the model rolls out immediately and climbs away on neutralising the rudder. Safe turns through 180° may thus be carried out by even the most inexperienced *radio* flyer as myself.

To the right, however, the rudder is best pulsed, as I use an E.D. multi-servo which when compared to a click-clack type is very slow for a model flying at this speed, and having the rudder as its only control surface. If full right rudder is held on for any length of time, the nose and wind immediately tuck under in a very fast spiral. This being useful for picking up speed in the shortest length of time, and enables one to perform loops easily and smoothly. I haven't had the necessary practice to perform the loops and flick rolls which I have seen the model execute whilst in the hands of a more experienced pilot, but I am sure it won't be long with a model such as this.

You might think it has taken long enough to get to this stage, but I've been so long in getting the right equipment, and then my time has been so limited over the past few years with examinations always in the offing. I have found the E.D. (NEW!) 6 channel receiver most reliable and their multi-servos excellent. I have had only one fly away due in part to radio failure and my own inexperience and foolishness.

Two days before I came back to college for this term, we had a really fine day, and we took the model up in the morning and afternoon (it was the only model flying). The batteries, which were then over 10 weeks old since I had put them in the model, had had something like four hours continuous running (two hours in the morning and two hours in the afternoon). I checked the batteries over dinner and saw they were low, but it was Sunday, and I could not change them, so I just replaced them in the model and prepared for the afternoon, as it would be my last chance to fly it for the next 10 weeks or so. Towards the end of the afternoon the wind was as strong as ever, and due to my over confidence I was allowing it to get down wind of me.

Unfortunately I gave it the wrong signal this time whereupon it streaked off down wind at some height and out of range. The standing current at this time must have been just over .5 m.A. instead of 1.5 m.A. with fresh batteries!

The model finally hit the top of a fairly branchless tree in a small wood at some distance from our flying field, and luckily fell to the ground. The total damage being two tissue tears and a slightly scuffed leading edge.

This I think says something for both the radio and the light yet strong structure of the model as a whole. A larger model (mine is just over five feet) would probably have been completely written off whereas a smaller model would not have been flown under the conditions, certainly not on virtually a test flight as mine was under going. Its previous long flight of the afternoon was ended within fifteen or ten yards of the transmitter.

Taking all into consideration my advice, for what it is worth, to anyone who wishes to take up radio flying that is both reliable and cheap in operation is:

1. Buy a *tone* set preferably an English set, which can easily be returned for repair if ever required, and does not cost half of its foreign equivalent.
2. Buy a receiver with six to eight reeds and room for addition of further relays or their equivalents.
3. Don't play around making servos. In my opinion, the best for the price is either E.D.'s or the Remtrol multi servo.
4. Use DEAC accumulators for power the 225's are ample for such servos as the above, even in a multi model with several servos. I have had mine for two years and they ran a proportional rudder Mighty Midget powered servo for 93 minutes at near enough the same rate.
5. Use large batteries but don't go to extremes. Two B123 in parallel with a condenser across them as given in *R.C.M. & E.* are quite adequate with a U11 for L.T.
6. Use a model large enough to carry reliable radio, yet small enough to take the knocks and bounce back for more. Let it also be large enough to get both hands into and be able to remove the receiver when ever required without having to remove the servo, tank and batteries first.
7. Build a strictly practical model specially designed for radio rather than the converted free flight or the latest multi-channel miracle.
8. For cheapness and from the last point build from a plan and start with rudder only on two channels. The low wing designs at this stage should be avoided as ailerons are the only safe directional control is useful for initial

test flying but depends on the individual size of purse.

I believe the DEACS (225's) are 25/- now for six and can be obtained in a welded pack for 28/- and these should be considered necessary. The saving in weight, space and improvement in reliability compared with two flat 4½s more than repays in a very short time.

It is as cheap or cheaper to build your own charging unit.

Two volts per cell are required thus a 13.3 volt + 20% transformer of the C.R.T. type available from any radio shop for 10/- or so plus a half wave rectifier and a 3000Ω pot. are all that are required costing in all about 15/-. A warning light and smoothing condenser may be added (for another 5/-) but are not necessary.

This unit is SAFE and it works too. Thus the total cost for reliable radio control capable of expansion with the experience of the operator for price of servos and relays alone is as follows:

	£	s.	d.
Receiver	10	0	0
Servo	3	10	0
Deacs	1	15	0
Charging Unit ...		15	0
Rx. Batteries		7	6
Model	2	0	0
Engine (R/C)	5	14	0
	£23	12	0

Add another 8/- for prop and tank and for £24 you're in business.

Addition of elevator, engine and aileron costs another £6 10s. 0d. for each control and it cannot be done cheaper with comparable results.

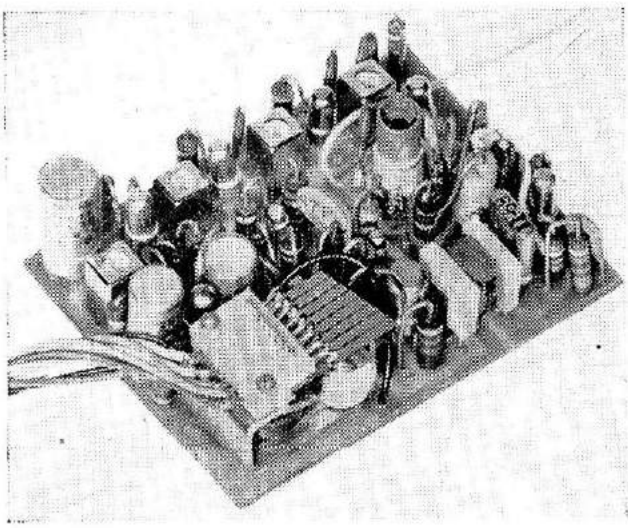
It is true that there are lighter and a *bit* more reliable set-ups available but that occasional need for a twist of a choke can save well over £20 in many cases and up to £100 in others. There is no indication of cheaper reliable multi control as every further increase in reliability seems to be OC $(£5)^3$ at the present time.

The multi channel equipment scores on the single in that the novice has no baffling sequence of button pressing to remember and no limit to the number of controls available later. Also loss of any control surface action does not mean disaster, as adequate control can be maintained with those remaining. All the other advantages may be gleaned from the foregoing.

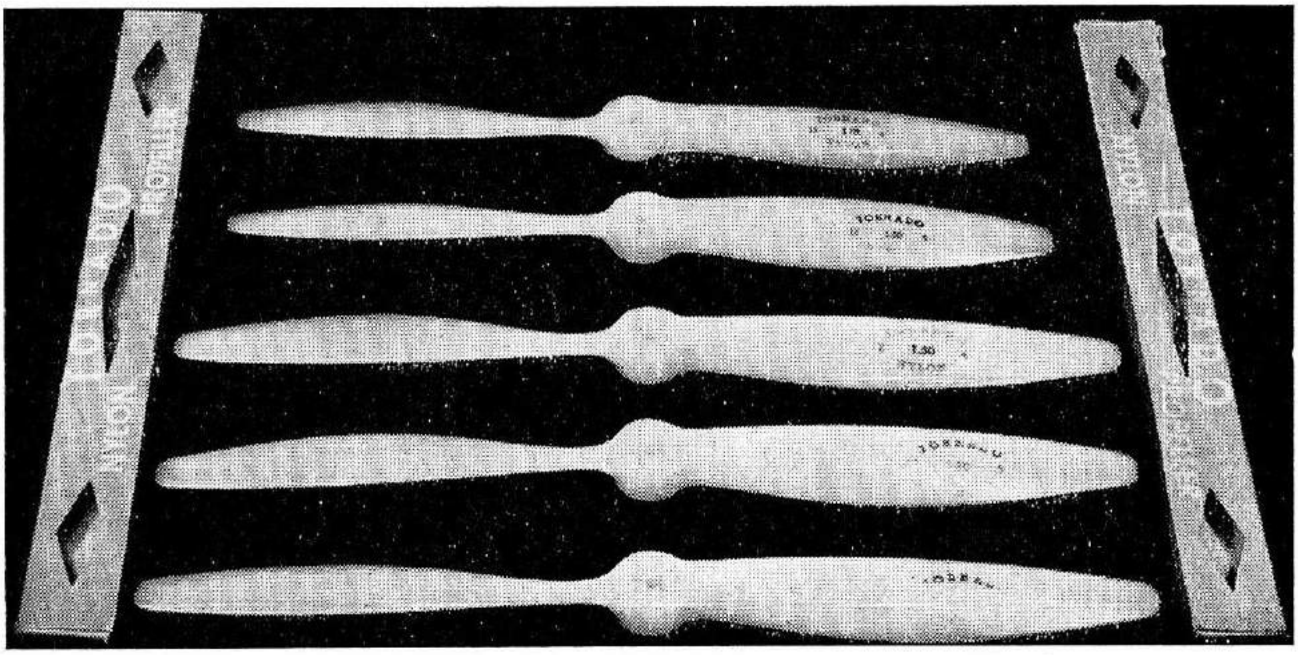
New Equipment

Popular Props

THE well-known and much-sought-after Tornado nylon props in the larger sizes for radio control aircraft use are now obtainable through Ed. Johnson. Assuming the dollar equivalent of 7/2d. the props shown here would be priced as follows: 12 in. × 4 in., 12 in. × 5 in. and 12 in. × 6 in., 10/9d. each. The 11 in. × 4 in. and 11 in. × 6 in., 7/2d. It is interesting to note that the makers' instructions state that the props should be aged for best resistance to breakage, the ageing time being six weeks to eight months depending on the temperature or humidity and exposure. They recommend accelerated ageing by soaking in boiling water for 15 minutes, then slowly adding cold water until cool. One cannot be sure how long a prop has been in stock so this method might be applied to other nylon props or components with advantage. Perhaps our manufacturers have something to contribute in this direction by preageing under controlled conditions if indeed they do not already employ such a process.



The new Min-X Superhet illustrated here is available in convertible channel form at $59.95 or four to twelve channel versions with or without relay packs. The receiver operates on 6 volts supplied by four pen cells or direct from servo batteries, the weight saved by this method is estimated to be about 6 oz. Current drain for the single channel version is 8-10 m.A. idle, 50

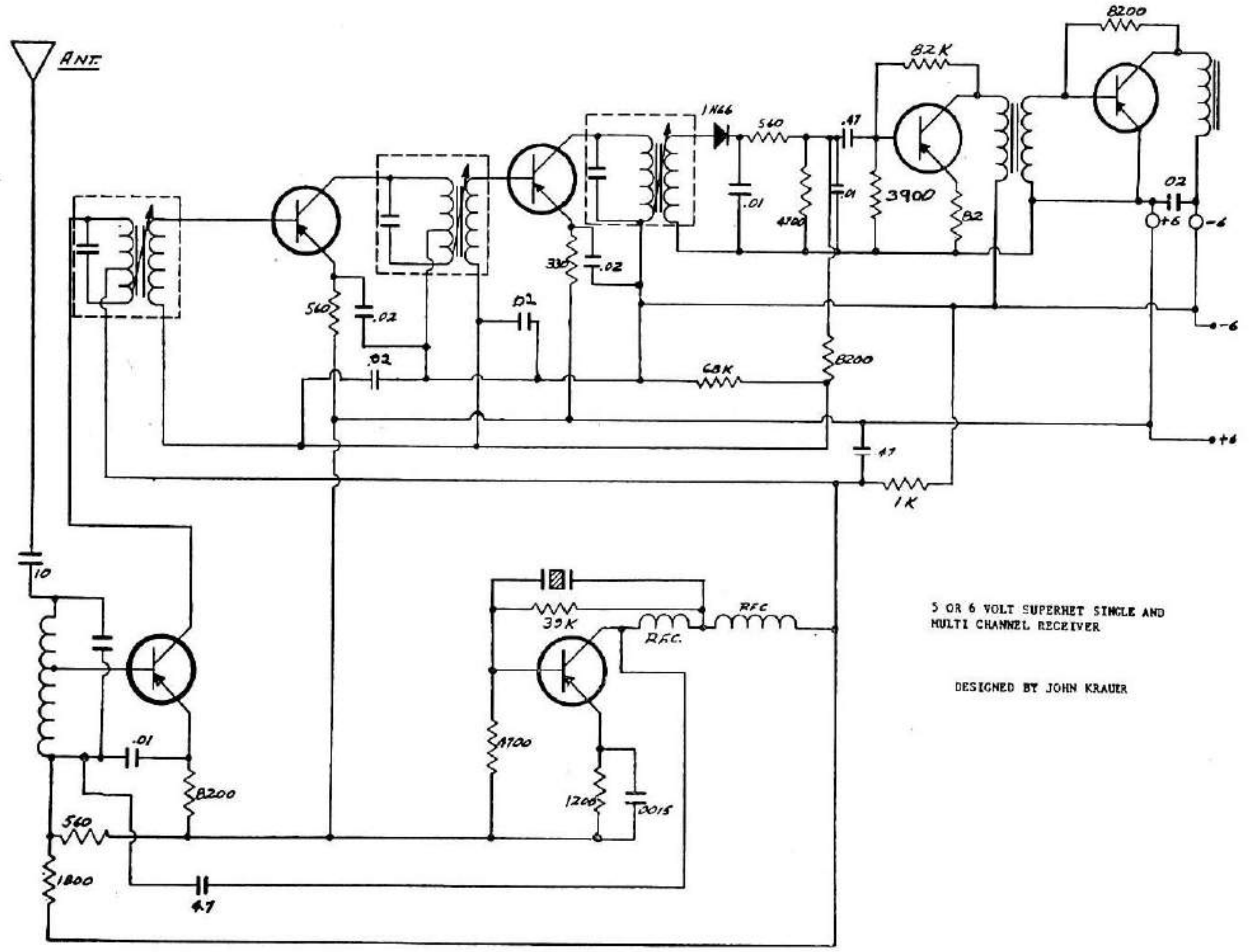


Heading picture: Min-X Superhet 8 Channel Rx. Above: Tornado Props (top to bottom — 11 in. x 4 in., 11 in. x 5 in., 12 in. x 4 in., 12 in. x 5 in. and 12 in. x 6 in.). Below: Circuit of Min-X Superhet from manufacturer's leaflet.

m.A. on signal. Multi: 8-10 m.A. idle, 25 m.A. on signal.

Tiny ($2\frac{1}{2}$ in. $\times$ $2\frac{3}{8}$ in. $\times$ $1\frac{1}{16}$ in.) and light, 4 oz. single, $4\frac{1}{2}$ oz. multi (relayless), a receiver to enable one to reduce the size and attendant expense of a multi aircraft.

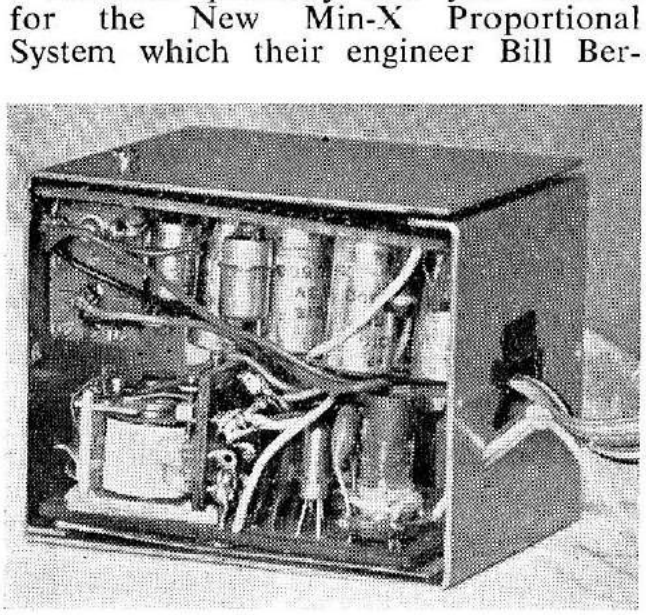
The four and six channel are non-simultaneous sell at $28.00 and $72.00 respectively and are available as a special combination offer complete with appropriate Tx. for $116.50 and $135.50 representing a saving of $10.00 in each case.

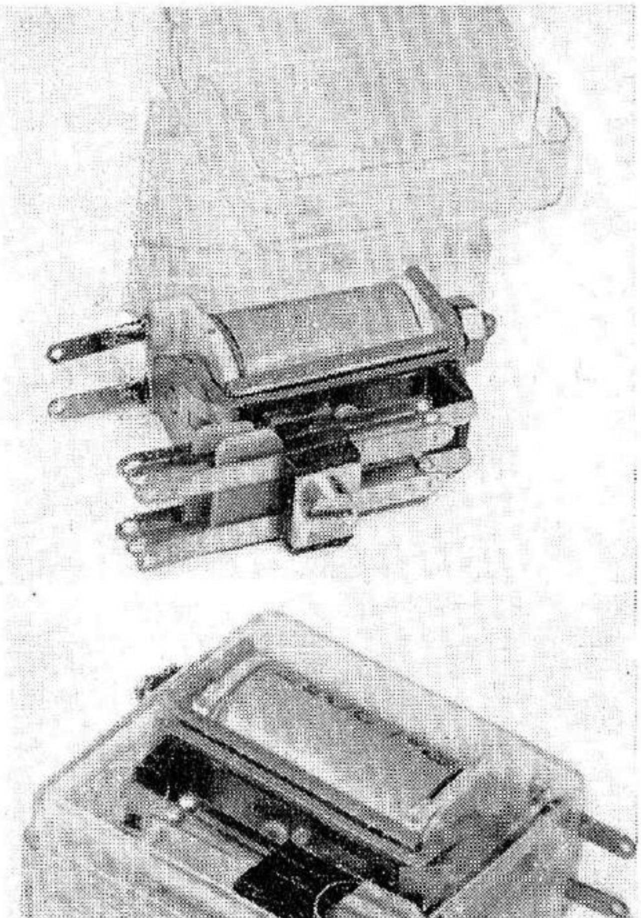


Above : Complete Min-X Proportional outfit in prototype form (the hooked wire on the servo pack (right of photo) appears to be a switch link for test purposes. Below : Rx. and discriminator pack (left in upper photo). Right : The Gruner 9057 showing the sturdy contacts and in its protective plastic case.

Eight, ten and twelve channel simultaneous versions are $79.95, $84.95 and $98.00. All these prices are for the relayless type.

Advance publicity has just arrived for the New Min-X Proportional System which their engineer Bill Bertrand has developed. Two fully proportional controls with no gallop of the surfaces and an additional trimable throttle control. No details are available yet and it is estimated that a year of further development and testing will elapse before production models are here. However we are glad to see that a manufacturer has done something to help the dual proportional enthusiast, and we shall look forward to seeing the production model in action.





A Gruner type 9057 relay with change over contacts and a dust excluding plastic case is available from Ed. Johnson and is intended for 4.5 volt operation. The contacts are separately insulated and operate simultaneously and will carry up to one amp. Reasonably priced at 26/-. Last month we referred to "Top Flite" bellcranks among Ed.'s material, true he does stock them, but the samples we reviewed actually came from Southern Radio to whom we owe our apologies.

Query Column

WE ANSWER QUERIES THROUGH THIS COLUMN EACH MONTH, AND WELCOME GENERAL INTEREST PROBLEMS. AT THE MOMENT WE CANNOT UNDERTAKE TO ANSWER QUERIES THROUGH THE POST, NOR SHOULD SETS BE SENT TO US UNLESS SPECIFICALLY REQUESTED.

I AM using a 3A5 push pull type carrier transmitter to which I have added a tone stage (G. H. Redlich "Transmutone" type) for use with the Kraft radio.

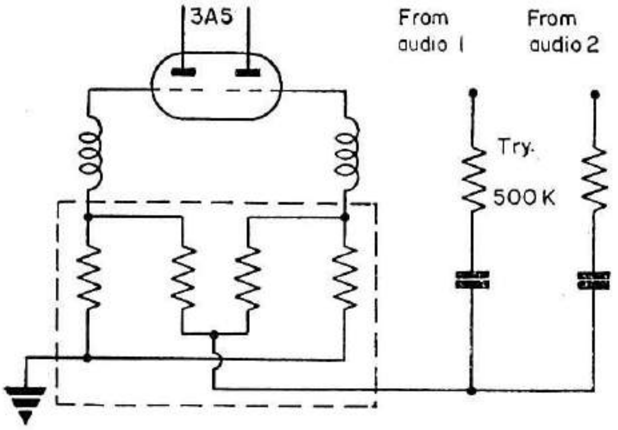
Could you please inform me, through your "McQuery" column, if I could build another identical tone stage and add it to the transmitter for Simultaneous control of a tuned reed set, and how would I mix the two tone stages at the 3A5? C. T., AUSTRALIA.

The addition of a second tone generator like the one you are already using should be quite satisfactory.

The mixing is readily accomplished by simply feeding the input of the second unit into the junction of the grid circuits of the 3A5 as at the moment but with the addition of a resistor in each lead (see sketch).

You may find that it is not possible to get a high enough value of this resistor to prevent interaction without dropping the modulation level to a point below that desired, if so you could add an amplifying stage, it is not likely this will be needed, however, as you will have to avoid over modulation in any case to avoid faulty operation.

Since your receiver is going to be rather costly why not build a crystal controlled transmitter while you are at it and avoid any possible trouble from detuning (on the ground at least).



WHILST glancing through the McQuery Column of the December issue of Radio Control Models & Electronics I was surprised to read the article by R.T. of Glasgow regarding the Aeromodeller transistor Rx.

I have recently made this unit using TM1 transistors and components bought separately from electrical retailers, but the equipment has not yet been tested for operation.

As I want a Rx. which will give me stable and consistent results would it not be better to "shelve" the transistor Rx. and build a "Hill" Rx. rather than risk a good model crashing ?

S. MURGATROYD, URMSTON.

With reference to your letter the Aeromodeller transistor Rx. is certainly affected by temperature changes but usually only by large changes and then only the more insensitive ones are affected.

The change in the valve stage is very small and anything which increases it helps in the temperature problem. Most failures have been due to this fault rather than the inherent temperature sensitivity of the transistor. In aircraft it is quite easy to fit a fail safe device and with any receiver I would recommend that anyway.

The receiver has proved to be very popular and the temperature trouble must have been limited to a few cases. The advantage, of course, is with the lightweight receiver and smaller batteries required it can be used in a smaller model.

Can you please tell me where I can obtain the construction data for the "McQue Pulser Tx." for use in the "Simpl Simul" control system as described in the February issue of R.C.M. & E.?

What modifications will be necessary for the crystal controlled version of the above Tx.?

J. H., LYTHAM ST. ANNES.

Tx. and Pulser appeared in May and June, 1960, issues. Please note D1 in original circuit shown reversed; red end should be earthed.

The mod. to the pulser for note change is simply to connect another 0.02μ F. via a normally closed micro-switch in parallel with C2.

While your hand is on the stick and the button pressed, this C is removed and VR3 is adjusted for "full speed engine" note. When the button is released the note drops and the engine goes to slow.

I AM a newcomer to the field of radio controlled models and am building an A.P.S. "Black Magic" for use with an Aeromodeller Transistor Receiver. My problem is that, whereas the aerial length specified for this receiver is 30 in. the maximum length which I can accommodate between the centre section T.E. of the wing and the top of the fin is only 21 in.

I have considered running the aerial along the T.E. of one wing, which would give the required 30 in., but have some doubt as to whether this would be satisfactory.

I shall, therefore, be obliged if you will tell me: (A) whether a 21 in. aerial would be sufficient and, (B) if not, how you suggest the problem can be solved.

A. W. B., NEW DUSTON.

You will find on reference to the article on the A.M. Transistor Rx. that the aerial length is not critical. The longer the aerial the greater the range but a length of 21 in. should be ample.

There is no objection to running the aerial along the trailing edge of the wing, on the contrary it might be an advantage as the aerial would then be at right angles to the receiver and actuator wiring. In any case why not try various arrangements until you are satisfied.

MAY I ask you for some advice? The manufacturers of popular R/C Tx. and Rx. have standardised their products. Result . . . possible frustrating interference.

I understand a R/C signal must be 27 something m/cs. Would you kindly advise me what the MODULATED frequency of a single tone Tx. and Rx. would have to be to comfortably avoid being "bothered" by other people's equipment including the FULL series of R.E.P. and Black Prince models . . . 1 to 8 channels. How many C.P.S.?

At a guess, could you say if it would present a problem to a manufacturer if I asked him to supply me with a special Unitone or Black I Tx. and matched Rx. operating on this higher modulated frequency?

Would this special equipment be just as efficient as the normal models?

Incidently, how close do tone Tx. and Rx. have to be matched. For instance, if a Tx. sent out a modulated signal of 390 C.P.S., would this operate a Rx. tuned for 400 C.P.S.?

One final query. I have a Reptone outfit. Could the Tx. and Rx. settings be altered sufficiently to reach your recommended "anti-pirate" modulation.

—B. G. H., LEICESTER.

I can well appreciate your desire for interference free R/C we all want the same thing, unfortunately attaining this end is not easy.

The carrier frequency for R/C work in this country is 26.96 to 27.28 m/cs. with an alternative frequency of 464 to 465 m/cs. No British equipment available.

As far as is known all British commercial receivers use a super regenerative detector, this having the virtues of very great gain, high discrimination against ignition interference and above all, simplicity.

It has the limitations of low selectivity and generally is unable to handle high modulation frequencies. This latter trouble stems from the fact that the super-regen. works by having an oscillating circuit (R.F.) quenched or cut off at a lower frequency, this lower frequency is rarely higher than 30 Kcs. and normally much lower than this, the highest modulation frequency that can be employed is in turn far lower than this, and in fact about 4 Kcs. is normally the accepted limit. If reed filters are used they in turn impose a limiting frequency of their own, from between 100 and 600 C.P.S. The only hope at the moment seems to be the added complication of the super-hetrodyn R.F. stage or possibly the R.F. amplifier that I believe R.E.P. are putting out, both these improving selectivity at radio frequencies and lessening the chances of interference that way.

BIRMINGHAM and MIDLANDS !

Your

Radio - Control Supplies

obviously means

"HORNTON'S"

All proprietary brands in stock; full range of boat and aircraft kits

Diesel Engines, Electric Motors.

Hire Purchase Facilities

CITY BRANCH:

32 Stephenson Street, Birmingham 2

Telephone: MIDland 0972

CLASSIFIED ADVERTISEMENTS

FOR SALE.—R/C Transmitter, with case, aerial and 3A5 valve. 45/-. S.a.e. details.—AMYES, 73 Thunder Lane, Thorpe, Norwich.

MARBLEHEAD Class HULLS in glass fibre. "Jemima Duck" and "Doris-H" designs available immediately from stock. Price £6.10.0d. each, includes Assembly Plans and Free Delivery.—ROBERTS, "The Gables", Dragons Green, Shipley, Horsham, Sussex.

PRINTED CIRCUIT panels for GROGAN'S MICRO-X TRANSISTOR Rx., price 2/3d. post free. Send S.a.e. for price list of other printed circuits published in this magazine. Printed circuits to your own design supplied against your full-size drawing. Price 3d. per square inch plus 1/- processing. For modellers having their own razor blade—and tenacity, cut panels of 1/16 in. copper clad formica at 3d. per square inch. Please add 6d. postage on orders under 5/-.—STAN SPENCER, Frederick Villa, Pitsea Road, Pitsea, Essex.

FOR SALE.—Wrights Receiver M11. Multi Relaytor and Standard, also transmitter, nearest £10. — 32 Britonside Avenue, Southdene, Kirkby, Lancs.

TERYLENE and Cloth SAILS for radio-controlled yachts.—ROBERTS, 'The Gables', Dragons Green, Shipley, Horsham, Sussex.

FOR SALE.—Astro Hog, airframes, one covered, £12.10.0, uncovered, £10. Buyers must collect, can be seen by arrangement.—J. BRADLEY, 58 Chesterfield Drive, Burton Joyce, Notts. Burton Joyce 3227.

TAPLIN WATER-COOLED TWIN, forward flywheel, silencer, completely overhauled makers, bill £7.—STIMSON, 79 Farnborough Avenue, South Croydon. Sanderstead 6604.

INTRODUCING THE QUALITY LINE IN RADIO CONTROL

ECKTRONICS

Sound, proven designs by Phil Kraft. Assembly is by fully trained personnel using the latest test equipment and production techniques.

Single Tone Transmitter	262/6
Single Tone Receiver	225/–
Six Channel Transmitter	562/6
Six Channel Receiver	600/–
Additional for Power Converter	75/–
Ten Channel Transmitter	1012/–
Extra Tuning Decks	
Ten Channel Transmitter	1012/6
Ten Channel Relayless Receiver	600/–
Additional for Power Converter	112/6

STAR FEATURES INCLUDE:

- ★ Crystal controlled transmitters using the economical Hi-Lo circuit.
- ★ High-Q toroids used in multi transmitters for extreme tone stability.
- ★ 10 channel transmitter is tri-simultaneous, has a flush-fitting interchangeable tuning deck and 2 rudder switches.
- ★ Receivers use hard tube detector for maximum reliability in all conditions.
- ★ The multi receivers use compact double-deck construction and have provision for a built-in power converter.
- ★ Glass epoxy printed circuit boards are used throughout and all equipment is fully temperature compensated.

MALCOLM DOUGLASS

Radio Control Equipment and Accessories, 19 BYRON DRIVE, RAWCLIFFE LANE, YORK

A HULL OF A PROBLEM ?

THEN HEAVE US A LINE !

For fully detailed scale ships hulls, working or showcase, warship (by N. A. Ough) or merchant, in fireproof glassfibre, and stainless steel shafts, bronze propellers, brass stern tubes (bushed), rudders, shaft brackets, and engine bearers.

S.A.E. please for illustrated leaflet.

G. H. ALBON (Modelmakers) & CO., 56 Langdale Road, Thornton Heath, Surrey.

Tel.: THO 7354.

Telephone: Harrogate 4468

HILL Tx & Rx KITS

Components for U.K. Rx.

Prices on Request.

A FULL RANGE OF

RADIOSPARES

COMPONENTS

Send S.A.E. for LISTS

HARROGATE Radio Co.

Proprietor: E. R. ROGERS

16 Regent Parade : Harrogate

Booklets and Circuits

NEW ! Just reprinted from "Model Maker"

RADIO CONTROL WITH VIBRATING REEDS

By R. H. Mapplebeck

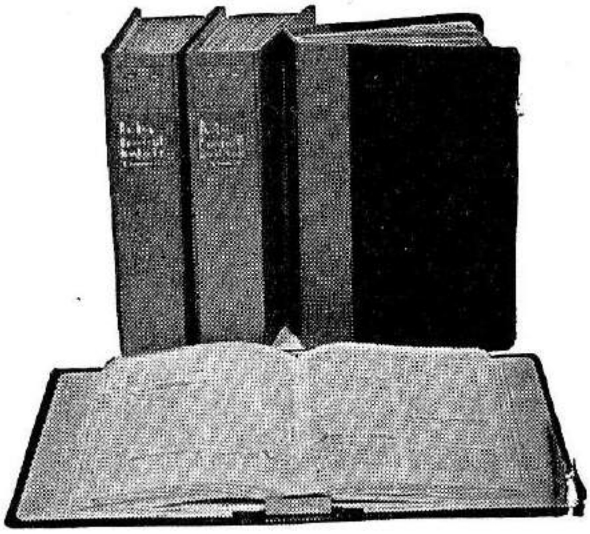
Covers complete instructions for building 3-valve Rx and 3-valve handheld Tx to suit, including making of reed bank. Not miniature equipment but ideal for boat use. 16 pages of detailed information. **3/6**

HILL 2-VALVE RECEIVER

By E. R. Hill

Eight-page booklet gives full constructional data for both standard and miniature versions of most successful carrier-wave set for aircraft, current rise 0.4 m/A to 4.0 mA.
RC/664 **2/-**

RADIO CONTROL MODELS & ELECTRONICS
(Plans Dept.)
38 CLARENDON RD., WATFORD, Herts



BINDERS

in handsome leathercloth with gold blocked name plate on spine to take twelve copies of your R.C.M. & E. Copies open flat and can be removed unmarked for annual binding.

Price, inclusive of postage - - - - - **12/6**

RADIO CONTROL MODELS & ELECTRONICS
38 Clarendon Road, WATFORD, Herts

B. CUTTRISS & SONS
49-51 Cleveland St., Doncaster
Radio Control Specialists
CALL AND SEE OUR SHOP. Tel. 2524

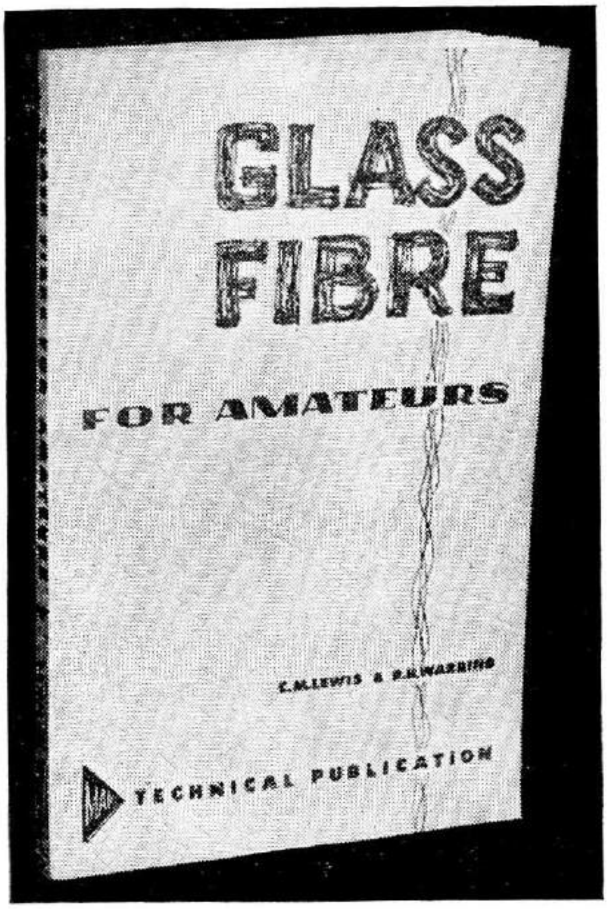
MODEL AIRCRAFT SUPPLIES LTD.
Stockists of R.E.P. radio control units.
(Easy terms available.)
We have a large selection of components, kits, engines and materials for boats and aircraft.
Phone, call, or write :
29 OLD KENT RD., LONDON, S.E.1

IVY — A.M. TRANSMITTER AND RECEIVER KITS

Full scale production following retooling will enable these kits to be continually available for immediate delivery to your dealer as from MAY, 1961. Attractively boxed, with fully illustrated building instructions, contents will include Boxed B.V.A. Valves, Telescopic Aerials, Steel Case, Printed Circuit Board, Wound Coils and latest new components. Every kit complete, even solder, no parts to make, just assemble. Remember, these kits are designed for the beginner to obtain positive results. Prices range from 27/6d. to 155/6d. including P.T. Literature available shortly, see your dealer and start construction the safe way.

In the event of difficulty in obtaining our kits, apply direct, quoting your usual retailer, to

MacGregor Industries
STATION WHARF, LANGLEY, BUCKS



Latest Title: The First BOOK ON GLASS FIBRE

This is essentially a practical book for all who are interested in making things with reinforced glass plastics, or using this most versatile material for repair work, etc. It is the first work of its kind to cover materials, techniques and a vast range of applications in a single comprehensive volume—giving the reader literally all the information he will ever need for producing successful glass fibre mouldings of any shape, form or size. Joint authors are well-known—Ron Warring is an old friend and Geoff Lewis is a working director of a leading glass fibre firm. 122 pages size $8\frac{1}{2} \times 5\frac{1}{2}$ ins., printed litho. with hundreds of illustrations and diagrams. Drawn on card cover in two colours. (A hard-bound library edition is also available at 10/6.)

Price 7'6

(Postage and packing inc. 8/6)

MODEL AERONAUTICAL PRESS LTD.

38 Clarendon Road, Watford, Herts

M·A·P BOOKS

DESIGN FOR AEROMODELLERS—by Ron Warring. 96 pages, $8\frac{1}{2} \times 5\frac{1}{2}$ in., profusely illustrated line drawings, plus 8 pages of art plates. 2-colour card cover. Price 5s. (Postage and packing inc. 6s.)

POWER MODEL BOATS—a book for the "average" modeller by Vic Smeed. 128 pages size $8\frac{1}{2} \times 5\frac{1}{2}$ in., printed on fine quality paper with 250 photo-illustrations and line drawings. Bound in hard boards, linson covered with gold foil title on spine. Two colour photo dust cover. Price 12/6d. (Postage and packing inc. 13s. 6d.)

SECRETS OF SHIPS IN BOTTLES—by Peter Thorne. The fascinating mystery explained! This generations old hobby of seadogs will interest you too. 64 pages size $7\frac{1}{4} \times 4\frac{1}{4}$ in., on high quality paper, profusely illustrated with line drawings and 8-page art inset (65 figs.). Bound in drawn on two colour card cover. Price 4s. 6d. (Postage & packing inc. 5s. 6d.)

CONSTRUCTION FOR AEROMODELLERS—96 pages, $8\frac{1}{2} \times 5\frac{1}{2}$ in., profusely illustrated with line drawings and 8 art plates; covers all aspects of building. 2-colour card cover. Price 5s. (Post. & pkg. inc. 6s.)

BOAT MODELLING—by Vic Smeed. 96 pages, $8\frac{1}{2} \times 5\frac{1}{2}$ in., 223 line drawings, 50 photos. Comprehensive coverage of yachts, power boats, etc. A best-seller. 2-colour card cover. Price 5s. (Postage and packing inc. 6s.)

SCALE MODEL CARS—by Harold Pratley. 80 pages, $7\frac{3}{4} \times 4\frac{1}{2}$ in., 43 drawings, 20 photos, 30,000 words on veteran, vintage and modern car modelling. 2-colour card cover. Price 5s. (Post. & pkg. inc. 6s.)

FLYING SCALE MODELS—by Ron Moulton. 128 pages, $8\frac{1}{2} \times 5\frac{1}{2}$ in. 137 line and photo illustrations, 15 three-view drawings. The finest book ever on all aspects of this subject. Art dust cover. Fully bound. Gold-blocked title. Price 10s. (Postage and packing inc. 11s.)

MODEL BOAT RADIO CONTROL—by A. R. Casebrook. 108 pages, $8\frac{1}{2} \times 5\frac{1}{2}$ in., 155 diagrams, 8 art plates. Includes circuits and practical information covering the entire subject 2-colour photo cover. Price 6s. (Postage and packing inc. 7s.)

AIRCRAFT IN MINIATURE—by W. O. Doylend. 130 pages, $8\frac{1}{2} \times 5\frac{1}{2}$ in., 244 detail drawings, over 30 photos, 50,000 words; a complete mine of information. Art dust cover. Fully bound. Gold-blocked title. Price 12s. 6d. (Postage and packing inc. 13s. 6d.)

THE AMATEUR ROD MAKER—by L. W. Taylor. 64 pages, $7\frac{1}{2} \times 4\frac{3}{4}$ in., many line illustrations showing how to make rods and other fishing tackle and accessories. 2-colour card cover. Price 4s. 6d. (Postage and packing inc. 5s. 6d.)

MODEL AERO ENGINE ENCYCLOPAEDIA—208 pages, size $8\frac{1}{2} \times 5\frac{1}{2}$ in., 75,000 words and over 300 illustrations make this the most comprehensive work on all aspects of model aero engines, construction, use, tuning, maintenance, data, tables. Fully cloth bound, 3-colour dust cover. Price 12s. 6d. (Postage and packing inc. 13s. 6d.)

MODEL CAR RAIL RACING—by D. J. Laidlaw-Dickson. 176 pages, $7\frac{1}{4} \times 4\frac{3}{4}$ in., cloth bound, profusely illustrated guide to this fascinating hobby of miniature car racing with 19 fact-packed chapters and 3 appendices. Over 180 working drawings. Photo dust cover in 2 colours. Fully bound. Gold-blocked title. Price 10s. (Postage and packing inc. 11s.)

MODEL MAKER MANUAL—128 pages, 10×8 in., filled with drawings, diagrams, photos to provide years of modelling activity. 8 complete full-size plans and 7 designs with full-size parts with leading features by 9 expert contributors. 2-colour dust cover. Fully bound. Gold-blocked title. Price 10s. (Postage and packing inc. 11s.)

Made and printed in Great Britain by Bletchley Printers Ltd., Central Gardens, Bletchley, Bucks, for the proprietors, Model Aeronautical Press Ltd., 38 Clarendon Road, Watford, Herts. Published by The Argus Press Ltd., 8/10 Temple Avenue, London, E.C.4, to whom all trade enquiries should be addressed. Registered at the G.P.O. for transmission by Canadian Magazine Post.

THE TOP TWO

IN RADIO CONTROL

KEILKRAFT

SUPER 60

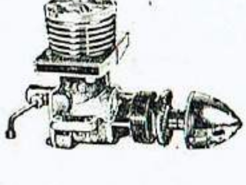
WINGSPAN 63"

FOR MOTORS 2.5cc AND OVER

- Ready-cut and shaped parts.
- R/C Aerobatic Fuel Tank.
- Preformed landing gear.
- Adequate materials.
- Full size plans (2 sheets).
- Illustrated instruction booklet.

£4 . 17 . 6

RECOMMENDED FOR THE SUPER 60



E.D. 2.46cc "RACER" engine £4.2.7

E.D. Black Prince/I single channel tone. Complete outfit - £18.13.0

R.E.P. Mini-Reptone. Complete outfit - £16.16.0

R.E.P. Reptone. Complete outfit - £15. 8.0

TOP FLITE

ORION

WINNER OF 1960 WORLD MULTI-CHANNEL R/C CHAMPIONSHIPS

DE LUXE R/C MULTI KIT

WINGSPAN 68". LENGTH 47".
WEIGHT (inc. equip.) $6\frac{1}{4}$ lbs.

- Ready-cut and shaped parts.
- Preformed landing gear.
- Nylon & metal fittings (132 pieces).
- 12" power propeller.

£11 . 10 . 11

RECOMMENDED FOR THE ORION

E.D. and R.E.P. 8 channel equipment.
MERCO 35 and O.S. Max III 35 multi-speed engines.

See them at your local model shop

KEILKRAFT

The Greatest Name in Model Kits

Effective Inductance of Shielded Coils

By R. H. Warring

The effective inductance of a coil shielded with a circular or square can can be determined from the formula—

$$L_e = L\ (I - \Delta)$$

where L_e = effective inductance of shielded coil.
L = inductance of coil as wound (i.e. outside can).
Δ = a correction factor read from the appropriate chart, according to whether the can is square or circular.

Strictly speaking the values of Δ are only accurate when the length of the can is greater than the wound length of the coil by an amount at least equal to d/2, where d is the diameter of the coil.

← Circular Cans

Criteria are—L = length of coil winding.
d = diameter of coil winding.
D = diameter of can.

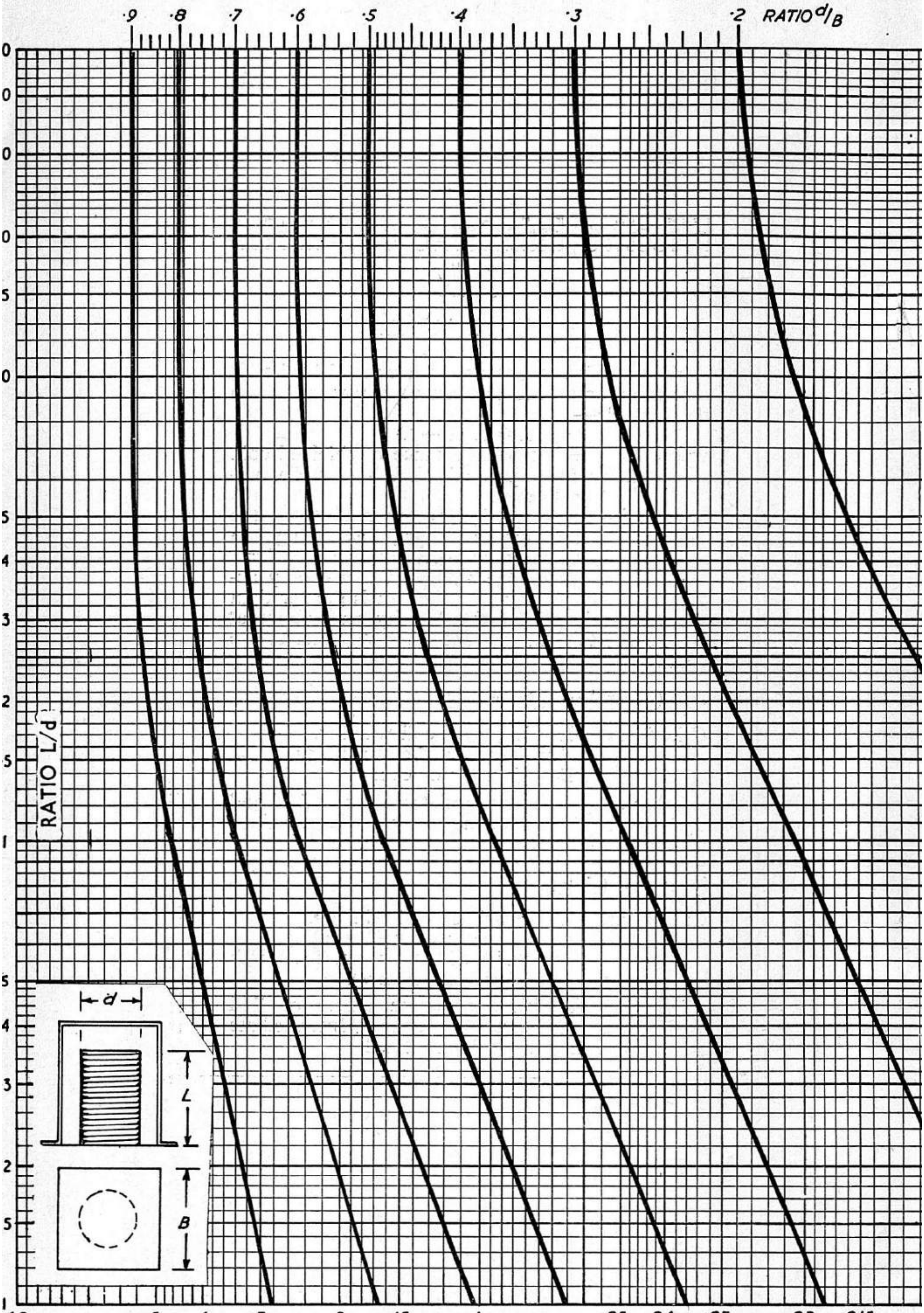
Enter chart with appropriate values of L/d and d/D to read correction factor Δ Intermediate values of D/d can be interpolated.

Square Cans →

Criteria are—L = length of coil winding.
d = diameter of coil winding.
B = width of face of can (i.e. length of side of square).

Enter chart with appropriate values of L/d and d/B to read correction factor Δ. Intermediate values of d/B can be interpolated.

EFFECTIVE


·9 ·8 ·7 ·6 ·5 ·4 ·3 ·2 RATIO d/B
RATIO L/d
1·0 ·5 ·4 ·3 ·2 ·15 ·1 ·05 ·04 ·03 ·02 ·015
CORRECTION FACTOR Δ
d
L
B

NDUCTANCE OF SHIELDED COILS

DATA SHEET No. 9