Radio Control Models & ELECTRONICS

DECEMBER - - - - 1960

ALL TRANSISTOR TRANSMITTER

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MAKING A "MATCHBOX" MONITOR

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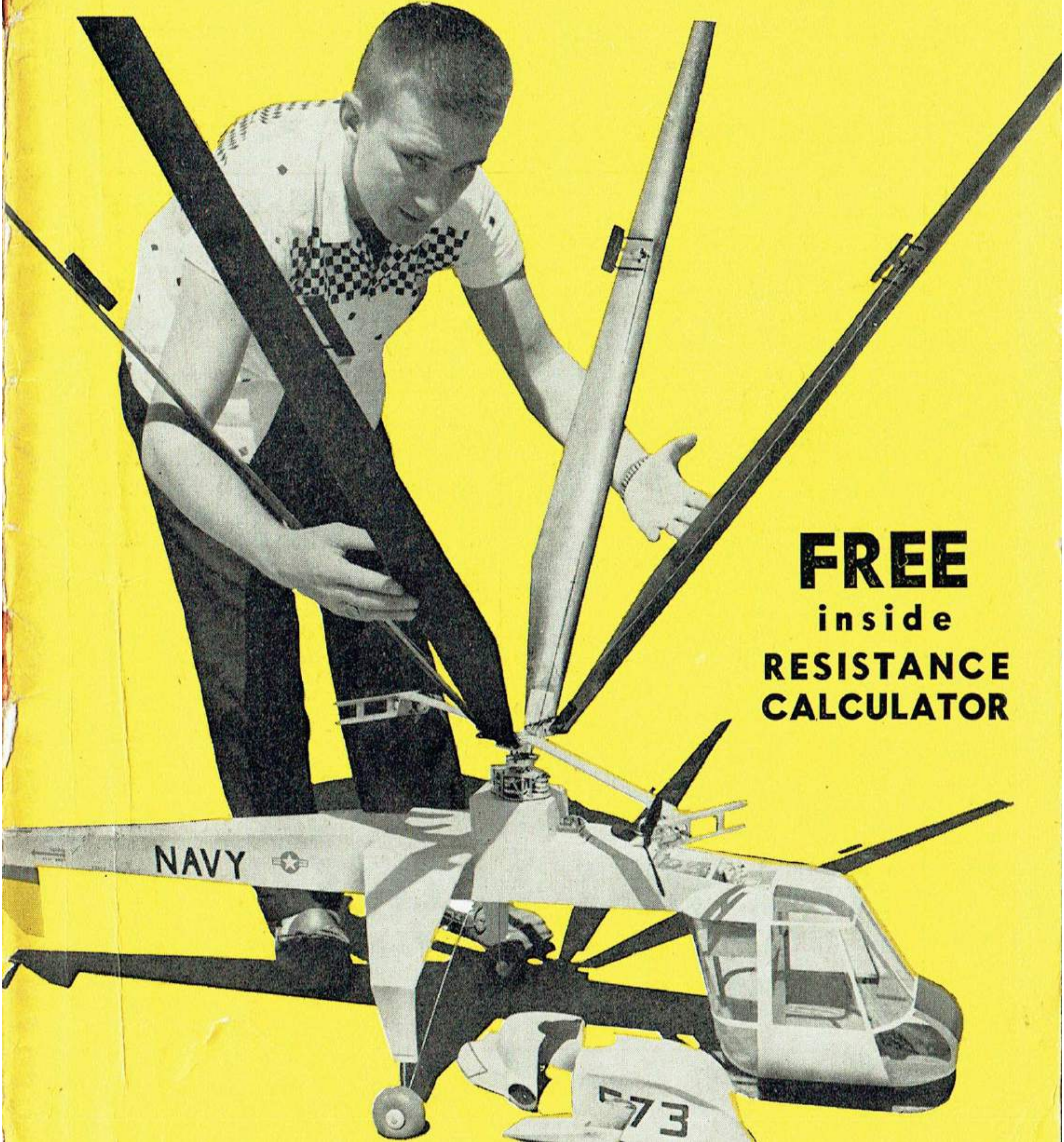

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The cheapest can prove to be the most expensive. We have tested Metz R/C equipment under the worst possible conditions for the past year and have no hesitation in recommending this equipment to anyone who WANTS TO FLY AND NOT FIDDLE.

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METZ "BABY" 6 volt all transistor receiver. Gruner relay. 2 oz. only Size 2½ in. x 1½ in. x ¾ in. High tone frequency. 2,000-5,000 c.p.s. See September issue of R.C.M. & E. for review. — **£10** TAX PAID

METZ 'UNIVERSAL' TRANSMITTER. Single tone (one of any three) or 3 channel (by using special control box). Neat Plastic case with sling. Power supply is 4-U2 cells. Telescopic aerial. **With special Control Box for use with the above Tranney 55/- extra.** — **£16.18.6**

METZ 190/2 RECEIVER. Single or 3 channel (by use of adaptor) 6 volt all transistor. Tuned filter. Small size. **Tuned Filter 3 channel adaptor for use with this Receiver £12.3.0 extra. The complete 3 channel outfit available from stock, £45.** — **£13/13/6**

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DEAC CELLS 225 DK. 1.2 volt	3/11
DEAC 225 DK. 6 volt pack	25/-
DEAC 450 DK. 7.2 volt tapped 3.6 volt	50/-
225 DK. 3.6 volt	14/-
225 DK. 7.2 volt tapped 3.6 volt	28/-
DEAC CHARGER with instructions	20/-

GET ON OUR MAILING LIST TODAY — FOR ALL THE LATEST IN R/C

E.D. CRYSTAL CONTROL UNIT

Black Prince/Arrow 4 channel	£31/14/6
Black Prince/Arrow 6 channel	£35/8/0

R/C PLANE KITS

RMA Vagabond 59" 2.5-5 c.c.	£6/5/0
RMA Viking 50" 2.5-5 c.c.	£6/12/6
Satellit 48" 1.5-2.5 c.c.	£5/5/0
Piper Pa 22 45" 1.5 c.c.	60/–
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Blackwell T.100 54" 2.5-5 c.c.	£5/9/6
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F.R. Compound Actuator	49/11
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O.S. Max III 35 Multi 6 c.c. Glow	£7/18/4
Veco 19 Multi 3.2 c.c. Glow	£8/10/0
Tornado Twin 5 c.c. Glow	£11/12/0
Taplin Twin 7 c.c. Diesel	£8/10/0
Allen Mercury 15 Multi 1.5 c.c.	70/8

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O.S. Max II 35 6 c.c. Glow	90/-
O.S. Max II 29 5 c.c. Glow	80/-
O.S. Max II 15 2.5 c.c. Glow	80/-

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EXTENDED PAYMENT All equipment over £8 is available on Extended Payment Terms. Call, write or phone.

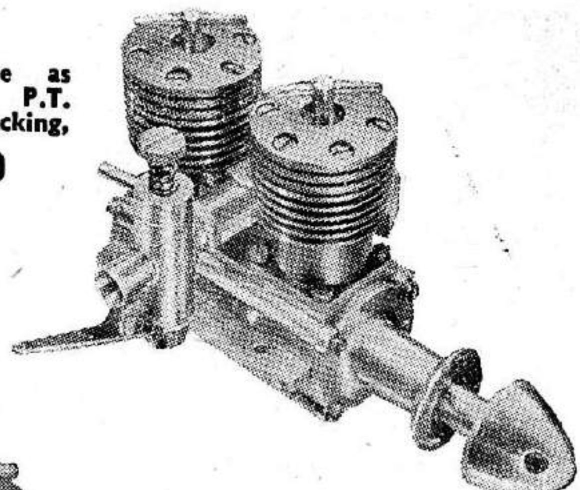
TAPLIN TWIN

British Patent No. 747742

AIRCOOLED VERSION :

Price complete as shown, inc. P.T. postage and packing,

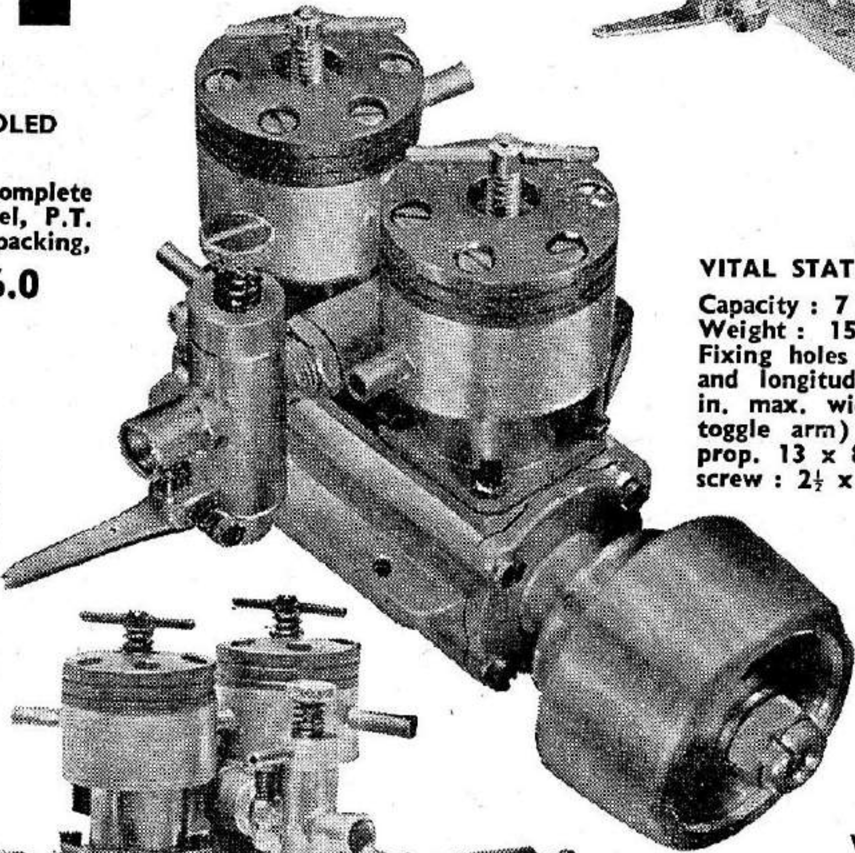
£8.10.0



WATERCOOLED VERSION :

Price complete with flywheel, P.T. postage & packing,

£9.16.0



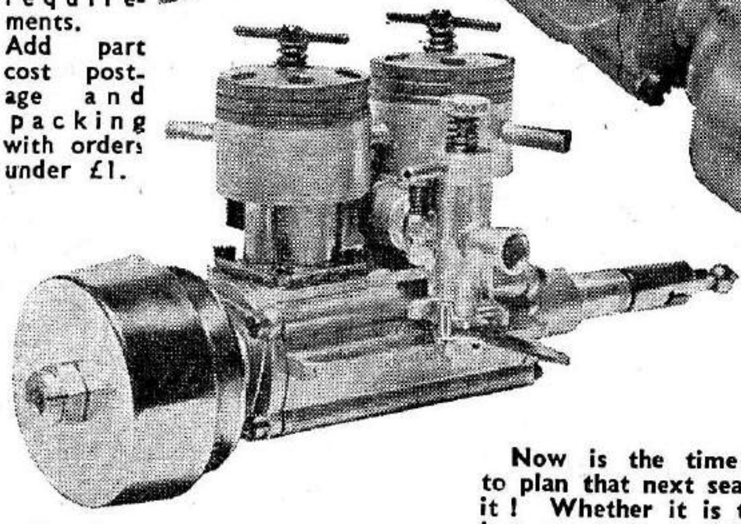
HOW TO ORDER

Name and address with remittance and precise requirements. Add part cost postage and packing with orders under £1.

VITAL STATISTICS :

Capacity : 7 c.c. (6.92 c.c. actual). Weight : 15 oz. Engine bearers : Fixing holes $1\frac{1}{2}$ in. centres laterally and longitudinally. Max. height $3\frac{1}{2}$ in. max. width (excluding throttle toggle arm) $2\frac{5}{8}$ in. Recommended prop. 13 x 8. Recommended water-screw : $2\frac{1}{2}$ x $2\frac{1}{2}$ (2-blader).

THREE BEARING CRANKSHAFT ALL BALL RACES



WATERCOOLED WITH FORWARD FLYWEEL

for more convenient starting. In response to demand this version is also available, price, inc. flywheel, P.T., postage and packing, **£11.8.0**

Now is the time with the long dark evenings before you to plan that next season's model that is going to carry all before it ! Whether it is to be a rakish boat, a multi R/C plane, or just a sports model for fun on the local field or water, its power unit will be the deciding factor in your future pleasure with it. Be wise, decide on a TAPLIN TWIN, lots of other people have to their abiding joy; we are confident you will find it a particularly willing worker, with good looks, trouble-free operation and a host of other points to recommend it.

If you are one of the dwindling number who have not yet acquired a TAPLIN TWIN may we point out some of its special features :

Wide speed range (500/7,000 r.p.m.); barrel type carburettor (infinite adjustment just like "full-size") quiet running; no vibration; clock or anti-clock running; handsome with anodised heads and spinner; easy starter; simple synchronisation : Recommended fuel : Mercury Marine Diesel Fuel.

Order safely by post since we guarantee satisfaction or money back. We will send yours anywhere in the world securely packed and insured, or just round the corner. You will find new enjoyment in your modelling with a TAPLIN TWIN—try one and see.

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NEW ! ! ! Universal Joint just like full-size practice. Suitable $1\frac{1}{2}$-10 c.c.
Price : 7/6d.

STAINLESS STEEL TWO-BLADER WATERSCREW : $2\frac{1}{2}$ in. dia. $2\frac{1}{2}$ in. pitch; tapped 4BA. Price : 9/6d. inc. P.T.

SILENCER : Nickel-plated Burgess type with centre baffle. Length overall 6 in., dia. $1\frac{3}{8}$ in. Price: 4/9d. inc. P.T.

80 c.c. TANK : Nickel-plate 80 c.c. Length 4 in., o.d. $1\frac{3}{8}$ in. Price : 4/9d. inc. P.T.

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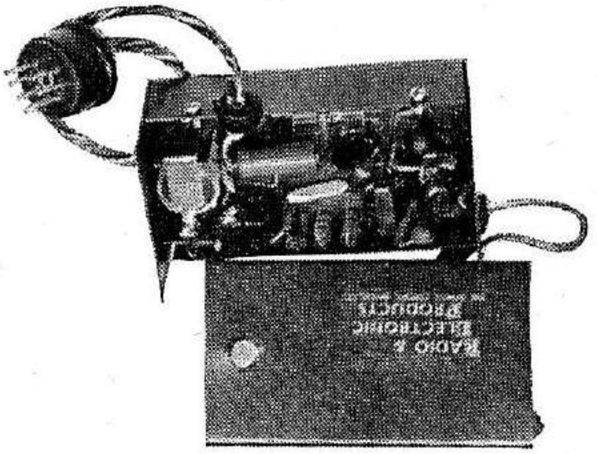
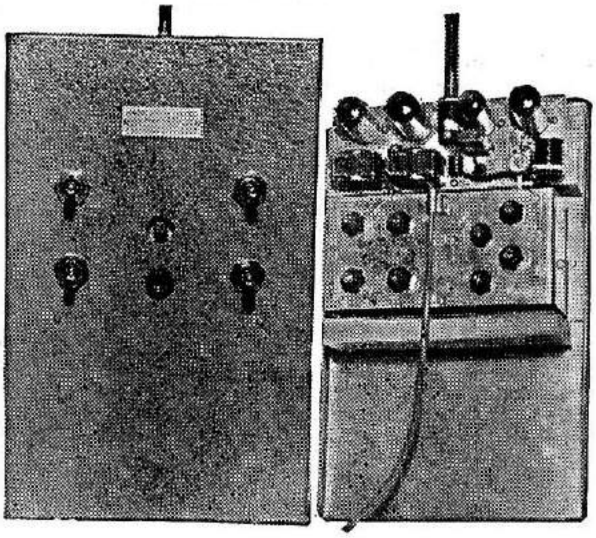
THE COMPLETE RANGE OF RADIO CONTROL EQUIPMENT

★ **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.**



" UNITONE "
Single Channel Tone, Exceptional Range.

OCTONE



"OCTONE"
Eight channel simultaneous crystal controlled TX. 10 oz. receiver.

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.** 2½ oz. Receiver **£7/7/6.**

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

" QUADRITONE "

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.**

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

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

A FULL RANGE OF ACCESSORIES

R.E.P. ½ 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/-.**

NEW! 2¼ x 2¾ x 2 Tx. H.T. Convertor. 6v. to 135v. at 25 m.A. £8/10/-.

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 and contain all finished components.

★ 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.

Ed. JOHNSON for AMERICAN RADIO CONTROL EQUIPMENT

British Retail Prices **inclusive** of Import Duty, Purchase Tax, and Surface Postage. Relayless Receivers **do** have Reed Units for direct connection to Bonner Transmites (or relays). Superhet Receivers and 465 Mc/s equipment available.

ORBIT MULTI

10 channel Transmitter (S) ...	£50. 3.4
10 channel Relayless Receiver ...	£32.19.4
10 channel, 10 Relay Receiver ...	£68. 1.8
8 channel Transmitter (S) ...	£45.17.4
8 channel, 8 Relay Receiver ...	£54.16.6
6 channel Transmitter (S) ...	£43.14.4
6 channel, 6 Relay Receiver ...	£49. 9.0
4 channel Transmitter & Receiver ...	£47.11.6

(S) = Simultaneous.

MIN. X Single and Multi (single channel Receiver convertible to Multi).

Single:	Receivers ...	£16. 0.0
	Transmitters ...	£15.12.0
Four:	Receivers ...	£30.16.0
	Transmitters ...	£23.12.0
	4-channel combo price ...	£48. 0.0
Six:	Receivers ...	£38. 8.0
	Transmitters ...	£29.12.0
	6-channel combo price ...	£57. 4.0
Eight:	Receivers ...	£43. 4.0
	Transmitters (S) ...	£45. 0.0
Ten:	Receivers ...	£51. 4.0
	Transmitters (S) ...	£50. 8.0
Twelve:	Receivers ...	£60. 0.0
	Transmitters (S) ...	£56. 0.0

BRAMCO Multi Channel Equipment.

NEW ! 10 channel APOLLO Relayless Receiver, 1" × 2" × 3".
UNIQUE four months' guarantee against **crash** damage, component failure, or manufacturing fault £27. 4.8

10 channel "Competition 10" Relay Receiver ...	£62.14.2
10 channel hand held Transmitter (S)	£55.18.0
8 channel Relay Receiver ...	£50.10.6
8 channel hand held Transmitter (S)	£50.10.6

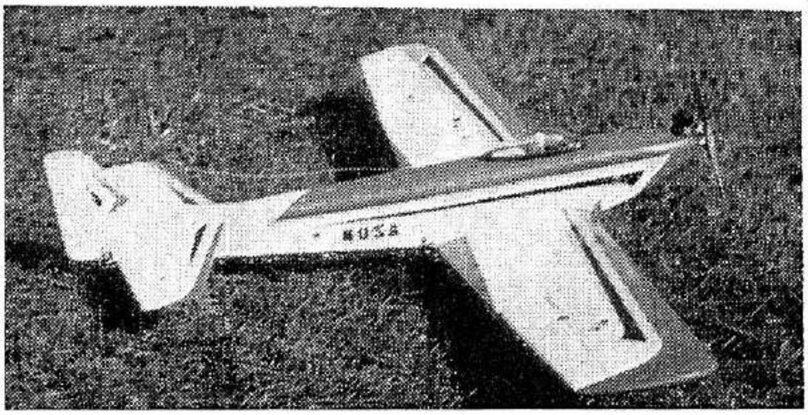
TRANSMITES (Bonner transistorised Duramites). Weight 3 ozs.

for moving all model controls. No relays required, operation direct from orthodox Reed Units. 'Built-in' 6 transistor amplifier.

Transmite Neutralising Servo ...	£12.0.0
Transmite Non-Neutralising Servo ...	£11.4.0
Duramite (for relays) ...	£ 5.4.0
Duramite-Transmite Conversion Unit ...	£ 8.0.0

Suitable Servo batteries: 4.8v. Deac, centre tapped, rechargeable.

Large capacity, 5 ozs. ...	36/-
Medium capacity, 3 ozs. ...	20/11



ORION. World Champion Multi Kit. £11.10.0 (tax paid).
Wingspan: 68". Length: 47". Wing Area: 690 sq. ins.
Weight incl. equipment: $6\frac{1}{4}$ lb. Engine: .35 – .45.

- ★ New Modern contest design—thoroughly flight tested.
- ★ Frise type aileron for smooth aileron response.
- ★ Top "Grade A" balsa wood, specially selected for each part. 4 inch wide planking—no splicing required.
- ★ Three big die-cut sheets of 5-ply aircraft plywood.
- ★ Many shaped Balsa parts—matched wing LE. Matched Stab. L.E. and spars, top fuselage block, motor support block, nose blocks and wing tips. Fuselage top block completely shaped and hollowed.
- ★ Fuselage sides die-cut from one piece of $5\frac{1}{2}$" × 42" balsa sheet—no splicing required.
- ★ Wing ribs made with special jig feature to give perfect alignment.
- ★ 132 pieces of complete hardware & fittings.
- ★ First kit with complete nylon parts. Aileron bellcranks and bushings, rudder horn, tailwheel bracket and aileron hinge brackets.
- ★ Formed landing gear of 5/52" piano wire and special clamps for mounting. Complete with wire, flexible cable and tubing for controls.
- ★ Elevator control horn silver soldered and complete with bearings.
- ★ Kit includes a 12/6 Power Prop. for best results with .45 engines.
- ★ Full F.A.I. stunt pattern with Merco 35 R/C In stock, £7.12.6.

I'll be pleased to answer specific questions about all available equipment. Example: "Dear Ed, my wife wants a chinchilla fur coat. How can I convince her an ORBIT 10 would be more useful?"

Ed. JOHNSON (RADIO CONTROL)

LARKHILL **WILTS** **ENGLAND**

Radio Control Models & Electronics

VOLUME 1 NUMBER 8 DECEMBER 1960

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Here, There & Everywhere

Christmas Greetings to our Readers Everywhere

THERE is always something very nice about sending Christmas Greetings, and we are delighted to have reached the first occasion when we can extend them to our readers. Even the fact that we are penning these words in mid-October cannot quite dampen our awakening festive spirit, though in spite of this early start some of our further flung friends will still receive our message too late to be seasonable. Although we are so young that we have not even celebrated our first anniversary, the last issue of the year seems a suitable moment to pause and take stock.

Do we feel we have accomplished anything in our eight months of existence? Certainly we do! If nothing else we have proved to our satisfaction that a sufficiently large public already exists to patronise our product. Whether we retain their interest depends first upon the quality of our future contents, which in their turn depend in no small part upon the quality of the contributors we persuade to write articles for us. Naturally, many of our feature articles are "made to measure" either by staff contributors, or by friendly discussion with would-be contributors, but there is always a welcome for freelance efforts by our "ordinary" readers if we may so call those who do not make a habit of writing articles. It used to be said that every one of us has a story to tell—in the hobby world that surely applies just as strongly and there must be something, great or small, that every reader can contribute for the good of the rest. We should add that we pay money for accepted material, not so large as we are sure many deserve, but the most generous that we can afford.

Another very much appreciated source of material comes from the many foreign technical magazines that we receive on a mutual exchange basis. We welcome any others that may still be unknown to us. By no means least in value, are the growing number of club and group newsletters published all over the world that so often contain items so practical and useful that it would be a wicked waste to restrict them to their necessarily small initial circulation.

Finally, there is the field of experiment. So many people are shy to advance as yet unproven or partly

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developed notions. Not so, we will gladly publicise ideas that seem sound and capable of development, for, with many thousands to think them over in place of two or three, a solution will appear so much sooner, or lead to other fruitful lines of experiment. Such notions we shall always be careful to classify as undeveloped so that less skilled readers will not accept them as ready-to-work schemes.

Meanwhile, we shall press on with lots of good things for the novices. They represent so large a part of our circulation that they deserve and will get a lion's share of future issues. Similarly our overseas readers are so numerous that we must soon devote special care to offering "substitute" components lists for those unable to shop easily in the U.K.

They Said It Was Impossible !

Cover picture this month shows Ken Norris's Sikorsky S-64 Skycrane radio controlled model! This, by the way, anticipates the full-size machine which has yet to fly. Ken, who comes from Denver, Colorado, was introduced a year or two ago to British helicopter expert Francis Boreham whose help in the project is gratefully acknowledged. Before this project got under way some 3,000 (yes three thousand) sketches of all types were made! A free flight version has been made and flown successfully at Denver, which is at 7,000 ft. altitude. To date the R/C version has not been flown since builder wishes to learn its flight characteristics from a test stand before risking the expensive radio and servo equipment which forms the major part of construction cost.

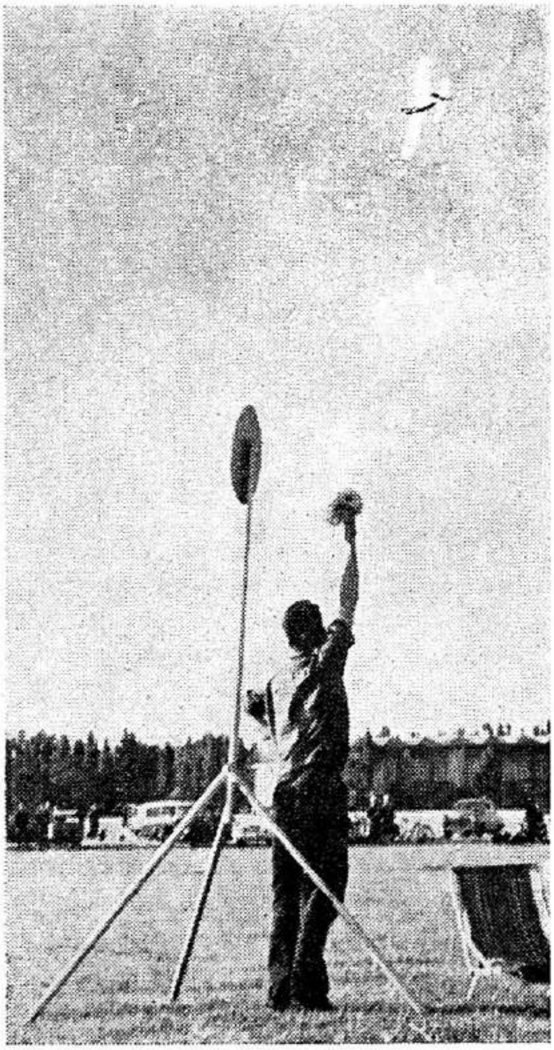
Equipment includes FM Electronics Atlas Rx., Hercules Tx., eight channel. Each channel must perform a special helicopter operation according to the following pairing: (1) Advance engine, *cyclic forward;* (2) Down elevator, *collective down;* (3) Retard engine, *cyclic aft;* (4) Up elevator, *collective up;* (5) Left rudder, *tail rotor left;* (6) Left aileron, *cyclic left;* (7) Right rudder, *tail rotor right;* (8) Right aileron, *cyclic right.* Phew!

As and when it flies successfully under R/C we hope to publish details of some of its more interesting features. We look upon this as the most ambitious R/C venture by a private modeller yet. If it proves practical then every major full-size helicopter manufacturer in the world should be climbing on the Ken Norris bandwagon since hundreds of thousands of pounds, dollars, pesos, roubles, etc., could be saved by model testing of helicopter experimental machines. Good fortune, Ken!

A New Model Waveband ?

We are persistently hearing rumours that the P.M.G. is contemplating something new in the matter of model wavebands. The idea has been current for quite a time that some form of crystal control may become compulsory. This would cost some of us a few hard earned shillings, but is a step we cannot argue against, some of our leading contributors, Dave McQue, for example, as well as our consulting editor, Tommy Ives, are all in favour. Latest rumour to reach our ears is that an alternative

Two Gannet powered P.L.4s in the forefront of the parade of models at the North Western R/C Regatta, organised by the Manchester Group of the I.R.C.M.S.



Frank van den Bergh's "Sky Duster" rounding a pylon in an elevator turn at A.R.C.C.'s Cranfield meeting in September. Fellow competitor Paul Rogers signals the turn, and pylons are by courtesy of R.E.P. (and available to other pylon meeting organisers).

wave band may be offered in place of the "specialists" 465 band, which, compared with the 27 mc/s band is virtually unused by R/C model enthusiasts. How true this is we cannot say, but it might be appropriate to consider what alternative band would best suit model needs, and be used as much as the present more popular choice. Here is a chance for readers to express a view. You may never get what you want, but there is no harm in airing opinions, backed up, if you please, with some good reasons.

Kodak Robot

We are advised that Kodak Ltd. have installed what they describe very unromantically as a "telephone answering machine"—not even TAM at your service! This delightful device provides 24-hour customer service, announcing itself, and instructing the caller on his message procedure, so that, even their prosaic leaflet on the subject is almost enough to make us order something at dead of night just to get their science-fiction sounding robot into action. We congratulate the firm on their enterprise, and though, perhaps, we should neither be surprised, amazed or astonished, in this scientific age, we confess, with hardly a blush, that we are!

North Western R/C Regatta

On Sunday, August 21st, the Manchester Group of the I.R.C.M.S. took "the bit between their teeth" and staged an open Regatta for R/C boats at the Marine Lake, Fleetwood, Lancashire.

It has often been said that there is not sufficient interest in the North to hold a Regatta, but the show at Fleetwood proved this to be definitely wrong when a total of 60 boats assembled to prove their worth.

Three events were held, the first being Slow Steering, with "Docking". This aroused great interest amongst the "electrics" and also brought into the picture Mr. Brierley's craft, which is powered by a 60 c.c. engine, complete with Dyno starter and reverse.

High Speed Steering brought a large number of entries from all parts of the region, and also entries from the Midlands.

Although the day was cloudy, the rain kept away, and a very large crowd spent an enjoyable day, which closed with the presentation of prizes by the Commodore of the Fleetwood Model Yacht and Power Boat Club.

Spin Dizzy

East Bay R.C. Carrier feature a novel suggestion in their current issue, that after completing the usual stunt pattern, the competitor should execute a three turn spiral dive against a stop watch and recover within a quarter turn. No judging points offered for this effort but fastest spins of the day win a prize. We offer this suggestion to both contest organisers, and even more particularly to trade sponsors who might find value of goods offered more than repaid by visits to the local model shop subsequently by less successful entrants!

The Other Side of the Picture

We have received a very sad little letter from a coloured R/C enthusiast in South Africa. For obvious reasons we give neither his name nor locality. He tells us how his local (coloured) club has faded away because members had no one they were allowed to fly against, and so he continues as lone hand. **In spite of this handicap plus** that of lack of pocket money, he has built a Hill Tx., an A.M. No. 1 Tx., and is now engaged upon the McQue Versatile Tx. Some of the European modellers have been very helpful he adds—what a pity they can't all get together and fly their troubles away!

Mayor on the Button

We show a picture taken on the occasion of the North Kent Nomads Dance Trophy (Charlie Dance is there at the mike in "gents natty" to honour it) when Trevor Walters handed over the Tx. to the Mayor of Dartford (Alderman F. Brown) with his *Uproar* at 600 feet. His Worship soon found the model nearly as hard to control as the Opposition at a rowdy council meeting but went to his task with enthusiasm as soon as he discovered the trick of keeping his model on a near horizontal plane. It is no exaggeration to say that the Tx. passed between Mayor and mentor like a hot brick, but this is the sort of thing that makes model clubs succeed. Well done Alderman Brown, well done W.K.N.

Mind the Wires!

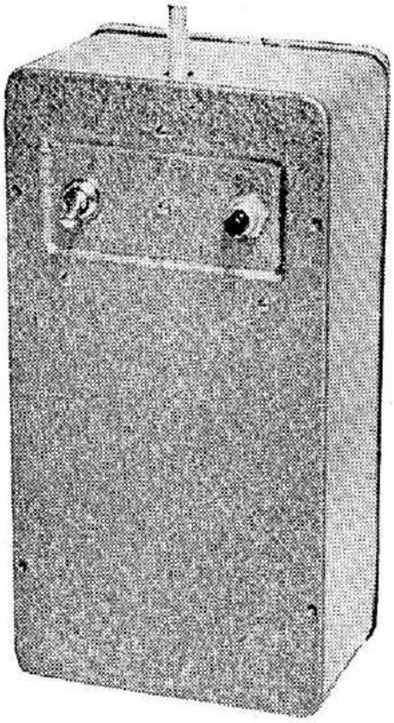
Nearly everybody is aware of the danger of control line flying near overhead cables, but we have just heard of them in connection with R/C flying. A reader reports that such a range of H.T. cables completely blanketed his signals when at right angles to model and Tx. Our comments are invited on the why, and would suggest that if the Rx. is carrier operated and has a sensitivity adjustment it might well be affected by H.T. wire. Howard Boys complained of this at the Darmstadt meeting. If a tone receiver it could only affect it if there was a continuous discharge from the wires.

As a final observation, we would add how undesirable flying near overhead wires is at any time, and whilst chances of a fatal accident, such as has, alas, attended control line flyers on several occasions, is negligible, it would not be impossible for a model out of control to short the cables and put a whole farm, village or even town out of action, with dire consequences for local flying in the future!

Our All-Transistor Transmitter

This project during its preparatory stages took quite a different turn from what we had first envisaged, that is a foolproof Tx. with traditional step by step instructions and so on. It soon became evident that there was such a wealth of unexplored byways that no one set could be even partly satisfactory to the type of reader likely to make it up. We have therefore dispensed with mechanical detail, and included instead a whole variety of leads, plus the particular line that we took ourselves. The result is a satisfactory experimental set with a range equal to comparable available equipment of more orthodox design, but of unlimited further development possibilities. Indeed just as soon as some more powerful transistors at a moderate price come on to the market immediate improvement becomes available without circuit changes, but alas, we cannot urge even our most monied readers to try their luck at £10 and more a transistor!

No! Your Worship, not that one up there, ours is flying on Dartford Heath. Alderman F. Brown looks a little worried under instruction from plane's owner Trevor Walters. Perhaps he would have been happier if Trevor had just let him get on with it! Illustration is from a colour transparency by Alan Smith, social secretary of North Kent Nomads M.F.C.



Small Tx. case which holds our prototype. This will be recognised as that already produced by MacGregor Industries for the Ivy - A.M. Tx. Inside layout is on the right. Batteries are located for space required only, and are not connected in the picture.

All Transistor

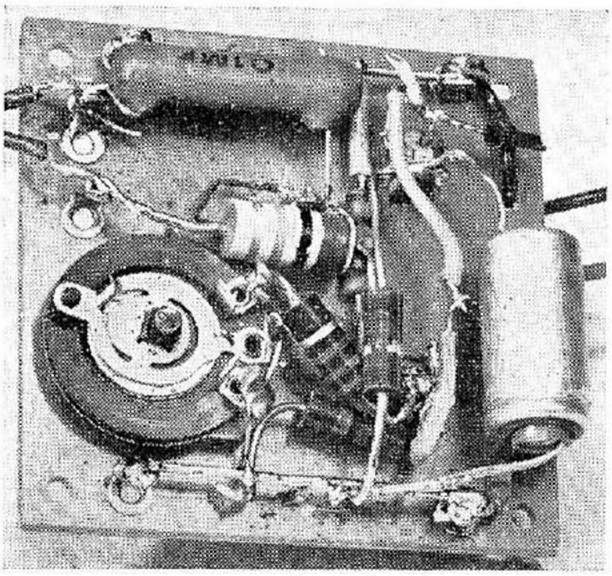
A PROJECT STRICTLY FOR

TOMMY IVES DID THE BUILDING DAVE McQUE PROVIDED THEORY

AN all transistor Tx. with its economy in batteries is something we should all like to have so long as (a) The cost of the high frequency transistors does not price the set out of all but Ed. Johnson's range and (b) The power output is adequate.

Under pressure from you readers and some gentle coaxing from Dickie we have investigated all the currently published circuits for TR Tx.'s and tried out not a few ideas of our own. Our experiments have been limited to the use of the Mullard OC 170 'drift' transistor and a few similar American types. We did enquire about certain 'mesa' type transistors but present quoted prices run to double figures.

Reluctantly we decided that in all fairness we could not produce a beginners' constructional article. Instead, we present a range of representative circuits with some guidance for those who feel able and want to have a go. The reason for this is that in order to get an acceptable power output and hence range, the transistors are run near their maximum ratings (in some of these circuits—not ours—they appear to be overrun so far as voltage is concerned) and careful adjustment is required to get the greatest usable output into the aerial.



All the Tx. circuits are of the Master Oscillator Power Amplifier type (MOPA) and use an overtone Xtal. However, those in possession of a second harmonic Xtal, i.e. in the 13.5 mc/s region, can use it if they increase the number of turns on the oscillator and drive coils by 1.4 and double the oscillator tuning capacitor(s), whilst connecting both output collectors to the *same* end of the output tuned circuit (leaving the other end free) and hence converting the output stage to a 'push push' doubler, i.e. having a push pull input and parallel output.

The power output of the Tx.'s is only of the order of 30-100mW. but when you consider the fact that range varies as the square of the radiated power (free space), i.e. to double range four times the power, is required (and more over ground, or water, due to a further exponential factor related to earth losses) you will see why 50 milliwatts can provide a quarter of the range of a 1,000 milliwatt or 1 watt Tx. and that means with a good Rx. at least a quarter of a mile. If your interest is boats on park ponds and land models, the oscillator used alone of any of these Tx.'s is worth considering as with 9v. supply at 4 m.A. over 100 yards range has been obtained. For tone, modulation of either the base or emitter current, has proved satisfactory.

The Xtal oscillator stages used fall

Transmitter

MORE EXPERT READERS

This article should appeal to experimentally minded enthusiasts, and for that reason we have given details of all circuits which have been studied in producing our prototype.

into two categories:

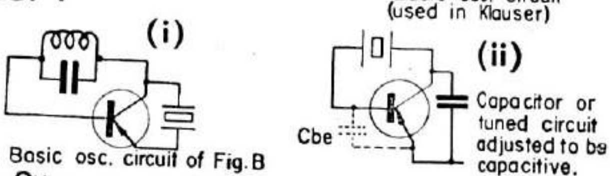
(1) Where the Xtal is used in series with the feedback loop and presents a low impedance at its series resonant frequency without phase shift, so it is connected between the collector and emitter circuits.

(2) Where the Xtal together with external capacitance forms a parallel tuned circuit with 180° phase shift and is connected between collector and base.

By moving the 'earth' point around, three versions of each can be made. Discerning readers will see the relationship between the two categories from Fig. 1, where both are drawn in skeleton form without D.C. supplies and biasing. Personally I prefer type 1 for overtone Xtals but it is worth trying both with any given Xtal.

Feedback in Type 1 can be controlled by tapping on the collector coil, or more conveniently, by 'tapping' the capacitor, see Fig. 2, here reducing the 150

FIG. 1



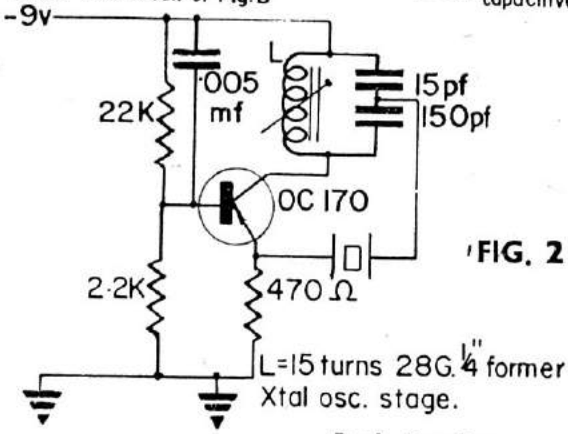
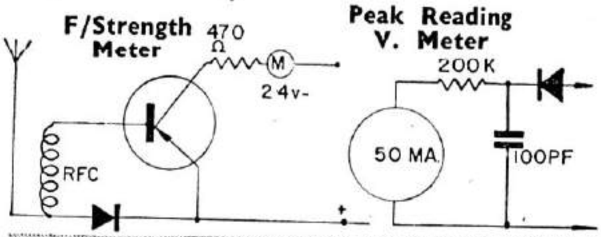
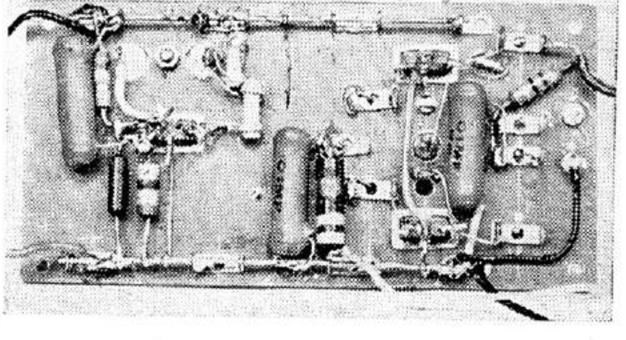
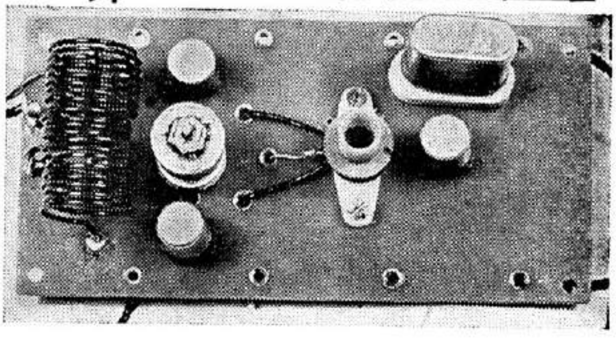


FIG. 2



Lower left and below: Dismantled panels for Tx. above to show disposition of components.





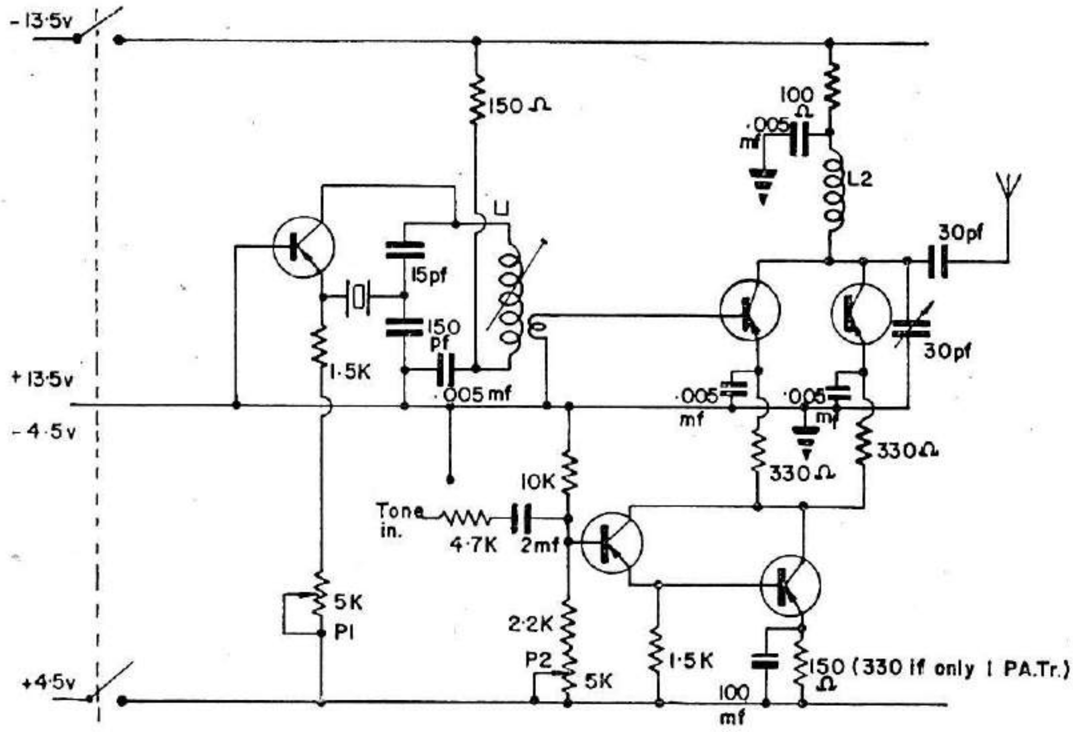


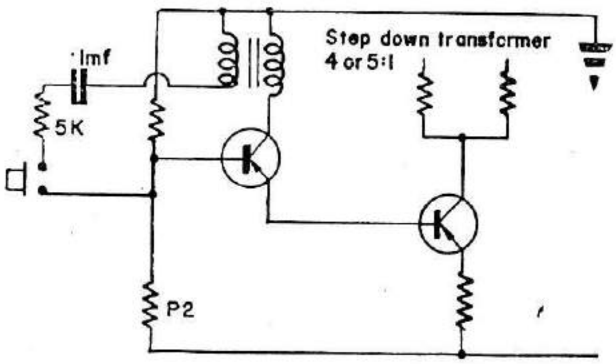
FIG. 5. DAVE McQUE CIRCUIT.

Values as indicated.

L1 15 turns 28g. enamelled close wound on ¼ in. former.

L2 10 turns 18g. enamelled wire spaced to ¾ in. wound on ½ in. mandrel.

FIG. 6 (right) : Showing addition of transformer for single channel tone.



NIEVERGELT CIRCUIT (Below).

R1	10 K.	D1	R.F. Choke.
R2	47 K.	D2	R.F. Choke.
R3	180 Ω	D3	R.F. Choke.
R4	180 Ω		C1, C3, C4, C5, C6, C8.
R5	180 Ω		1,000 pf. ceramic.
R6	1 K.		C2, C7, 25pf. Phillips Trimmer.
			C9, 10 mfd. electrolytic.
Pot 1	100 K.		T1, T2, T3, OC 170.
Pot 2	5 K.		T4, OC 72.
Pot 3	5 K.		

Overtone Quartz

L1 16 turns .032 wire spaced .032 ½ in. former.
L2 3½ turns .02 wire.
L3 16 turns .06 wire ½ in. i.d. divided at centre.
L4 4 turns .02 wire between halves of L3.

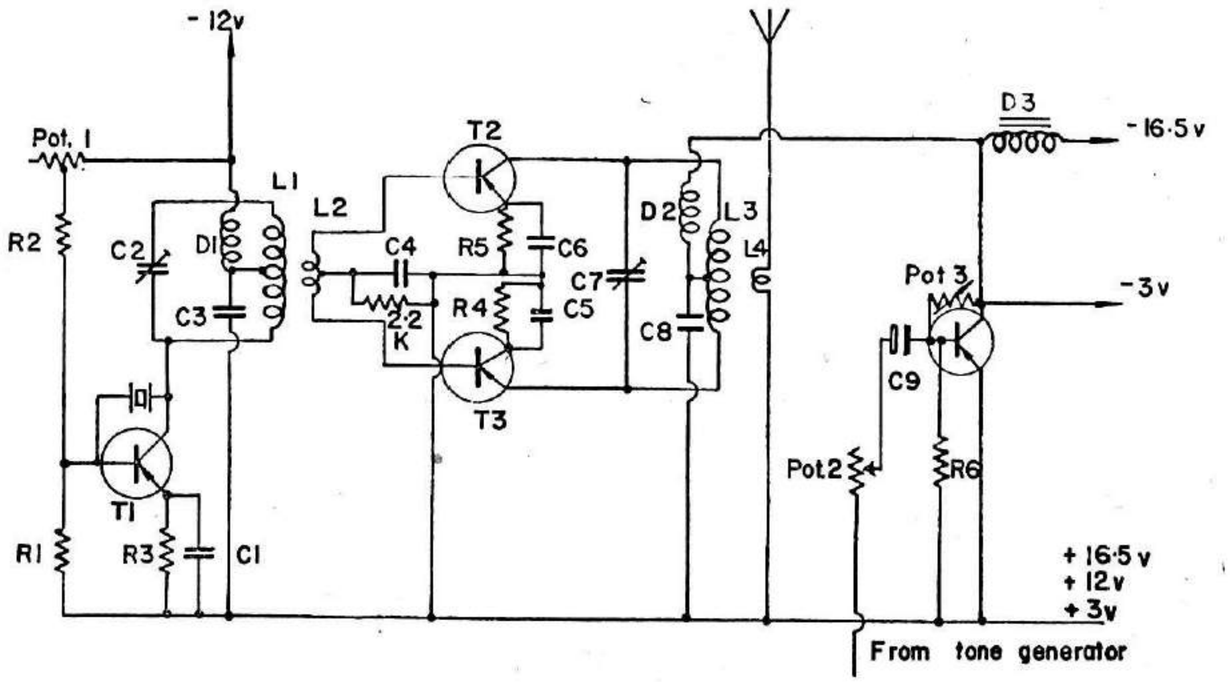
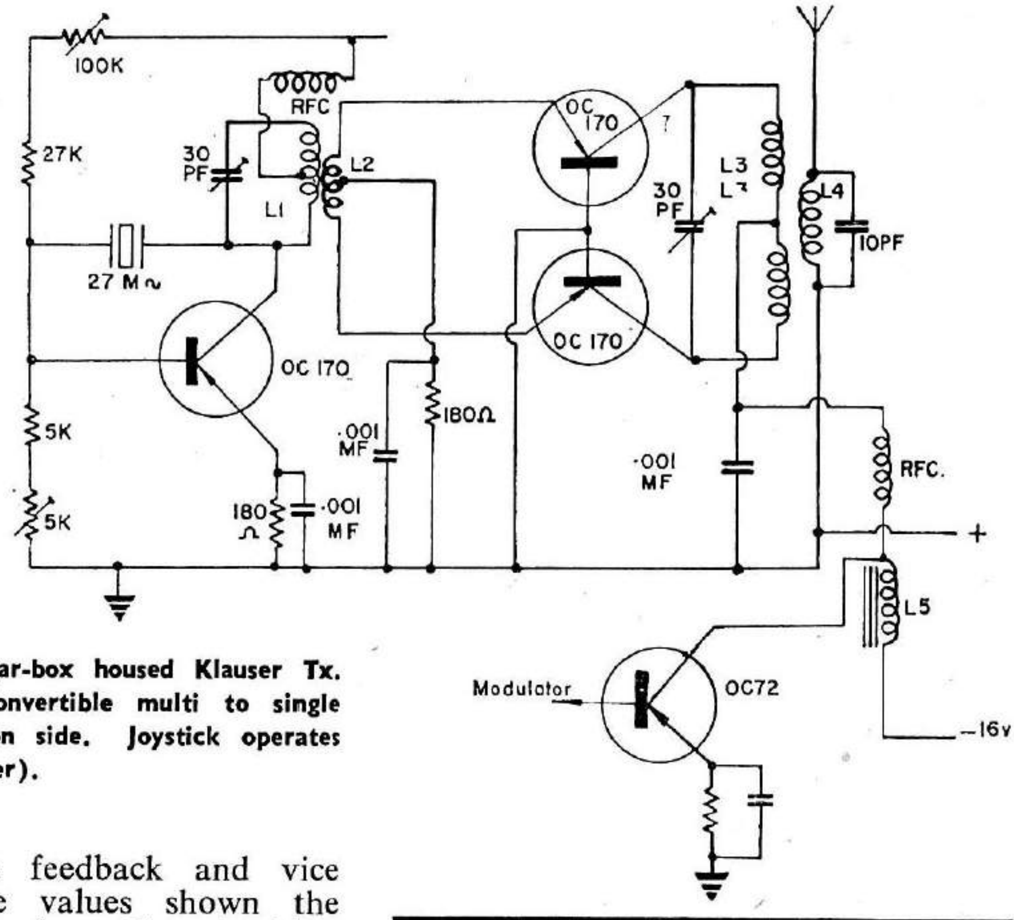


FIG. 7. KLAUSER CIRCUIT

L1 8 plus 8 turns 26 g. ½ in. former.
L2 2 plus 2 turns on L1 (at centre).
L3 8 plus 8 turns 18 g. on ½ in. former.
L4 6 turns at centre of L3.
L5 Choke or transformer primary.
CRYSTAL. 27mc. overtone.

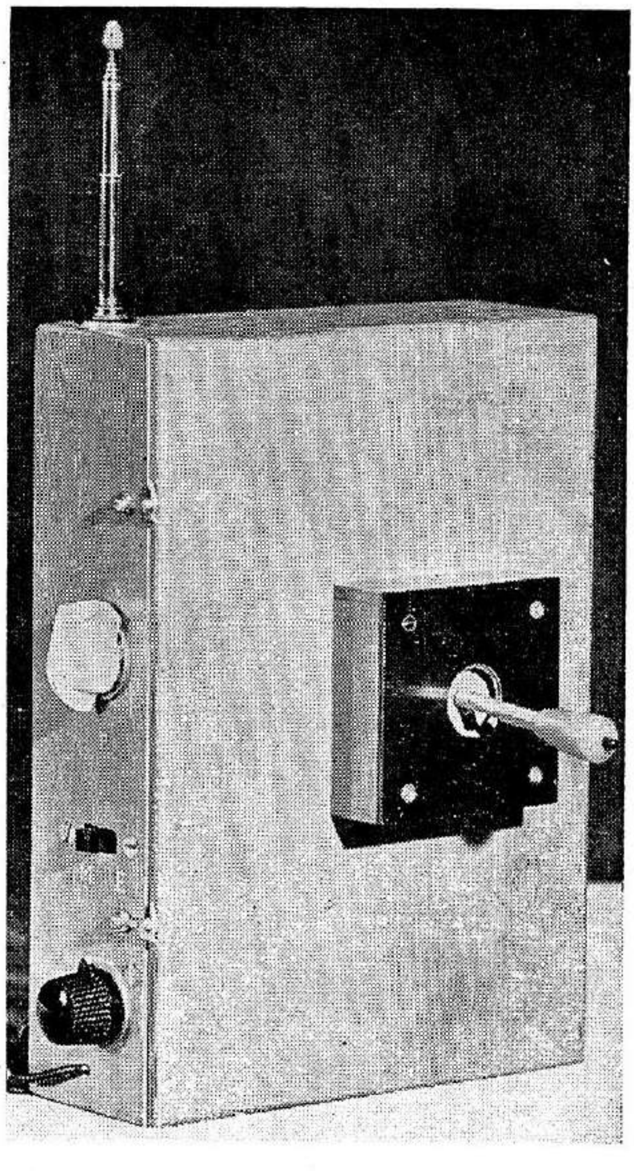


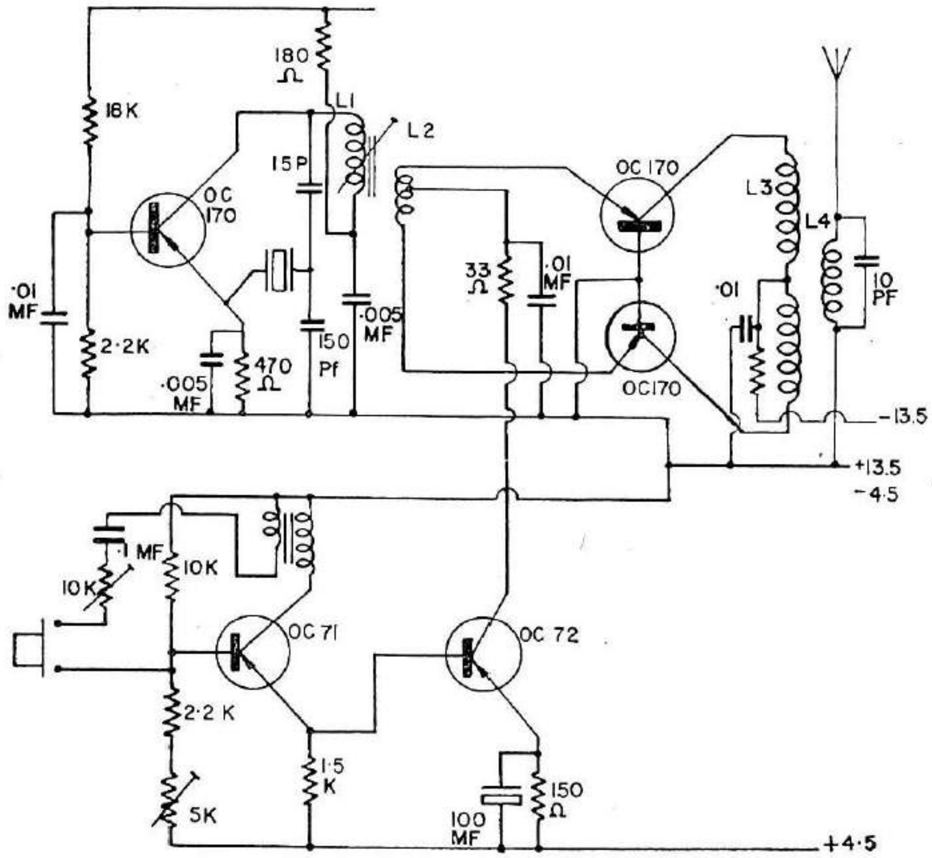
Below : The neat cigar-box housed Klauser Tx. which is instantly convertible multi to single channel by pointer on side. Joystick operates multi controls (see over).

pf. increases the feedback and vice versa. With the values shown the standing current is about 1½ m.A. rising to about 2 m.A. when on tune. Greater output can be obtained by reducing the 470 Ω (220 Ω min.) or the 22 K. (10 K. min.). As it stands it provides adequate drive for one or two OC 170 via two turn coupling winding(s).

The P.A. stage can have either one or two OC 170 depending on the depth of your pocket! With the majority of valve Tx.'s it is doubtful if the max. radiated output is achieved, especially in hand held versions. The major problem is to load the Tx. adequately with the short (compared with the wavelength) aerial. The radiation resistance of even a 4 ft. aerial is only a few ohms so that it has a high Q (ratio of reactance to resistance) and when tuned by means of a loading coil it is quite likely that half the power will be lost in this! There is no doubt that a centre loaded aerial is more efficient than a bottom loaded one, but it is rather distracting to find that connecting an unloaded aerial to one of the 'hot' ends of the main tuning coil gave apparently better results than a centre loaded version. This was because the losses of the loading coil were missing and the tuned circuit which had to be there anyway bottom loaded the aerial.

The operating conditions for all the P.A.'s is Class B tending to C, i.e. col-





On opposite page: Inside the Klauser Tx. Ernst has gone several steps further, and his set includes no less than eight tuned filters—strongest of which is used for single channel as required.

FIG. 8. PROTOTYPE (as illustrated)

This is the set devised by Tommy Ives being a variation of the Klauser and Nievergelt circuits.

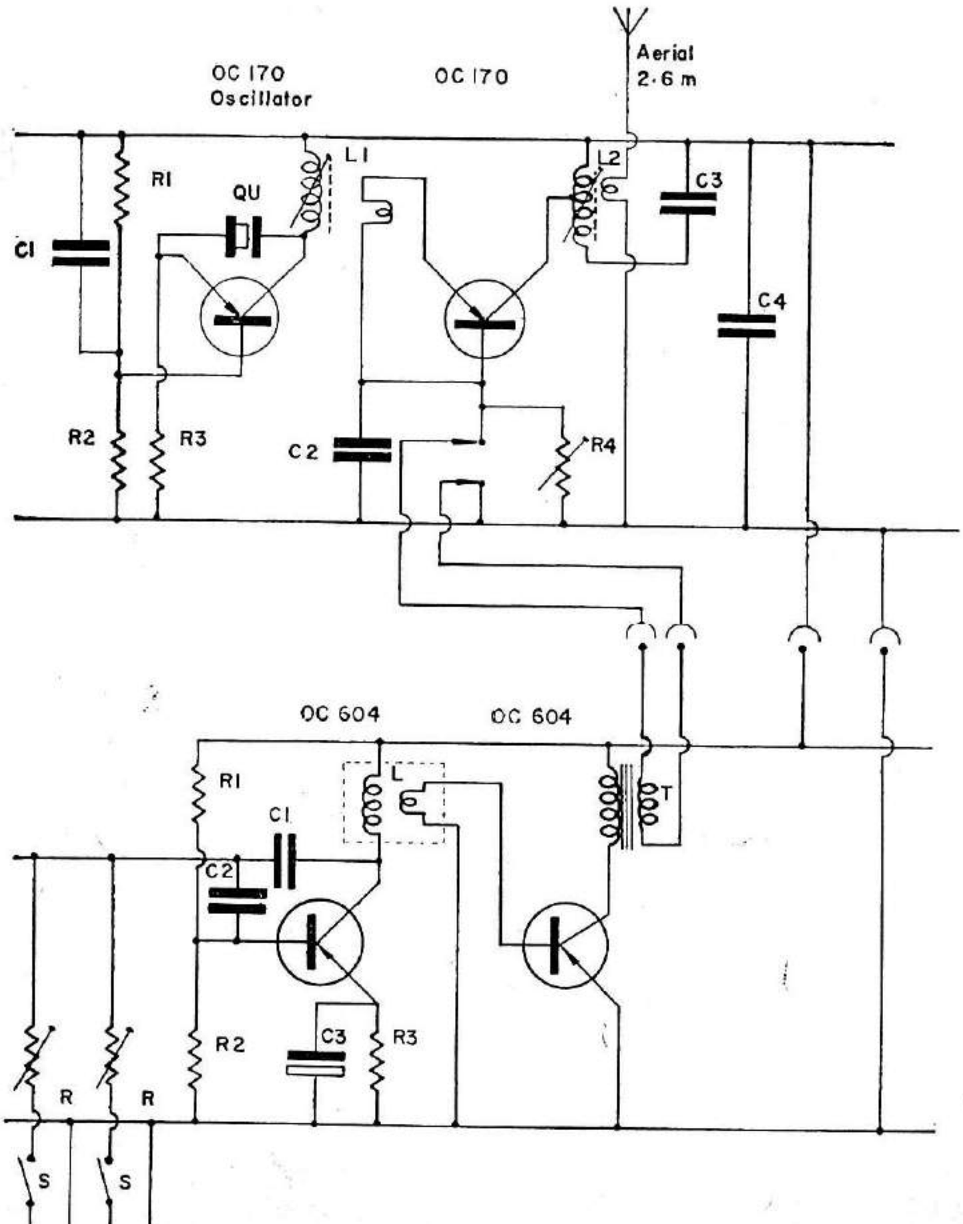
L1 15 turns 26g. on ¼ in. former.

L2 2 plus 2 turns over L1.

L3 8 plus 8 turns 18 g. on ½ in. former.

L4 6 turns over centre of L3.

Crystal 27 mc. overtone.

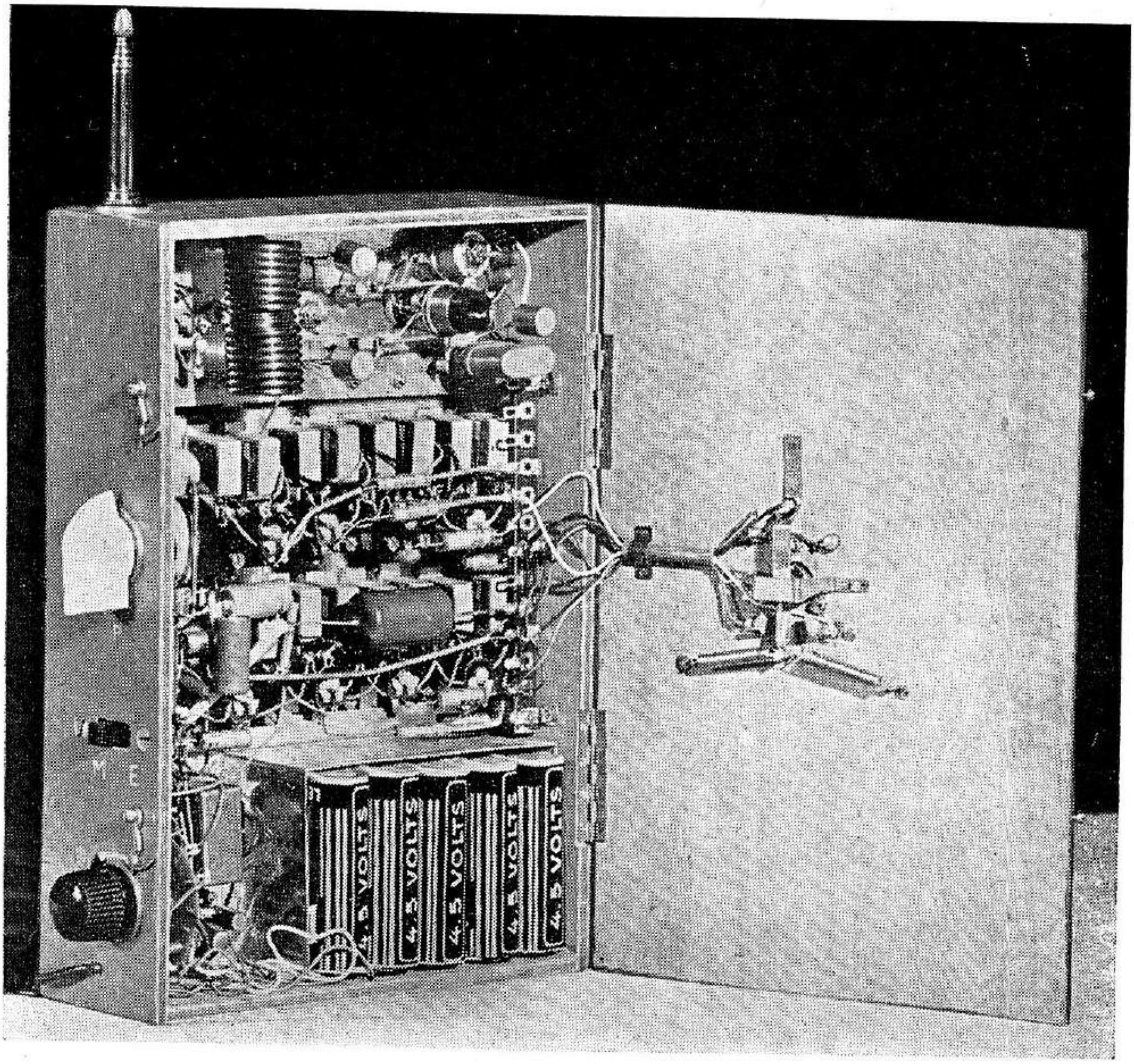


HANS DIETE HECK CIRCUIT

R1 10 K Ω
R2 2.5 K Ω
R3 1 K Ω
R4 Pot. 1 K Ω
C1 10,000 pf.
C2 5,000 pf.
C3 10 pf.
C4 0.1 μ f.
27 mc.
Qu Quartz crystal
L1 15 t. .3mm. enam. wire on 7 mm. former iron cored with 3 t. over of .5 mm. dia. wire spaced 1 mm. apart.
L2 16 t. .5 mm. dia. wire plus 8 t. over iron core. Aerial link coil 3 t. pvc. covered.

MODULATOR

R1 20 K Ω
R2 10 K Ω
R3 1 K Ω
Pots 1 2 K Ω
C1, C2 10,000 pf.
C3 25 μ f. electrolytic.

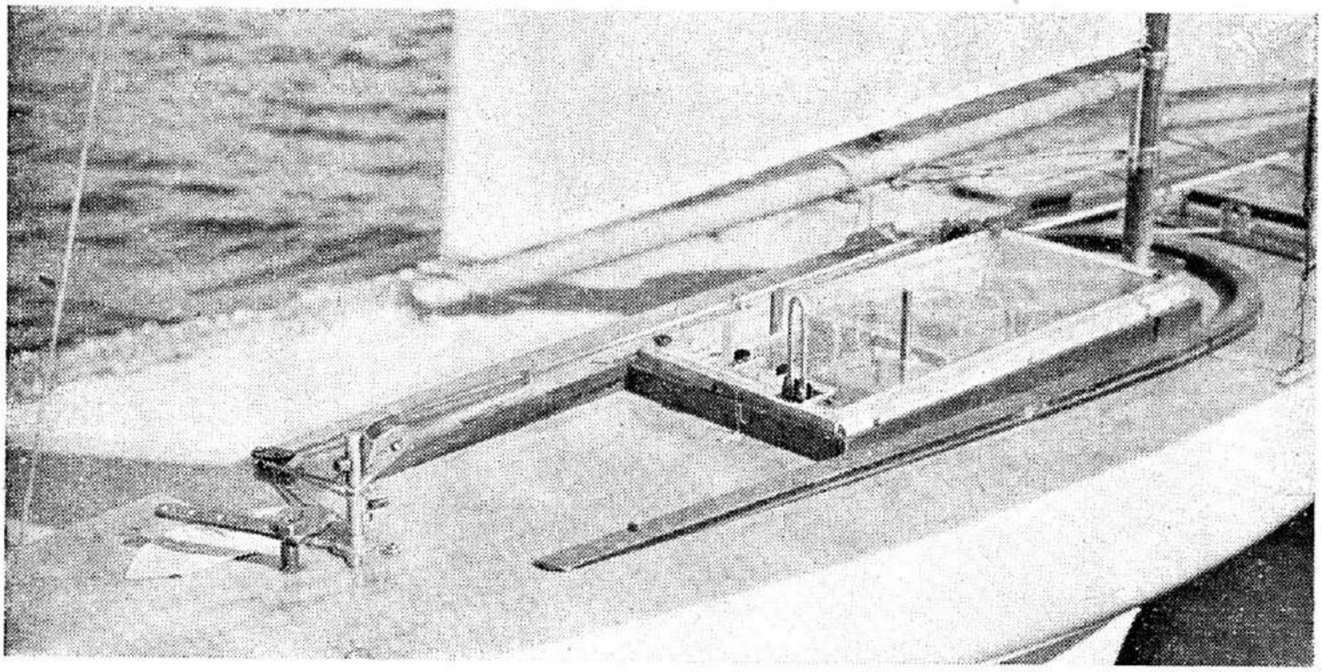


lector current only flows for a portion of the negative half cycle of the driving waveform. This means that the peak collector current will be three or more times the average as read on a meter. We have used Class B as it gives us the greatest output for a given peak collector current and have used emitter current modulation to avoid exceeding the max. voltage rating. For when collector modulation is used the peak voltage at the collector is four times the D.C. supply volts (for 100% modulation).

Best results to date have been achieved using a 4 ft. unloaded aerial with a 3 ft. flexible wire 'tail' dangling from the Tx. case. A field strength meter is a must in making adjustments and comparisons. A simple peak reading voltmeter is useful in checking loading on the P.A. by measuring the R.F. voltage from collector to supply negative. On tune peak R.F. voltage (unloaded) is nearly equal to the supply. A load which reduces this by about 1½ volts appears right. Work is still proceeding and any reports and experimental results from our readers will be welcomed.

The two stage modulator can be fed from either of the transistor tone generators used with the Versatile Tx. (see June issue). For single channel tone a transformer can be added as in Fig. 6.

To tune up the Tx. of Fig. 5 first earth the emitters of the output TR.'s. Start with P1 at max. resistance, adjust L1 for max. P.A. collector current and then adjust P1 to bring P.A. current to about 4 m.A. Tune P.A. coil for dip. Further adjust P1 for a current of 5 m.A. per TR. Remove earth and adjust P2 to give half this value (i.e. 2.5 m.A. per TR.).



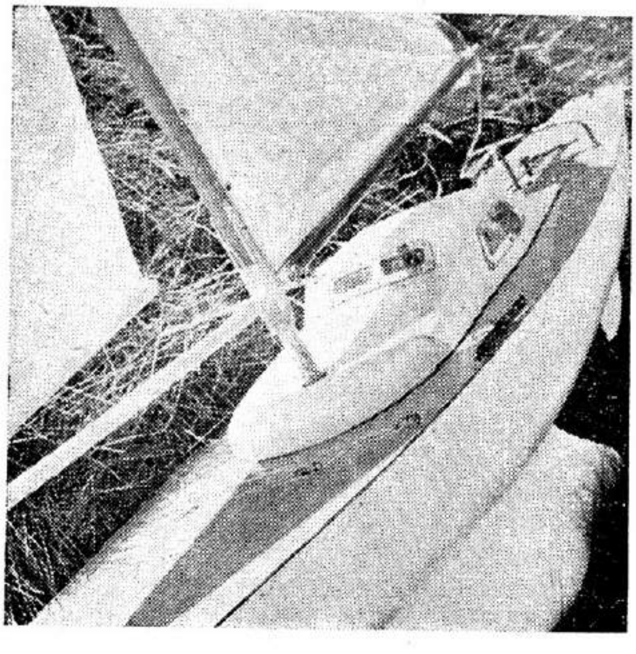
Hogg's deck showing helm indicator; huge mainsheet block; hoop sheet lead and drum spindle. Rudder pushrod removed.

Alan Tamplin Challenge Cup Meeting

GOSPORT: 18th SEPTEMBER

REPORTED BY T. V. BARLOW

Col. Bowden's "All Flying" rig shows simplicity of deck gear—one sheet only!



THE meeting was most efficiently run in ideal conditions by the Gosport club. A total of nine boats were entered ranging from a Marblehead to Bowden "Q" hulls.

Racing was on the tournament system, and produced only a few close matches, notably the tie round between Tamplin and Hogg who were never apart by more than a couple of yards. The meeting was the first at which three of Col. Bowden's *One Design* hulls had competed, and despite the different rigs used, gave very close racing. A radio Marblehead seems to be overpowered in any wind over eight m.p.h., but the six metre of Foster's appeared quite happy.

The meeting was voted extremely successful by everyone and thanks are due to Alan Tamplin, the donor of the Cup; to Mrs. Stalkartt who presented the prizes; and last but not least to the Gosport club for their hospitality and the invitation to come again next year.

From the R/C Notebook

Bowden; Curwen; Hogg. Using similar Tx/Rx equipment to that described in previous articles by the owners. Tx's are quite small and the boat entire set weighs 8½ lb. Bowden's and Hogg's sets were completely interchangeable.

Foster and Merrick from Birmingham were using six valve Xtal control superhets with no pondside tuning. Control is on an electronic mark/space system operating at 450 c.p.s. This set up gives non-simultaneous proportional for sheets and rudder.

Hogg, junior, uses a Hill Rx with variable mark/space for rudder and signal on/off for sail trim.

Stalkartt has an R.E.P. Octone set up with either the standard Octone Rx or G.H.R.'s new superhet. He also uses what others refer to as "Those o——o little motors" for control on his "Q". They should be grossly overloaded but almost always work, despite the gloomy prophesies.

Tamplin, running the only 465 radio in the race should have been clear of everybody but in fact the impossible happened, and it was found that his Nol. Tx. was radiating on 27 mc/s. and giving a higher reading on Foster's "Box" than Merrick's 27 Tx.! However his No. 2 Tx. gave no cause for complaint. Otherwise the set is very reliable but heavy, about 15 lb., with a single power source of a sizeable 12 v. accumulator. Major advantage is that six boats may be run off the same Tx. using plug-in control boxes which are fairly simple. The Rx. and its decoding gear though are rather complex with latching relays and difficulties of "lag" on interlocking mark/space circuits, as only one tuned circuit is allocated to each yacht.

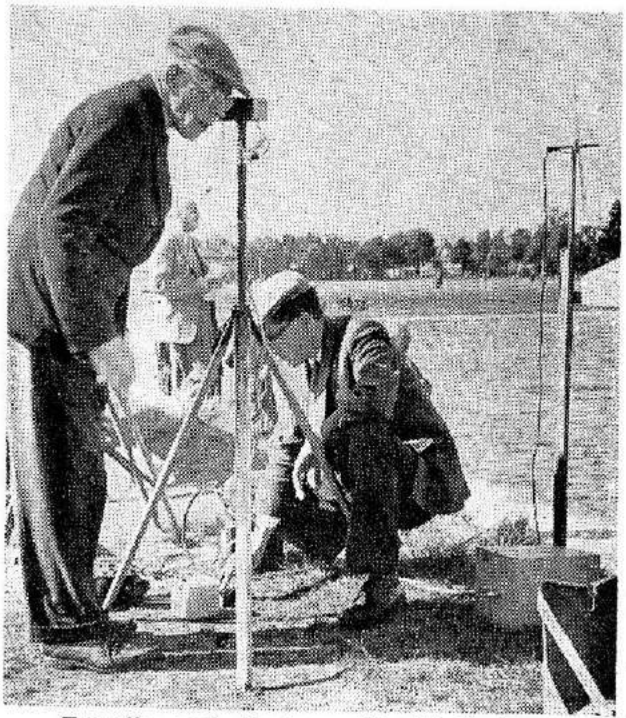
The problem of interference at regattas when strangers meet for the first time is not solved yet; best bet seems to be a pair of switching Xtals in each set.

Prize for the neatest boat went to Gascoigne whose deck was so clear of nuts, bolts, and gadgets, that it was unbelievable. Prize for the largest mainsheet to Mr. Hogg, senior, who was using ⅜ circ. hawser laid Terylene.

A hearty pat on the back to Messrs. Foster and Merrick for bringing a Wee Six and a "Q" all the way from Birmingham. Both had similar radio gear of six valve Xtal superhets with mark-space electronically induced at 450, yes 450 c.p.s. Control was non-simul proportional on sheets and rudder.

If rumour is to be believed, consumption of the local brew is due for a big drop since some of the Gosport die-hards saw Col. Bowden's "All Flying" rig early on Sunday morning!

Finally, it would seem that 60 in. is about the minimum satisfactory size for happy operation of a R/C yacht on a stretch of water large enough to have worthwhile racing.



Tamplin and Foster: "I didn't know you could HEAR the difference between 465 and 27 m/c"—or perhaps its a sputnik.

ALAN TAMPLIN CHALLENGE CUP.
Gosport M.Y.C., September 18th, 1960

Boat No.	Skipper	Name	Type	Points
1.	Hogg	Sunlight	Q hull	19½ (1st)
2.	Foster	Cinderella	6 metre	4½
3.	Gascoigne	Zephyr	Q	Retd.
4.	Merrick	Gypsy	Q	10½
5.	Stalkartt	Mimosa	Q	Retd.
6.	Tamplin	Selma	Q	16½ (2nd)
7.	Hogg, jnr.	Sunray II	M 50/800	1½
8.	Curwen	Windrush	10 rater	7½
9.	Bowden	Morven II	Q hull	9

Col. Bowden and "Sunlight" — "I'm sure it wasn't as big as that when I designed it!"

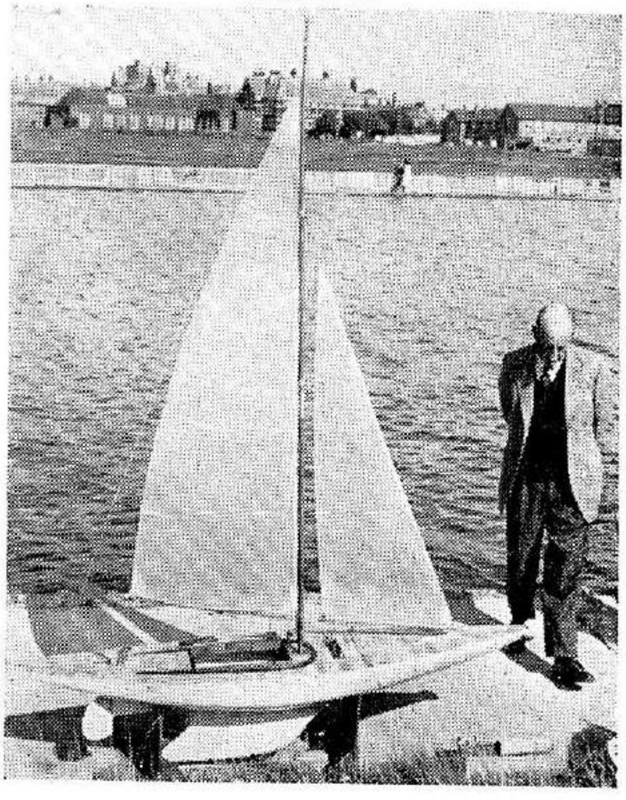


FIG. 1. Miniature receiver stowed in its matchbox. As the author dryly informed us replacement of case as necessary can be cheaply effected !

The Monitor

A truly match-box size receiver built into a matchbox to prove it, featuring printed circuit all transistor construction for use as a monitor, or for adaptation for use with a reed unit.

By S/Ldr. STAN SARLL,
R.A.F., A.M. (Brit.), I.R.E.

Introduction

How often, when on the flying field or by the water, have you wished that you could hear and know that you, and you alone are transmitting. When the reeds don't buzz or the relay won't move, how consoling to know that the transmitter is doing its stuff by hearing the tones. Even to know that a troublesome receiver is at least superregenerating by hearing the effect upon another receiver is certainly worth while.

This article describes the construction of a miniature three transistor receiver, housed in a matchbox, which has satisfied these needs successfully during the past eight months without trouble. It also describes an adaptation to use the receiver as a 'front end' to drive a reed/relay unit.

General Description

The receiver shown in Fig. 1 is powered by a 1.5 volt U16 battery which is clipped inside, without a switch to cause trouble. Consumption is only 1.2 m.A. so the battery will last quite a time, even if left in for long periods. On this voltage a SB305 H.F. transistor operates very well as a superregen. detector drawing 0.3 to 0.4 m.A. Two OC71 A.F. transistors provide the audio gain to drive an ER250 Ω hearing aid earphone. Others may work as well, but if different components are used the circuit values may need adjusting.

An overall size of $1\frac{15}{16}''$ by $1\frac{11}{32}''$ by $\frac{17}{32}''$ high (including the battery) is made possible by using the lowest voltage rating and smallest size components readily available, stacked in two layers above a printed circuit baseboard (see Fig. 2). The cost was less than £4. This miniaturisation makes the receiver a little tricky to build if one has had insufficient experience of miniature equipment or soldering printed circuit board (Fig. 3).

In use the receiver is tucked into a top pocket with the aerial dangling, and the phone fitted into the ear. Now the hands are free and movement unrestricted but signals can be readily heard.

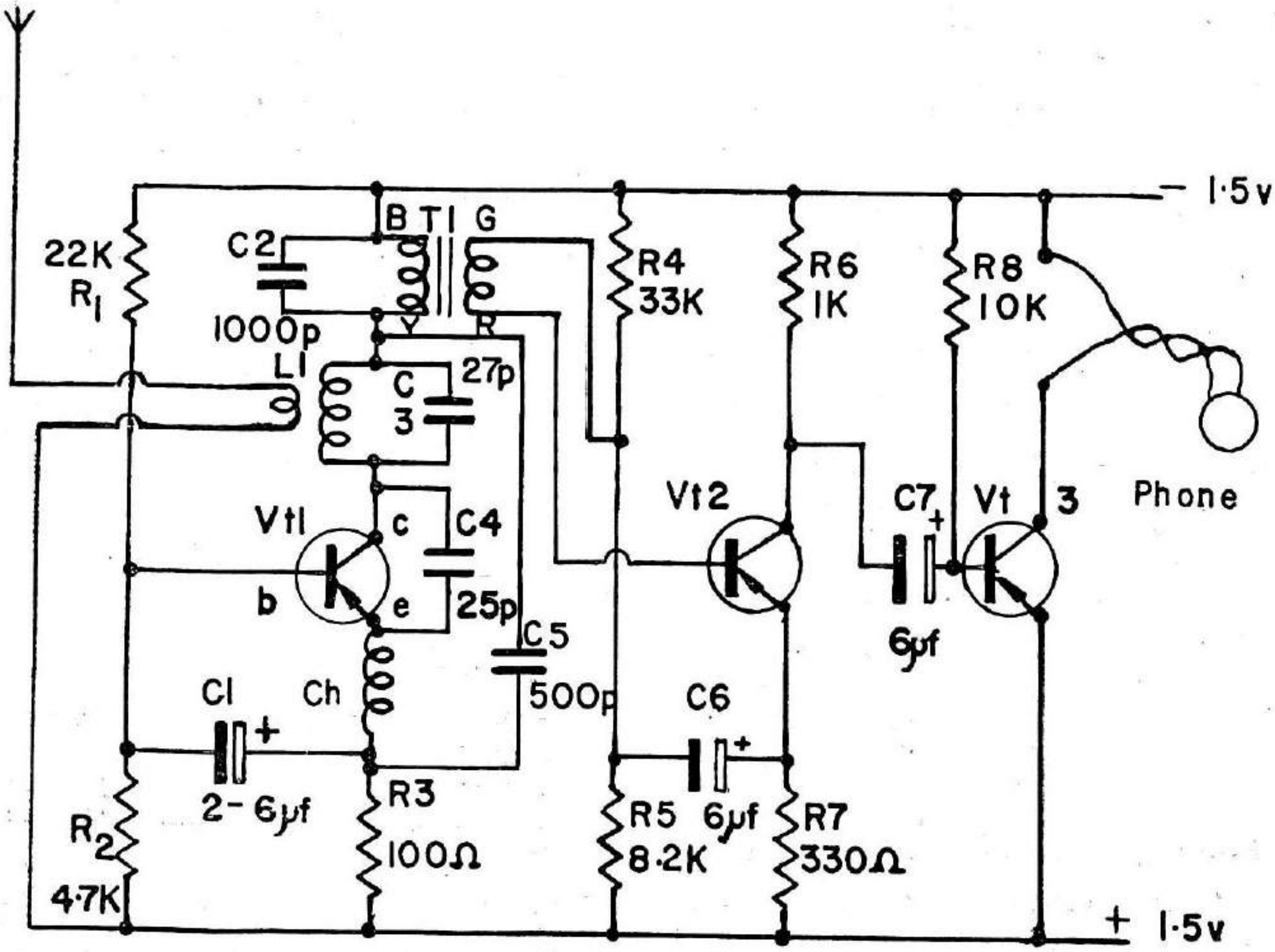
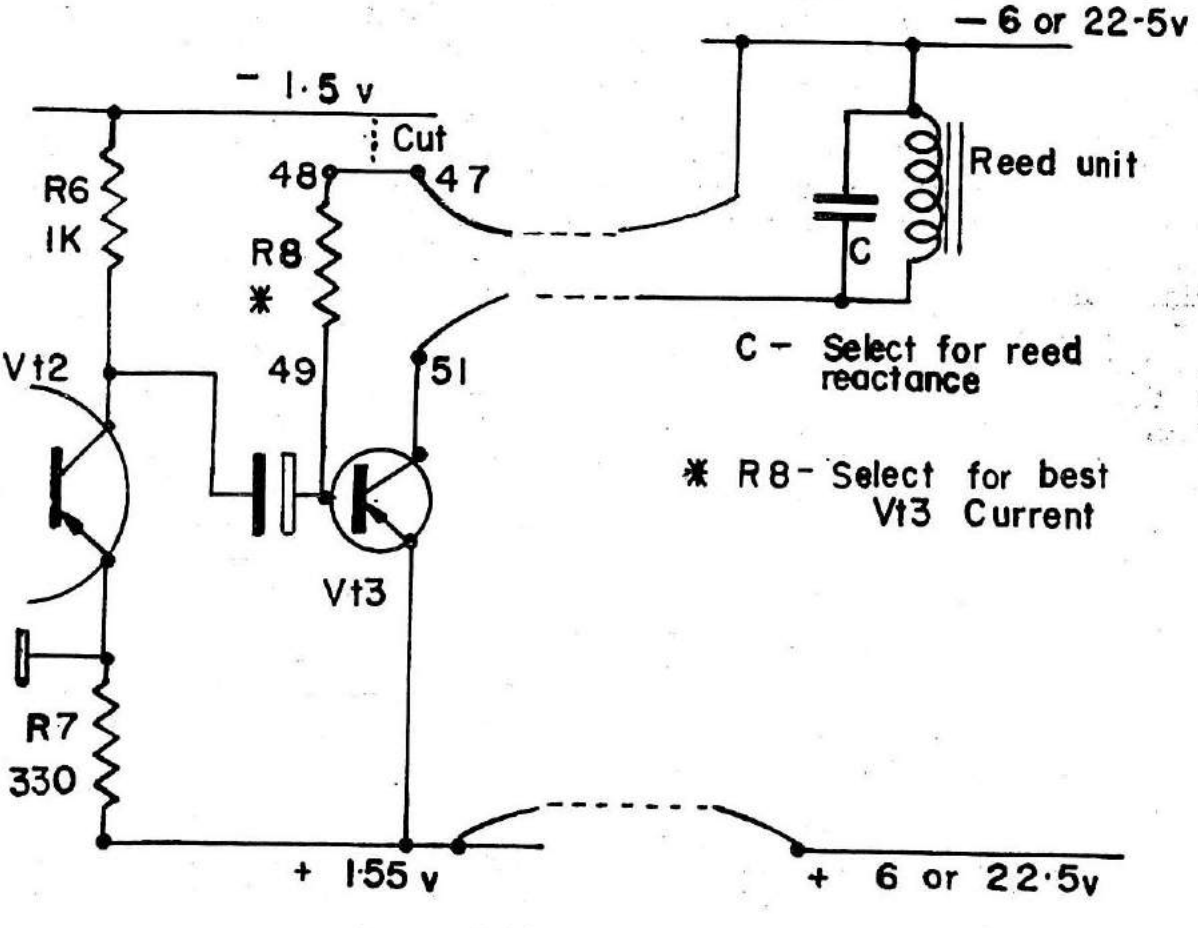
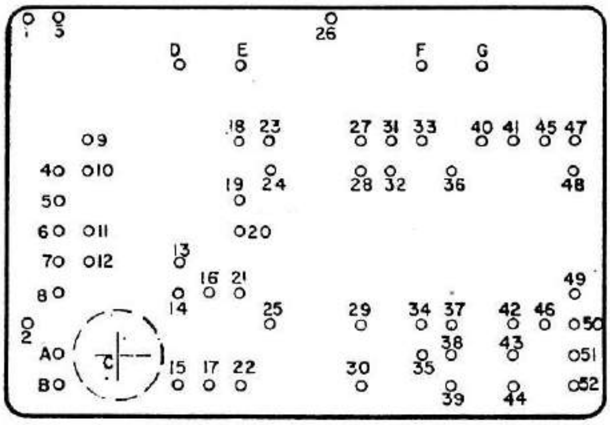
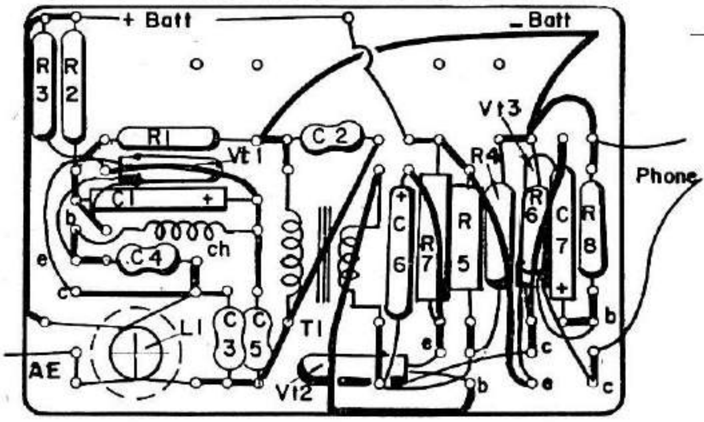
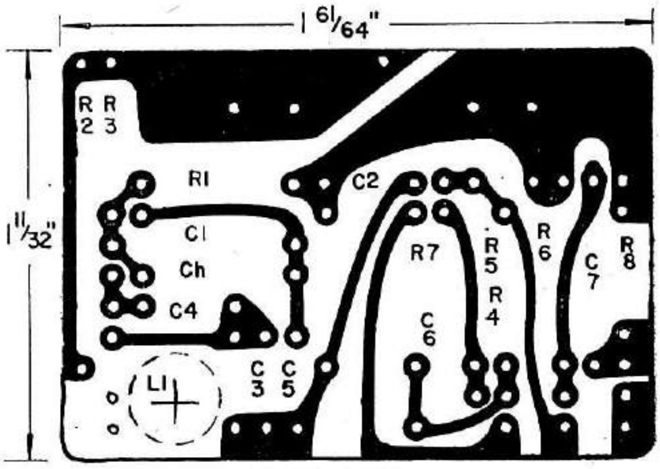


FIG. 7. Theoretical Circuit diagram, with below adaptation for reed unit use.









FULL SIZE

Hole	*Drill Size*
A & B	No. 58
C	$\frac{9}{32}$"
D & G	52
E & F	60
All numbered holes	60

Check that there are no unwanted remnants of copper or false connections, then wrap in a cloth to prevent oxidization of the copper, until ready to solder.

Making the Printed Circuit

A description of the method used to produce the printed circuit board was given in November *R.C.M. & E.* and in the *Aeromodeller* for January, 1960, with a fuller description in the November, 1959, issue of the *Radio Constructor.* Only an outline will be given here.

Cut a piece of printed circuit (PC) laminate board to size and mark the hole positions by accurately placing the board beneath the full size hole plan, (Fig. 4), and marking through the paper with a sharp scriber. Accentuate with a centre punch, and using a fine artist's paint brush such as a Reeves No. 156 and any convenient cellulose paint copy the printed circuit pattern, Fig. 5, on to the clean copper surface. Make small blobs around the hole positions and paint connecting lines between the blobs where required. Take care not to let the paint 'run' and produce unwanted connections. Rather than try to rectify a mistake or a poor painting, it is easier to wipe clean and start again.

As soon as the paint is surface dry etch in a dish of Ferric Chloride until all the uncovered copper is removed. Wipe off the paint with a rag dipped in thinners, and scrub the board clean under running water with a kitchen scouring powder such as Vim.

Drill all the holes in accordance with the following table:—

Preparation of Components

Transformer. Apply a pin head size spot of Araldite to the transformer leads where they emerge from the former as a protection against breakage. Twist the loose wires into five or six turn coils around a No. 60 drill and lay the coils down the side of the transformer with the ends ready to pass through the P.C. board. Allow time for the Araldite to harden before handling further.

Battery Clips. Make up the two battery clips as shown in Fig. 6, 'dimple' the positive clip with a centre punch flattened to $\frac{3}{32}$" dia., and pierce the negative clip with a sharp point to improve battery contact.

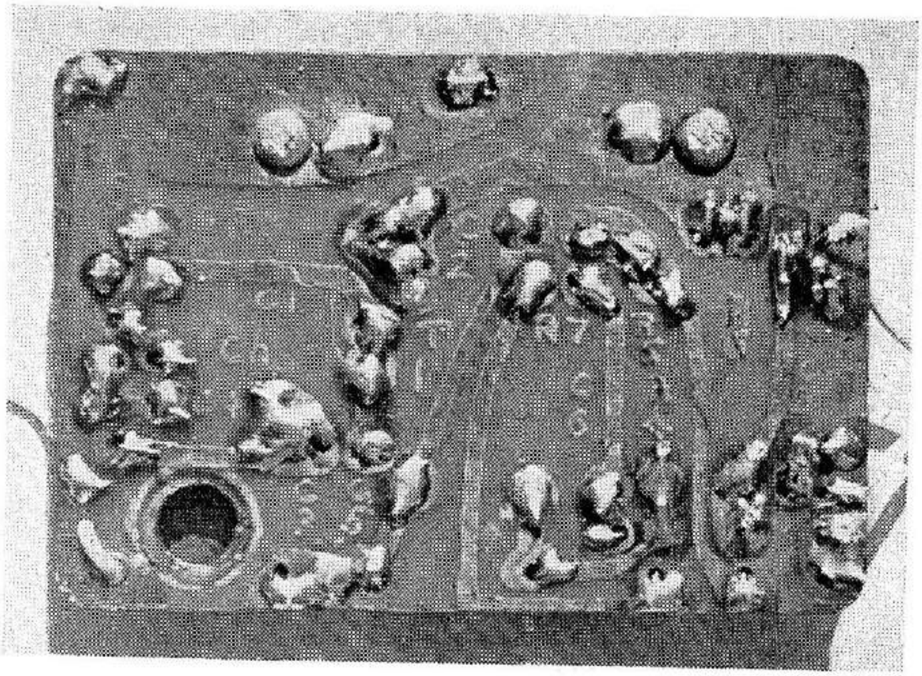
Coil Former. Cut a $\frac{3}{8}$" long piece off a $\frac{1}{4}$" dia. coil former and secure in hole 'B' with a little Araldite. Carefully cut off a $\frac{1}{4}$" length from the dust iron core and screw into the former with a short piece of $\frac{1}{32}$" rubber as a friction lock.

Resistors and Capacitors. Clean (and tin if necessary) all the resistor, capacitor and choke connecting wires. Bend the wires at right angles to the components, as close to the components as possible. Miniature tubular 'Low puffage' ceramic capacitors already have their wires at right angles and are the most suitable for this receiver.

FIG. 3 (right). Printed circuit connections shown approximately $1\frac{1}{2}$ times full-size.

FIG. 4 (left). Drilling jig (full-size) for panel, and numbered holes followed in step-by-step building instructions.

FIG. 5. Printed circuit pattern (full-size). Can be traced direct or photographed according to etching method employed.



Soldering Technique for Printed Circuits

The technique for soldering to printed circuit board with miniature components differs from conventional construction, and unless one has discovered the tricks and had some practice it is difficult to make a really good job. Too much heat applied to the join will damage the component or cause the copper connections to break away from the board. Too much solder will run uncontrollably over other connections. Surfaces which are not clean will produce 'dry joints'. A few tips should help:—

(*a*) Clean the copper surface and clean or tin all component leads.

(*b*) Use a low wattage iron (25w. or less) with a hot clean $\frac{1}{8}$" or "$\frac{1}{4}$ chamfered bit and keep the working surface well tinned, bright and free from surplus solder.

(*c*) Fix a heat shunt, or pointed flat nose pliers to the wires close to the component ends so as not to alter their characteristics.

(*d*) Use a resin cored solder, preferably the 22 s.w.g. 60/40 ratio, supplied for printed circuit soldering.. It melts at a low temperature and in controllable amounts.

(*e*) Apply the iron bit equally to copper and lead and feed the solder direct on to the junction until it flows to form a small bright blob. Withdraw solder and iron and blow on to the joint to cool it quickly.

It is usually necessary to buy a larger piece of printed circuit board than the actual receiver size, the scraps cut off edges, etc., can be profitably used to practice this soldering. Clean the copper and drill a few holes with No. 60 drill. Practice soldering one end of some spare component leads into the holes.

Assembly to Board

In this receiver all components are mounted on the plain side of the board with connecting leads passing through, bent and clipped off to lie flat along

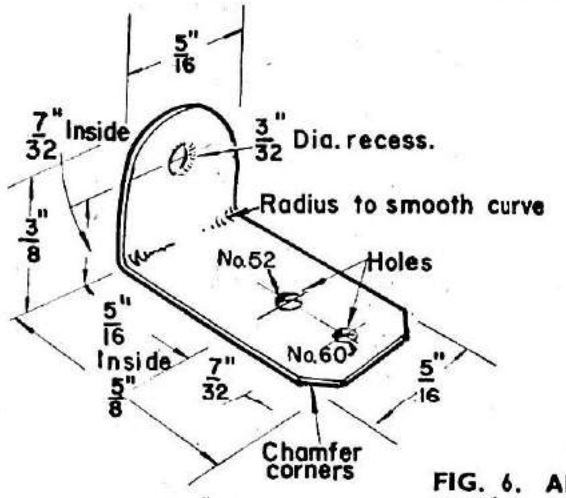
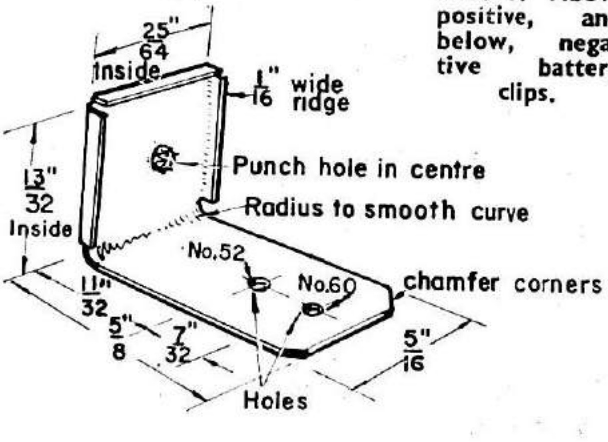


FIG. 6. Above positive, and below, negative battery clips.



the copper wiring. (It is easier to bend and clip off in one operation using side or end cutting pliers.)

Assemble and solder in the following sequence, referring to Fig. 4 and component layout drawing:—

(1) Both battery clips to board with positive clip at R2/R3 end using short $\frac{1}{16}$" alloy rivets in holes D and G. File off surplus rivet head and tail. Check that battery 'sits' close to panel and fits firmly between clips. Solder a short lead link through holes E and F to improve connection and steady battery clips. Solder on to brass clip before soldering to copper side.

(2) L1 on coil former by winding 8½ turns of No. 28 s.w.g. enamelled wire, close spaced, the ends cleaned of enamel passed through holes 14 and 15 tinned and soldered.

(3) A 26" length of very thin 'flea weight' plastic covered wire as the aerial, the end soldered through hole 2, wrapped 1½ times around L1, passed down hole B and up hole A and out. Lock L1 and aerial wire with low R.F. loss polystyrene cement.

(4) T1 between holes 22, 25, 28 and 29 with a little Araldite after scratching smooth surface of board. Feed wires through holes:—Blue in hole 24, Yellow in hole 25, Red in hole 28 and Green in hole 29. Solder wires. (Complete stage 8 before Araldite is set to ensure correct T1 position.)

(5) C5 into holes 21 and 22 close to board.

(6) C3 into holes 16 and 17 above C5 and near to 'bottom' edge of board.

(7) R7 into holes 33 and 34 close to board. Push close to transformer and towards C5 as far as possible.

(8) C2 into holes 23 and 27, close to board and T1. Ensure battery still fits in. (Leave room 'below' T1 for Vt 2).

(9) C4 into holes 12 and 13 close to board.

(10) Ch into holes 6 and 20 above C4 but not touching it.

(11) R1 into holes 9 and 18 close to board. Check battery still fits in.

(12) C1 into holes 5 and 19 close to board. Positive end into 19.

(13) R2 into holes 3 and 4 close to board and near edge.

(14) R3 into holes 1 and 10 above R2 near edge of board. Twist leads to make R3 'sit' neatly.

(15) Vt1 with leads sleeved and bent carefully so that it lays above C1 and wires go:—

(a) Emitter (red sleeve) into hole 7.
(b) Base (green sleeve) into hole 11.
(c) Collector (blue sleeve) into hole 8.

The battery consumption check can be done here, see under Test and Tune.

(16) C6 into holes 32 and 30 on top of R7. Positive end into hole 32. Bend lead into hole 30 to lie flat on board.

(17) R4 into holes 40 and 38 close to the board.

(18) R5 into holes 36 and 37 above R7/R4.

(19) Positive linking lead into holes 26 and 31.

(20) R6 into holes 41 and 42 close to board.

(21) R8 into holes 48 and 49 close to board.

(22) C7 into holes 45 and 46 above R6/R8. Positive end into hole 46.

(23) Vt2 with leads sleeved and bent carefully so that it lays below T1 and wires go:—

(a) Emitter (red sleeve) into hole 35.
(b) Base (green sleeve) into hole 39.
(c) Collector (blue sleeve) into hole 43.

(24) Vt3 with leads sleeved and bent carefully so that it lays above R4/R6, and wires go:—

(a) Emitter (red sleeve) into hole 44.
(b) Base (green sleeve) into hole 50.
(c) Collector (blue sleeve) into hole 52.

(25) Phone leads into holes 47 and 51. Apply a spot of Araldite where the lead comes out of the holes to prevent fracture.

Test and Tune

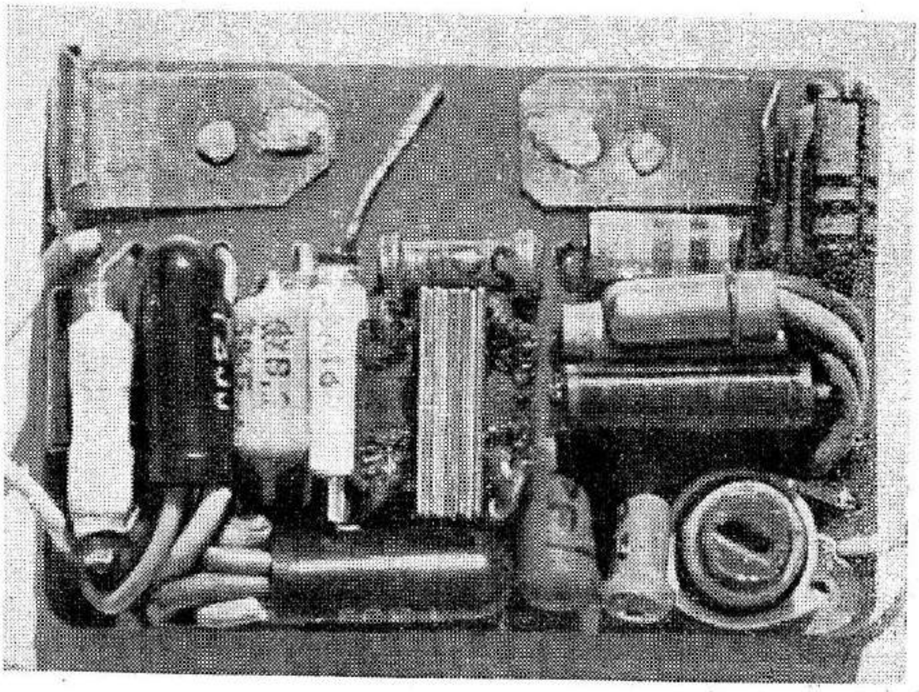
Before connecting the battery, particularly if any transistor has been connected into circuit, it is wise to check visually that nothing is out of place or touching something it shouldn't. A watchmaker's eyeglass helps here! If all is well, clip in the battery and listen for a healthy background 'mush'.

Connecting the battery via a 0—10 m.A. meter should give the following results:—

(a) Full load about 1.2 m.A. (up to 4 m.A. without 'mush').
(b) Earphone unplugged .8 m.A.
(c) Vt2 and Vt3 disconnected (end of stage 15) .3/.4 m.A.

If incorrect results are obtained and the test after stage 15 was correct, connect a pair of *high* impedance phones across T1 primary (holes 24 and 25) when a

FIG. 2. Component side of receiver shown approximately 1½ times full-size.



weak superregen mush should be heard. Adjust the dust iron core to obtain the mush, or a signal from a transmitter. Set the tuning finally on a weak signal or with the Rx. at a distance from the transmitter. The receiver will probably swamp close to a transmitter unless the carrier is keyed as well as the tone modulation. Other transmitters in the area can be heard transmitting, be they tone or carrier type.

Protection

As a protection against damage the receiver can be fitted into a Bryant & May's matchbox (after removing the matches!). Alternatively the receiver can be 'potted'. (*To be described in January R.C.M. & E.*)

Further Adaptation

This receiver can be adapted to drive a reed relay unit as shown in Fig. 7 by:—

(1) Disconnecting R8 Vt3 from the existing negative supply by cutting through the copper printed circuit above hole 47. Disconnecting and removing R8.

(2) Connecting an additional 6V. or 22.5V. battery (depending upon reed impedance) positive to positive of the 1.5V. battery into another hole drilled near hole 26. Negative to reed unit and also to hole 47 (in place of the phone lead).

(3) Connecting a lead from hole 51 (in place of the other phone lead) to the other side of reed unit.

(4) Replacing R8 with a suitable higher value for the supply voltage in use. For example, a 39K will suit a 6V. supply, with a 300 Ω reed coil.

[*The author regrets that he cannot enter into correspondence regarding the details offered. Queries will, however, be handled through our McQuery Column*]

PARTS LIST

R1	22 K	10% ½ watt Radio Spares Type T or ⅛ watt Erie Type 16
R2	4.7 K	
R3	100 Ω	
R4	33 K	
R5	8.2 K	
R6	1 K	
R7	330 Ω	
R8	10 K	
C1	2 to 6μf Electrolytic 1.5V. Plessey.	
C2	1,000pf. tubular ceramic	Erie or Radio Spares
C3	27pf. ,, ,,	
C4	25pf. ,, ,,	
C5	500pf. ,, ,,	
C6	6μf electrolytic 1.5V. Plessey.	
C7	6μf electrolytic 1.5V. Plessey.	

Ch 5/32" dia. x 9/16" R.F. dust iron core choke. R.E.P.

L1 ¼" Aladdin coil former (polystyrene) with dust iron core. 8½ turns No. 28 s.w.g. enamelled copper wire. Aerial coil 1½ turns ultra fine P.V.C. covered wire 30" long. (Radio Spares).

T1 D1001 (T1079) transformer (Ardente). Henry's Radio.

Vt1 SB.305 H.F. transistor (Semi-conductor). Henry's Radio.

Vt2 Vt3 OC.71 A.F. transistor (Mullard). Henry's Radio.

Phones ER.250 miniature hearing aid type with lead and plug. Henry's Radio.

Baseboard 1/16" Printed Circuit laminate board cut to 1 61/64" x 1 11/32". R.E.P.

Battery clips 3" x ½" 28 s.w.g. spring brass strip.

Two 1/16" alloy rivets.

Araldite.

Polystyrene low loss solution 'Denfix' Denco (Clacton).

Solder Ersin multicore 60/40 22 s.w.g. P.C. solder.

Ferric Chloride strong solution. Boots Chemists.

Cellulose paint, thinners, Vim scouring powder.

Modified normal S.S. servo.

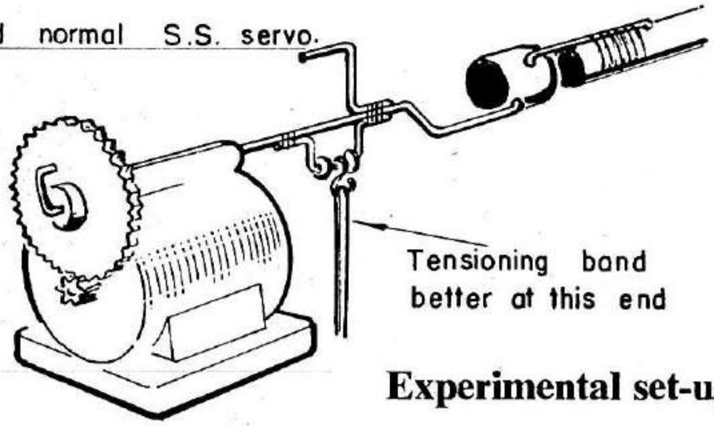


FIG. 1

Special Simpl Simul Servos

Experimental set-ups by Peter Lovegrove, B.Sc.

At present, Simpl Simul is well and truly on the upgrade, and rightly so, since it offers more pleasures in flying at very much less expense than any other systems, including cascade escapement schemes. To my mind it is not a "competition standard" control method but is superior to all the alternatives for sport flying. By far its greatest advantage is that it allows *a* model to be controlled even in the windiest conditions, and let us face it, how often are we without wind in Great Britain?

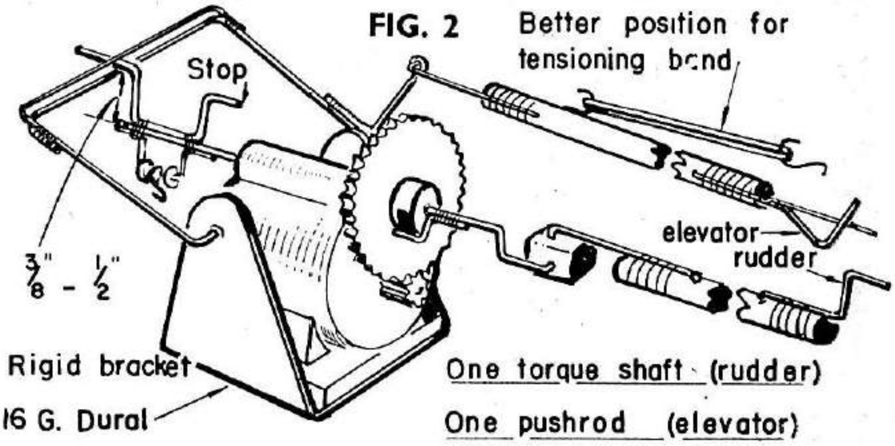
When adopting a new system like this, people tend to follow to the letter what they find written in the literature. This is a perfectly sensible approach but has the snag that, occasionally, a model already in existence does not lend itself to adaptation. The normal cause of this is the relative positioning of the rudder and elevator. The usual servo calls for the hinge-lines of rudder and elevator to be in the same plane. (Ugh! Sorry!)

The servos proposed in this article will allow separate actuator rods to be used for the tiro surfaces, so that hinge-lines may be relatively displaced.

The basic requirement of the S.S. servo is that the rudder and elevator actions shall be 90° out of phase. This can be achieved in a variety of ways.

In all of these servos the arc of swing of the torque shaft of the motor is restricted to 270° by stops fitted appropriately. Without the stops one can devise methods of engine control by wipers, toggle actions, etc., and even have some degree of fail-safe, but one still has to devise a way of satisfactory flight control when full rotation of the torque shaft starts occurring involuntarily on extreme rudder and elevetor positions!

FIG. 2



Points to watch on the above arrangements are as follows:—

(1) Try to avoid sideways, "hammering", loads on the gear end of the reduced-speed shaft. Otherwise you will tend to ruin the bearing and the gears so that they will cease to mesh. For this reason type 4 should not be used except on a model with modest control areas and engine power. Types 2 and 5 avoid this difficulty whilst type 6 tends to reduce its effect as much as possible by leverage reduction.

(2) Keep all linkage light and stiff. You rarely need more than 20 s.w.g. for this kind of job even with a 0.35 engine on a 4 ft. span model, where the battering on the servo is cruel-

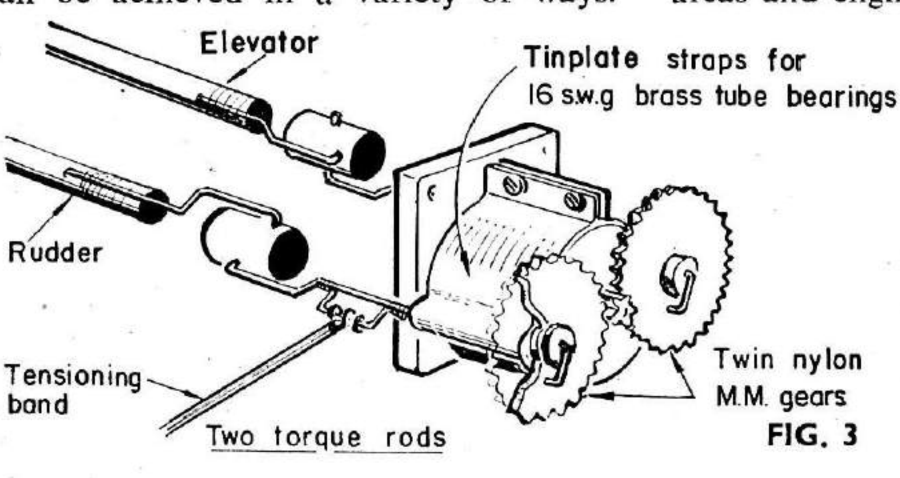


FIG. 3

lest. Light dowels are better than thick balsa in some cases but, in general, hard ¼ square balsa makes the best and lightest pushrod.

(3) Avoid tightness in bearings, eye-holes, etc.

(4) Where possible use a tensioning band which acts on a pushrod so as to give the same effect as the tensioning in Fig. 1, i.e. a pull towards down elevator and neutral rudder. This is kindest on the servo and still gives the desired effect.

(5) Where metal brackets are used, make them rigid as flexibility in these arrangements play havoc with the control.

All of the above arrangements are offered as material for experiment. They have all been tried on the bench to my satisfaction but only one version (Fig. 2) used in the air (I only have two hands and little time!) In this trial I made the mistake of putting the operating crank at the gear end and with the high power loading my model possessed, soon ruined the torque shaft bearing and gear meshing, so be warned.

The Editor will be delighted to hear of results obtained with any of these new arrangements so go to it!

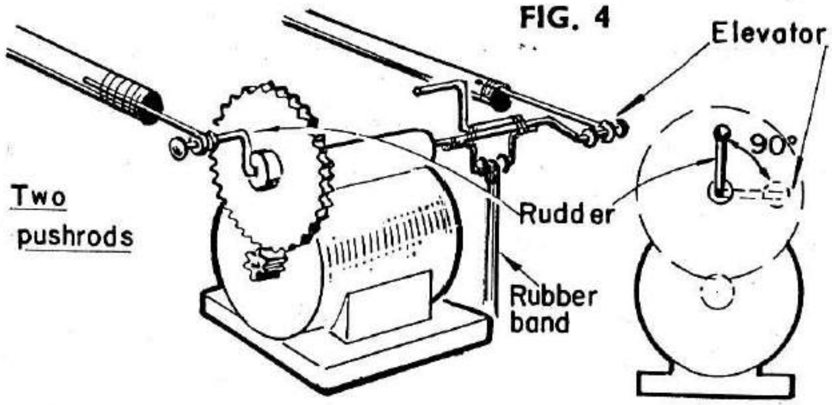


FIG. 4

Simpl Simul

Simply explained for the uninitiated

By

Peter Lovegrove, B.Sc.

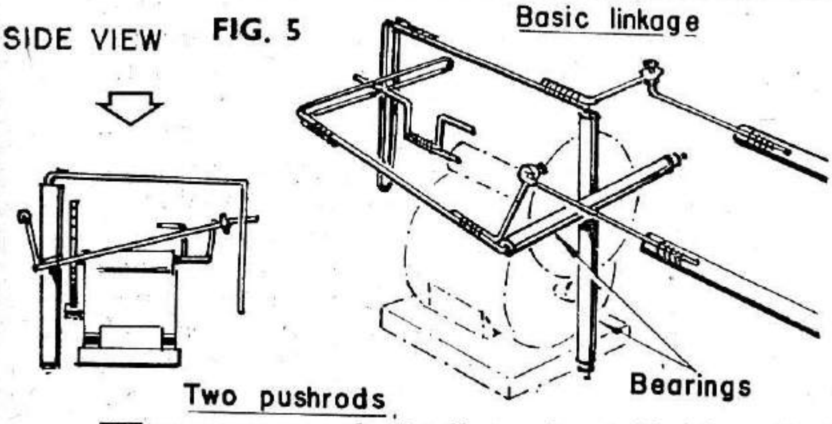


FIG. 5

THE more people I talk to about Simpl Simul—or Galloping Ghost, call it what you will—the more I realise that few people really grasp what it does and why. So at the risk of sticking my neck out I will try to elucidate.

Let us first consider the basic principle about radio control, namely that we have a relay in the aeroplane which will be held "on" by a full signal and allowed to go "off" with no signal. Obviously, by means of the appropriate clobber at the transmitting end, we can arrange to switch the signal on and off at any desired number of operations (cycles) per sec. With Simpl Simul we need the rate to be variable between 3 and, say, 12 operations per second.

Now, quite independently of this control of rate we can control the time spent "on-signal" and "off-signal" relatively, in the space of time taken up by one on-off operation, i.e. in one cycle. With an arrangement like the McQue Versatile transistor pulser, the limit of mark-space or on-off ratio is 75/25, so that this means at a pulse rate of five operations per second we have 1/5 second per operation, and we can spend a maximum of:

$$\frac{25}{100} \times \frac{1}{5} \text{ seconds on-signal} = \frac{1}{20}$$

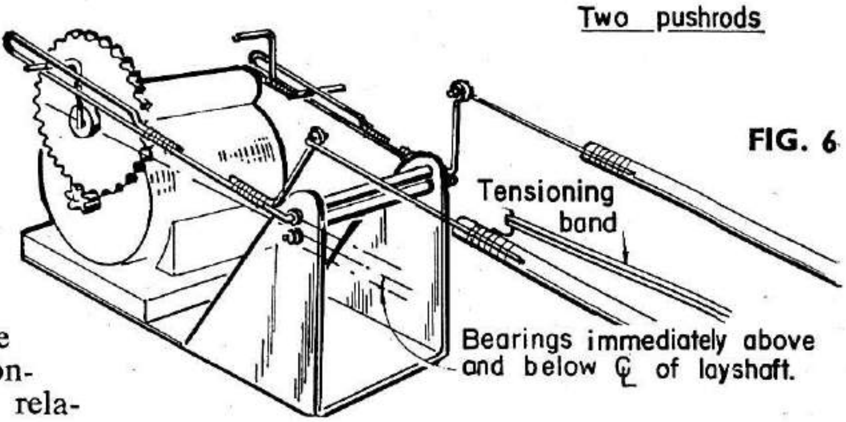


FIG. 6

second on-signal = 50 milliseconds;

and $\frac{75}{100} \times \frac{1}{5}$ seconds off-signal = $\frac{3}{20}$ second off-signal = 150 milliseconds.

This would be one limit of rudder control; the opposite way would give: $\frac{3}{20}$ second on-signal and $\frac{1}{20}$ second off-signal.

(It will be noticed that I have ignored the time taken for the relay leaf to travel from the "on" to "off" positions. But with any relay suited to pulsing this time is small anyway—a Siemens 73 relay takes 2 to 3 milliseconds to move across—so we can ignore transit time.)

With the pulse rate increased to 10 per second the maximum time the relay can be on or off is proportionally decreased, i.e.:

$\frac{75}{100} \times \frac{1}{10} = \frac{3}{40}$ second = 75 milliseconds,

And the minimum time it can spend on or off is:

$\frac{25}{100} \times \frac{1}{10} = \frac{1}{40}$ second = 25 milliseconds.

Having established that much let us look at the motor servo. Assume that we have an Ever Ready TG 18 fitted with Mighty Midget gears and—to keep the explanation as uncluttered as possible—stops fitted to allow the output torque shaft to rotate through 270° only. This is a perfectly normal arrangement, in fact. Again being practical, assume four Deac cells giving 2.5 volts each way.

Suppose the motor to be resting at one stop position with the torque rod appropriately coupled to rudder and elevator. If the battery supply of correct polarity is now switched on the motor will rotate the torque rod to the other stop position, i.e. through 270°. We can ignore the rubber band tensioning because, under these circumstances, its effect is self-cancelling either side of neutral as far as variation of motor speed is concerned.

If you measured it you would find that such a rotational took about an eighth of a second on good batteries, i.e. 125 milliseconds.

Now, reverting to our earlier arguments about rate and signal-space or "mark-space" ratio we can derive the following information.

With the rate at its lowest value, say three pulses per second, and with the mark-space at 50:50 (i.e. neutral rudder position), the relay leaf will spend:

$\frac{1}{3} \times \frac{50}{100}$ seconds on the "in" and "out" contacts alternately = $\frac{1}{6}$ second ÷ 167 milliseconds.

But the motor takes only 125 milliseconds to rotate the 270° from stop to stop, therefore it will be stalled against the stop for (167–125) milliseconds=42 milliseconds. So in every on-off cycle at 3 pps. the elevator will be locked up and stationary for 84 milliseconds. Also the motion of the torque shaft is such that the rotation through the down-elevator part of the 270° swing (i.e. 45° either side of the vertical neutral on a normal Simpl Simul model), is at the maximum speed the servo motor can produce (vide Simple Harmonic Motion).

The decrease due to this and the increase due to the stalling on the limit stops is where we get our up-elevator effect.

Increasing the rate to 4 pps. on neutral rudder gives a relay contact time—on and off the same—of 0.125 seconds, i.e. 1·25 milliseconds. So the motor rotates the torque shaft to the stops, but does not dwell there at all. This gives slightly less up-elevator.

Increasing the rate takes this process further until we get to the point where the 12 pps. is obtained. Neutral rudder gives 40 milliseconds dwell on each relay contact so that, bearing in mind the wholly opposing effect of the rubber tensioning now, the torque shaft rotates back and forth over a 30-40° arc, well within the 90° range between the two neutral-elevator limits, hence we have a definite down-elevator condition—and how!

The rudder action on Simpl Simul may be considered quite separately for the elevator action. The explanation is this: As the relay leaf moves back and from one contact to the other, we get bursts of current supplied to the servo motor. The current value, which ideally is constant either way through the motor, times the period which the relay leaf spends on a given contact gives us

[Continued on page 400]

Modulation Technique . . .

FOR SIMULTANEOUS MULTI-CHANNEL CONTROL

By

H. CUCKSON, A.M.Brit., I.R.E.

In Part 2 the author proceeds to develop his subject with practical applications of special interest to radio control model enthusiasts.

IN the introduction to this series the fundamental theory of modulation was explained. It was seen that amplitude modulation is the process of generating side frequencies. Power relationships were discussed and it was stated that to avoid distortion in the modulation a depth of 100% modulation should not be exceeded. It was also found that when a self quenched superregenerative detector was used as the receiver, the modulation depth should not exceed 60% to avoid distortion and certainly not more than 80% to avoid severe distortion.

It is not possible within the scope of this series to describe all the facets and techniques known, attention will be confined solely to systems of practical use to the model control enthusiast.

Modulated Class C Amplifiers

1. *Anode modulation.*

It is a fact that the R.F. output of a Class C R.F. amplifier having a constant grid excitation varies almost linearly with the D.C. anode supply voltage, Fig. 1, and so modulation is applied by superimposing the modulating voltage on to the D.C. anode supply. The modulating supply voltage to the class C amplifier may be obtained by direct connection to the anode of the modulators as in figs. 2a and b, but a better method is to use a low frequency transformer to couple the two circuits.

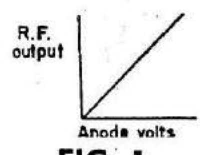
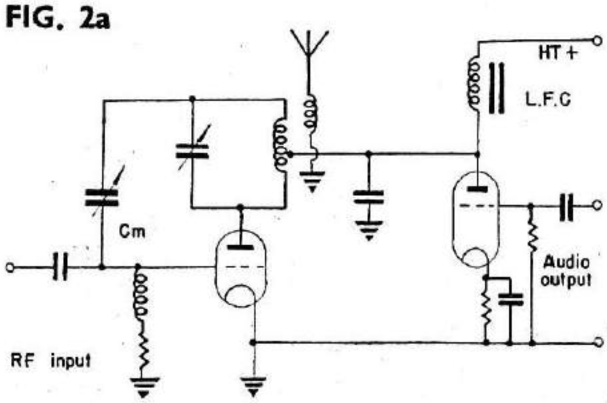


FIG. 1

It can be stated that with anode modulation the carrier power is supplied by the H.T. supply, and the power in the side frequencies is supplied by the modulator.

Herein lies the rub!

FIG. 2a



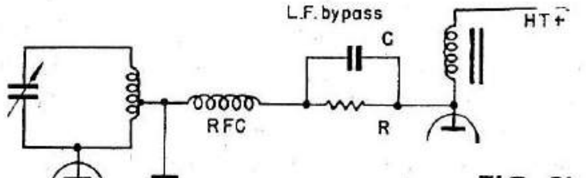


FIG. 2b

A Class C amplifier can operate at an efficiency as high as 85%, whereas the modulator operating under normal Class A conditions to avoid distortion has an efficiency of 25%.

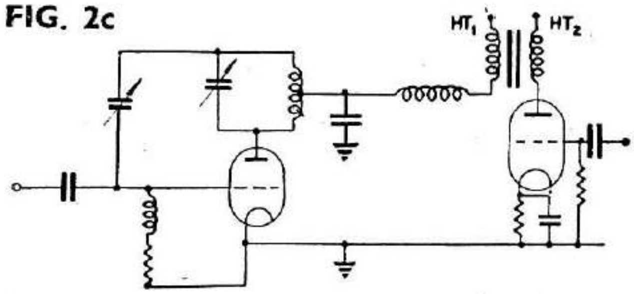
Since from the power relationships of P mod. $= Pc \left(1 + \frac{m^2}{2}\right)$ it has been ascertained that 50% extra power is needed to produce 100% modulation, it is evident that the modulator has to work under conditions of greater input power than does the Class C amplifier. The H.T. drain therefore is more than doubled than with carrier alone and with small hand held transmitters, the battery drain may be prohibitive and this may well be the reason that this system of modulation is not more popular in the field.

On the other hand if 60% modulation is not to be exceeded the modulation power is $\frac{m^2}{2} = \frac{.6^2}{2} = .18$, thus a valve such as a 3S4 or 3V4 can generate sufficient power to modulate a 3A4 developing 1.2 watt R.F. carrier power.

Referring again to Fig. 2a, this circuit should not be used when modulation depths approaching 100% are required.

The circuit of Fig. 2b is an improvement. The D.C. supply to the Class C amplifier is dropped by resistance R,

FIG. 2c



but the modulating voltage is applied direct by the capacitor C. Here the D.C. input supply to the modulator is greater than to the R.F. amplifier and greater modulation depths are possible.

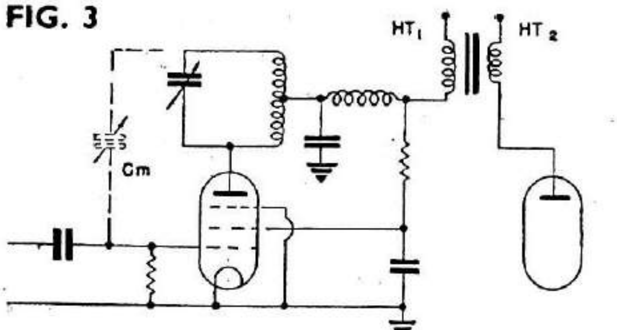
The circuit of Fig. 2c provides the best answer since the input supplies can be adjusted independently and the load presented to the modulator can be accurately matched.

The load presented to the modulator can be found by dividing the anode supply volts by the anode current under conditions of carrier only.

e.g. Let the anode voltage supply = 100 volts.
Let the anode current supply = 10 m.A.
∴ Resistance required to be matched to the modulation is $\frac{V_s}{I_a} = 10\ K\Omega$.

Suppose the optimum load of the modulator is 5K, then the ratio of the modulation transformer is $\sqrt{2} : 1. \doteqdot 1.4 : 1$.

FIG. 3



It should be noted that if a pentode or tetrode is used both anode and screen should be modulated, Fig. 3, because anode current is dependent on screen voltage rather than anode voltage, so that variation in the anode supply alone would produce little change in output. The screen by pass capacitor will be sufficiently small so that its reactance is high at the highest audio frequency encountered.

Grid Modulated Class C Amplifier

In this method the output of a Class C amplifier is controlled by varying the grid bias voltage in accordance with the modulation. The grid is biased well beyond cut off and the optimum bias point is found by noting the voltage required so that the R.F. excitation just drives the amplifier into grid current and then finding the voltage required to completely cut off the valve. The operating point is then midway between the two extremes. Modulation is then added and adjusted in amplitude till at the peak grid current just flows and at the trough of modulation the valve is nearly cut off. With careful adjustment this type of modulation can be made quite linear and has the advantage of requiring very little modulator power. This is offset by the fact that the carrier power of the grid modulated amplifier is only a quarter of the power that the same valve will generate as a straightforward class C amplifier.

A typical circuit is given in Fig. 4a.

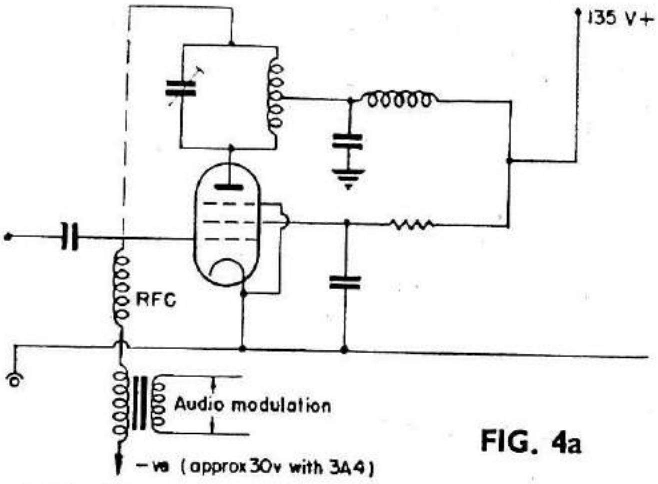
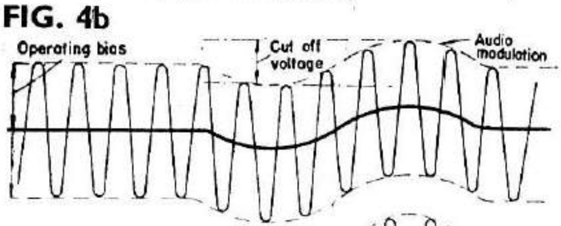


FIG. 4a

FIG. 4b



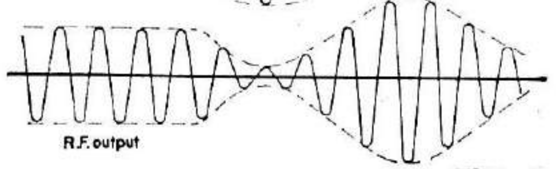


FIG. 4c

Modulated Class A Amplifier (Van der Bijl)

This method is of interest because of its simplicity. A *small* R.F. voltage and a larger modulating signal are applied to the grid of the Class A R.F. amplifier, a simplified circuit and details of operation are given in Fig. 5. Modulation depends on the curvature of the

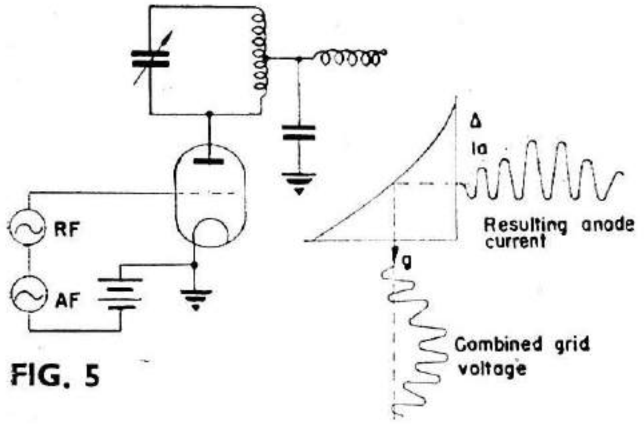


FIG. 5

Ia/Vg characteristic. A mathematic analysis shows that the side frequencies are produced by the second order action, the carrier by the first order. Because the characteristic of the valve departs from a true parabola severe distortion is produced at large modulation depths and the system is used when intelligence rather than quality is to be transmitted. The R.F. efficiency is low.

Modulated Class C Oscillators

A self-excited Class C oscillator when anode modulated exhibits similar characteristics to the Class C amplifier, the R.F. output being proportional to the D.C. supply volts (the only possible objection to this system is that frequency modulation is also introduced). The modulator design follows exactly that described earlier for Class C amplifiers.

FIG. 6a

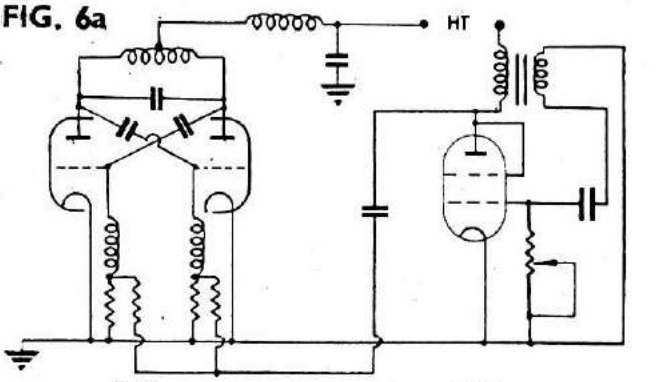
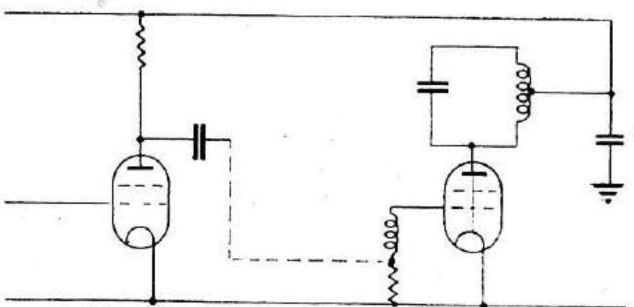


FIG. 6b



Crystal Oscillators

It is a widely held belief that crystal controlled oscillators cannot be modulated. This is far from the truth as anyone who has used a C.G. transmitter will know. In this circuit the modulating voltage is applied to the screen and clearly enough modulation intelligence is produced to ensure reliable operation of the receiver.

Common But Incorrect Methods of Modulation in R/C Transmitters

A method in common use is to apply a larger modulation voltage to the grid of the R.F. oscillator or P.A. stage. Fig. 6a and b.

The modulating voltage which is several times greater than the grid base of the valve serves only to switch on and off that particular stage, resulting in a carrier wave chopped at the modulating frequency (Fig. 7). At the best this is a square wave which as any mathematician will know contains the fundamental, increased to $\frac{4}{\pi}$, i.e. 1.274 of its former value and all its odd harmonics with amplitudes proportional to their frequencies. A filter in the receiver trough has no difficulty in selecting the fundamental and the equipment works quite well.

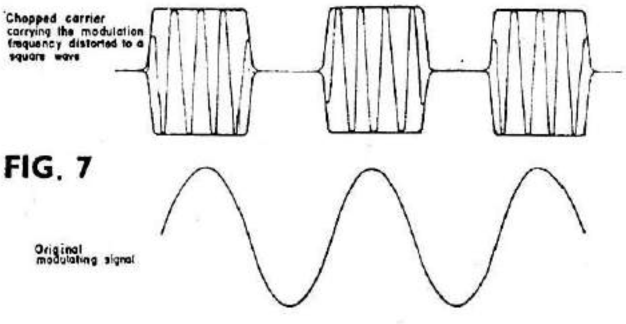
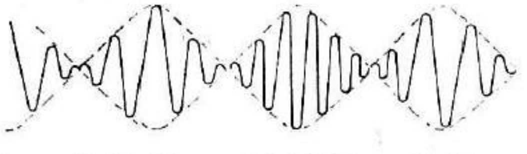


FIG. 7

Now consider a modulating signal consisting of two sine waves of equal amplitudes, but differing frequencies. The resulting signal as mentioned in part 1 becomes $E_m \text{Sin}\ \omega_1 t + E_m \text{Sin}\ \omega_2 t = 2\ Em$

FIG. 8a



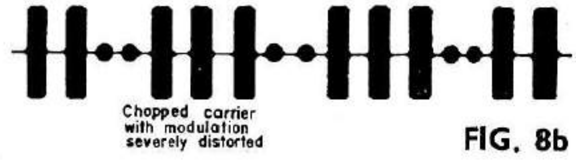


FIG. 8b

$\frac{(\sin \omega_1 t + \omega_2 t}{2} . \frac{\cos \omega_1 t - \omega_2 t)}{2}.$
(Fig. 8a).

The solid line carries the term

$$\frac{\omega_1 t + \omega_2 t}{2}$$

and the dotted line is the 'imaginary' envelope $\frac{\omega_1 t - \omega_2 t}{2}$, in fact it appears that we now have a new frequency of one half the sum of the two, but varying in amplitude at the difference frequency. However, at this stage two filters would have no difficulty in selecting the original two frequencies. Now apply this signal to the grid of the P.A. stage and the modulated carrier takes on this form (Fig. 8b).

It can be seen that the modulation frequency now largely comprises the frequency $\frac{\omega_1 t + \omega_2 t}{2}$ and its odd harmonics, and the amplitudes of the original signals have been considerably reduced depending on the degree of limiting.

Example

Suppose $\omega_1 t = 250$ c/s and $\omega_2 t = 240$ c/s, two adjacent reed frequencies, then the modulated carrier when detected gives mainly 245 c/s, 735 c/s, 1225 c/s, etc. and 250 c/s and 240 c/s reduced.

Bearing in mind the fact that the two original modulating signals may not be sinusoidal anyway, the imagination begins to boggle.

While it must be admitted that certain transmitters use this system and manage to operate two channels simultaneously it can only be said that the equipment works in spite of the modulation not because of it.

Coil Design

Both theoretical and practical aspects of coil design are dealt with in this article

by R. H. WARRING

THE performance of electro-magnetic devices in general, and relays in particular, is dependent on the design and construction of the coil. The coil provides the vital link converting electrical energy into mechanical force. There are two aspects to consider, the electro-magnetic requirements and the physical side or 'geometry' of the coil. These are closely related, but it is most convenient to consider them separately. The final physical design then aims at achieving a desired 'ampere-turns' figure, calculated or estimated as required for the particular electro-magnetic performance.

Both aspects of design involve formulas, but these are quite straight-forward and readily worked. Essentially, in fact, they involve nothing more than ordinary arithmetic calculations, although these may appear a little complex at first sight. Short cuts are made possible with the use of standard wire data tables.

The mechanical pull generated by a magnetic force acting between two parallel surfaces can be calculated from the basic formula—

$$P = \frac{B^2 A}{8 \pi}$$

where P = force expressed in dynes;
B = flux density (assumed uniform) in gauss;
A = area of the surfaces in sq. cm.

Strictly speaking, this formula holds good only for small air gaps and where there is no flux leakage or flux distortion. Also the units involved are not particularly usable. As far as electro-magnets are concerned, the formula can be developed to express the requirements in terms of *ampere-turns* (number of turns × current) and rendered in everyday units

ampere turns $= K \times 1 \times \sqrt{P/A}$
where 1 = length of air gap in ins.
P and A are as before, except that A can be rendered in sq. ins. and the force P in pounds or ounces, according to the value of the constant 'K' used.
For P in pounds, K = 2,660.
For P in ounces, K =.

This formula, again, does not allow for losses due to flux leakage, which in practice will occur both in the magnetic circuit and the air gap. The actual losses will be dependent on the design involved and are usually estimated as a nominal percentage, increasing the calculated ampere turns accordingly. It is impossible to give generalised figures since so many factors may vary in different designs, particularly on the iron circuit.

For good designs with ground pole pieces, losses in the iron part of the circuit may be of the order of 25—50 per cent, to which must be added air gap losses accounting for a further 10 per cent, upwards. In the case of miniature relays, with many different armature-polepiece combinations, design factors may vary as much as 5 to 1. However, in this particular application experience indicates that for first class design and fabrication the *total* ampere-turns required can be as low as 20 and ensure positive operation. For relatively poor and typically 'amateur' designs, up to 100 ampere-turns may be needed for positive operation. Obviously the former figure is more desirable since the latter leads to impractical—or 'impossible' coil sizes. Hence the strict necessity of ensuring good mechanical design and fabrication.

The original formula is also of use in checking or cross-checking the pole areas. Rendering this in practical units—

$$P = \frac{B^2A}{72} \text{ divided by } 10^6,$$

where P is expressed in pounds,

$$\text{or } P = \frac{B^2A}{72} \text{ divided by } 10,$$

where P is expressed in ounces. B is then the flux density in lines per square inch and A is in square inches.

The figure for B is dependent on the core material, 80,000 lines per sq. in. being a typical figure for a good quality iron core magnetised to saturation. If preferred, the original design calculation can be worked on this basis and related to ampere turns by the following formula—

$$\text{ampere turns} = .31\ B \times 1.$$

The electrical side of the design investigation having arrived at a required ampere turns figure, the geometry and wire size for the coil can then be determined, for a given (D.C.) voltage. Basically—

$$\text{ampere turns} = \frac{\text{applied voltage} \times \text{number of turns}}{\text{coil resistance}} = \frac{VT}{R}$$

The exact procedure adopted then depends upon the physical factors involved. The most general problem, for example, is to find a suitable size of wire to fit a coil of given dimensions, rather than base the ultimate geometric size of coil around a calculated length of wire of specified diameter. Due allowance may also have to be made for any interlays which may be used and the type and method of winding. Tables specifying turns per square inch for different sizes of wires and types of insulation, for instance, are based on maximum space factor or the type of winding where adjacent coils are staggered to fit into a minimum of space.

Having found the ampere turns required for a coil, and knowing the operating voltage, the approximate bare wire diameter can be calculated from the following formula—

$$d \text{ (inches)} = \sqrt{\frac{1.36 \times N \times I\,(D_1 + D_2)}{V}} \text{ divided by } 1{,}000$$

where N = number of turns

I = current in amps

D_1 and D_2 are coil former inner and outer diameters, as defined in Fig. 1.

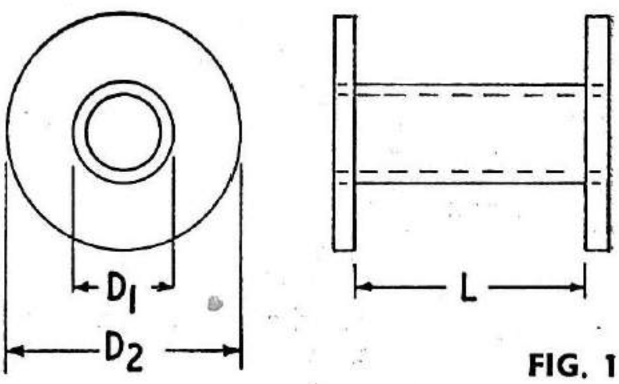


FIG. 1

The quantities under the square root bracket give, in effect, the bare wire diameter in thousandths of an inch.

This formula may, however, involve quantities unknown at this stage. It may, therefore, be necessary to estimate a possible wire size, based on previous experience or consistent with similar design practice. Standard procedure is then as follows—

(i) Calculate maximum number of turns which can be accommodated within the winding space of the coil.

(ii) Calculate the mean turn length $= \frac{1}{2}\,\pi\,(D_1 + D_2)$.

(iii) Calculate total length of wire = mean turn length × number of turns.

(iv) Calculate wire resistance from total length (referring to wire tables).

(v) Calculate ampere turns =

$$\frac{\text{volts} \times \text{number of turns}}{\text{wire resistance}}$$

If the ampere turns figure arrived at is too small, the initial wire diameter selected is too small, so recalculate on the basis of a larger wire diameter. Similarly, if the ampere turns figure is too large, recalculate with a smaller wire size. It is quite common to have to go up or down a gauge or two in size to arrive at the best results.

Additional factors which may have to be taken into account concern the heating effect under working conditions. This concerns both the *rating* of the coil and its effective resistance at operating temperatures. An increase in temperature will result in an increase in resistance and thus the effective ampere turns figure will be reduced. Thus the original ampere turns figure required will have to be increased to allow for this effect—an increase in 25 per cent being a not uncommon allowance.

The temperature rise can be estimated from the increase in resistance when heated up under service conditions. A general figure is that there is a temperature rise of one degree C for every 0.4 per cent increase in resistance (measured), i.e.

temperature rise =

$$\frac{250\,(R_2 - R_1)}{R_2}\ ^\circ C.$$

where R_1 is the cold (specified) resistance.

R_2 is the actual (measured) resistance at working temperature.

In practice, of course, the coil will not be heated uniformly and localised high spots can develop, which could lead to failure. This would be suspected where the overall temperature rise calculated as above is high. A maximum temperature rise of 40 to 50 degrees C is generally acceptable for continuous duty windings, or up to 70 degrees C with enamel insulation.

The rating is concerned with the ability of the coil surface to dissipate heat. The actual wattage to be lost is equal to $(\text{current})^2$ a resistance and the rating figure expressed as watts lost divided by the curved surface area of the coil. For continuous operation it is generally considered that the maximum rating should not exceed 0.5 watts per square inch and that the normal operating range should be between 0.3 to 0.5 watts per sq. inch. Higher ratings may well be acceptable, however, provided the peak temperature rise is not excessive.

SUMMARY OF COIL WINDING FORMULAE

(All dimensions in inches)

(a) **Winding depth** $= \frac{1}{2}(D_1 - D_2)$.

(b) **Winding space** $= \frac{1}{2}L(D_1 - D_2)$.

(c) **Mean turn length** $= \frac{1}{2}\pi(D_1 + D_2)$.

(d) **Theoretical number of turns per layer** $= \dfrac{L}{dc}$.

(e) **Practical number of turns per layer** $= \dfrac{195L}{dc}$

(f) **Number of layers** $= \frac{1}{2}(D_1 - D_2)$ **divided by dc.**

(g) **Maximum number of turns per sq. in. coil section** $= \dfrac{dc^2}{199}$ **(approx.).**

(h) **Total number of turns, N** $= \dfrac{\frac{1}{2}L(D_1 - D_2)}{(dc)^2}$

(i) **Length of wire** $= \dfrac{\pi L(D_1^2 - D_2^2)}{4\,(dc)^2}$.

(j) **Diameter of covered wire, dc** =

$$\sqrt{\frac{L(D_1 - D_2)}{2N}}$$

Nomenclature :

D_1 = **outside diameter of winding.**
D_2 = **inside diameter of winding.**
L = **length of winding.**
N = **number of turns.**
d = **bare wire diameter.**
dc = **covered wire diameter.**

(k) **Bare wire dia.** $= \sqrt{\dfrac{1.36\,N.I.\,(D_1 + D_2)}{V}}$ **thousandths of an inch.**

McQUERY COLUMN

DAVE McQUE WILL ANSWER QUERIES THROUGH THIS COLUMN EACH MONTH, AND WE 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 NOTED with great interest your current construction article on the "305" All Transistor Receiver. I would like to build it but have run across a stumbling block—that is U.S.A. equivalents of the transistor and transformer. Would it be possible to publish this information for this receiver and future construction articles.

—T. J. S., MARYLAND, U.S.A.

Unfortunately I cannot give you details of the American equivalents of the components in the "305" receiver.

However the values are not critical and the following might help:—Transformer any subminiature with a ratio of approx. 4 or 4.5 to 1. The S.B.305 you can, of course, obtain and the intermediate transistors should have a gain of not less than say 50. The output transistor is a semi-power one with a gain of not less than say 30 it you can obtain it. It should be capable of carrying a current of at least 400 m.A. without overheating.

I AM hoping to build a McQue Tx. in the not too distant future, and would be glad if you could tell me if DEAC cells be used for the low tension supply ?—T. J. F., SOLIHULL.

There would appear to be no objection to the use of DEAC cells for the Tx. provided you ensure that they are sufficiently charged. The circuit given would be quite satisfactory but I make the dropper resistance for the 200 m.A. line to be 4.5 ohms for a drop of .9 volts.

COULD you tell me if the "Orbit I" circuit published in May, 1959, "Aeromodeller" would be suitable for use with an E.D. 6 reed unit and if any modifications would be necessary? I notice that in many circuits there is a condenser of between 1-25 mfd. between collector and emitter of the final transistor. Could you tell me the purpose of this condenser please ?

—M. B. F., KIDDERMINSTER.

The Orbit receiver described is for single channel operation and the output stage would need modification for reed use.

The Orbit 8 channel receiver would be suitable for use with an E.D. reed unit.

In single channel operation the high value capacitor (1 to 25 mfds. and usually 25 to 50 mfds.) is to smooth out the ripples produced by the tone modulation. Without this smoothing the relay would try to follow the tone frequency but due to its mass would be unable to do so and the receiver would not therefore function without the capacitor.

In the case of reed systems the capacitor is usually across the reed unit coil and is there for the purpose of tuning the coil roughly to the reed frequencies used. In the case of high resistance coils this is usually .03 mfd. and the low resistance 1 mfd.

I AM building my first radio control receiver, The New Ivy Receiver, from your excellent instructions. I just have one question which I would be very grateful if you would answer, a S.A.E. has been enclosed for this purpose.

Under quench coil the instructions say connect leads from one coil to tags 4 and 7 and the other coil to 5 and 8. My question is should the START *of one coil go to tag 4 and the* START *of the other coil go to tag 5 ?*

—R. H. U., AYLESFORD.

With reference to your letter the connections are such in the case of the quench coil that each section is series aiding and if used without the RF coil would produce oscillation at the quench frequency. For this condition assume that the two coils are one with a centre tap which could be two ends of the coil joined, the centre tap being taken to earth (this could be H.T. plus or L.T. minus the batteries being used merely to supply voltage for the valve).

Under these conditions the commencement of the coil would go to grid and the end to anode (or vice versa).

It is not wise to say definitely that a start goes to tag 4, etc., as the coils may not be wound in the same direction so as to be series aiding.

However, it is not as difficult as it sounds as all you have to do is watch the meter when adjusting the sensitivity slug. If the current rises well above the figure stated reverse one of the quench coil connections when all should be well.

CAN you please tell me how I can add a transistor stage to the New Ivy Receiver as presented in last month's Radio Control; I feel that this will be necessary since the relay I have is a siemens high speed 1700 + 1700 Ω.
—F. M. G., STAFFORD.

It has not been found practical to provide a simple method of adding a single transistor to the "Ivy" receiver.

There are two ways of doing this: (1) Using A/C coupling and allowing the quench voltage to bias off the transistor. Upon signal the quench is reduced and the bias removed allowing the transistor to conduct. This requires a great deal of experiment with the quench arrangements before a satisfactory arrangement can be found. (2) Using D/C coupling and making use of the reasonable change in the valve circuit. Whilst reasonably easy to achieve the resultant change was not high enough to justify publication.

It is suggested therefore that a good relay suitable for the receiver be used. The Sigma 4F is highly satisfactory for the purpose.

I HAVE built "Aeromodeller" Transistor Rx. with parts supplied by R.E.P. and a Ripmax Relay. Results have been excellent with a range of over 500 *yds.—but—only when the temperature rises to* 75° + *range drops to* 50 *yds. or less.*

I would be very pleased if you could tell me how to deal with this situation.
—R. T., GLASGOW.

It has been found unfortunately that the "Aeromodeller" transistor receiver is affected by temperature changes and there is not a great deal to be done about it. The main thing is to get as large a change in the valve stage in order to minimise the temperature effect. The change is small enough anyway in that stage and the maximum efficiency here is desirable.

The fault arises in the first transistor and it could be replaced with a Silicon transistor with improved results. The cost of one of these is high, however, and there would probably be necessary a change of components in order to obtain correct operating conditions.

WHAT modification to the Versatile Tx. is required for the simultaneous operation of two channels. This would have application in the case of two boats each using its own, say, four channels of an eight channel outfit and controlled from one versatile which in turn is controlled from two four channel control boxes.—A. L. C., PRETORIA.

To mix the input of two tone units apply them both to SK4 via 100K and connect a 2M pot. in series with 0.1 from V3 anode to V3 grid. This acts as a mod. depth control. Connect R1 to earth. Remove D and connect R5 to — 9V. from a grid bias battery the + Ve of which is earthed.

The Rx. should be capable of reproducing two notes *at adequate strength* simultaneously. It is best to avoid those pairs which produce slow beats.

SIMPL SIMUL—HOW IT WORKS . . (from page 392)

a measure of the energy supplied to the motor for one direction of rotation. At 50:50 mark-space, AT ANY RATE OF PULSING, the mean energy supplied to the motor in each direction is the same so that, although it oscillates, it has no excess drive in either direction.

As soon as the mark-space is moved away from neutral say by 5%, giving 45:55, the effective change is doubled because what is given to one side must be subtracted from the other. So the mean energy supply to rotation one way is 10% greater than that to the other hence the motor servo has positive drive in one direction superimposed on a basic neutral oscillation. Accordingly the motor rotates its arc of oscillation until the excess electrical energy one way is counterbalanced by the mechanical tension of the rubber band. Greater unbalance of mark-space gives a greater displacement of arc of rotation before the mechanical tension equalises the electrical unbalance effect—hence more rudder.

Basic Radio

PART 2: ALTERNATING CURRENT

By G. E. DIXEY

This new series is intended for the raw beginner who needs to re-learn (or acquire) the background to radio electronics without which so much that is simple appears hard to understand.

IN Pt. 1 we learnt that if we applied a voltage across the ends of a conductor we caused a current of electrons to flow through the conductor. If we increase the voltage more electrons (i.e. a greater current) flow and if we decrease the voltage less electrons flow.

Now if we had some control which caused the voltage to rise and fall alternately we should find that the current rose and fell in sympathy. We thus have a form of alternating voltage and current.

The most fundamental form of alternating voltage (or current) is the sine wave shown in Fig. 1.

Here we need to learn a few definitions.

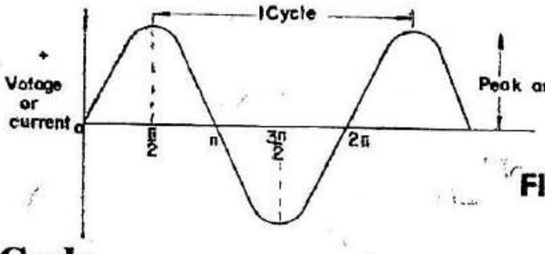


FIG. 1

Cycle

A cycle is one complete sequence of events. Thus if we follow the behaviour of the sine wave from the point marked 0 we see the voltage rise to a maximum (+) at $\frac{\pi}{2}$, fall to zero at π, rise to a maximum (—) at $\frac{3\pi}{2}$ and return to zero at 2π. This traces out one complete cycle. Had we continued we should simply have repeated ourselves.

Frequency

The frequency of an alternating current or voltage is the number of times that the above sequence is traced out in every second, i.e. the number of cycles per second. This is written shortly as c/s.

Amplitude

The amplitude of an alternating waveform is the height of the wave above the baseline (see Fig. 1). Normally we use the term to describe the maximum height as shown: this is known as the peak amplitude, but in fact, the amplitude can refer to the height of the wave at any point: it is then termed the instantaneous amplitude.

It will be noticed that we have used the terms $\frac{\pi}{2}$, π, etc. and the reason for this may not be clear.

To explain it fully would mean going into the derivation of the sine wave, which is not really essential for an elementary study of alternating currents. Let us just say briefly that in A.C. theory we use radians instead of degrees to measure angles and that one cycle is equivalent to 360 degrees, i.e. a complete circle. One radian is approximately equal to 57 degrees, so there are 2π radians in one cycle since 57 degrees $\times\ 2\pi = 360$ degrees.

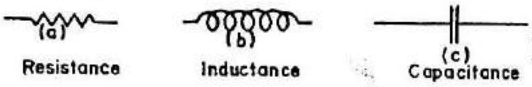


FIG. 2

Inductance and Capacitance

We have already met resistance which is the opposition offered by any material to the flow of current through it.

In A.C. theory we meet two other important properties. These are inductive reactance and capacitive reactance. Inductive reactance is also an opposing force exhibited, in this case, by any coil of wire to an alternating current. This reactance depends on two main factors:—

(1) The physical construction of the coil, e.g. length, diameter, number of turns; and

(2) The frequency of the alternating current.

The coil possesses a property known as its inductance which is a measure of its ability to oppose the flow of alternating current. This inductance, symbol L, depends on the physical construction of the coil and whether or not it has a metal core.

We can now say that the inductive reactance depends upon the inductance of the coil and the frequency of the A.C. applied to the coil.

The formula for inductive reactance is:—

Inductive reactance $(X_L) = 2\pi f L$ ohms where f is the frequency of the A.C. in c/s and L is the inductance in Henries.

The term $2\pi f$ in the above equation is often written as w (omega).

From this equation we see that X_L will increase in size as the frequency increases. This fact is very important as we shall soon see.

A capacitor (or condenser) is also a device which offers a reactance to alternating currents. As in the case of the coil the reactance depends on the physical construction of the capacitor and the frequency of the A.C. applied to it.

The formula for capacitive reactance is:—

Capacitive reactance $(Xc) = \frac{1}{2\pi fC}$ ohms, where C is the capacitance in Farads.

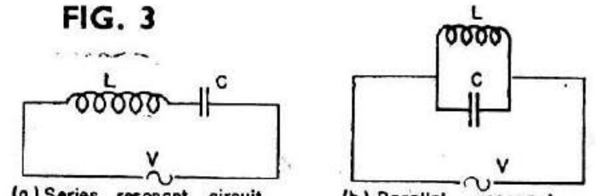
From this equation we see that Xc will *decrease* in size as the frequency increases.

Resonance

We now come to a very important phenomenon where we have combined L and C and applied an alternating voltage to the circuit. L and C may be combined to form a series resonant or 'acceptor' circuit (Fig. 3(a)) or a parallel resonant or 'rejector' circuit (Fig. 3(b)).

We have mentioned that as the frequency increases the reactance of the inductance increases and the reactance of the capacitor decreases. If our A.C. voltage V in Fig. 3 (a) is variable in frequency then if we start at some low frequency, and gradually increase it, we shall find the reactance of the inductance going up and the reactance of the capacitor going down. At one particular frequency these reactances will be equal. Because inductive reactance may be considered positive and capacitive reactance negative, these reactances will ancel out, and the effect is the same as if no reactance were in the circuit at all! Consequently, at this one particular frequency, known as the resonant frequency, a very large current flows in the series circuit. Thus the circuit is able to select a particular frequency and respond to it to the ex-

FIG. 3



(a) Series resonant circuit (b) Parallel resonant circuit

clusion of other frequencies which do not produce this effect.

We get a similar phenomenon occurring in the parallel resonant circuit (Fig. 3(b)), but in this case the current is a minimum at the resonant frequency, because, although large currents flow in the branches of the circuit, none is drawn from the supply.

The above descriptions neglect any resistance which is always present in a circuit to some extent, and modifies the above somewhat, but is often small enough to be ignored in an elementary treatment.

Where a circuit contains both reactance and resistance the combined opposition offered by these is termed the 'impedance' of the circuit.

To conclude our study of A.C. theory we shall indulge in a little mathematics to determine the value of the frequency at which resonance occurs.

Remember that at resonance:—

Inductive reactance = capacitive reactance,

i.e. $2\pi f L = \frac{1}{2\pi fC}$

$\therefore\ 2\pi L f^2 = \frac{1}{2\pi C}$

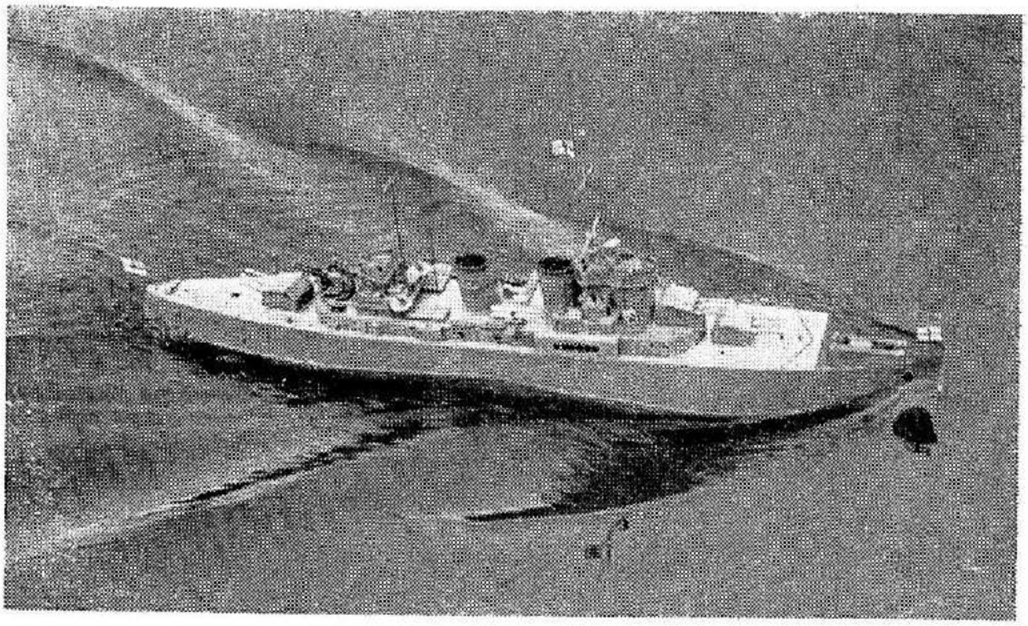
$\therefore\ f^2 = \frac{1}{4\pi 2 LC}$

$\therefore\ f = \frac{1}{\sqrt{4\pi 2 LC}} = \frac{1}{2\pi\sqrt{LC}}$ c/s

Thus if we have a coil and condenser and we know their values of inductance in Henries and capacitance in Farads respectively, we can find out at what frequency they will resonate.

NOTE.—In radio the Henry and Farad are too large for practical purposes. We use instead the millihenry (mH) equal to one thousandth of a Henry, the microhenry (μH) equal to one millionth of a Henry, the microfarad, (μF) equal to one millionth of a Farad, and the picafarad (pF) equal to one billionth of a Farad.

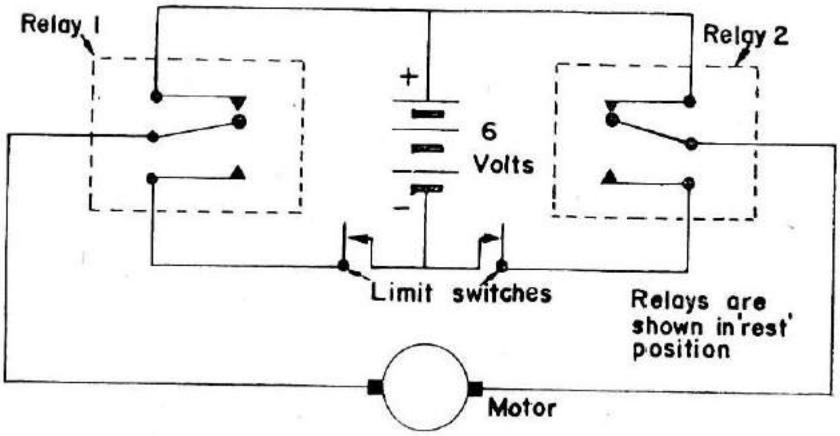
However, in the equation above we must insert the values of L and C in Henries and Farads respectively.



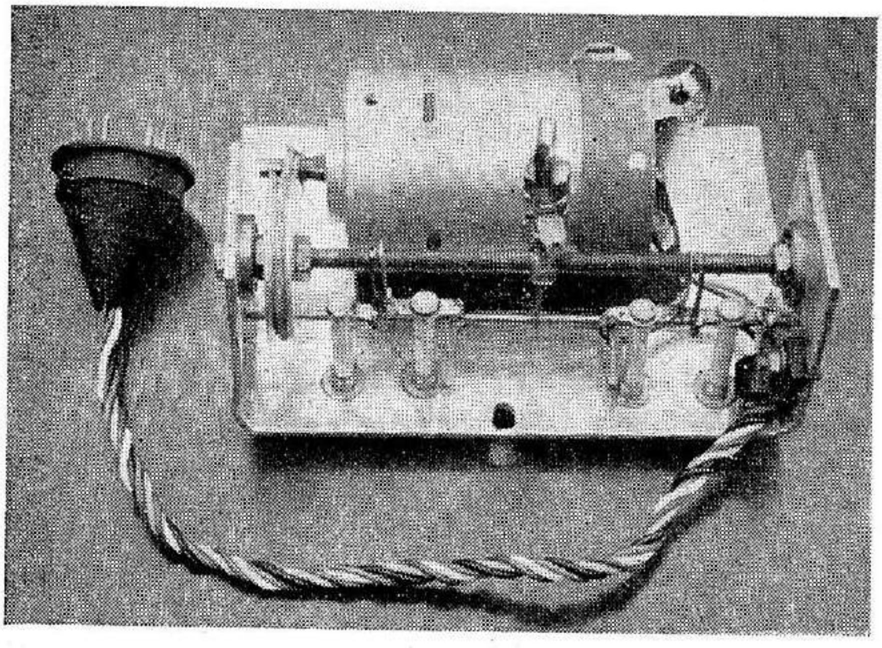
The author's model of "H.M.S. Wolvertown" at speed. This model has been the test bed for an immense variety of remote controlled movements using the equipment described.

Cruiser Under Control

Author P. Drake shows how much can be done to obtain a multitude of boat controls without any too lavish expenditure, ranging from simple speed to depth charge dropping.



TWO years ago I decided to embark on a very ambitious project—that of constructing a fully working semi-scale model cruiser. I required exact and independent control over both direction and speed together with a means of controlling the various 'luxury items' which include rotating, elevating and firing guns, lights, a smoke screen, depth charges, radar and a are. While these sound complicated requirements I was determined to eliminate 'gremlins' at all cost and simplify the working as much as possible. Two requirements were essential, the first being absolute reliability, the second was that the cost should be small. With these in mind I devised a system of control which needed a six-channel

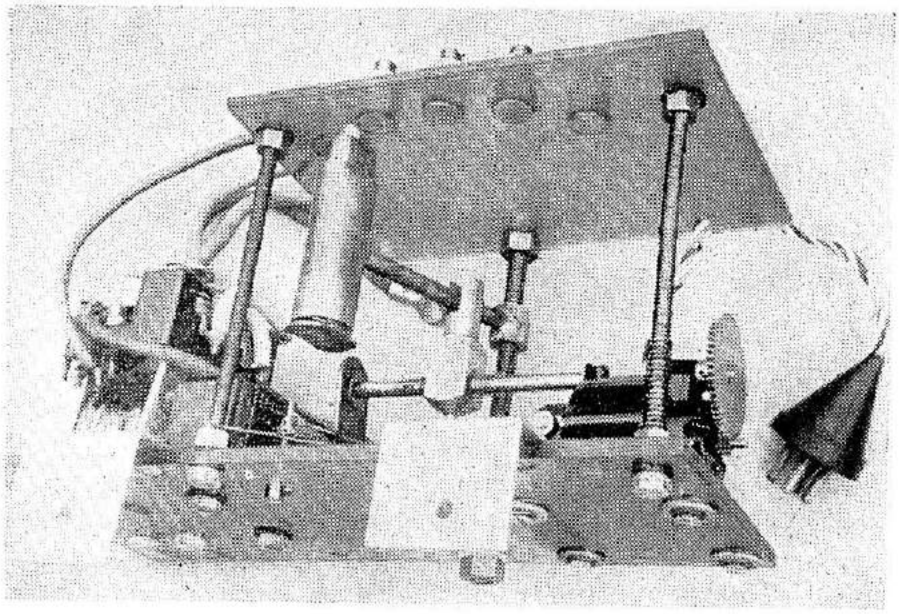


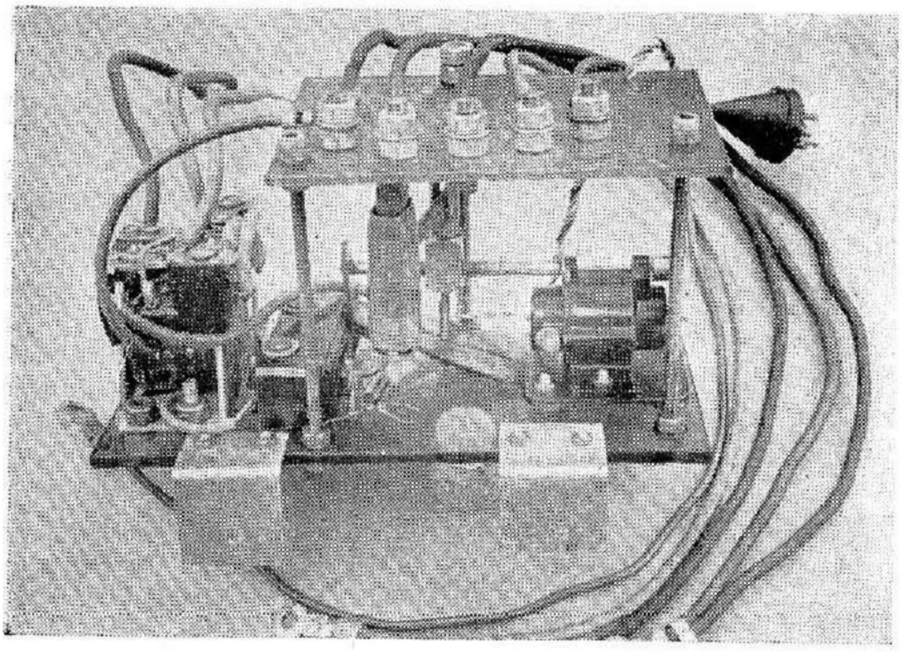
THE RUDDER STEERING UNIT

The motor in the background drives the pulley on the left causing the nut on the threaded rod to move to the left or right depending on the direction of cu:-rent flow. The limit switches can be seen in the foreground. Note the use of ball races at either end.

receiver to operate it. In order to eliminate the unexpected and troublesome radio faults which have always accompanied my home-made single channel sets, I decided to invest in an E.D. 'Black Arrow' receiver which is giving excellent results.

The system operates as follows: Relays one and two give me positional rudder control. Relays three and four operate a speed control selector and the last two operate a siren and an eleven position rotary selector switch. The rudder and speed selector operate from a small separate six volt accumulator which ensures that accurate control is obtained independent of the condition of the main drive batteries.





THE SPEED-CONTROL SELECTOR

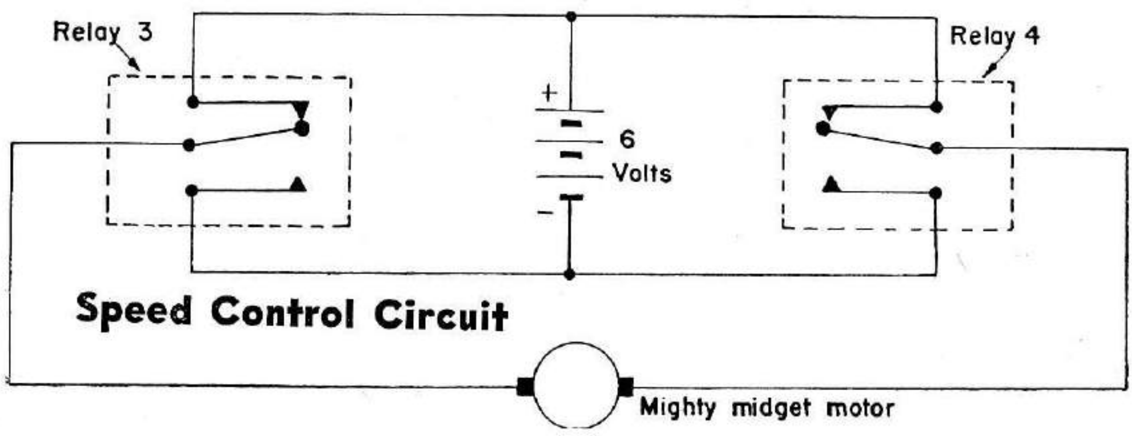
Two views showing the layout. The 'Ripmax' steering unit moves the wipe rm over the fixed contacts above. Between the reversing relay (on the extreme left) and the steering unit can be seen the micro-switch and its contact arm with return spring. Note the use of heavy guage wires.

The top contact platform can be adjusted to make the correct pressure with the wiper arm by raising or lowering it on its vertical-threaded rod, supports.

Opposite page

Location of components in the author's "H.M.S. Wolvertown":

- **A** Radio batteries.
- **B** Accumulators.
- **C** Smoke screen generator.
- **D** Depth charge dropper Port.
- **E** Starboard ditto.
- **F** Gun rotator.
- **G** Uniselector switch.
- **H** Torpedo tube.
- **J** Speed control selector.
- **K** Propulsion motors.



Speed Control Circuit

Rudder Circuit

This is a conventional rudder unit driven by a six volt electric motor operating a threaded rod and bush, limit switches being provided at each end. Mine are made from old relay contacts which I have found to be very reliable. The whole unit should be mounted on a removable base so that cleaning can be regularly carried out.

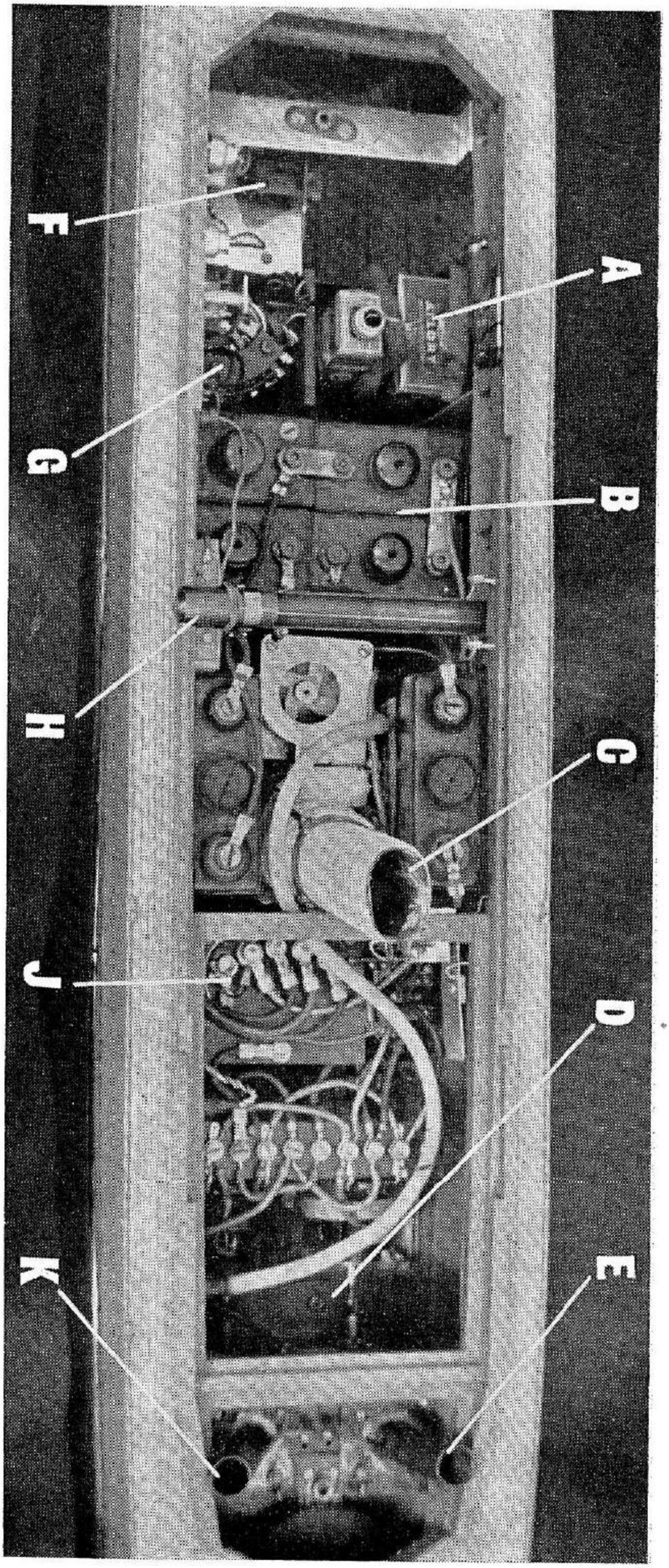
Speed Control Selector

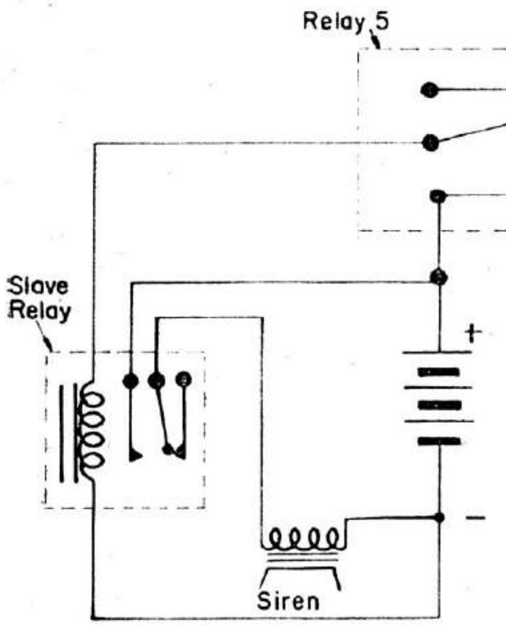
This is a little more complicated since it has to overcome three major problems.

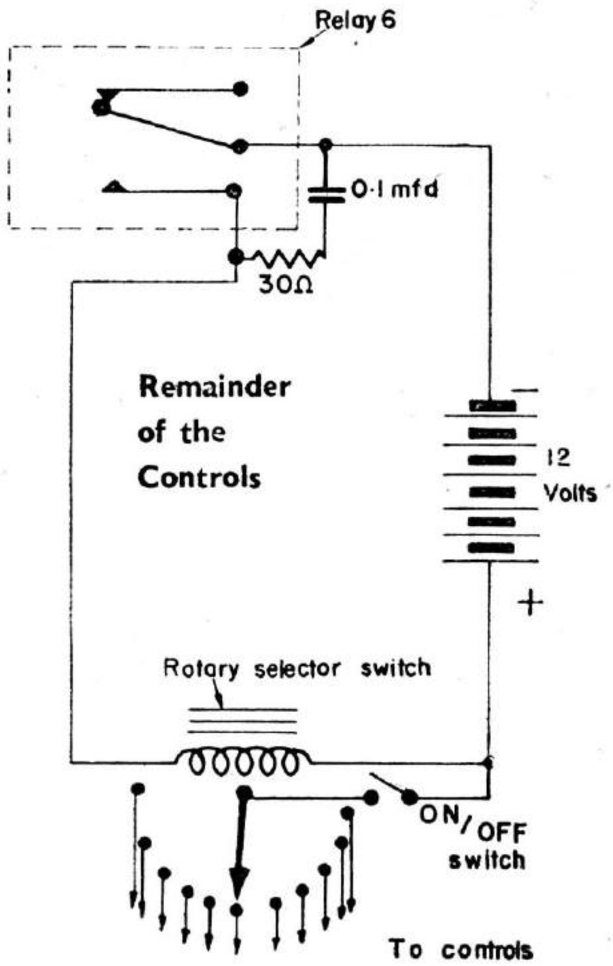
(1) To provide equal current to the propulsion motors, these being two field wound 12 volt Hoover rotary transformers (only the primary windings are used). These were chosen as they give enormous power which was needed to push 50 lbs. of ship through the water.

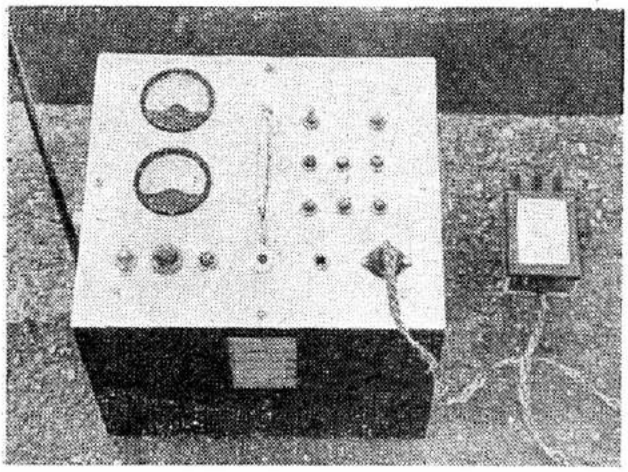
(2) Total current consumption is in the region of 5 amps.

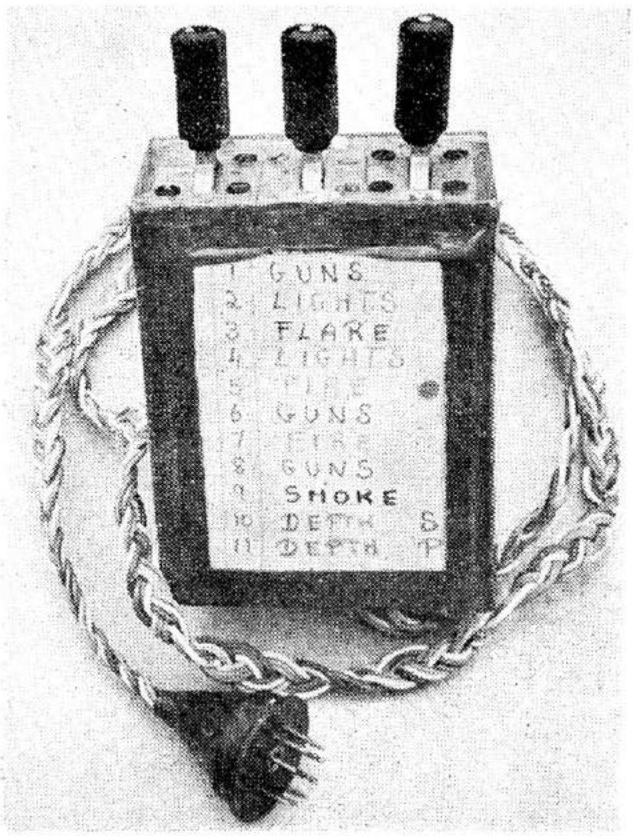
(3) I required some means of reversing the motors. Relays three and four are wired to a 'Ripmax' Mighty midget steering unit, which is driven either to the left or to the right depending on the reed operating. No limit switches are needed because the bush runs off the thread at each end of the run. The bush is coupled to a wiper arm which carries a carbon brush and spring. This runs over five brass contacts which are wired to the main accumulator and various voltages can be 'tapped off' and applied to the











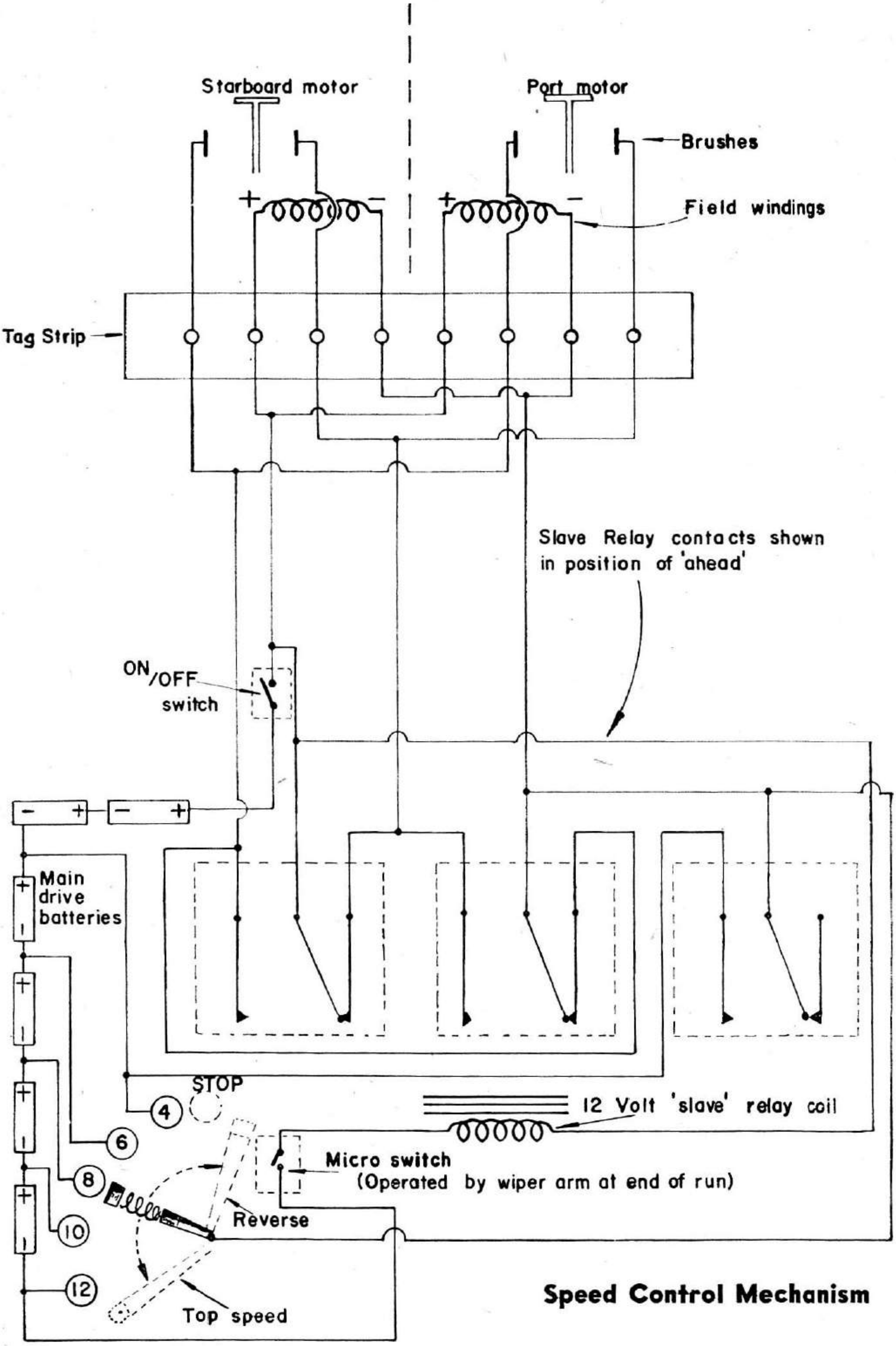
motors. At one end of the run the wiper presses on a micro-switch which causes a 'slave' relay to pull in, this in turn causes the flow of current to be reversed giving a slow astern effect.

The beauty of this circuit is that it is not possible to reverse the motor on anything more than four volts (which is my slowest speed) so that the gears don't suffer, the water screws stay on the shafts and the boat doen't sink stern first. Another advantage in using this system is that it is impossible to suddenly apply the full twelve volts to the motors and so cause the ship to leap forward very unrealistically and dangerously. A 'stop' position is provided between 'slow astern' and 'slow ahead', and with a little practice one soon gets the 'feel' of the controls.

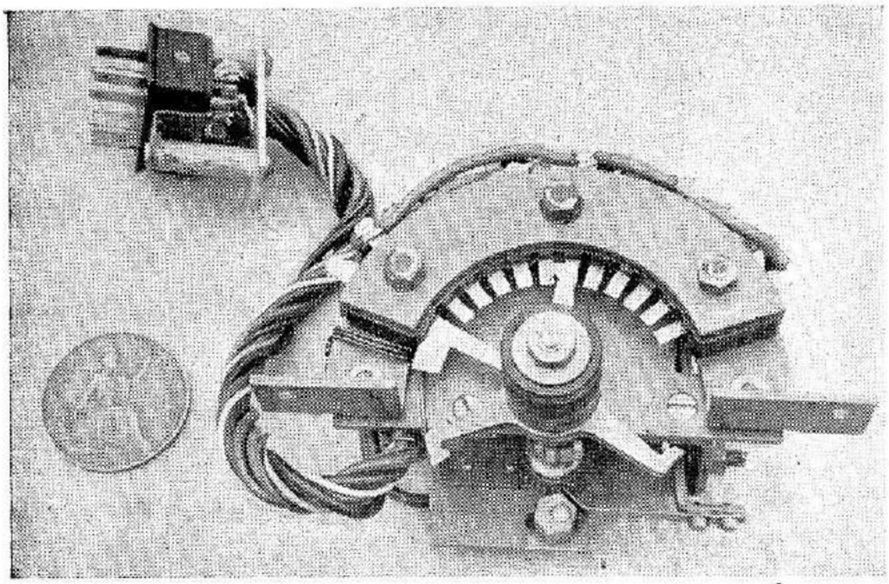
This speed control system was chosen instead of the more usual one of using a variable resistance because I found that with currents in excess of two amps the resistance always overheated and a lot of power was wasted.

COMPACT SIX-CHANNEL CONTROL BOX

Note absence of variable "pots". These being included on the Tx. The position of the rotary selector can be easily seen.



Speed Control Mechanism



The Ex-Government Rotary Selector Switch (two banks of contacts have been removed). These are small, cheap units easily obtainable on the surplus market. They are simple to adjust and reliable in operation. A penny is included for size comparison.

Remainder of the Controls

Relay number 5 is used to operate a siren via a small robust relay (450 ohms). I decided to have independent control over the siren as I thought it would be nice to be able to 'play tunes' on approaching other boats.

Relay number 6 operates an eleven-position Siemens selector switch, obtainable on the surplus market for about a pound. The 30 ohm coil works easily on twelve volts and if required it can very easily be re-wound to pull in on six volts. This switch gives one a set sequence of controls and a list of these must be made and attached to the transmitter. I discarded the upper two banks of contacts but the ambitious reader may like to use these as well. The centre contact is wired to a switch and the latter to the positive end of the main drive battery. The outer contacts are taken via a plug (and resistances if necessary) to the lights, servo—motors, guns, etc., the other ends of which are connected together and joined to the common negative. A spark suppressor *must* be connected across the no 6 radio relay and if possible they should be wired across the other relays as well. Mine consist of 0.1 mfd. condensers and 30 ohm resistors in series. This equipment is fairly heavy and a minimum boat length of 36 in. is required. Correctly wired up this system will operate indefinitely, hardly any adjustments are needed and faults can be quickly located and eliminated.

RECENT NEW EQUIPMENT . . . (from facing page)

tained by bushing the pivot hole with brass, which stands a little proud of the bakelite, the pin goes through this and with washers each side offers minimum of friction, absence of slop usually necessary so that double movement can take place when aileron is deflected. At the moment these are to order only (4/11d. per pair).

Short Notices

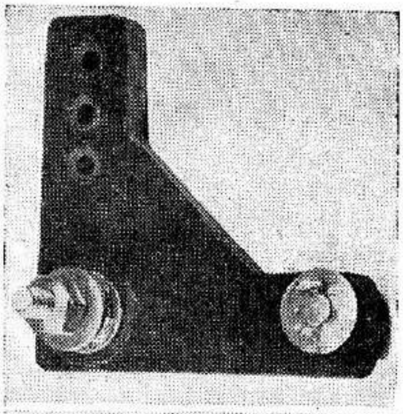
Other items seen recently include Graupner wheels, soft rubber that requires no pumping up and inseparably joined to hubs, which will assist shy types unwilling to ask for those American drugstore specialities which have supported Kazmirski and Dunham machines! Also neat little nylon tail wheel brackets by Bonner, and a magnificent 15-pin plug and socket assembly which is really miniaturised by Crescent of America (15/- from Ed.). Deacs it will be seen from current advertisements are down in price; we also hear that a British manufacturer is releasing similar cells, if not already, in the very immediate future.

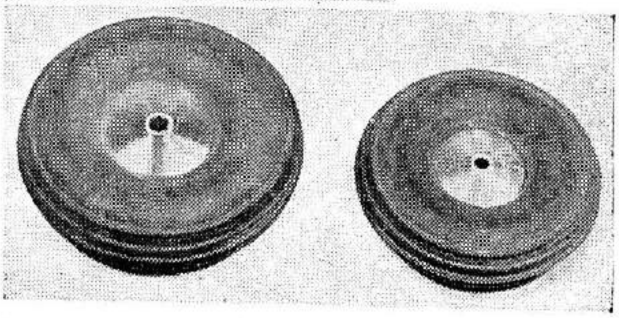
Kilroy was Here !

"The Perrys" of Alum Rock Road, Birmingham point out that in our report of the Wellesbourne R/C Rally we wrongly identified another Birmingham model shop as being in attendance, when, in fact, it was none other than "The Perrys". Customers will already know this, but others should note for the future that this active midland model shop regularly goes on safari to the better model meetings.

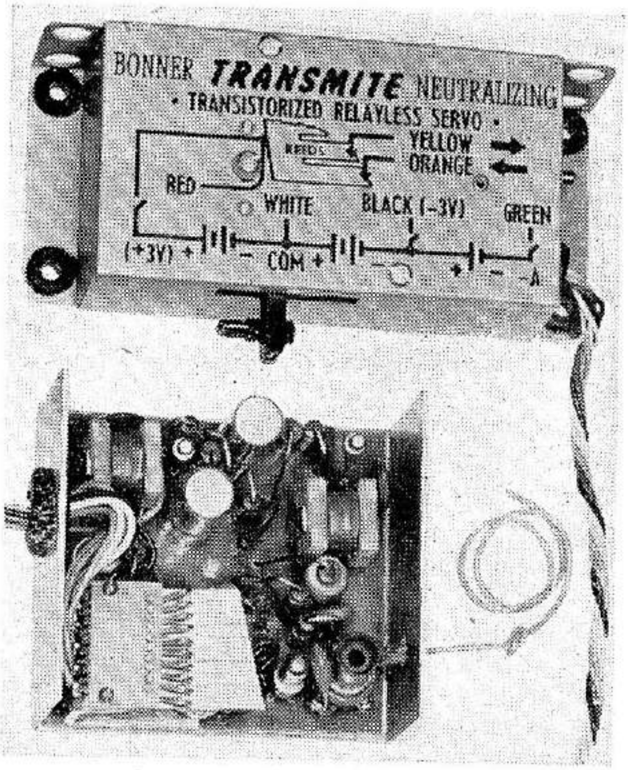
Recent New Equipment

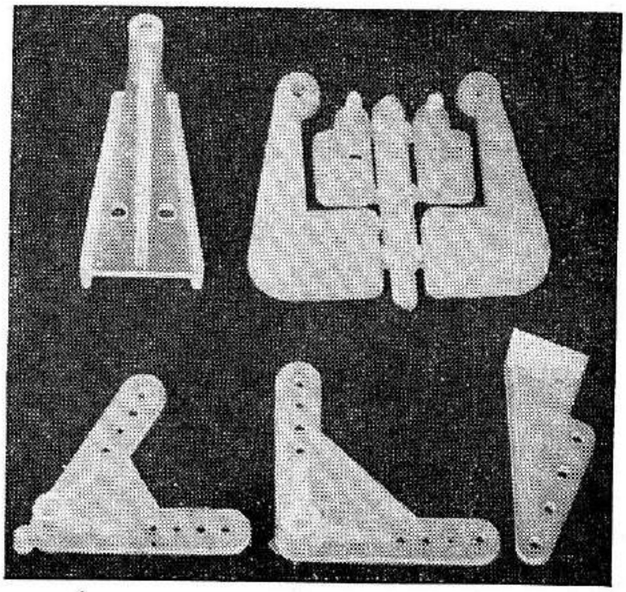
ITEMS OF INTEREST TO OUR READERS WITH PARTICULAR EMPHASIS ON THEIR RADIO CONTROL USE. WE WELCOME SUCH NEW PRODUCTS FOR UNBIASSED COMMENT





TOP LEFT : The new British-made no-bind bellcrank "larger than life". BELOW LEFT : Graupner soft rubber wheels—no blowing up ! BELOW : The latest Transmite relayless servo pictured with a Min-X Rx. BELOW BOTTOM : Nylon parts, including a "tree" of aileron hinges, tail wheel bracket, two angles of cranks and an elevator crank.





No More Relays ?

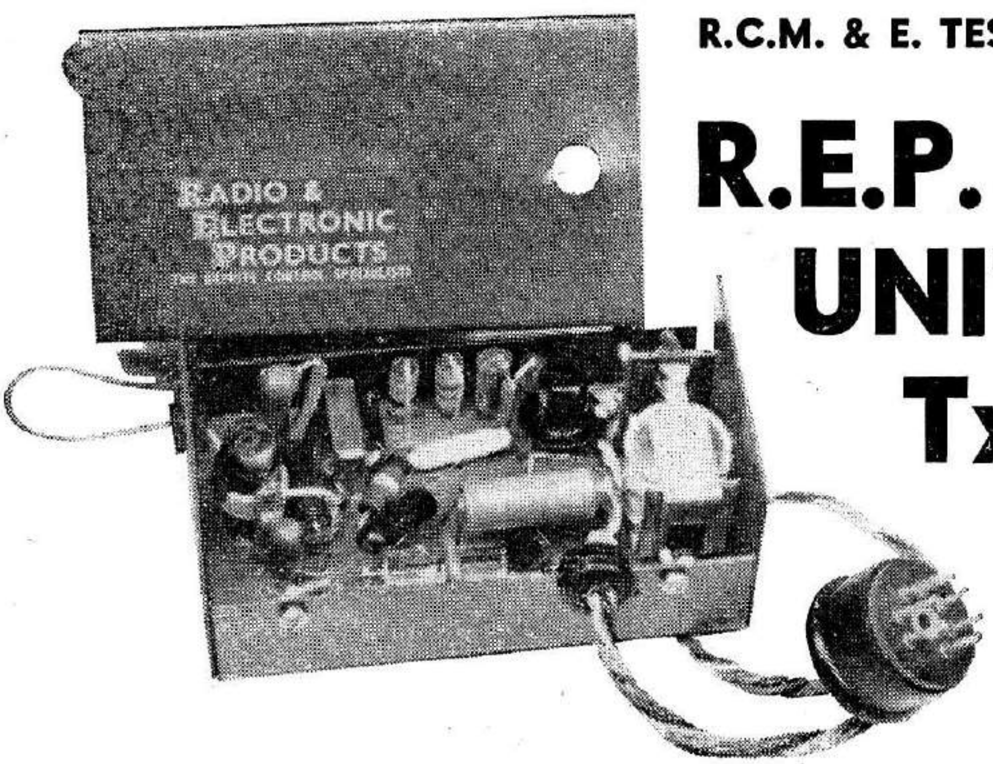
The Bonner Transmite is apparently now on sale as promised, and mentioned in our *News from America* last month. The Min-X radio people draw special attention to the fact that all their multi-channel Rx.s may be used with these relayless servos without changing a thing. Their research department has given Transmites a thorough testing under actual flight conditions and gives unqualified endorsement for use with their equipment —a degree of official approval which may well encourage doubtful starters to spring the necessary £5/5/0 which is their approximate price in sterling.

Bevy of Bellcranks

We have just seen (thanks to Ed. Johnson) examples of the William Bros. nylon aileron hinges and bellcranks. Hinges come as two hinge sets still fixed to their nylon "tree" — the pipe-like piece for attachment to wing, the smaller squarish piece having a moulded-on hinge-pin goes on the aileron. The nylon aileron bellcranks are available in 60° and 90° angles, again sold in pairs. A series of attachment holes varies up and down movement in a wide range of permutations.

Also from Ed. is a bakelite and brass prototype of a British made "no bind" aileron bellcrank, which whilst not so "pretty" as the nylon jobs from America has the merit of super efficient operation. The no-bind aspect is ob-

[Continued on opposite page]



R.C.M. & E. TEST REPORT No. 5

R.E.P. UNITONE Tx & Rx

A review of this popular equipment conducted jointly by Tommy Ives and Dave McQue.

UNITONE was first reviewed in the January, 1960, *Aeromodeller*. The equipment supplied for this test from current production incorporated some modifications and improvements.

The Tx. is little changed beyond the use of a steel case in blue hammer finish. The appearance whilst not up to the eye appeal of current continental equipments is neat and workmanlike.

Circuit includes a single value RF oscillator using a 3V4. This is coupled to the aerial inductively and although there is no provision to load the oscillator fully there appears to be ample RF output to meet all requirements. The RF oscillator is modulated by a DK-96 in a Dynatron circuit in which a subminiature choke is included in the second grid circuit. This method is standard in all tone transmitters produced by R.E.P. and has been found to be extremely stable for reed work. Its inclusion in the single-channel version is merely to conform with the standard circuit and provides a reliable source of modulation.

Input power is approximately 1.5 watts and the output is ample for all needs.

The Rx. is now assembled on a printed circuit board and is of much neater appearance than the previous tagboard model and is somewhat more mechanically sound.

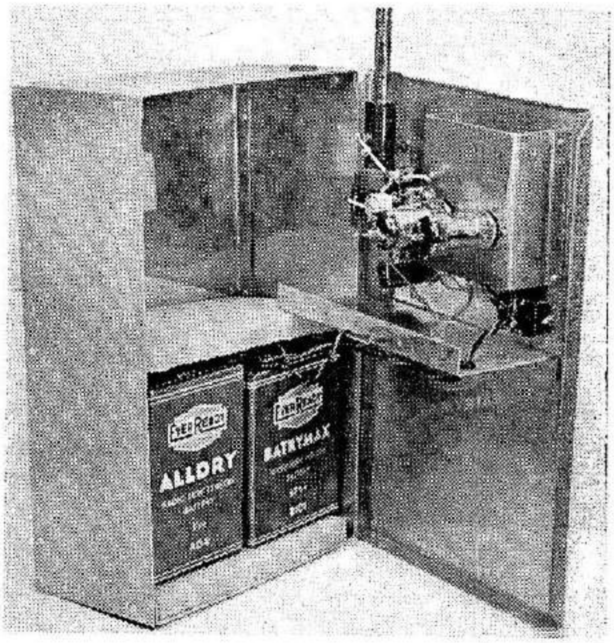
The circuit is a hybrid using a valve super-regenerative detector followed by two transformer-coupled transistor stages. The new R.E.P. ½ oz. relay is in the final circuit and is set to make contact at 2.8 m.A.

We decided to check the equipment initially by treating it as tyros might. Batteries were installed following the instructions supplied and the Rx. and its aerial laid out as in an aircraft. No adjustments were made (or were necessary) at all worked straight off to a range of 500 yds. plus. Tired feet not loss of signal concluded this test. Advice to other beginners is to leave well alone and follow this method taking the line that no adjustments to Rx. tuning should be attempted unless proved necessary. If our results are not duplicated it would be well to have the Tx. frequency checked before disturbing the Rx. as the possibility of either being upset during transit, whilst small, is an even chance.

The Tx. is not Xtal controlled but as received was in the band the out frequency in common with all Tx.s of this kind does vary with aerial length, etc., but not sufficiently to produce out of band working. It is advisable, however, to have its frequency checked every so often and especially if V2 has to be charged. We are informed that a Xtal controlled version is also available and for those who may not have easy access to frequency checking facilities this is to be highly recommended. No interference with TV was evident.

The 400 c/s modulation as seen on an oscilloscope was virtually square wave—100% plus. The works are assembled on a rigid aluminium chassis,

Neat Rx. appears opposite with top removed from its all enclosing case. On the right is the Tx., now newly housed in a robust grey hammered vitreous enamelled steel case, and enlivened by a handsome maker's escutcheon.



but the soldering whilst secure was not as clean as we have come to expect from George. The aerial coupling coil was rather loose as the securing cement had come unstuck.

The Rx. follows good design practice and compares favourably with other current models for sensitivity and temperature stability. It is not prone to overload or instability at close range—a not infrequent fault with others. The only fault we could find was that it would not pulse over about 4 c/s however, specially adjusted models can be obtained for use with pulse systems such as Galloping Ghost. This is no disadvantage with escapement working and spurious operation by interference pulses is less likely.

Minor criticisms are as follows. The absence of transmitter switch markings which is being corrected by the inclusion of an engraved escutcheon. The flexible leads are not anchored at the point of connection. Relay adjustment is a little coarse and in view of the change of 3 m.A. care in setting up is desirable, although not normally necessary.

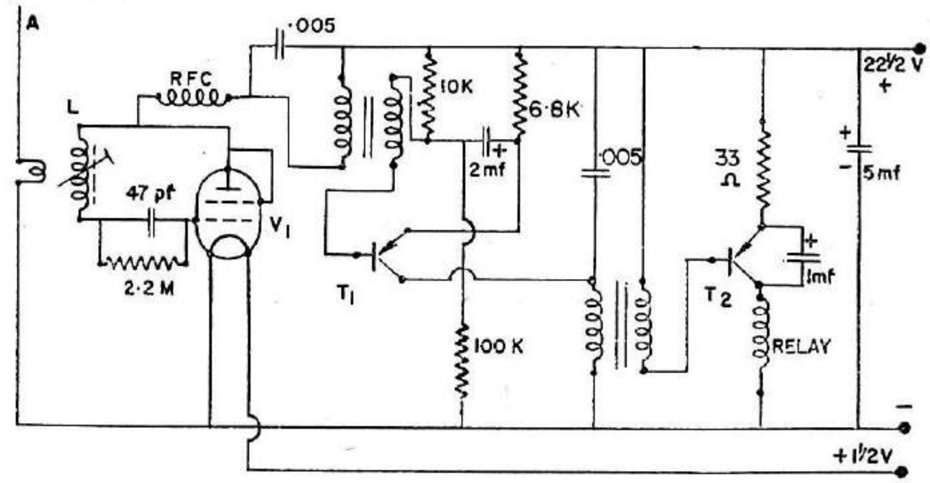
Specification

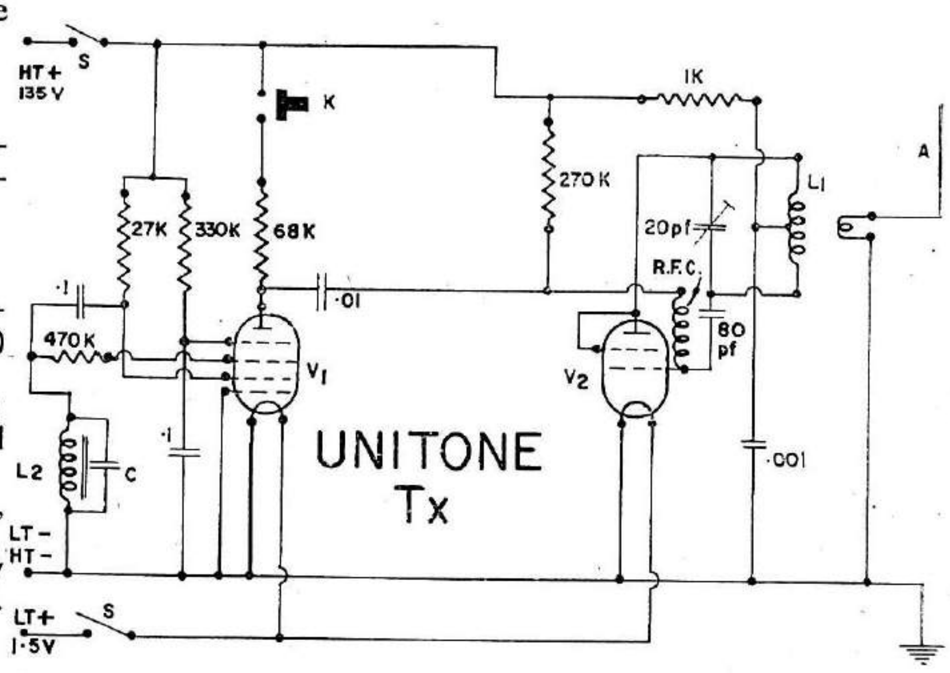
Transmitter :

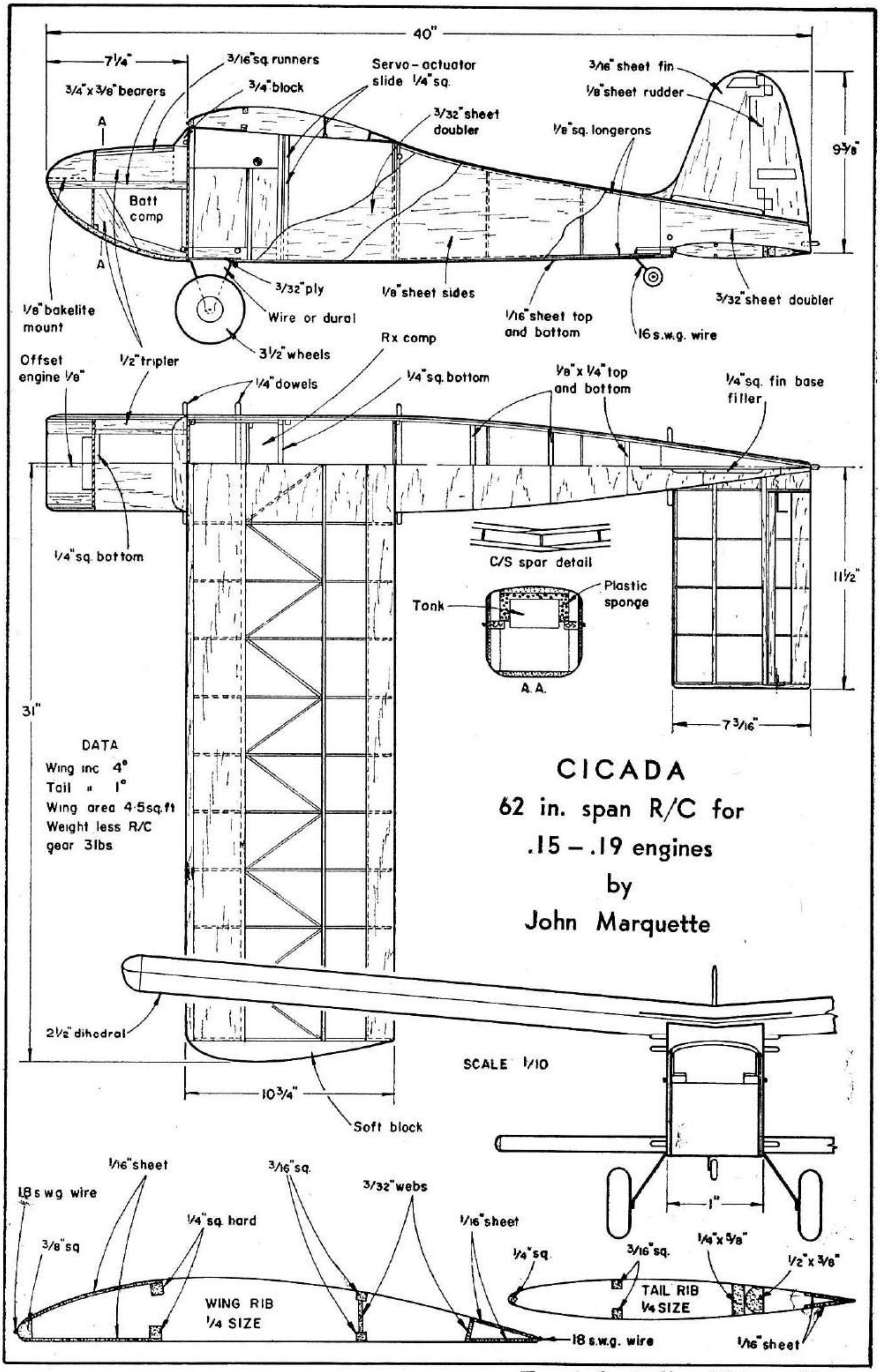
Single valve RF oscillator (3V4) modulated by a Dynatron L.F. oscillator (DK96).
H.T. voltage 135 (two Ever Ready B101 batteries).
L.T. voltage 1.5 (Ever Ready AD4).
Total L.T. current 125 m.A.
Total H.T. current 9 m.A.
Total H.T. current (no modulation) 10.5 m.A. Price £9/3/0.

Receiver :

Valve super-regenerative detector followed by two transistor A.C. coupled amplifier.
H.T. voltage 22½ (B122).
L.T. voltage 1.5 (pencell).
Total standing current (no signal) 1.2 m.A.; (signal on) 4.2 m.A.
Standing current (final stage): (no signal) .3 m.A.; (signal on) 3.4 m.A.
Relay opens at 1.8 m.A., closes at 2.8 m.A.
Weight 3 oz. complete. Battery weight 1⅝ oz. Price £7/7/6.







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by

John Marquette

From Australian MODEL NEWS

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V15/20-IP (Newmarket Ltd.): This excellent power transistor combines small size with high gain and high current capabilities. It is the ideal transistor for direct actuator operation. H.T. power converters for transmitters, etc. Price, complete with mounting clip, **18/6.**

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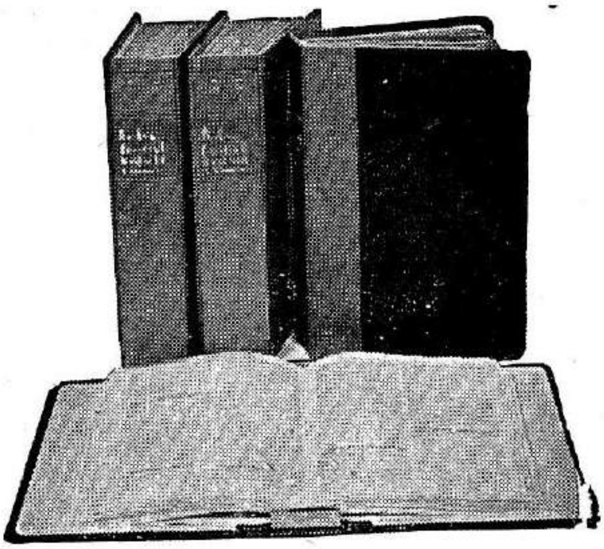

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