Radio Control Models & ELECTRONICS

JUNE 1960

Free Inside

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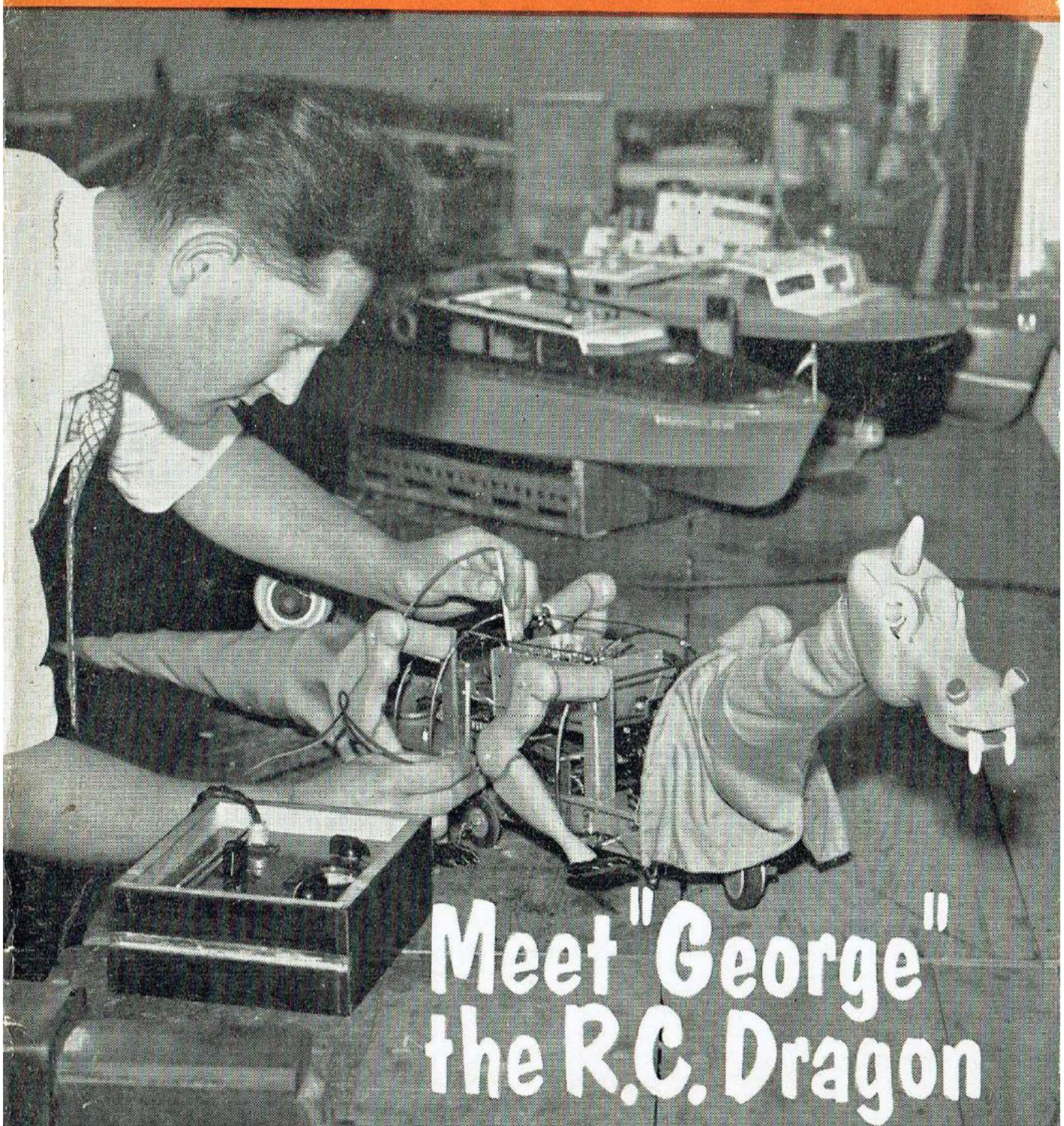
★ ★ ★

McQUE TONE GENERATORS

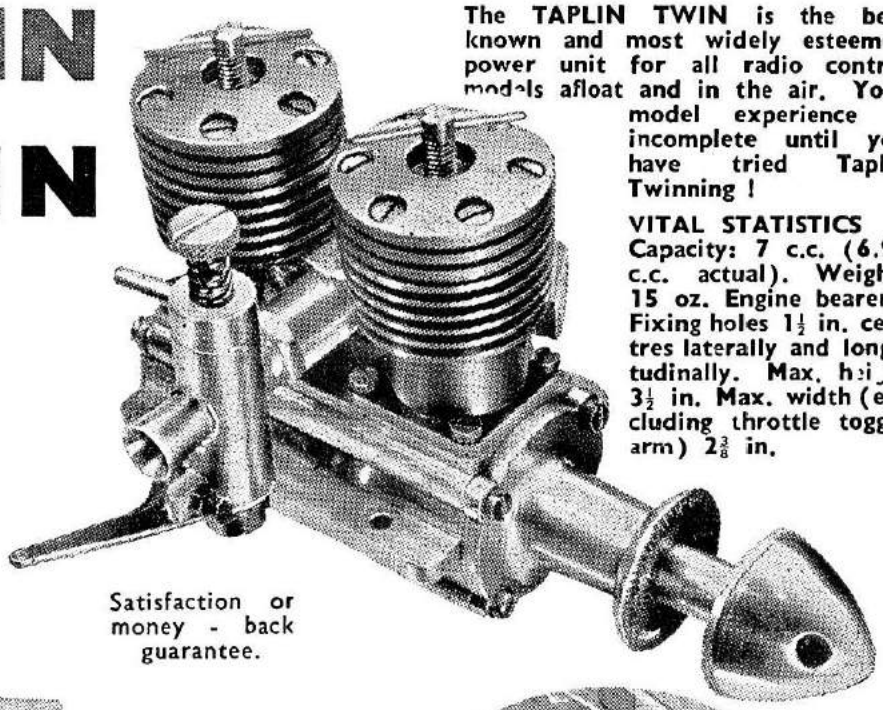
PRICE - - TWO SHILLINGS



Meet "George" the R.C. Dragon

TAPLIN TWIN

THE MOTOR FOR ALL R/C JOBS!



The TAPLIN TWIN is the best known and most widely esteemed power unit for all radio control models afloat and in the air. Your model experience is incomplete until you have tried Taplin Twinning!

VITAL STATISTICS
Capacity: 7 c.c. (6.92 c.c. actual). Weight: 15 oz. Engine bearers: Fixing holes 1½ in. centres laterally and longitudinally. Max. height 3½ in. Max. width (excluding throttle toggle arm) 2⅜ in.

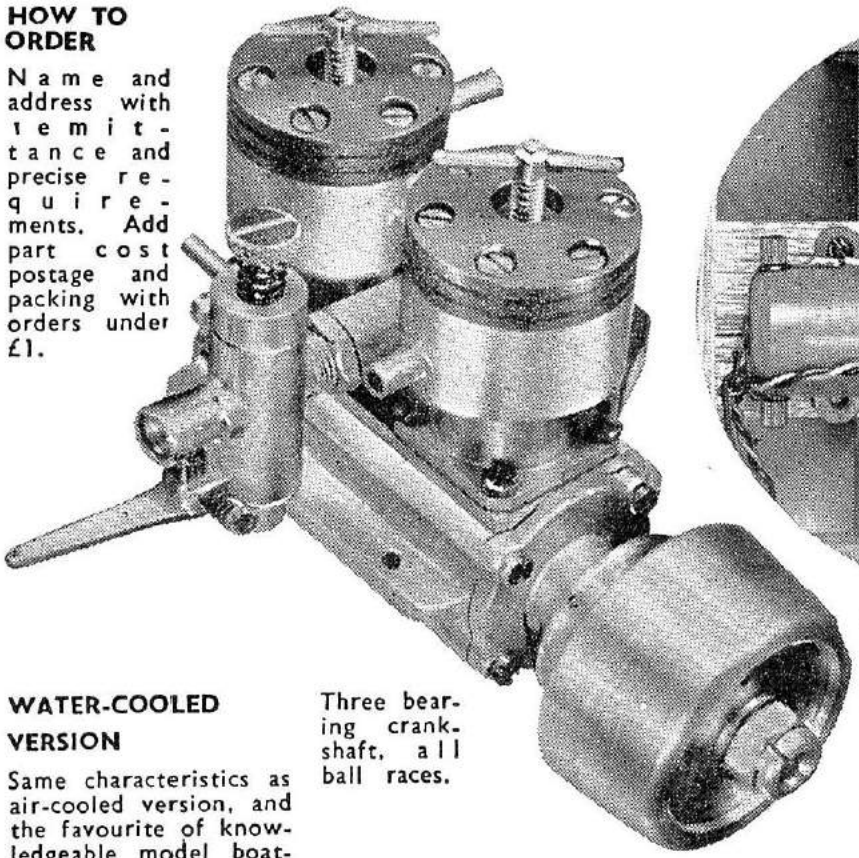
AIR-COOLED VERSION

Easy to start, with speed range of 500/7000 r.p.m. Infinite adjustment of barrel-type carburettor. Quiet and clean running, in either direction. Simple to adjust, rigidly mounted, vibrationless in action. Runs on simple diesel fuel formula. Price **£8.12.0d.** (Inc. P.T. post. and pkg.)

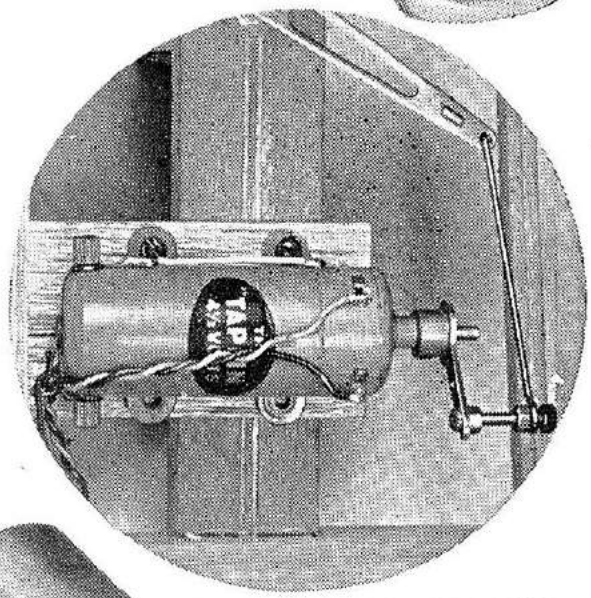
Satisfaction or money - back guarantee.

HOW TO ORDER

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



Three bearing crankshaft, all ball races.



SINGLE CHANNEL ACTUATOR

Specially designed for single channel operation. Optional right or left turns and self-neutralising without mark-space complications. Connected direct to relay in circuit with 4½ v. battery one key gives one turn; two the other; no signal neutral. Movements at 90° and 270°. Powered by Taplin Micro-geared motor Suitable for boat rudder or engine control, etc. Price : **54/-** inc. P.T.

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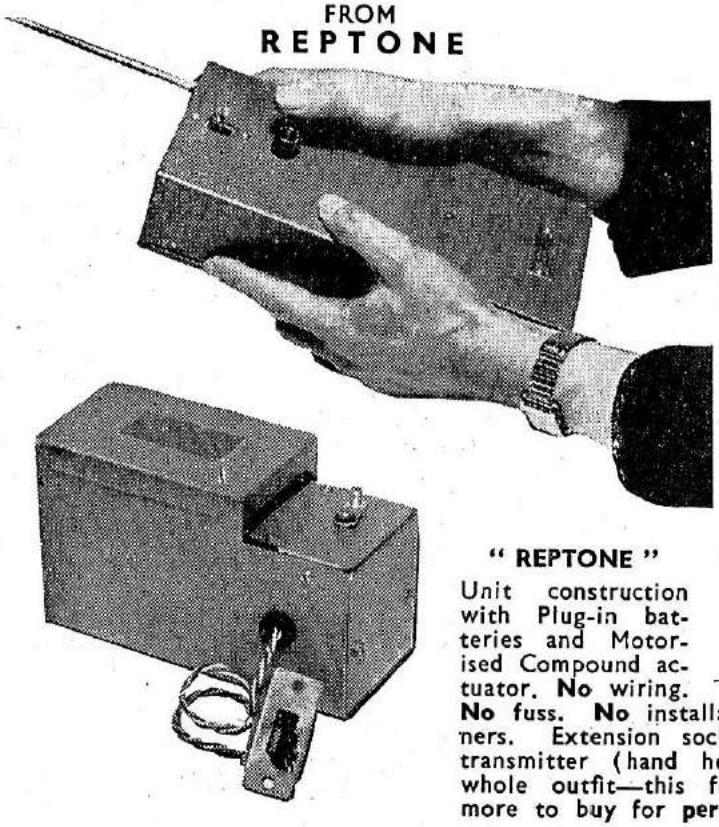
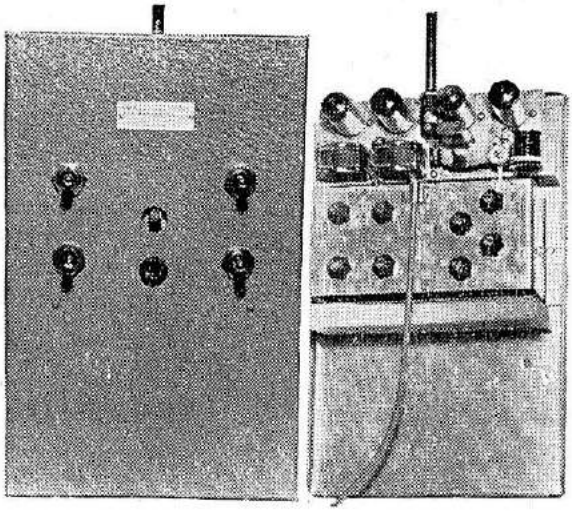


TO
OCTONE



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Unit construction with Plug-in batteries and Motorised Compound actuator. **No** wiring.

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"UNIAC" motorised **44/-.** "MINI UNIAC" motorised **52/-.** "OMNIAC" motorised for single or multi **60/-.**

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FOR SINGLE CHANNEL

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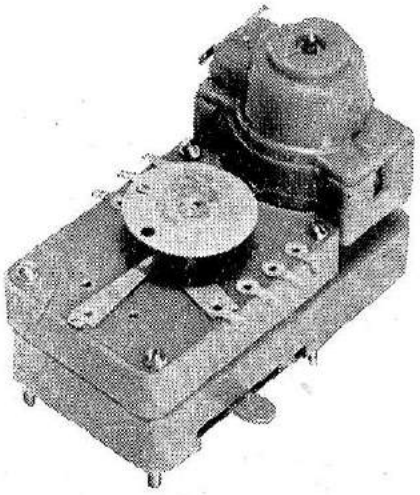
MICRO 4



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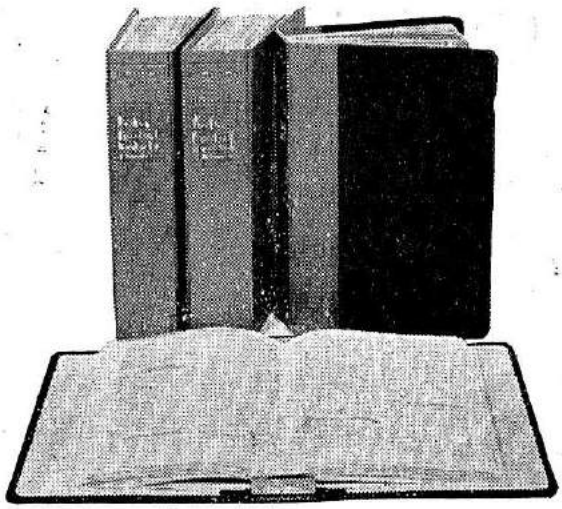

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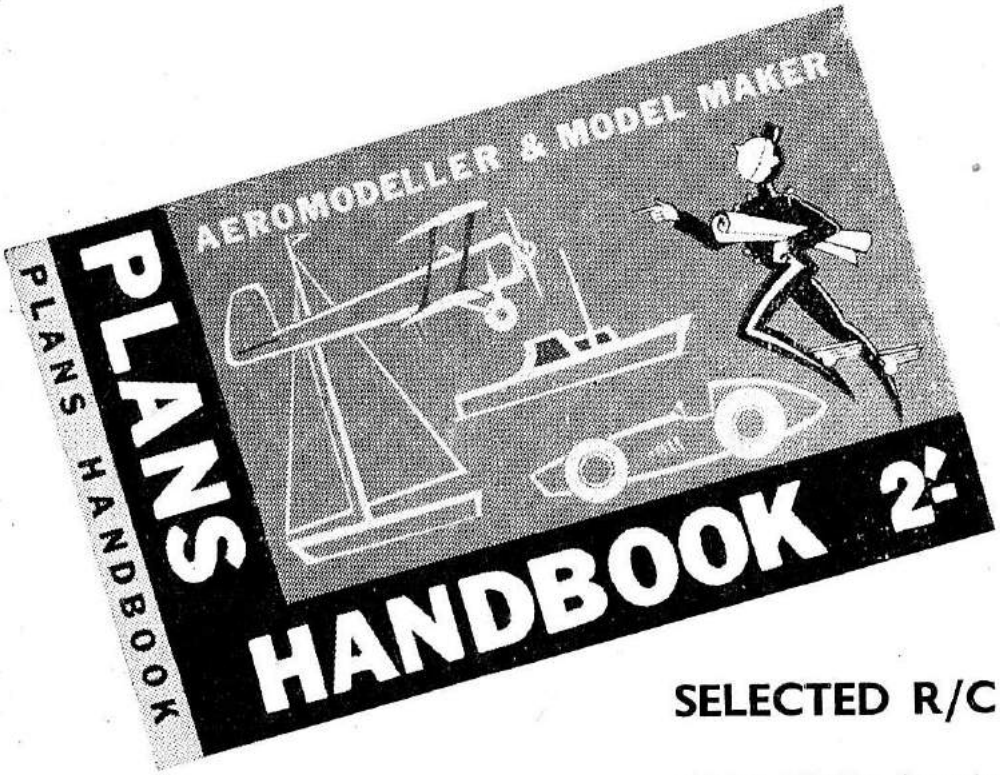

160 PAGES

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AEROMODELLER & MODEL MAKER PLANS HANDBOOK is more than just a catalogue, it is full of useful articles to help the newcomer to the hobby, in addition to the many hundreds of proven designs of aircraft, boats, cars, etc., that have been sold and built in their thousands all over the world. Whatever your interest there is sure to be something in it to rouse your building instincts and set you to work. Every model is illustrated and even if you decide on a design of your own in the end, there is more than enough material to provide you with hosts of suggestions.

You can get your copy from most model shops, or wherever you get your copy of this magazine, or we will gladly send you one if you let us have name and address together with postal order value 2/-.

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

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Jap Silk 6/- per sq. yd. O.M.U. 3-channel TX crystal control £20. New Engel 7 x 9, 7 x 8, & 9 x 6. Metz 3-channel outfit £40. Polished wooden props 3/- post 6d.. Discount for six or more. **Tornado Nylon :** 9 x 6, 6/9d.; 10 x 6, 6/9d.; 8 x 8 and 7 x 6, 5/-. Post 6d. extra.

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Radio Control Models & ELECTRONICS

VOLUME 1 NUMBER 2 JUNE 1960

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CONSULTING EDITOR : T. H. IVES.
Advertisement Director : C. S. Rushbrooke.

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38 CLARENDON ROAD : WATFORD : HERTS
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Here, There & Everywhere

Thank You Everybody !

WHAT a truly magnificent welcome you have given us! Many of you have written to say how much you like our new baby, with no other thought behind the letter, than to say, thank you. Others have taken the opportunity of writing on the same lines and added constructive suggestions for future features. Our trade outlets, the model shops, the newsagents, the book shops and the wholesalers have encouraged us immensely by initial support that was virtually 'blind', followed by quick repeats when they realised that the public really did want to buy copies! We should be less than human if, like Liberace in a somewhat different context, we did not find wholly satisfying the sweet music of the cash register. Thank you, one and all. In the months to come we shall endeavour to provide a mixture that will keep most of you happy.

Of course, there have been certain extremes of opinion ranging from the boffin who found it 'kid's stuff, just useless' to the eager but unversed few who found some of it rather over their heads. We must have something for both these groups and for the hosts of ordinary people in between, and this we shall labour to obtain or produce. One very sensible fear expressed by a reader was that we might lean over too much towards the aircraft section of our readership. We have no intention of doing this. Aircraft enthusiasts are still the largest single group interested in R/C, but are by no means so much larger than the boat enthusiasts as they fondly believe, if our statistics mean anything. A great deal of material is, happily, dual purpose in that it can apply equally to anv form of model use, but the special needs of the boat brigade will certainly be covered, and Vic Smeed is here to see that they are.

Shark Ho !

On the subject of sampling techniques, we like the story told in the 2nd R.C. Symposium, of the contestant in the Florida Orange meeting, who wanted

CONTENTS

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to swim though warned of sharks. He decided to investigate first hand, dipped a pail of water and found no sharks, and so concluded he had been misinformed. After his swim, minus one leg, he realised he had drawn the wrong conclusion from such meagre data. All was not lost, however, as with proper matching, coils, his new 'leg' has proved to be a most efficient quarter wave aerial!

Transistor Prices

A lot of people still think transistors are financially beyond them, though they would like to enjoy the battery economies and other advantages that their use would permit. With this thought in mind we took the opportunity of checking a few prices of more popular types with Mullards, who give us the following retail selling prices: OC 70, 14/-; OC 71, 14/-; OC 75, 15/-; OC 76, 15/- and OC 170, 35/-. Those who prefer the Newmarket range can enjoy similar prices with comparable transistors. One or two suppliers offer still lower figures though except from reputable firms they should be accepted with caution on the old principle that you only buy what you pay for!

Midland Maestros

Sutton Coldfield Radio Control Model Aero Club has completed its first year of existence with an annual dinner and forty active members — only four without planes—so that they must even begin to think about restricting membership. Special talents include production of a one-and-a-half times up Gasser by president G. A. V. Marsh, and a special o/d single channel job which has proved the ideal for gale flying by John Pearson. Nor is this all, for they even possess a club artist in the shape of W. R. Plumley who produced the cartoon appearing below. It first saw the light of day in the local paper, which again is one up for the club P.R.O. Club notepaper is embellished with a most elegant winged valve in two colours, again evidence of an artist at work. Good luck Sutton!

Radio Control Photography

Life photographer Joseph Scherschel is engaged on a project to fascinate readers. He is working on a camera mounted aboard a racing car to be triggered by radio control during the race when safe and sound on his two feet

" You were right dear, it ISN'T metal! "

he can see something promising looming up. Initial trials were scheduled for the recent Sebring meeting, but alas unforeseen delays have put off trials and it will be later in the year before we can see results. Joe confirms that radio parts are as available to American modellers, but highly refined to have longer than usual range and minimum interference. He promises more details after a successful tryout.

Instone Air Line DeH 34

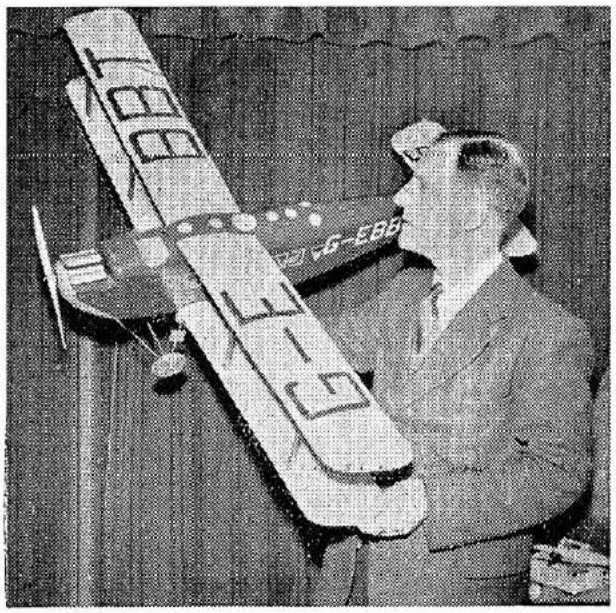
South Coast R.C. Model Society Hon. Secretary R. P. Brown sends us a picture of his De Havilland 34 in Instone Air Line's colours of blue fuselage and silver wings, nostalgic memory of his early spotting days at now defunct Croydon Aerodrome. With balsa sheeted fuselage and span of 51 ins., it has a Mills 1.3 Mk. II installed and weighs 1½ lbs. Radio is yet to be fitted and will probably demand a somewhat more powerful engine.

Dubendorf Prospects

Excitement mounts as the July 23rd-24th date for the World Championships approaches. The Swiss Aero Club has announced that it cannot assist spectators in obtaining accommodation—which is only fair: and this in turn releases the information that onlookers *will* be able to enter the military airfield at Zurich. Teams, consisting of three competitors, three mechanics and a manager will be arriving on the 22nd with the contest running over two days. There will be a strong several car-load contingent of British "supporters" travelling over for the weekend to enjoy the skills of the world's best multi-flyers.

Hans Schumacher has his proportional 10-channel Polyton installed in a semi-scale Me 109 (Ruppert 8.5 c.c.) and is a likely performer for Germany. The British team will be selected at Wigsley over May 21st–22nd. Czechoslovakia may send her first entry into International R/C. Russia may well reappear after missing the last two years' Internationals, and the U.S.A. team now has the assurance of U.S.A.F. transport over the Atlantic.

Meanwhile we cannot expect the victorious Swiss hosts to be resting on 1959's Laurels, so we can anticipate great things in the permitted 13.56, 27.12 and 40.68 mc/s frequencies.



R. P. Brown with his De Havilland 34 soon to blossom forth with R/C equipment.

No April Fools These !

April 1st found North London M.E.S. headquarters packed with over seventy members to hear Mullard's Norman Kyte supported by Leslie Kemp lecture on radio control. Block diagrams on a blackboard were used to show progress from the simplest single channel rig to ten channel simultaneous equipment. Other novelties included an all transistor receiver with a current rise of 10 m.A. which could be thrown to the ground without damage and a six-channel filter unit with a rotating search switch enabling any channel to be selected at will. The latter could do the normal six-channel unit's job with only one filter and relay. Marine and Aero sections of the society had gathered a fine selection of models on display and their inspection rounded off a splendid evening. Talks such as this over the past twelve months have been a part of North London's policy, and growing interest in R/C work and models generally point to their immense value.

Eggheads Only !

That LARK's bomb dropping contest mentioned last month produced one entry dropping raw eggs! No hits intentional or otherwise were scored—perhaps a pity—but nothing was wasted as local dogs lapped up the lot. Those intent on trying should use egg-sponent

Dale Nutter's method of fixing with sellotape round egg and hook to release. Egg Marketing Board's proposed new Sales Promotion Man may like to promote a special contest.

Swings and Roundabouts

The Model Power Boat Association is disturbed by the rapidly dwindling interest in R.T.P. hydroplanes. As anyone attending regattas must notice, radio boats are growing fast, and though the hobby is attracting many new recruits, a good proportion of the old hands are turning to R/C. A scale type boat, with radio switched off, can be run in a nomination or steering event, so that entries for these events keep up, but the hydroplane man turning to radio is a complete loss from the pole-running side of things. No doubt speed craft, racing under radio, will eventually develop where suitable waters exist, and will to some extent take the place of the disappearing tethered model.

Peace

With considerable satisfaction we note that engine manufacturers are making some slight moves towards helping the boat enthusiast to keep his boat (and his equipment) free of exhaust oil and fumes, as well as enabling him to reduce noise nuisance.

Three recently introduced engines, the Frog 3.49, the re-designed E.D. Super Fury 1.5, and the 1 c.c. M.E. Heron, are fitted with exhaust stubs as purchased, making the addition of exhaust pipe, silencer, and oil trap a fairly simple job. Let us hope that other makers will follow this sensible lead—after all, silencers and traps are mandatory on all L.C.C. and some other waters, and with the Noise Abatement Bill moving towards its final stages, few boatmen will be able to run at all without properly equiping their boats.

Twin Boats

Experiments are going on with boats equipped with twin diesel engines—for example, we know of two models each fitted with two Taplin Twins — twin Twins. Apart from sheer speed, this idea seems to have few advantages, though we have seen an astonishingly manoeuvrable French model, electric powered, with steering effected by independent motor speed control. It seems that even for speed work, twin motors can produce headaches, most of which stem from interaction between the propellers which are, of course, relatively larger than the screws used on full-size craft. Quite a lot of experimental work must be done before the additional power of two motors can be used effectively.

Our Dutch Correspondent "Windy" Kreulen has a cine session with the newsreel company intent on capturing a R/C story.

Alligator No Match

In preparing our Dragon feature we thought how nice to have another creature to keep George company, and remembered Diana Dors' co-star in the film "An Alligator named Daisy". Effects department at Pinewood had only too vivid recollections of it all, and told us how the studio lights during a day's shooting brought temperature from 60° to nearly 100° with evil effects on the R/C alligator (and this before transistors!). Alas, for pictures though, plenty of Diana, none of Daisy . . . she lacked those vital box-office statistics!

British Trans'stor Receiver

Next month's all transistor receiver designed by Dave Cuttriss will appear with step by step building instructions. Test made by staff member *who had never — repeat never — built any R/C equipment* produced a working RX straight away so we offer it with confidence to all near novices.

". . . live in glass (fibre) houses . . ."

Overheard at Easter was this description of a certain well-known R/C flier's model as "like a flying rockery covered in Fibreglass!"

D.E.A.C. Cells

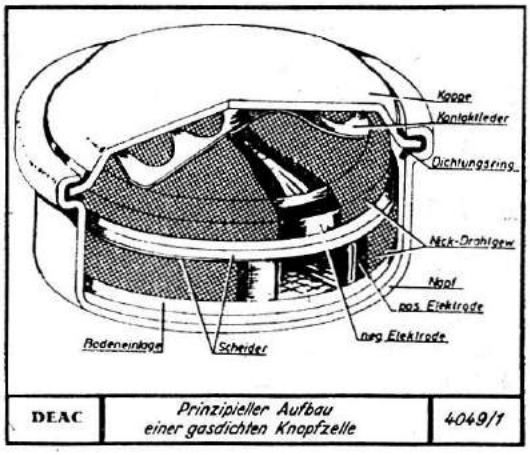
Use, Care and Charging

By Ed. JOHNSON

Capacity and Voltages Definitions

To avoid confusion, I'll call each individual unit a cell, but when we want to increase voltage or capacity a number of cells are joined together to form a 'battery'.

The next bit is not for 'I knows', but is Lesson 1, to explain to beginners about 'capacity and voltage'. Example: A free-running motor connected to 1 Deac 225 DK. runs at 2,000 r.p.m. The speed of this motor is determined primarily by the voltage applied to its terminals. More voltage = more revs., less voltage = less revs., so our motor will keep running at 2,000 r.p.m. as long as the voltage remains at 1.2 for say one hour, but as this drops so do the revs. The ability of our cell to MAINTAIN this voltage is known as its capacity. To increase the ability of our cell to maintain 2,000 r.p.m. we add another similar cell in PARALLEL with it connecting positive to positive, negative to negative, and we have a battery which will, broadly speaking, maintain 2,000 r.p.m. for twice as long, i.e. two hours. To increase the SPEED of our motor, we must increase the voltage applied to it, so we connect another similar cell in SERIES. With the original, i.e. original cell negative to new cell positive. Now we have a battery which for the purpose of this explanation is capable of driving our motor at twice the speed, for one hour. (Now that you 'I knows' HAVE read this, DON'T write to me about increased voltage means increased current means shorter duration—I know!).



D.E.A.C. (Deutsche Edison-Akkumulatoren-Company GMBH) official works drawing of the cell. Legend—Kappe: cap; Kontaktfeder: contact spring; Dictungsring: gasket; Nick-Drahtgew: nickel wire gauze; Napf: cup; pos. Elektrode: positive electrode; neg. Elektrode: negative electrode; Scheider: separators; Bodeneinlage: base filling.

What is a D.E.A.C. ?

A DEAC is virtually a 'dry' cell, with all the advantages of an accumulator. It requires no maintenance, apart from re-charging, because it is completely sealed. It has unlimited storage life, is not affected by temperature in the range—40° F. to + 190° F., nor by vibration nor 'G'.

It is particularly suited as a source of power for model control equipment, measuring and testing equipment, miniature electric toys, portable radios, flashlights, electric razors, hearing aids, clocks, etc., because, during discharge, they produce a constant voltage, and it can be recharged, very easily, more than 500 times. So, although the initial cost is higher than the normal 'dry battery', in the long run it is much cheaper and far more convenient. It is now normal practice to 'build' the batteries (if welded) into the model or equipment for which they are needed, with no provision for access to them, or their removal. The only indication of their presence is the 'charging socket' on the side of the model. This built-in feature is especially useful when using modern transistorised equipment (an Ultraton type receiver needs only one 6 volt battery supply which can also be used to provide actuator power) because it does mean increased simplicity and reliability.

The voltage obtained from one 'cell' is 1.25 V., in comparison with 1.5 V.

from a dry battery, but individual cells may be soldered together (using a hot iron quickly applied, so as not to heat up the complete cell), thus increasing the voltage to the required total. Alternatively, button types are available spot welded together—as required—at extra cost.

Deacs—in production at the moment, are of three main types:

(1) Disc-cells, of 50-450 milliamps per hour capacity commonly called 'button type'.
(2) Tubular type, 450 milliamps per hour capacity and over. In appearance, like a dry cell.
(3) Rectangular type from 2 ampere hour capacity to 23 amp/hour capacity.

The cheapest and lightest are the button type, available in the following capacities expressed in milliamp / hours 20, 50, 100, 150, 225, 450. The estimated output of say a 225 type, designation 225 DK, is 225 milliamps at 1.2 volts, for one hour, or 22.5 m.A. for 10 hours continuously, but these discharge currents can be exceeded by three and four times for short periods when operating model control servos, without damage.

The two most convenient sizes, for aircraft use, are 225 DK at 4/11d. each, dimensions being 25 mm. diameter × 8.7 mm. high, weight 0.44 ozs.; or 450 DK at 6/11d. each, size 43 mm. diameter × 7.3 mm. high, weight 1.16 ozs.

For most models, 225 size is most suitable capacity / weight, though for land vehicles, or boats 450 DK in this series, or even tubular or rectangular types could be used.

My preference is for 225 DK and at present I am using 5 cells (specially welded and sleeved at extra cost), for actuator operation (Babcock, Micro 4, Rising, Elmic, E.D., Mactuator), and 6 × 225 DK, welded, sleeved and centre tapped for use with multi-channel servos giving 3.6 V. each way suitable for Bonner DURAMITE, R.E.P. UNIAC, Olsen, or E.D. servos. An objection to welding cells together has been 'what happens if one cell is damaged' but this has never happened in two years of use and if it does it is a simple matter to remove the dud, insert a new one and either solder it to the others or make up a 'battery' holder.

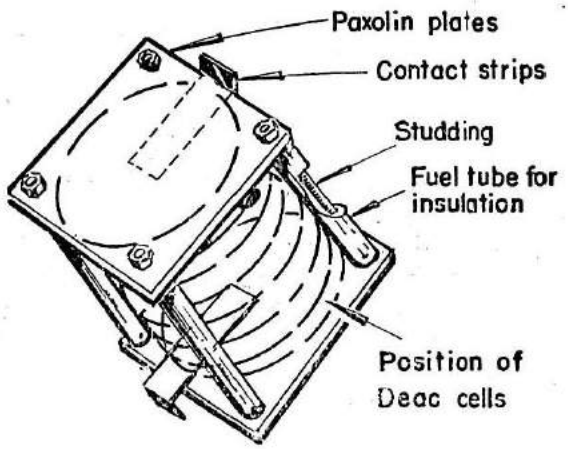
A simple battery holder, consists of two end plates of paxolin or similar, four lengths threaded rod, four lengths fuel tubing as insulators, phosphor bronze strips for contacts, and eight nuts. The end plates are square, slightly larger than the diameter of the Deacs, and have a hole in each corner for the rod. Cells and contact strips are clamped in position, positive of one cell to negative of next with thin smear of vaseline on each 'face'. Nuts should be tight enough so that Deacs cannot move, but overtightening will dent the Deacs. I recommend you to 'take down' this assembly every three months to ensure 'no corrosion' between cells.

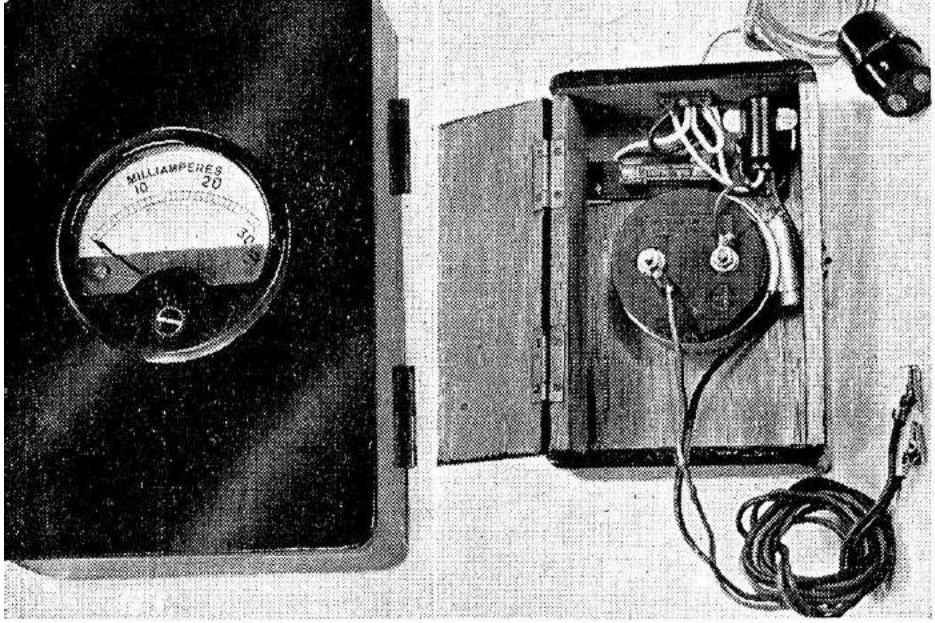
Charging

This is very simple and straightforward for the following reasons. These batteries can be charged for 90 days or more *continuously* without damage *PROVIDING*—now this is the important bit — providing you do *not* connect up the battery to the charger the wrong way round and you do *not* exceed the recommended charging current. For a type 225 DK this figure is 22 milliamps, for a type 450 DK it is 45 milliamps. Now a *BATTERY* should never be allowed to discharge below one volt per *cell* and so long as you put the battery on charge for 24 hours before use at the recommended rate you will always be sure it is fully charged.

Indication of the charging current does mean a meter to show the 'milliamps' (m.A.) into the Deacs from the charging supply. Using 225 DK, an 0-30 m.A. meter is needed, with 450 DK's—an 0.50 or 0-100 m.A. is required. The charging supply can be a

Simple battery holder for D.E.A.C.s using paxolin end plates and threaded studding.

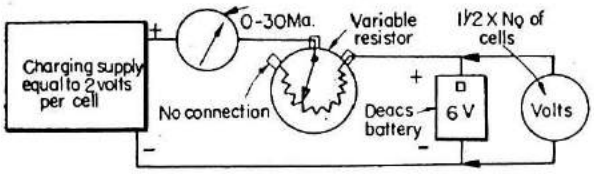




S/Ldr. Cable's neat combined D.E.A.C. charging unit and milliammeter, the latter being secured in place by a jubilee clip. The encapsulated charger is in right top corner and protector resistor lies horizontal on the left. Cigar box provided the container.

Another method of carrying D.E.A.C.s, this time that favoured by Dave McQ·e. Balsa box contains the cells, contact pads press down, and 'he whole thing is kept secure with sponge packing.

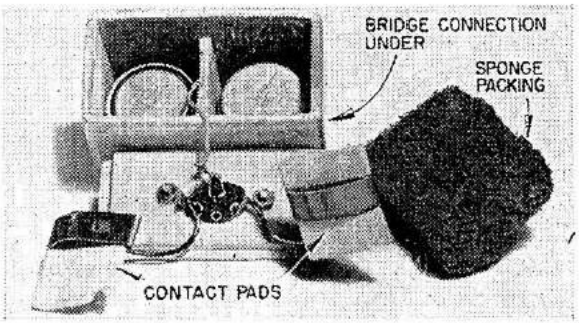
commercial Deac charger (but it doesn't have a meter) from the distributor—G. A. Stanley Palmer Ltd. Alternatively any D.C. source can be used. This includes a 'car type' battery charger, a car battery, or even Ever Ready box batteries (dry cells). Here we go again with cells and batteries. The charging voltage required should be equal to two volts *per cell*. (A battery comprised of 5 cells needs 10 volts minimum to charge it, likewise my 6 cell battery needs 12V. minimum) Now two things I should have mentioned before, all cells must be rearranged *in series before* charging them, and if you use a battery tapped at say 0—3.6—7.2, you should arrange to recharge each half separately *if* there is unequal use of each section of the battery.



Circuit for D.E.A.C. charging without recourse to the official charging unit, but using any D.C. source.

To charge say—a 5 cell—6 volt battery of 225 DKs—that you are using. You need:

(1) An 0—30 m.A. meter.
(2) A charging supply, car battery, battery charger or any 10 or 12 volt source (e.g. from Ever Ready box batteries).
(3) A 1,000 ohm wire wound 3 watt, current limiting variable resistor, and—if you want to *know* when your batteries are charged a voltmeter capable of reading 1.5 volts per cell—in this case. 5 × 1.5 = 7.5 volts.

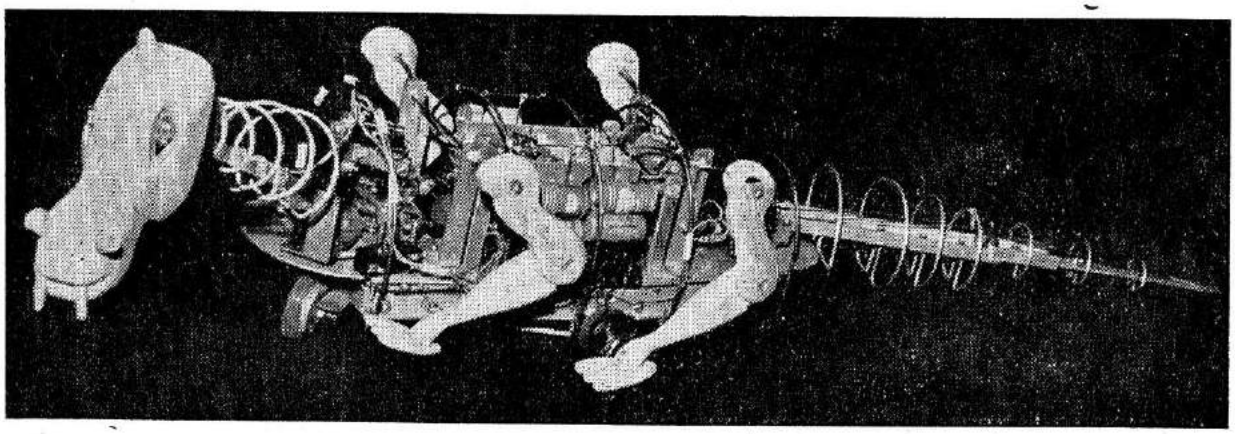


It doesn't matter how *many* cells type 225 you have in series to make up your battery, *still charge at* 22 m.A. (using 450 DK, charge at 45 m.A.). The *voltage* of the charging supply does vary as previously stated, depending on how many cells are being charged. A Deac battery is fully charged when a voltmeter across its terminals reads 1.5V. × the number of cells in the battery.

A Deac can be installed in any position.

Deacs are mainly used, in models, to operate the servos, actuators, escapements, etc. To give some idea of 'which size to use'. My 6V. Deac battery (225 DKs) weighs 2½ oz. and lasts longer, after one charge, than the 4 × U10's, weight 00 oz. I previously used to operate a single channel escapement.

I regret that I cannot enter into correspondence about this article, and I cannot supply INDIVIDUAL *cells, as no trade discount is allowed on them by the distributors, but I do have a few welded batteries, and will be pleased to supply suitable motors and variable resistors as required (and if I get 'on the board' of 'you know who' after this lot, I'll agitate for lower priced Deacs).*

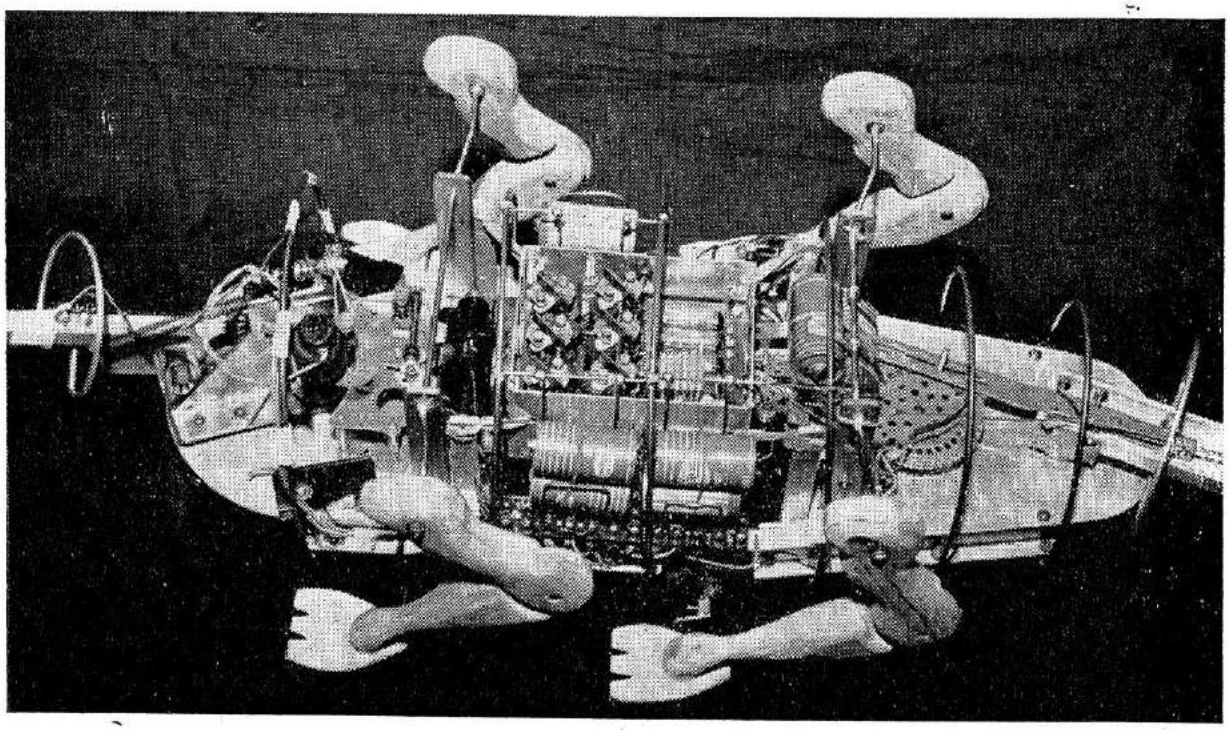


Quest for a Dragon

With apologies to David Attenborough & the B.B.C. from V. Warner of Aylesford Paper Mills M.E.C., who recounts his adventures making George for the club exhibition.

OUR club holds an annual exhibition, and a couple of years ago before we had our two portable demonstration tanks for boats, I wanted to show the public what radio control could do. Being mainly interested in boats I had quite a problem trying to think of some novel item for land use. This had to be constructed in three months and possibly dismantled after the show. After considering the possibilities of motor cars, tanks and other everyday items my 'goonish' brain hit on the idea of "George the Radio Dragon". He could be made of metal and have a framework of steel rod covered with cloth, which would hide the hasty work underneath.

I then commenced to draw what I thought ancient dragons looked like and on asking my good wife her opinion of these drawings she burst out laughing and said that they looked like nothing



on earth. After these encouraging words I copied some drawings from a fairy tale book and started on the chassis. This for lightness was made from dural, channel section, and for manoeuvrability three rubber tyred wheels were used, the rear two for driving and the front single for steering. Pivoted with the steering is the neck and head which is also arranged to nod up and down. The tail was also pivoted to wag to and fro, and because I could not think of a simple way to make George breathe fire two bulbs were fixed in the head for eyes. These are connected to the batteries via a contact switch on the tail and flash as the tail wags. The various drives were made with the aid of old clocks as reduction gear boxes, and bits of trix. Power for the different units is from Mighty Midget motors and elastic bands.

The head was laminated from ¼ in. balsa and the legs from ordinary tree wood. The legs are moved by means of cranks, and the feet only just touch the ground as George moves along. The body supporting struts were then shaped and fitted, and then George was given his skin of bright green material. My wife, who had stopped laughing at my drawings by this time, gave me a helping hand, she was also resigned to the fact that we were to have a dragon in the family. Access to the works is by means of a zip fastener along the back.

Control is by means of a six reed receiver giving the following commands, steering to left and right (with head movement at the same time), walking forwards and backwards, head nod and tail wag (with eyes flashing). The tail also houses the radio aerial.

Then the great day came and George was duly 'launched' onto the floor and slowly walked around the furniture sending the dog yelping out into the garden. Since that day George has performed to the amusement of the public on several occasions, and I have grown so attached to seeing him peering at me in bed from his home on top of the wardrobe, that I haven't the heart to dismantle him.

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.

WE are faced with a problem. We have built quite a number of model aeroplanes, and have decided to begin on radio control. I myself am going to build the Electra, but we do not know whether to employ the tone or transistor method. Whereas we appreciate the future advantages of tone, we think the transistor is more simple on the whole. I want to build my own transmitter and receiver—would it be better to do it from a kit, or not even that ?

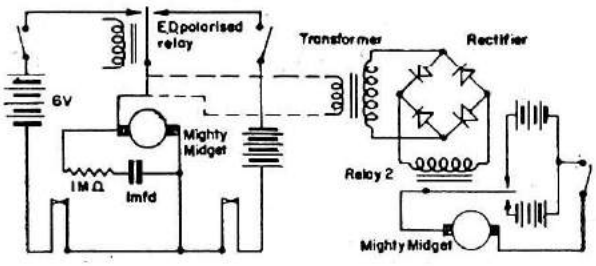
Can I purchase the necessary components for a fully transistorised receiver in G.B. ? Are there any plans for printed circuits available, and are home-made printed circuits good for a beginner ?—T. J. P., REPTON.

I can't honestly advise you to purchase any hardware—yet. Have a good look round our advertisers' wares first then make up your mind. A tone set whether it contains transistors or not (and all the modern ones do) has the advantage of easy conversion to reeds and is easier to tune than the majority of carrier RXs. However, a modulated TX is required. Try G. Honnest-Redlich for the components for a fully transistorised RX. Printed circuits require a good skill in soldering, but help with layout and constructional problems. Leave them alone for a first venture.

I HAVE been told that pure transistor receivers have limited range. I am building a W class destroyer and it could probably carry a transistor receiver, batteries and a sequential escapement. I intend to use a Honnest-Redlich printed circuit transmitter and would require a maximum range of 150 *yards. Would a transistor receiver be all right for this and could you suggest a circuit ?*—C. W., ALNWICK.

It all depends what you mean by an all transistor RX. There are some simple ones which use a diode detector followed by amplifying stages — these have limited range and you would not get 150 yards. However, if the first stage (valve or transistor) is a super-regenerative detector then you would be able to get much more than 150 yards so long as, in the case of tone sets, the detector is followed by two stages of a valve or three stages of a transistor. I built a T.R. 4.5 all transistor set in the latter category which has a ground range of over 600 yards. Remember a modulated TX is required. G. H. Redlich can supply a suitable modulator kit for his TX.

I AM using a pulse system radio control in my boat and I want to fit an engine cut out to it. I have tried having a variable pulse rate which is fed into a transformer and rectified before putting through a second relay. Up to a point it has worked but when the transformer is wired in (a midget radio output one, of ratio 30:1) then the Mighty Midget operating the steering gear does not function. Would this be because the windings of the primary have too high a resistance, or can you think of any other reason? Also with this system I find that the receiver relay (an E.D. polarised) will not take a high enough pulse rate to produce a steady D.C. current from the rectifier circuit. Would a two transistor relay give better results? If you have any other suggestions for fitting an engine cut out on to my existing circuit I would be much obliged for them. I give below the circuit used at present.—M. P. W., BLANDFORD.



Have you got the transformer the right way round? These speaker transformers are normally used to step down and have a high resistance primary and low resistance secondary. You need to use it in reverse with the 'secondary' in series with the M.M. motor.

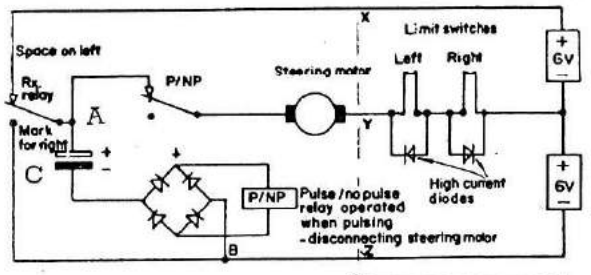
There are certain snags with your circuit as shown. (1) The first M.M. is being continually reversed and unless the M/S is 50:50 will tend to creep. (2) When the steering servo is at one limit the current through the transformer is reduced. Due to (1) the current drain is high.

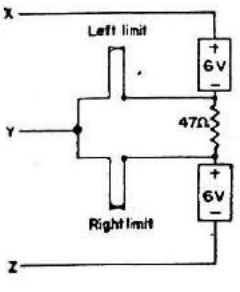
A better system is to arrange that so long as pulsing occurs the steering motor is dead. Then when pulsing is turned off the steering motor runs left, say, on space, and right on mark. The limit switches are an embarrassment if the servo batteries are to be used for the pulsing relay, but failing the use of the separate battery can be dispensed with by:

(1) At C try 5 to 50 μ F.
too small P/NP won't operate.
too large P/NP takes too long to drop out.
(2) As above but with no limit switches; use slipping clutch instead.
(3) As above but with circuit amended on X-Y-Z as smaller sketch.

47 Ω reduces limit/current to 20 m.A. whilst still providing circuit for pulse/no pulse relay. This arrangement is more tricky to set up as pulse/no pulse relay current is reduced when steering motor is on limits.

For engine control another relay, capacitor, and rectifier circuit is required to operate a sequence escapement. The capacitor will be smaller and should be chosen so that the relay only operates when the pulse rate is increased. The circuit is identical with that for P/NP relay except for the size of C and should be connected to A and B. Its contacts can be arranged to switch one of the 6V. batteries to an escapement operating a throttle.





Aeromodeller Transistor RX is used by reader with this equipment, plus A.M. TX and mechanical pulse box.

McQue Relayless Pulsed Tone Generator & 3-Transistor Tone Generator for Reeds

By DAVE McQUE

Transistor Pulsed Tone Generator

THIS was designed for use with the Versatile TX and tone receivers for Galloping Ghost and other similar systems. The output is a pulsed tone, the tone frequency being set by VR3. The rate of pulsing of the tone is controlled by VR2 and the mark space of the pulsing by VR1. Although a total of five transistors is used there is no relay, so an overall economy is effected and pulsing is more precise.

Circuit Description

VT1 and VT2 together with their associated components form the pulsing multivibrator and similarly VT4 and VT5 the tone multivibrator. VT3, controlled by the pulsing multivib, switches the tone multivib on and off.

The two multivibs use the same basic circuit and are a type of emitter coupled multivibrator closely analogous to the cathode coupled multivibs of the valve era.

The advantages of this circuit over the more usual collector coupled M/V are that only one coupling capacitor is

FIG. 1

Transistor pulsed tone generator circuit. Lead colours are for our office version and bear little relation to suggested colours on our Data Chart!

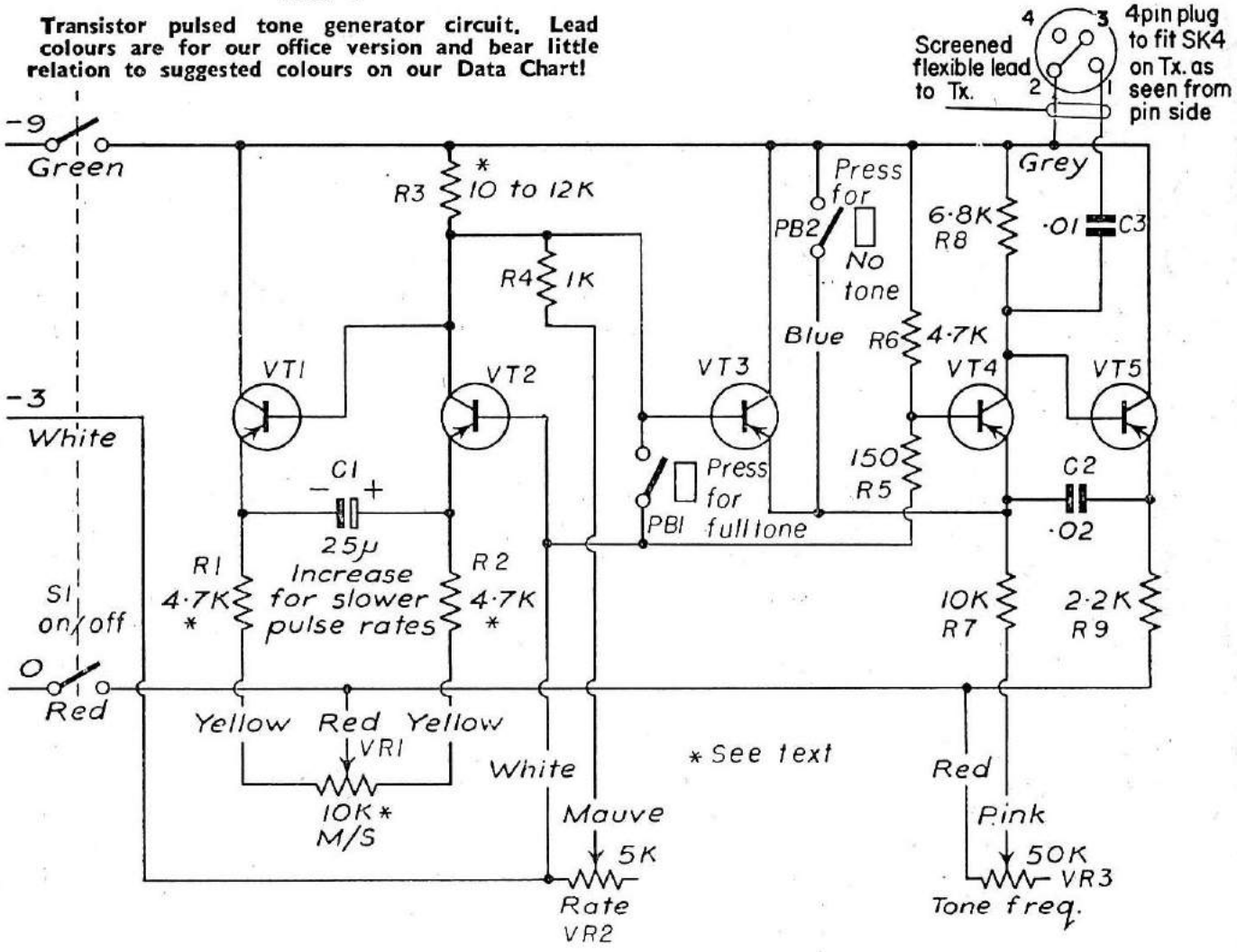
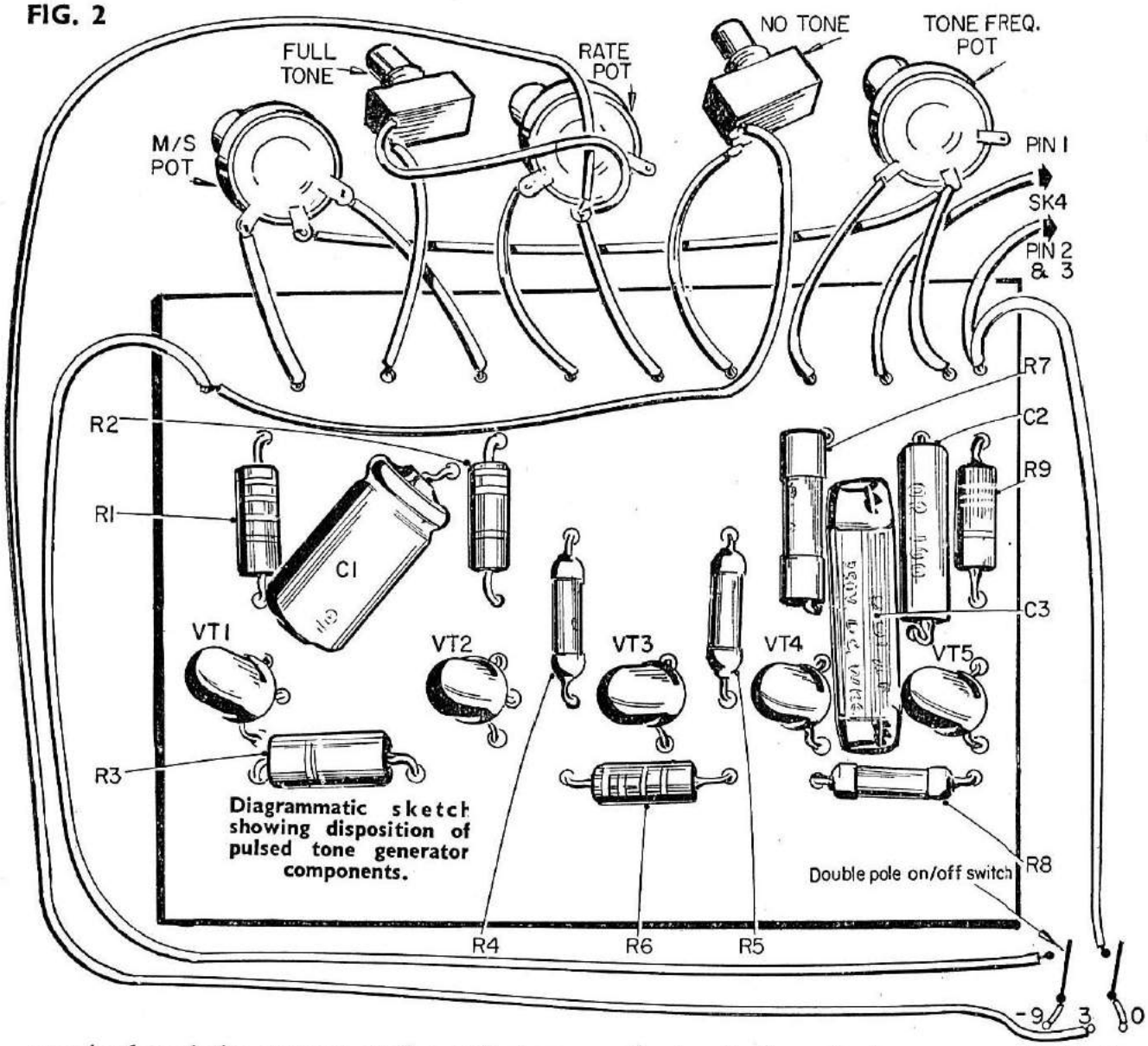


FIG. 2



Diagrammatic sketch showing disposition of pulsed tone generator components.

required and the output at the collector of VT2 is free from transients, i.e. purely rectangular ((that of the collector coupled type is not due to the re-charging of the cross connecting capacitors).

The disadvantages are that a tapped supply (or an extra VT) is required together with a double pole ON/OFF switch and the mark/space range is limited to 75/25 in one direction.

Practical trials have shown that a mark/space variation of from 25/75 to 75/25 is more than adequate for Galloping Ghost.

Multivibrator operation of VT1 and VT2

This multivib, like any other, is an astable device having two quasi/stable states. These are simply State A, VT1 ON and VT2 OFF and State B, VT1 OFF and VT2 ON. Here On means current flow (other than the minute collector to base leakage current). State B corresponds in this circuit to mark i.e. tone on, State A to space i.e. no tone.

What happens when you first switch on is of academic interest only as even if the battery was connected very "gently" by means of potentiometers 'noise' would ensure that it started to

PARTS LIST FOR PULSED TONE GENERATOR

R1	see text	C1	25μ F. min. working volts 6
R2	see text		
R3	see text	C2	0.02 paper
R4	1K		
R5	150		
R6	4.7K		
R7	10K	VR1	see text
R8	6.8K	VR2	see text
R9	2.2K	VR3	50K preset

All resistors $\frac{1}{4}$ or $\frac{1}{2}$ watt 10%.
VT1, VT3. V10/50A, OC 71, selected high beta yellow/green spot.
VT2, VT4, VT5. V10/15A, V10/30A, OC70, OC71 or moderate beta yellow/green spot.

oscillate between the states. Here it is brought on with a thump by the switch and very rapidly settles down to normal operation.

Because we must have a starting point let us start from the beginning of State A. VT2 will be off so the voltage at its collector, and hence the base of VT1 will be decided by R4 and R3, the setting of VR2 and to a much lesser extent by the base current of VT1.

VT1 is ON so its emitter voltage will be very nearly the same as its base. The voltage across C1 will be very small so the emitter of VT2 will be negative with respect to its base so it will be OFF as previously stated.

How long this state will persist depends on how fast the voltage across C1 increases as it charges up due to the current flowing from the left hand plate of C1 through VT1 to the negative terminal of the battery, through the battery to the positive terminal and thence to the right hand plate of C1 via part of VR1 and R2 thence making the right hand plate progressively more positive with respect to its left. When it is sufficiently positive the emitter of VT2 will become positive W.R.T. its base and it will start to pass collector current thus making its collector voltage, the base voltage of VT1, and hence the emitter of VT1 more positive causing VT2's emitter to be made still further positive, which is where we came in, and so the action is cumulative. The circuit switches rapidly to State B with VT1 OFF and VT2 ON. At this point the emitter of VT2 will be about 0.3V positive with respect to its base and as C1 charged up during State A. The emitter of VT1 will be negative with respect to its base by almost the full voltage across C1 (so long as VT2 is "Bottomed" or saturated) so VT1 will be cut off. As will be seen later it is necessary for VT2 to be saturated for the Rate or frequency to be independent of mark/space variation. As VT2 is working as a common base amplifier this is achieved by making its emitter current during State B greater than alpha X its collector current. (Alpha is very nearly One for a junction transistor.) The emitter current of VT2 is made up of two components. One is the steady value as determined by part of VR1 and R2 and the other is the discharge current of C1 flowing through R1 and the other part of VR1. For saturation of VT2 the sum of these currents must be greater than 0.6 m.A. (R3 = 10K and base to collector volts supply for VT2 equal 6 volts.)

As C1 discharges the voltage at the emitter of VT1 approaches its base and after a time proportional to R1 and part of VR1, VT1 conducts preventing any further discharge of C1. Then, so long as the current through R2 is insufficient alone to maintain saturation,

Waveforms if NPN transistors were used.

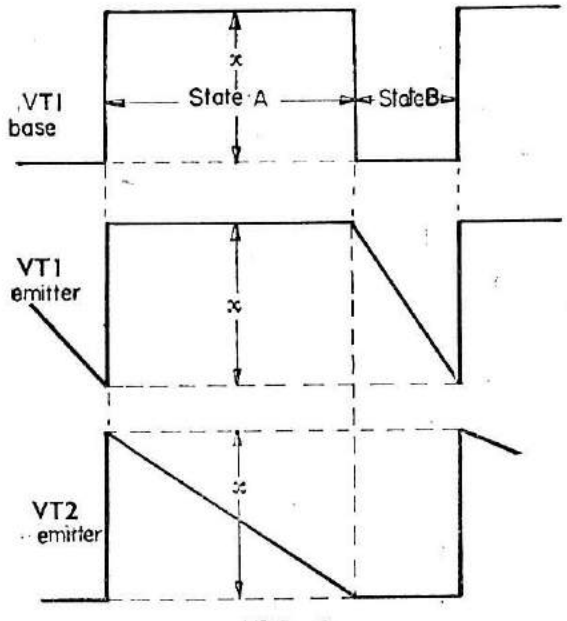
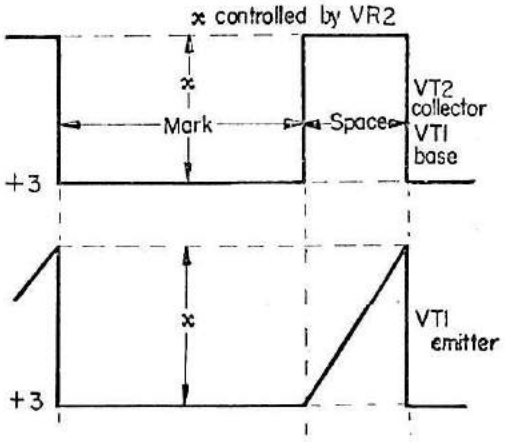
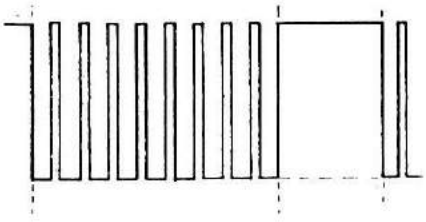


FIG. 3

Actual waveforms for the PNP transistors specified.



Output waveform at VT4 collector. The 'tone' frequency has been reduced for clarity.



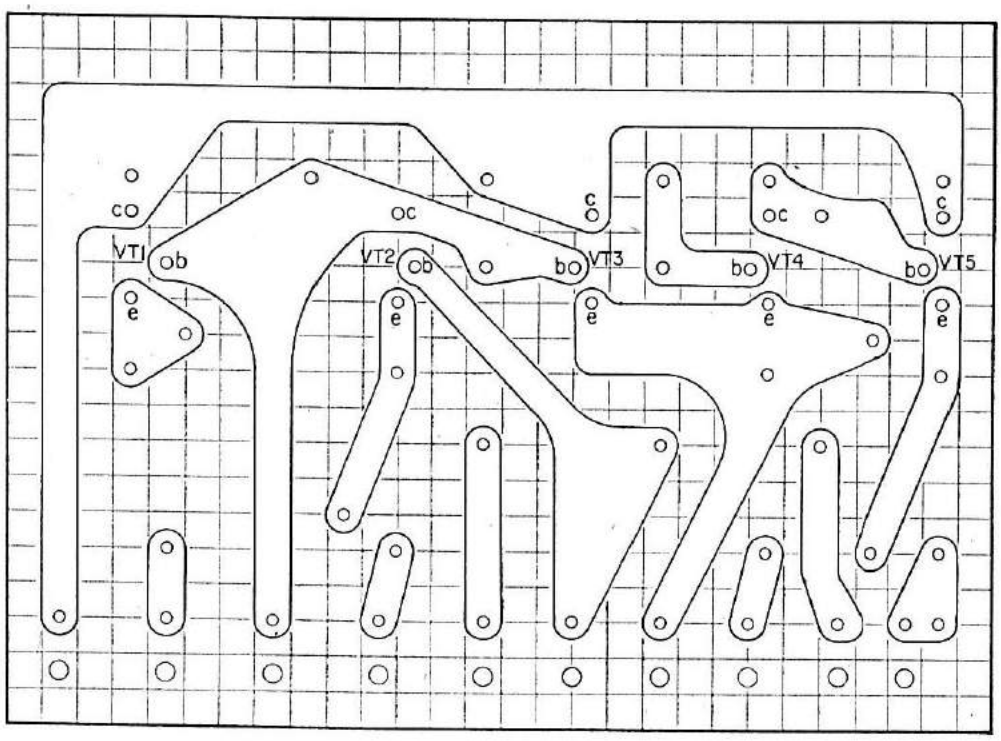


FIG. 4.—Full - size Printed circuit layout for transistor pulsed tone generator. Use of squared paper for p.c. design simplifies layout. Simple "do - it - yourself" p.c. construction article appeared in AERO-MODELLER ANNUAL 1959 / 60, covering a variety of home methods.

VT2 comes out of saturation and its collector potential goes negative taking with it the base and emitter of VT1 and hence the base of VT2 cutting VT2 off by another cumulative action which switches the circuit back to state A. This explanation is somewhat lengthy but was put in to bring out the design factors. Typical waveforms are shown in Fig. 3. (Note for those who like myself have been brought up on valve circuits a useful, if cowardly dodge, is to invert the power supplies, i.e., make them +3 and +9 respectively, and fit N.P.N. Transistor and then, having worked out the waveforms and action, put back as shown inverting the N.P.N. waveforms to get those for the P.N.P. transistors actually used.)

Design

The starting point is the saturation current for VT2. This has to be kept reasonably small to avoid excessively large valves for C1 and not too small compared with Icbo (collector base leakage current). A value of 0.6m.A. was chosen. This sets R3 at 10K as base collector supply volts are six. R4 and VR2 can be ignored as when VT2 is saturated its base collector potential is zero and no current flows through R4 and VR2.

The sum of the currents through R1 and R2 must now be arranged to be not less than 0.6m.A. during state B and yet the current through R2 alone not greater than 0.6m.A. or the circuit will not switch to state A. This sets the maximum value of R1 and its associated part of VR1 in parallel with R2 and its associated part of Vr1. At 5K (for a 3 volt emitter to base supply). This maximum value will occur when VR1 is midway and thus VR1 = 10K

$$\frac{(5k + \frac{1}{2} \times 10K)}{2} = 5K.$$

There is no particular limitation on the maximum valve of R1 except the reverse leakage current of VT1, but for equal mark/space variation about 50/50 it has to be made equal to R2. Due to component tolerance some measure of selection must be made if reasonable precision is required. Normal pots. have a tolerance of up to 20% so R1 and R2 should be selected to be each equal to $\frac{1}{2}$ the actual value of VR1. An attractive alternative is to use a 20K pot. for VR1 and to fit this with mechanical stops either side of the centre at the 5K points. It is then not necessary to gear the pot. as, typically, the movement will be ± 60° (i.e. a total of 120° for a 10K variation) but be very careful that the pot. never reaches either end or you will burn out one of the transistors. Similarly for minimum interaction between VR1 and VR2, R3 should be made adjustable in the first instance (use 4.7 or 6.8K fixed and 10K variable). Adjust so that rate does not vary with mark/space but full 25/75 to 75/25 mark/space range can still be achieved.

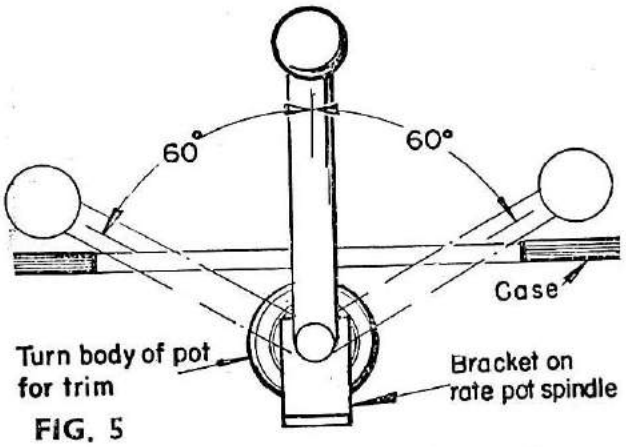


FIG. 5

Simple transistor-protecting device using edges on hole in case as limiting stops.

Most of mine worked best with R3 = 12K.

The effect of VR2 is simply to control the negative excursion of VT2 collector during state A. To avoid gearing again one end of a 20K pot. can be used. If two 20K pots. are used for VR1 and VR2 the case of one can be mounted on a bracket fixed to the spindle of the other and joystick control obtained without gearing. The edges of the hole cut out in the case can provide the mechanical stops and a simple easily built arrangement results. (Fig. 5).

Keying VT4 has its base returned to 3.1V so when VT2 is ON VT3 is OFF and VT4 and VT5 can function as a multivib. When VT2 is OFF VT3 is on and "lifts" the emitter of VT4 above its base thus preventing it from conducting, hence the tone multivib can only function when VT1–VT2 are in state B. The full tone button achieves the same effect as state B and the no tone as state A.

Suitable transistors are Newmarket V10/30 B or Mullard OC71. If surplus type Transistors are used VT1 and VT3 should be high beta units.

3 Transistor Tone Generator

THIS circuit is a phase shift oscillator which can be used to produce the tone (or tones) to modulate the TX when single channel tone, multi-channel reed or multi-channel tone filter receivers are used.

Despite its complex appearance it is simple to use and, most important, stable in operation. A single inexpensive "Grid Bias" battery has powered mine for two years now and is due for replacement only because its "Shelf Life" is nearing its end.

VT1 and VT2 are two phase splitters, which each feed single section phase shifting networks whilst VT3 is an inverting amplifier whose gain is controlled by the setting of VR2. The overall D.C. connection provides negative feedback for close stabilization of the operating condition.

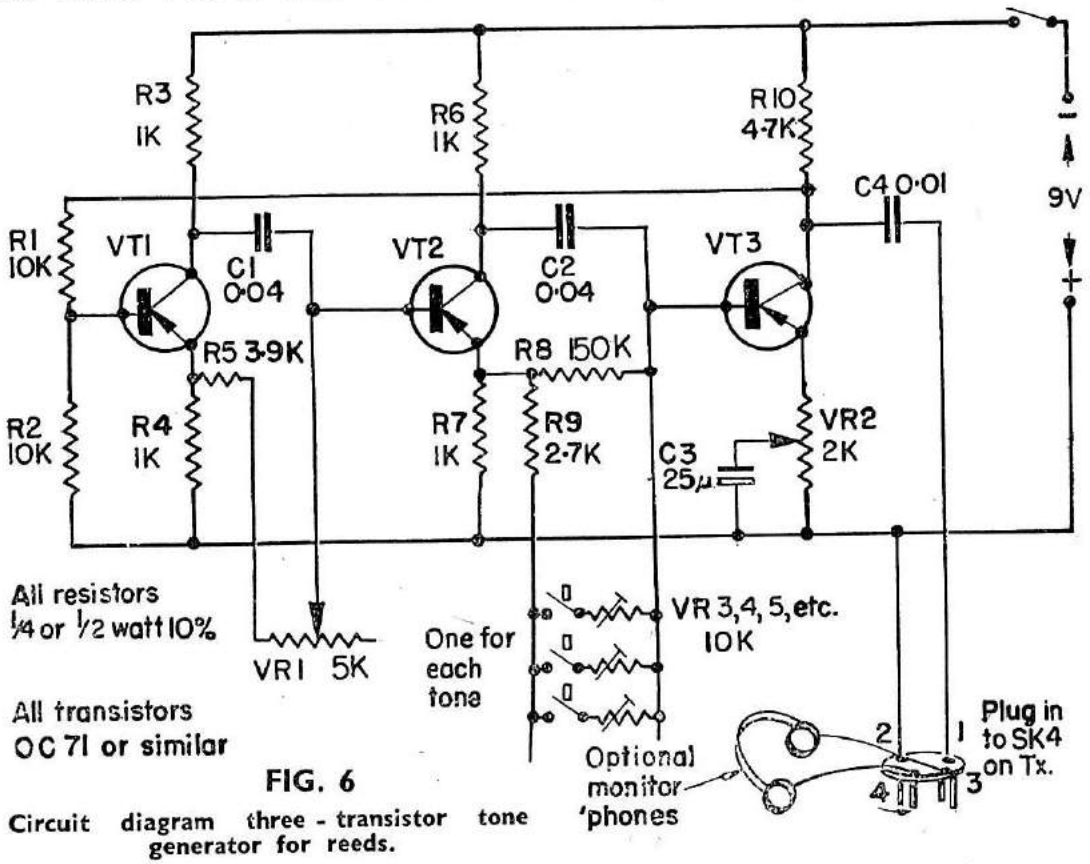


FIG. 6

Circuit diagram three - transistor tone generator for reeds.

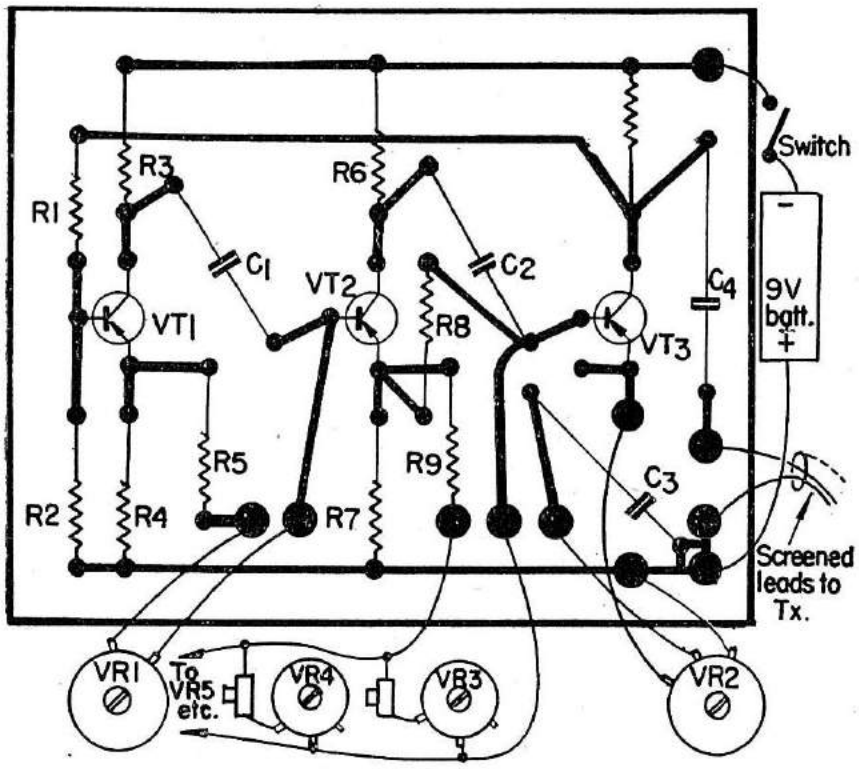


FIG. 7
Printed circuit for Tone Generator for Reeds. P.C. in heavier lines, components and leads to externals in lighter lines.

In use VR1 is used to set the range of tones obtainable with the individual tone pots. (VR3 onwards).

VR2, the feedback control, should be adjusted so that the circuit does not oscillate unless a button is pressed, but will oscillate over the entire range of tones obtainable by any of the individual tone pots. (VR3 onwards) when its button is pressed.

Don't connect phones, directly across the output of this unit (it is designed to work into the high input impedance of the valve amplifier in the Versatile) or you will introduce a further phase shift which will alter the frequency of the tones. If you want to monitor the output do so via a resistor of 100K Ω – 220K Ω and use H.R. phones.

To obtain the maximum advantage from the stability of this unit a special procedure in tuning it to reeds should be employed.

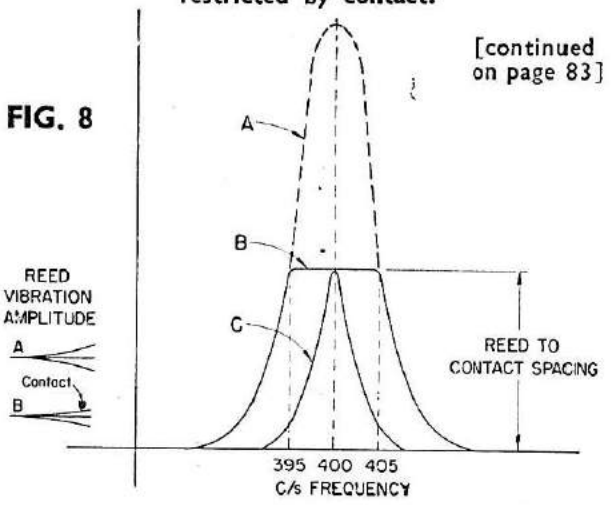
Curve A in Fig. 8 shows a typical response curve for a reed when it is not restricted by a contact. Curve B shows the practical response when the contact

PARTS LIST FOR TONE GENERATOR FOR REEDS

R1	10K	C1	0.04 (or 0.05) paper
R2	10K	C2	0.04 (or 0.05) paper
R3	1K	C3	25μ 6V. (or more) working voltage
R4	1K		
R5	3.9K	C4	0.01 paper
R6	1K	VR1	5K preset
R7	1K	VR3, 4, 5, etc.	10K preset
R8	150K	VT1, 2 and 3.	V10/30A, OC 71, or medium beta yellow / green spot.
R9	2.7K		
R10	4.7K		

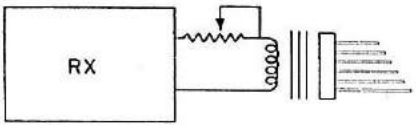
My complete generator, together, with switches and 9V. 'grid bias battery' sits comfortably in an OXO tin. The pots., switches and circuitry mounting on a panel which reinforces the lid.

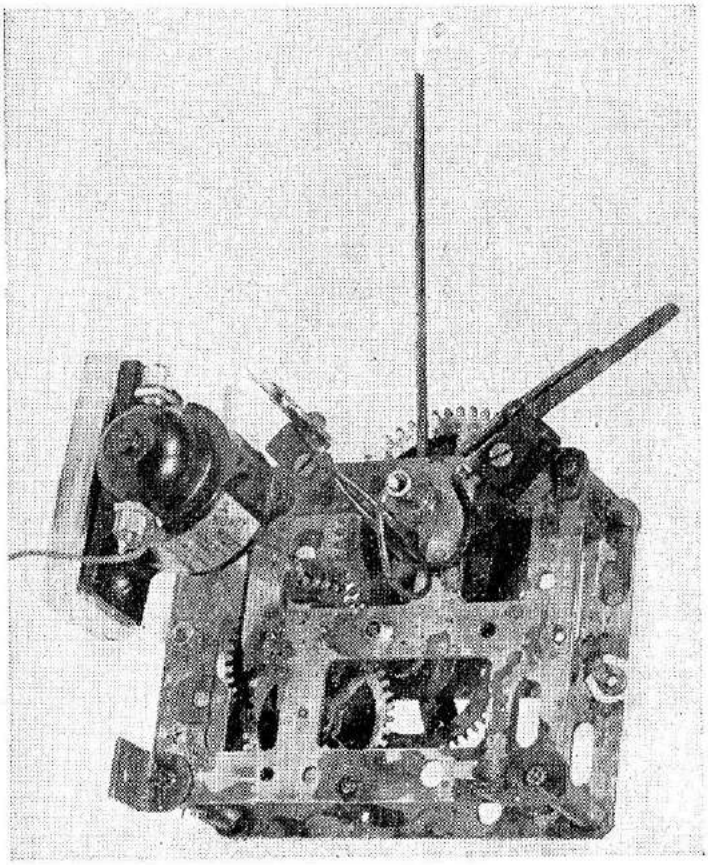
FIG. 8
Typical reed response curve when unrestricted by contact.



[continued on page 83]

FIG. 9
Variable resistor inserted between RX and reed coil.





A Marblehead winch which is a very simple conversion of an old alarm clock mechanism. Photograph illustrates the unit in installed position, as it is mounted vertically on the radio box end. Note limit switches broken by sheet arm.

Jack Gascoigne brings to radio control many years of model engineering experience which is of special value when the subject is radio control model yachting. Here he describes some simple adaptations of surplus odds and ends to provide a variety of sheeting winches.

Sheeting Winches

THE first thing that the newcomer to R/C yachting will have to tackle will be the making of a winch to control the sail settings. This is generally made for operation by an electric motor and some typical types of gear are shown in this article.

A fair amount of power is required to haul the sails in under a stiff breeze, but at the same time the time taken to achieve this must not be unduly long. Obviously the shorter the time taken for the operation at a given load, the more powerful the driving motor must be, since the gearing will be higher.

Taking the two extremes that can obtain and between which one decides to aim, on the one hand, a fast rate of haul allows for a quick change of sail setting and, especially if signals for steering and sheeting have to be sent separately, does not leave one with such a long period when the steering cannot be used. On the other hand a slower rate of haul allows for more accurate trimming of the sails which is a very important factor in efficient sailing.

In practical terms, the average requirements are that the full movement from the free position to the close-hauled position should be achieved in four to six seconds. In the case of a 'Marblehead' the gear must be able to work against a pull of up to 1½ lb. and with an 'A' Class yacht against a pull of up to 4 lb. The power required to achieve these duties is quite considerable, and as a guide to electric motor requirements it will be found that a 'Mighty Midget' or 'Ever Ready' motor is suitable for a 'Marblehead' providing that the gearing is fairly low (about eight seconds for full travel). About three times the power would be required for an 'A' Class yacht and the Orbit 505 or similar motor would cover the requirements in this case.

The choice of motor must depend somewhat on the source of electric supply. If accumulators are used for the intergear the choice is greater since heavier consumption motors can be used than if the power source is dry batteries. Alternatively if dry batteries or D.E.A.C. cells are used 12 or 24 volt motors with low consumption (of which there are a number of ex-government ones available) could be used.

The motor must be chosen before the gearing arrangement is finalised, since motor speeds vary considerably and therefore affect the reduction ratio to be arrived at.

'A' Class Winch Two Drum

Based on the design of separate drums for the jib and main sheets, this winch has the advantage that the different amount of haul required by the two sheets can be allowed for and if found necessary, can easily be altered.

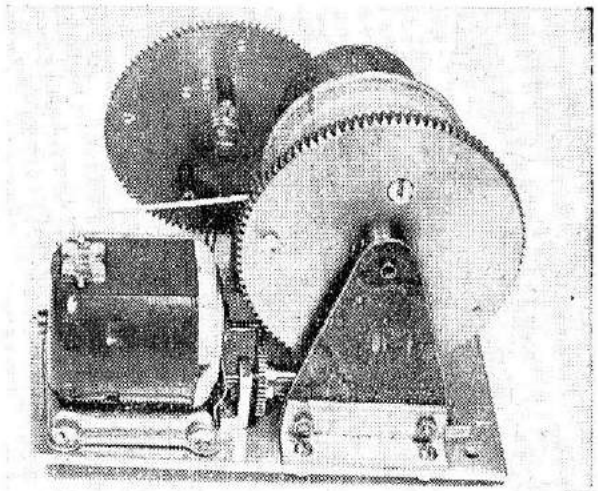
The construction is straightforward as can be seen. The main gear is in the form of a 100-1 worm (to lock the drums against unwinding by the pull of the sheets) with a further reduction by spur gear to suit the motor speed. In the original an 'Orbit 505' motor was used and the spur gears were 3-1 ratio. The gears are Messrs. Bonds' of Euston Road.

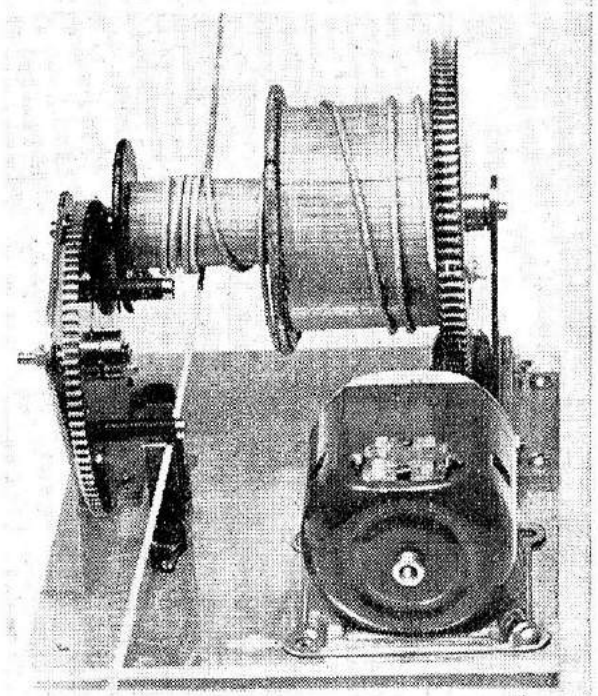
It will be noticed that the limit switch is operated via a reduction gear. This is necessary since the drums will revolve four or five turns for their complete travel, whereas the pins to operate the limit switches must only make a part turn. The driven pinion is spring loaded so that it can be taken out of mesh enabling adjustment between the sail position and the breaking position of the switches. For initial adjustment the sail should be wound in to the approximate 'close-haul' position (final adjustment being made by the bowsie on the boom) and the one pin set to be just breaking the appropriate limit switch. The sail is then run out to its 'free' position and the second pin positioned so that the other limit switch is just breaking. A series of tapped holes in the driven pinion for the second pin, will make for easy positioning.

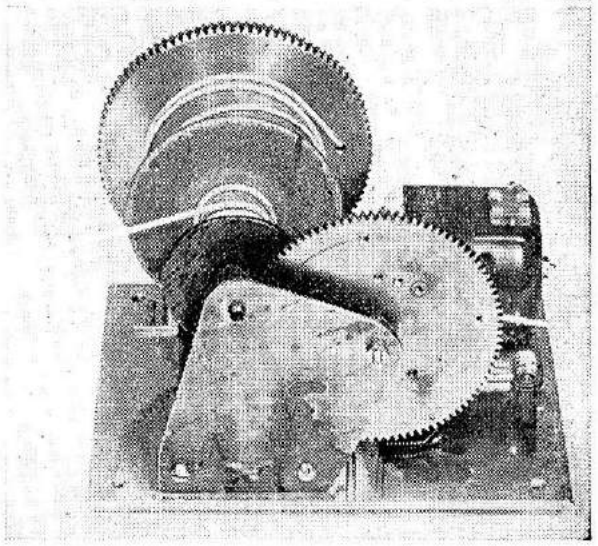
A 'Marblehead' Winch

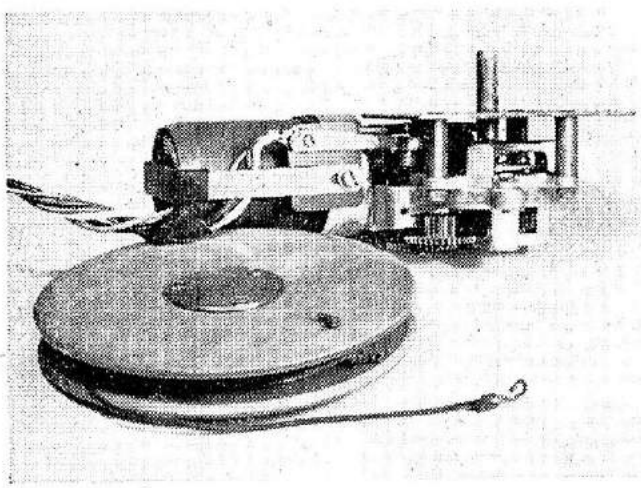
Made from an old alarm clock movement, this winch has been successfully in use for a number of years. This straightforward arrangement of reduction by pinion gears has its limitations in that sufficient load on the output shaft can cause rotation of the whole gear train and the driving motor. However, for an 'M' class yacht the pull on the sheets is not sufficient to do this, and therefore makes a simple reduction gear arrangement. At the input end the escapement and first gear train should be removed. The second gear shaft has to

Three pictures showing the two-diameter drum winch. Points to note are the limit switch striker pins threaded into the final gear, with additional tapped holes allowing adjustment of position of one pin ; this gear can be pushed out of alignment against a spring and rotated as required, the spring ensuring that it falls back into mesh.

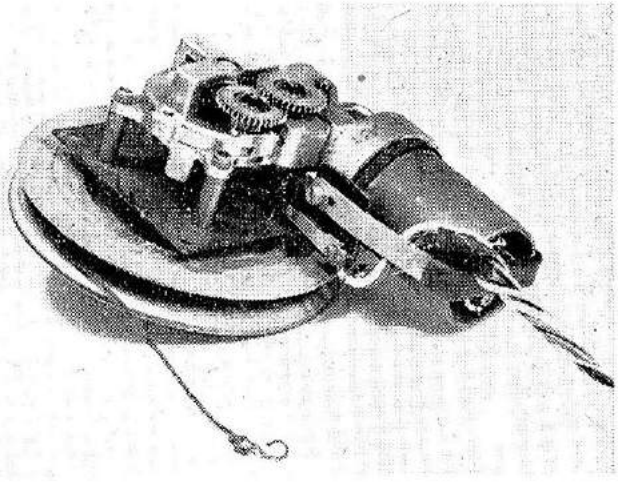






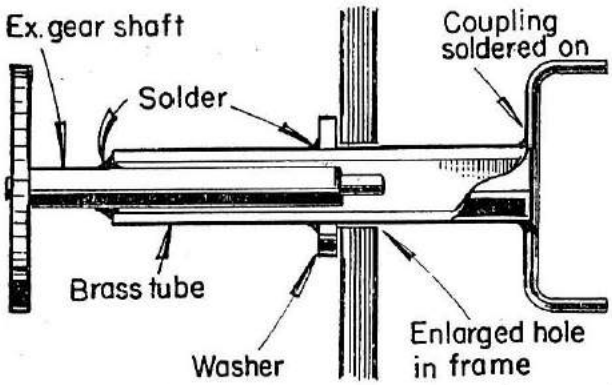


The single-drum winch built from an ex-govt. gear unit (source unfortunately unknown) with a minimum of modification. Unit is screwed beneath deck, drum fitted to spindle above deck.



View of same winch from beneath, showing spur gears, limit switches, etc. This winch is the heaviest of the three discussed, and not suitable for smaller yachts ; principle is worth following, however.

be extended to outside the frame for coupling to the motor. This is done by soldering a short piece of suitable size brass tube on to one end of the shaft together with a locating washer. The bearing hole in the frame also has to be opened out to fit the brass tube (*see sketch*).



A 'Mighty Midget' motor is used because of its higher R.P.M. and the fact that the gear train gives rather a slow output speed.

At the output end, the winding spring is removed and the operating arm is fitted to the first gear wheel. Alternatively, as has been done in the unit illustrated, the ratchet winding arrangement is locked solid and the operating arm is in the form of a piece of $\frac{1}{16}$ in. dia. spring steel wire soldered into a hole in the gear shaft. The spring steel wire was used with the idea of protecting the gear teeth against damage.

A further improvement, when using an alarm clock movement, is to utilise the spring to add to the power available when 'hauling in'. As will be appreciated, very little power is required to 'free' the sails, as the wind takes them out. Therefore motor power can be spared to wind the spring up and in the reverse operation the spring then assists the motor in 'hauling in' the sails.

'A' Class Winch Single Drum

This winch is made from an ex-government motor / reduction gear unit in which only three adaptations are needed. These are: (1) locking of the overload clutch, (2) extension of the output spindle to pass through the deck and to carry the pulley, and (3) the fitting of limit switches.

The photographs show the whole unit including the adaptations. The pulley is of such a diameter as to require just under one turn to fully haul in the main sheet, and in this case was $3\frac{1}{4}$ in. effective dia. giving approximately 10 in. total haul. The point of attachment of the sheet to the main boom has to be such that the 10 in. movement covers the full travel required and this will be found to be approximately half way along its length.

At least 18 volts will be required to provide sufficient power and speed at the pulley. This winch has been in use in *'Senorita'* for the last two seasons and powered by two 9 volt grid bias batteries gives a good many hours sailing before they need changing.

The foregoing units do not by any means represent the only types of control gear possible, and in fact many other ingenious arrangements are actually in use.

Using the Colour Code Chart

RESISTORS and capacitors come in a wide variety of shapes and sizes. Those in most general use for radio control work are illustrated on our Data Sheet No. 1. There are some other shapes but these are used for purposes outside our interests. Colour bands or dots are used to identify them, and this colour code is worldwide.

According to shape and type slightly different methods are used in valuing the colours. Thus with colour band resistors, first figure of their value is on extreme right, followed by second figure, and then the multiplier of 'number of noughts' that must be added. Finally comes the tolerance which is *always* indicated by gold, silver or nothing at all. The body, tip, dot or narrow band system resistors tend to cheat somewhat in that their first figure is always the body colour of the casing, second digit is on left, multiplier in the middle and tolerance at the opposite end. Since gold and silver are never anything but tolerances confusion in which way to read cannot arise.

When we come to capacitors, there is the slight risk of confusion of moulded insulated type with resistors, but this need never be if it is remembered that capacitors have *five* colour bands, one being broad and the others narrow. Ceramic type also have the five bands, the first being the temperature coefficient, which may in some instances be of importance. Some capacitors have four bands, followed by a space then two more, these last two bands indicating voltage rating. Generally, reference to the illustrations will service to identify type being checked, and any special methods of going to work.

It will take a little practice to read off values straight away, but an hour or two and a handful of mixed types and values to try and the colours will soon be nearly as explicit as figures. As a cheerful thought, many capacitors now hav their values printed on them in good old fashioned figures.

Wattage rating of carbon resistors has a bearing on their size, by size meaning bulk. Usual ratings for R/C are 1, $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{8}$, 1/10 watt.

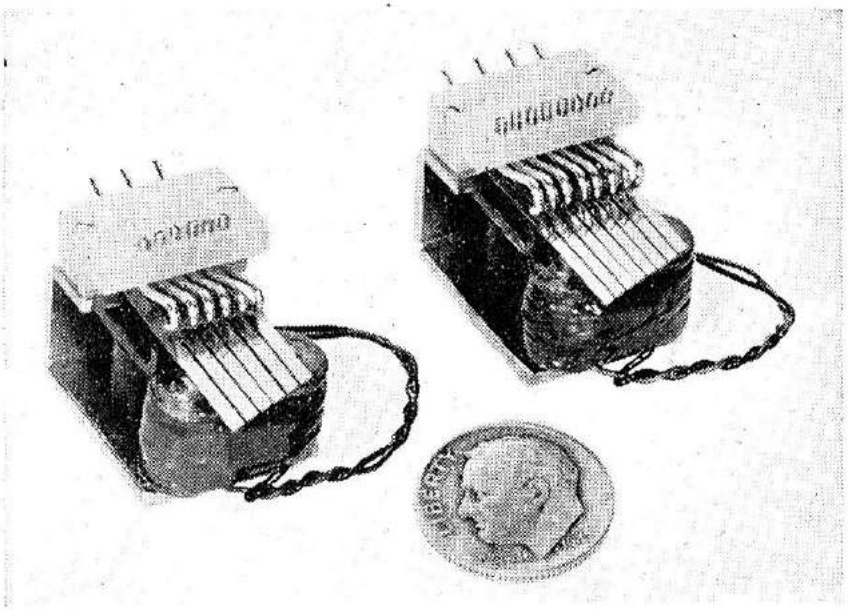
Beginners are advised to keep these explanatory notes handy until they have had sufficient practice, when they will be able to read the colours as easily as a bus timetable!

When buying resistors and capacitors, however, there is some considerable variety in the sizes that can be obtained of the same value. Those in use for normal radio use are bulkier and if bought in error will certainly not be squeezed into some of the modern subminiature layouts, though from the point of view of working they would do the job perfectly. Very many stockists are now carrying the smallest subminiature sizes and its worthwhile shopping around if necessary to be sure of getting the smallest available.

A final point with electrolytic capacitors is to note their polarity, since direction in which they are installed is important. Positive end is usually indicated by a red mark on it. Where unmarked case is earth, or negative, i.e. insulated wire is positive.

Coloured Leads

We hope that these 'common practice' colours will eventually be accepted as the standard, but for the time being they have no official standing. With strange equipment they can be regarded only as a starting point for sorting out a circuit, never as assured. Naturally, with the growing use of vast numbers of relays and reeds the constructor tends to run out of single colours and must start on the wide range of two colour leads now on the market. It is not so many years ago that anything much beyond the inevitable red, black and yellow were very hard if not impossible to obtain. To attempt to suggest a code for all these possible combinations is beyond us, all we can suggest is that the user should stick to a regular scheme, and have a colour identification chart stuck to his equipment in case of need when trouble shooting.



Subminiature reed relays illustrated are by Min-X. Adjustable contacts, and available with either low resistance (60 ohms resistance 200 ohms impedance) or high resistance (3,000 ohms resistance, 5,000 ohms impedance) coil. Typical size 8-reed is ¾ x 1¼ x ⅞ ins.

A FEATURE FOR BEGINNERS

MULTI CHANNEL OPERATION

PART II

By Lt. Col. H. J. TAPLIN

In this instalment Taps deals with fault finding and cure and also covers audio tuning and choke tuning. A further article will appear with special reference to non-adjustable reeds, which share the market on an almost fifty-fifty basis.

Actuator Ceases to Function

So far we have dealt with the normal adjustments of a set which is in good working order, but what if we have carried out all these instructions correctly and we still fail to get one or other of the reeds or even all of them operating due to some breakdown and how do we find it? We will therefore consider some of the breakdowns which do occasionally occur and the effects which they cause.

Let us assume that our set has been working satisfactorily and we suddenly find that one of our actuators has ceased to function; obviously the first thing to check is to make sure that the battery for that particular relay has not run down. The next thing to do is to check the actuator circuit itself by operating the particular relay manually. By doing this we make a mechanical contact through the relay to the actuator and if the actuator fails then to function it is quite obvious that there is a breakdown in the wiring somewhere between the relay and the actuator. Assuming, however, that the actuator does function when we manually operate the relay, we can then dismiss this source of trouble. Next we have to see whether the relay is operating correctly through the reed, so we then raise the particular reed mechanically with the set switched on, so that it touches its contact screw and note whether the relay comes in. Since this action is then mechanical contact from the reed via its contact screw to the relay, if the relay then fails to function it is reasonable to suppose that no current is passing through the relay coil, and it is practically certain that the relay coil has broken down. If you have an ohm meter you can check this quite easily by putting the two terminals of the ohm meter across the two ends of the wires of the relay coil which normally should show between 3,500

and 4,000 ohms; if your ohm meter fails to move, then your worst fears are confirmed, i.e. that the particular relay coil has gone open circuit and must be replaced.

Faulty Contact Screw

Let us go back a little and continue our investigation from the point where we were testing the relay by means of the reed and assume that the relay does operate when the contact is made between the reed and its contact screw; if when we key the note of this particular reed we find that the reed itself does vibrate, which can be observed visually, but fails to operate the relay, our first bet is to adjust the contact screw a little closer to make sure that it is in fact making proper contact with the reed. If we are satisfied about this, then the next thing is to remove the contact screw and make sure that the point is clean as there is a tendency after a while to develop a tiny black spot on the contact screw and also on the reed itself. If when this is cleaned and put back and adjusted and we still get the same result, i.e. that the reed will vibrate but fails to operate the relay but does operate it when the reed is pressed against its contact screw mechanically, then it is pretty certain that the condenser which we have mentioned earlier in this particular reed circuit has broken down and must be replaced.

If we go one step further and we find that none of the relays work and in addition none of the reeds will vibrate, then it is probable that the reed coil itself has broken down and here again this can be tested in exactly the same manner as we have previously indicated can be done with the relay coil. A further indication of an open circuit reed coil is indicated by a standing current on the milliammeter much below normal.

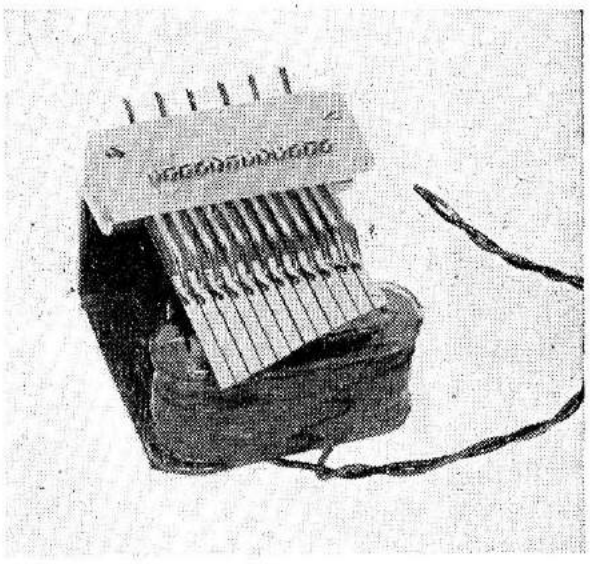
We have mentioned above that after some considerable use a tiny black spot may appear on the points of the contact screw and on the reeds and it is a wise plan to occasionally take the screws out and clean them and the reed contact points and readjust. This, however, is only a precautionary measure.

Battery Faults

We have already referred to the standing current as shown on the milliammeter when the receiver is switched on as being between possibly 2 and 4 milliamps, but this standing current should at all times be *steady*. If it is found that the milliammeter needle wavers or vibrates, it is usually an indication that the Low Tension battery or the High Tension battery feeding the set are at fault; *usually* the High Tension battery. Some High Tension batteries, whilst showing only a small drop in voltage after use, an insufficient drop, in fact, to fail to make the set work in the normal way, may develop what is known as a high internal resistance. The effect of this high internal resistance is to produce a wavering or vibrating of the milliammeter needle and the battery must be replaced. The Low Tension battery is also liable to produce somewhat the same effect although this is normally only shown as a standing current slightly less than is normal. It is important that both the Low Tension batteries and the High Tension batteries feeding the set are kept up to 'scratch'. It is false economy (particularly when flying radio controlled aircraft), to try to economise on receiver and transmitter batteries since the few extra flights which you might get out of a radio controlled aircraft with a run down battery is poor compensation for a 'written off' machine, as compared with the comparatively small cost of replacing the batteries.

Relay Points

In the same way that we have indicated that the points of the reed contact screw and reeds should be cleaned



occasionally, the same remarks also apply to the relay contact points. These can be cleaned very easily by using a small strip of clean paper and placing it between the points of the relay and pressing the contacts together and drawing the paper out once or twice.

Audio Tuning

We have suggested a milliammeter for tuning, inserted in the two-pin socket; another method of tuning can be adopted without the use of the milliamp meter by inserting the leads of a pair of high resistance (approx. 2,000 ohms) phones into this two-pin socket. When tuning by this method, the procedure is much about the same, i.e. you tune first for the waveband and the actual note of the modulated carrier when a key on the control is operated can be heard on the phones and it should be tuned to its maximum volume by the waveband control on the receiver. When this has been done, you proceed as above to tune in number 1 reed and, as the potentiometer is moved on the control box, the note will be heard in the phones to rise and fall; and if it is the longest reed that we start to tune, i.e. the lowest note, it will be obvious that the next note to listen for on the second button is one just slightly above it and so on up to the top note of the last reed.

Normally on a reed set, the total range of tone from the bottom note to the top note is something less than an octave since it is possible to make a reed vibrate with a note a complete octave above or below it. The reed, however, will not vibrate so vigorously as on its correct actual note. In other words, it is possible for a reed to vibrate to a harmonic of its own note which may be an octave above or below, care must be taken to see that the whole range of notes sent out by your transmitter are not, in fact, an octave below or above that of the receiver, otherwise you may do a complete tuning on harmonics and, as indicated above, your effective range of control will be very much reduced.

A trick which the writer has used for some years and which would be found extremely useful is to include a small loudspeaker in the transmitter. This is wired in series with the H.T. positive lead from the transmitter battery and a 100 ohm resistor wired in parallel across the loudspeaker terminals. The effect of this is for the note of the transmitter to be heard clearly in the loudspeaker. This method has the advantage that you can always hear the note which is being transmitted, it also helps you to know that the transmitter is working.

There is little to be said about transmitters which, in the main, require but little attention other than the occasional renewal of batteries. There is, however, one point which may be of interest where a loudspeaker is used as indicated, or for that matter the use of phones; if when a note is sent out from the transmitter and is heard on the phones or loudspeaker to vary in pitch, slowly rises to a high pitch and finally disappears out of the roof, it is a sure indication that either the L.T. battery or the H.T. battery of the transmitter is failing. An unsteady note probably means a dirty switch in your control box. Bear in mind that your reeds only answer to their correct note so that if the transmitter does not send out a clear note, the response of the receiver will be unreliable.

Choke Tuning

We do not propose to go into the question of choke tuned transmitter and receiver since these are very few and far between, and they have many disadvantages. For example, on a six channel tuned choke receiver, it is necessary to have the normal number of valves for the receiving and amplifying portion of the set (which usually is three), plus one extra valve for each channel. This makes for a heavy and expensive set. The principal of this system is to have chokes wound in pairs which are perfectly matched, one being used in the transmitter and one in the receiver; one pair for each channel. Once the tuned choke equipment has been successfully made, it has, however, one outstanding advantage—it never requires tuning, but its complications, however, far outweigh this advantage.

Whilst we have mentioned the disadvantages of the tuned choke system, the more recent advent of transistors can, and no doubt will, revolutionize the design and application of this system, making for small and lighter equipment with much reduced current drain. The same applies to all receivers; there are already, in fact, a number of transistorised sets on the market, the

methods of tuning in the foregoing are much about the same.

In flying radio controlled model aircraft either multi or single channel control, always check them up to make sure that they are functioning correctly in your workshop *before* going out to fly them and never launch a machine if you have any doubt of the functioning of your radio. If you have any doubts of your radio before launching your machine *'although you think it will be all right—don't launch it'*. Never have just one more last flight in the dusk before dark as this is usually when you come 'unstuck'; the silhouette of an aircraft is exactly the same coming towards you as going away from you and you are very liable to get a little further away than you had intended in the dusk and when turning the machine for 'home' find too late that you are flying *away* out of range. In flying full-size aircraft, it is highly dangerous to do turns near the ground unless you are very experienced, and exactly the same thing applies to model aircraft—do not try and do turns near the ground unless you are an expert. One other point in flying aircraft, whether multi-channel or single channel radio controlled, do not start pressing the knobs as soon as the machine has left your hands or just got into the air R.O.G., but give it time to climb to a reasonably safe height, otherwise you are very liable to stick it into the deck before it has had time to get its second wind !

PULSED TONE GENERATORS

[continued from page 75]

restricts the reed movement. Now with this response it is difficult to judge the centre frequency but if the power to the reed unit is reduced to that for Curve C, the reed will only touch the contact at the centre frequency.

The power supplied to the reed unit is readily reduced by temporarily inserting a variable resistor between the RX and the reed coil as shown in Fig. 9.

In my case the reed coil is low impdance (about 1k Ω with a D.C. resistance of 150 Ω for use with transistor receivers on 8 volts supply), so a 5K Ω pot. is used. For the more common high impedance reed units which have a D.C. resistance of about 3K Ω and an impedance of about 10K Ω a 50 to 100K pot. should be used.

First roughly tune the notes with the pot. set to zero giving maximum power to the reed coil. Then progressively reduce the power by increasing the resistance until the reed fails to contact. Then touch up the tuning and further reduce the power until it is impossible to make further improvement. The pot. setting for the condition where the power is just sufficient for the reed to contact should be noted and can be used in future checks. Finally remove the pot. and you have your note at the centre of curve B with the greatest possible tolerance available for any drift.

Typically I find that 3–4K Ω can be inserted to get curve C and I accept anything greater than 2K Ω when checking.

This procedure avoids upsetting the tuning pots. (VR3 onwards) unnecessarily and they last much longer.

I flew my glider all last summer without disturbing the pots., but it took a couple of hours (wee small ones for quiet) to set them up to my liking in the first instance. Naturally they were checked by the use of the series pot. in the RX before each outing.

RADIO CONTROL CALENDAR

May 15th: Open Informal Yacht R/C Meeting.
Y.M.6m.O.A. Rick Pond, Hampton Court.
May 21st/22nd: F.A.I. Radio Control Trials.
Wigsley Aerodrome, Lincs.
May 22nd: Brighton.
Hove Lagoon.
May 28th/29th: *Poole International* R/C Boats.
June 5th: S. M. A. E. British Nationals.
Scampton, Nr. Lincoln.
S.M.A.E. Cup for Multi.
June 6th: S.M.A.E. British Nationals.
Ripmax Trophy—F.A.I. Single.
June 5th/6th: Hull Corporation R/C Boats.
June 6th: Bownville R/C Boats.

New from Nuremberg

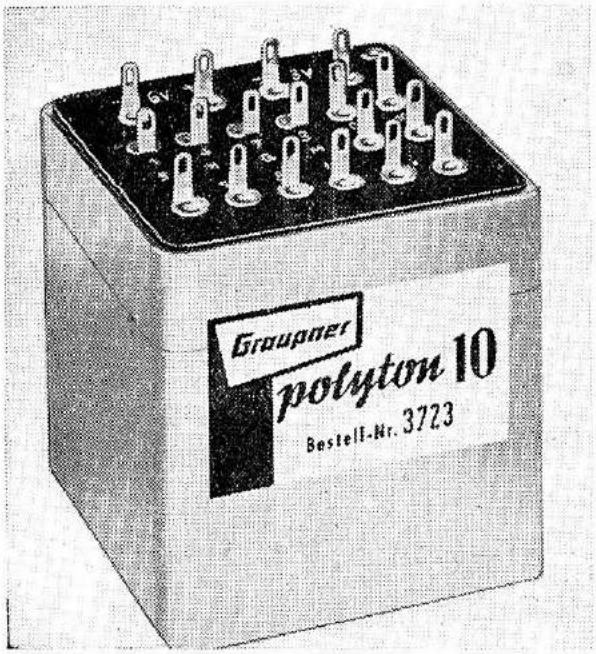
INTERESTING NEW EQUIPMENT FROM GERMANY

WE publish the uncensored, and only very slightly Anglicised comments of our Dutch correspondent, E. 'Windy' Kreulen, perhaps Holland's best known R/C expert, on some exhibits at the Nuremburg Toy Fair. His technical descriptions can be accepted as strictly accurate, his asides delight us, as we hope they will you.

"Bellaphon 3-channel (Graupner)

New ALL TRANSISTOR transmitter! Very neat, housed in the well-known Bellaphon case. R.F. circuit uses three OC 170 transistors, one Xtal oscillator in basic circuit, the other two as power amplifiers also in basic circuit. Aerial is coupled by "Phi-filter" and has an aerial extension coil that is centrally positioned (similar to that used some time ago on a Ripmax TX). The A.F. section is a normal resistor - condenser modulator inductively coupled (of course it is with an OC 76 transistor). The most refined thing is that for power the new 'Sonneshein' accumulator (all sealed-leakproof) is used and that the recharger is built in the TX case. There is one joystick for left-right and a button for third command. The price? Too much for a Dutchman! The frequency? 40.68 mc/s.—not allowed in Holland!

The three-channel Receiver works with tuned filters and is quite neat, double the size of the 'Ultraton' all transistor receiver. Can, however, be used on 27.12 or 40.68 mc/s. From a technical viewpoint this outfit is the best I have seen.

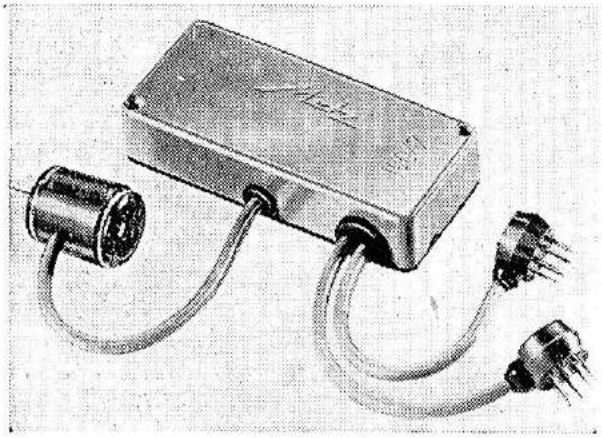


Bellaphon 10-channel (Graupner)

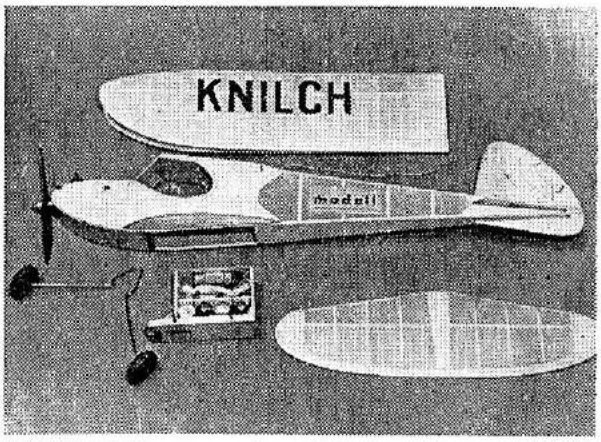
Announcements for this have already appeared in the press. I saw and tried it at the Fair. It has three modulators that work simultaneously, and a built-in pulser with 2 Micromax motors on the main joystick, a pulser is also coupled on the second joystick. Thus, with Bellamatics one has proportional controls. The other four channels have buttons. Electrically the TX is similar to the three-channel except that it has three modulators instead of one!

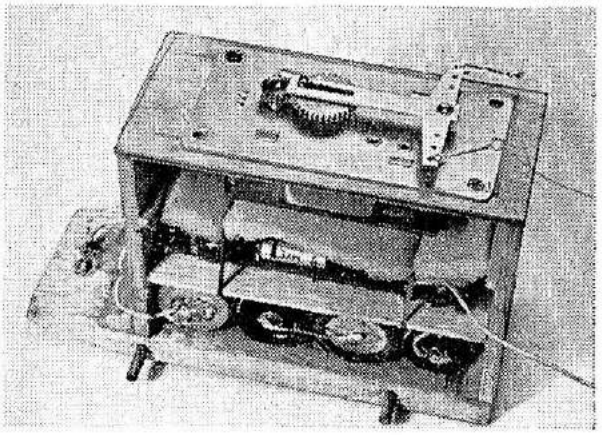
Bellaphon 3-channel TX, fully transistorised, lower consumption but same output as earlier model. 10-channel in same case with additional joystick.

Left : Polyton 10-channel RX. Compare with Min-X 12-channel on following page.



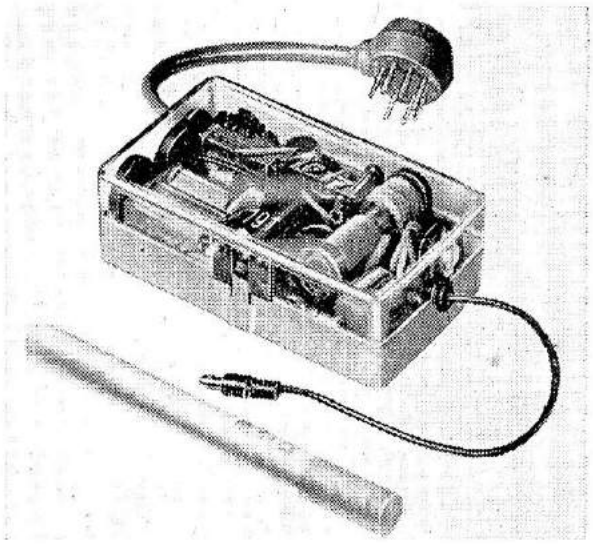
Metz 3-channel adapter for Mecatron RX which converts it from single channel.





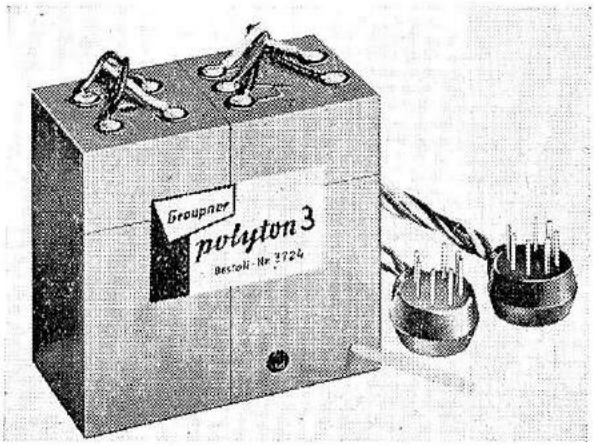
Right : Knilch kit model for R/C with RX removed from neat underbelly slot. Below is the complete control unit—a Kussmaul "Strato X" transistor type with EKV servo. Plane and equipment weigh complete approx. 1 lb. RX alone about 6½ oz. in all, made by Karl-Heinz Denzin.

The receiver is a nice compact almost square block $2\frac{1}{2} \times 2\frac{1}{2} \times 2\frac{3}{4}$ ins. and only 10 ozs. *complete with* 10 *relays,* 14 *transistors and* 10 *diodes* (OA 81). The receiver takes only 4 m.A. but one thing I do not like much, it will build up to over 20 m.A. when TX is not working! This may harm it. It is by no means a thing for beginners and rich people will as usual be bored after first 'unsuccessful flight' anyway, so what if it does break? For experts or wealthy boys it is something to try, but with import duty, tax and so on the set will come in at the price of *20 Oliver Tiger engines!* It works on 12V. 45 m.A. and Micromax on 2V.



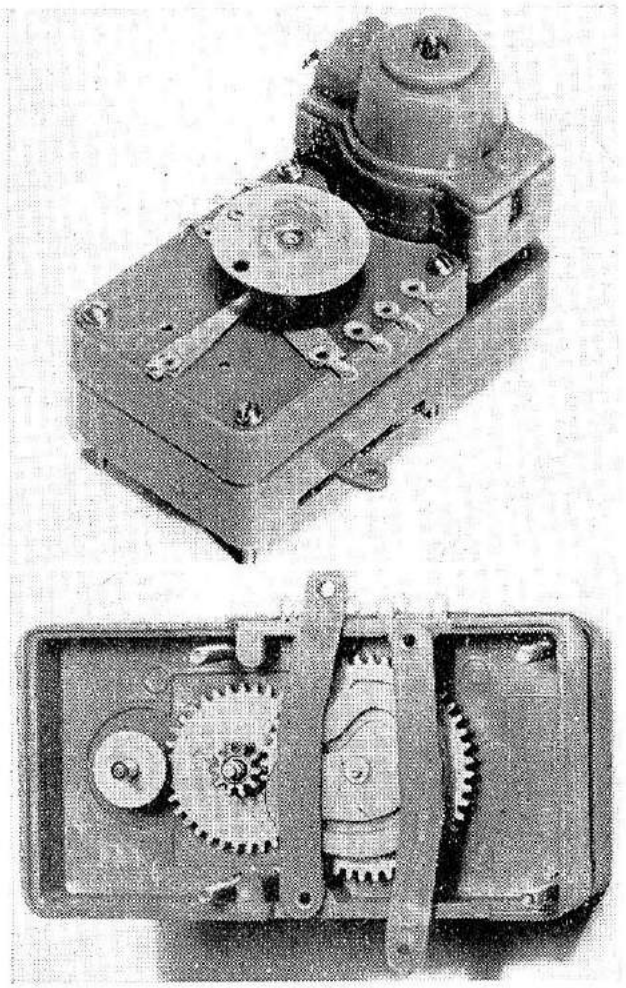
Baby Metz

Metz has also come out with a new receiver that is more attractive than before, but not exceptionally — it is a small all transistor RX for single channel only but it needs a rathr high A.F. frequency".



Lower centre : Baby Metz receiver, weight just under 2 ozs. It is modulated on 3,3 Kcs.

Polyton 3 which goes with Bellaphon 3 and is given top marks by Windy Kreulen. It is same size as Mikrocombi.



Multi-Purpose Actuator by Cobb Hobby

For years now, we have watched the American advertisements from a Powder Springs, Georgia address, offering all sorts of embellishments for the single and multi-channel enthusiasts. Proprietor L. R. Purdy, whose practical servo test feature was published last month, has always tried to satisfy the constant demand for something "extra" out of stock TX/RX outfits. His clockwork drive "beep" boxes and Selector-four or Electro-four combinations have offered the virtues of five-channel control, even permitting simultaneous rudder/elevator for spin action. These four position actuators have acted as switch gear for slave servos on rudder and/or elevator according to surface power required, and have had direct operation of one control off two of the main actuator positions.

Now we have the ultimate in the COBB HOBBY line. This is the Micro-Four, a $12.95 two-decker sandwich which must rate as the most complex, yet universal actuator ever produced since the days of the Mercury Cossor unit a decade ago.

The Micro-Four has the same all-encased motor and basic red plastic housing as the Multi servo (reviewed last month) and the 3 position compound or SN actuators in Purdy's Micro series. Brush renewal is therefore not possible; but there is no reason to suppose that dismantling or examination would ever be necessary in the normal span of motorised actuator life. Current drain figures are as mentioned last month and it should be emphasised that NO current is used while the unit holds any of its four positions. Moreover, positioning is 100% due to Purdy's incorporated electronic brake arranged through special battery tapping and circuitry. Switching on the main four-position actuator is by four wipers on an internal fibre disc and on the reverse (upper) face of the disc is *another* circuit pattern for no less than six more wiper fingers to bring in the slave servos of used for switching. With all this electrical gadgetry we have as many as fourteen external connecting tags for use in a wide variety of systems.

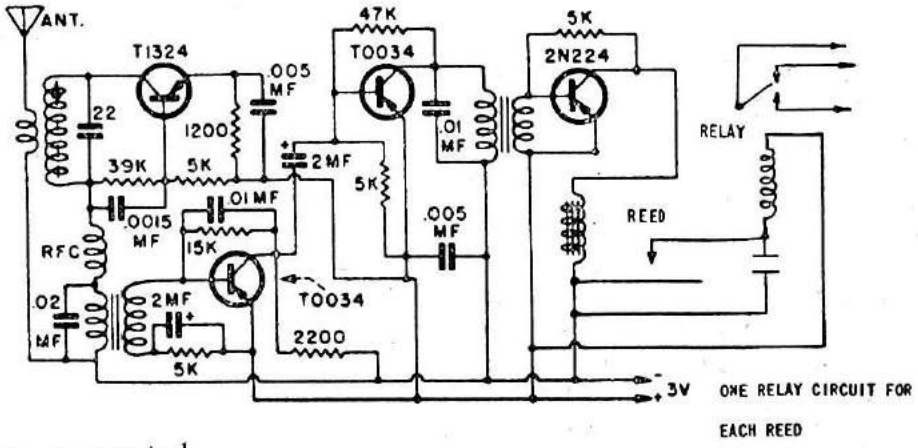
The basic four position unit also has a nylon cam attached to the final gear. Into the cam fit two followers, and these project as operating arms, one each side of the actuator for rudder and elevator action. They are self neutralising on one neutral, can be held at extreme positions, and can be manually keyed on the usual cascaded escapement scheme of blip, blip and hold, two blips and hold or three blips and hold. Such takes practice, but anyone used to three position actuator selection can soon master it with a good microswitch. We did it in five minutes: but the easy way out is to get the Cobb Micro controller to sort out the blips for you. This has yet to be examined but promises well.

So for a small model (power off the arms is not enough for anything larger than Smog Hog size rudder) one can have off single channel, the benefits of two servos for rudder and elevator, plus quick-blip for engine escapement and all off one battery set of four pencells. Where tough power is needed for large

[continued on page 101]

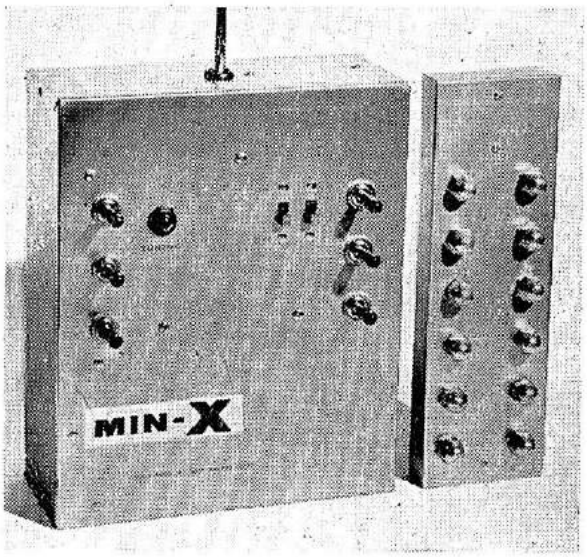
12 CHANNEL FROM U.S.A.

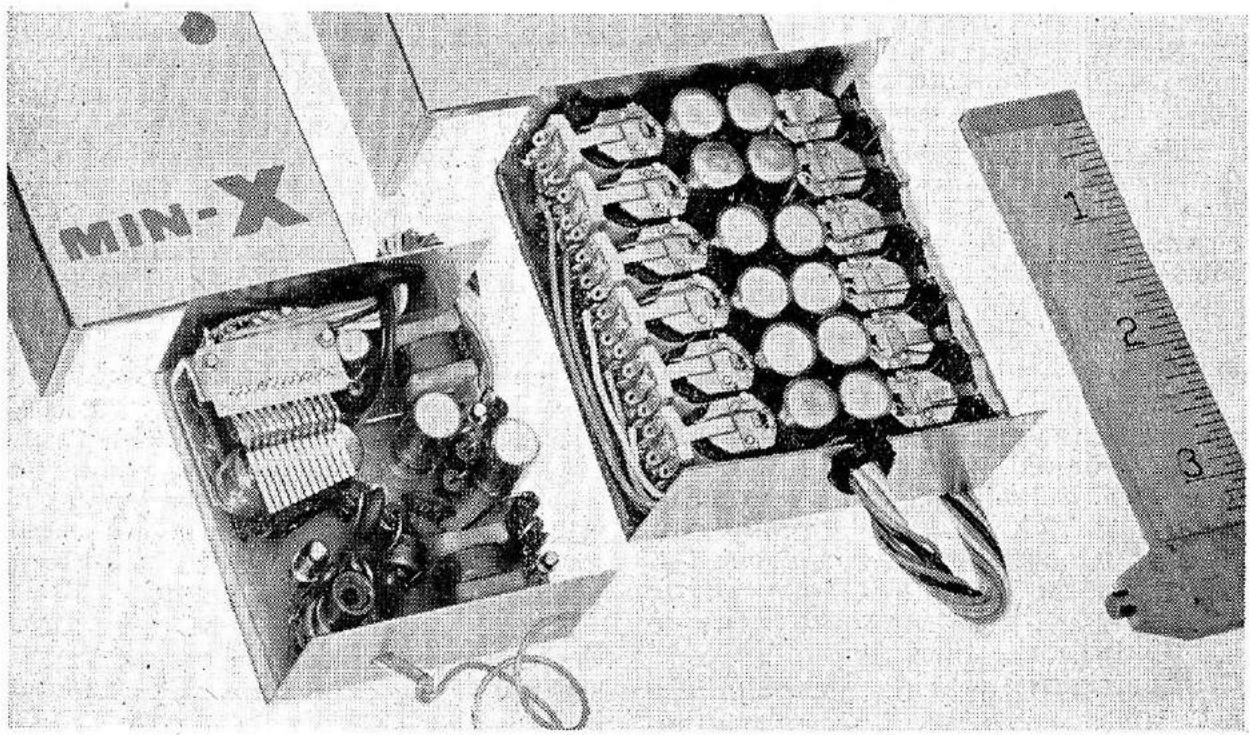
PHEW — did we say MULTI - channel ! Latest from Min - X Radio, Detroit, Michigan, is a 12-reed outfit as pictured on these pages, and for those not already aware of the Min-X system, it should be pointed out that the entire range of 4, 6, 8, 10 or 12 channel sets use a common receiver (circuit at right) and their single channel set can be converted to any of the various multi-reed banks simply by a plug - in unit scheme. There are, of course, small conversions needed to get the reeds on the basic RX panel where the single relay normally sits (see the reeds in picture at bottom of page) and this is done by Min-X at a small servicing charge.

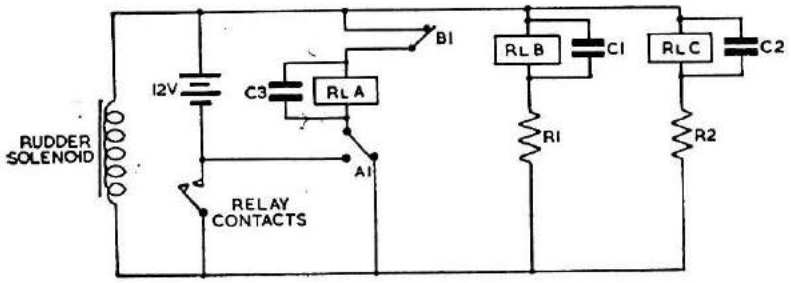


The Tone TX has a separate pot. box which fits on the back of the main case, but is shown here detached. Deans relays of the new sub-miniature type are used for all sets, and Jaico reed banks for six or eight channel, with Deans reeds for four, 10 or 12 channel.

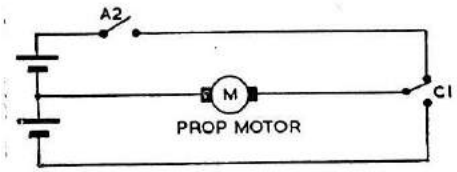
A feature of the basic single channel Min-X is that the Transmitter can be switched to operate either Carrier or Tone. The RF section of this crystal controlled TX is of the MOPA type (Master Oscillator Power Amplifier) with a very high signal output.







R1.A	180 Ω
R1.B	1,000 Ω
R1.C	3,400 Ω
R1	250 Ω
R2	250 Ω
C1	500 μ F
C2	1,000 μ F
C3	50 μ F



Here is a simple and inexpensive method of enjoying a number of controls for boat operation by Peter Wells. Those who fancy something more elaborate should study our Kinematic feature on p. 100.

Simple Boat Control

WHEN considering the design of a radio control system for a model boat, many prospective enthusiasts must ask themselves, "How much will it cost me?" This is precisely the thought that ran through my mind when I became interested in radio control. I wanted to make a model perform the manœuvres any full-size craft is capable of, within reason, without the expense of a multi valve receiver, mark space ratios, an audio modulated transmitter, etc., etc.

I built a conventional transmitter of the push-pull type using two 3A4's and a super regen. receiver using one 3S4 switching a series of relays to give the controls I needed.

The system, because of its simplicity, only gives sequence control of the rudder, but the rudder can be operated through its sequence continuously without affecting the state of the propeller drive, i.e. ahead off or astern.

The rudder is operated by a rubber driven escapement and moves every time the TX is keyed, right-centre-left-centre, etc. The rudder escapement solenoid operates direct from the RX relay contacts. Also operating from these contacts is the relay system shown in Fig. 1.

The first pulse from the TX (of short duration) energises relay A and the rudder solenoid. Contacts A1 change over and maintain the supply to relay A after the RX relay has dropped out. Contact A2 also makes, completing the supply to the propeller motor giving forward drive. Further short pulses of the TX steer the boat.

If the TX is keyed for approximately half a second relay B energises, i.e. when the voltage across C1 has risen to a sufficient value. As soon as relay B energises contacts B1 open so de-energising relay A. Contacts A1 and A2 drop out and the driving motor stops.

Relay C operates on a one and a half second time constant and when the TX is continuously keyed, relay C energises (after one and a half seconds) and contacts C1 change over reversing the propeller drive.

In order to select reverse, relay A energises for about half a second in the process thus forward drive occurs momentarily, but this has little effect on forward motion. As relay C takes one and a half seconds to energise from the start of continuous keying, it will take the same time to drop out when keying ceases, due to the charge on C2. This is a serious disadvantage if your model comes within one second of sudden disaster when going astern — too bad, you can't avoid it, but the hold-on property of the relay enables the rudder to be used when going astern by unkeying the TX for short periods (less than one and a half seconds of course!) until the rudder sequence brings it to the desired position.

Control takes very little practice and this is learned when setting up the relays. Experimenting with intermediate relays can produce additional effects, half-ahead, depth charges, or a scuttle relay if control does not come up to expectation! The final result can be as ingenious as the builder.

Relay operating times are only approximate and depend on circuit resistance voltage, etc., and are best found by experiment.

Potpourri of Gadgets and Gimmicks

[SKETCHES OVERLEAF]

THIS first selection of readers' notions combines the useful with the purely "doing it the hard way" type of gadget so dear to so many modellers. We hope others will be stimulated to send in their ideas. Sketches may be rough if understandable and descriptive writing should be as brief as possible.

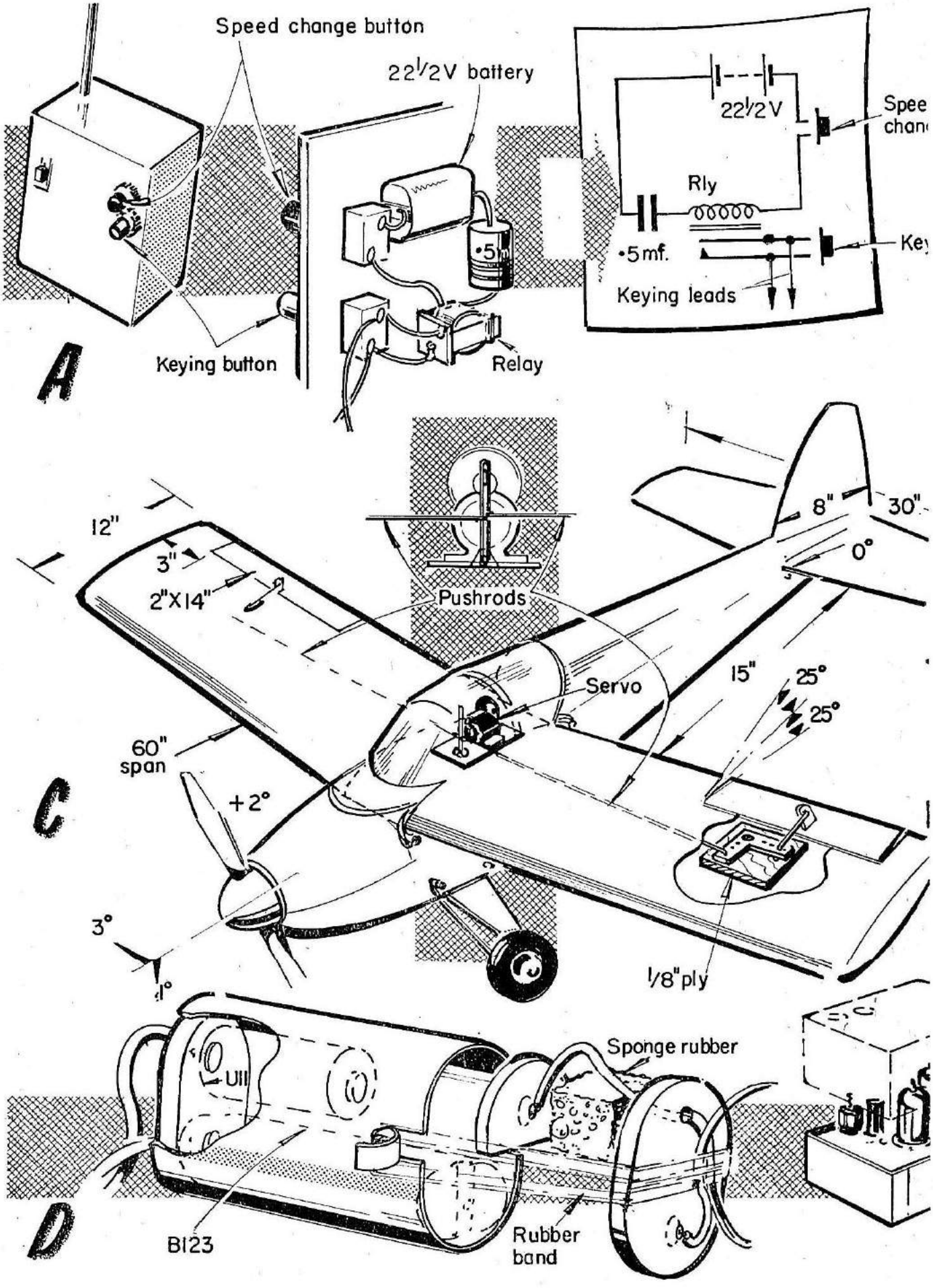
Idea **A** comes from LARK Newsletter and is a transmitter modification for no-miss engine control used by the Barks Club members at a recent meeting. Briefly, an additional speed change button is added, with its own relay, condenser and 22½V. battery (this can be an old 'tired' one as it has not to work too hard). Any press signal, long or short, provides a quick blip radio signal, using Varicomp or similar systems.

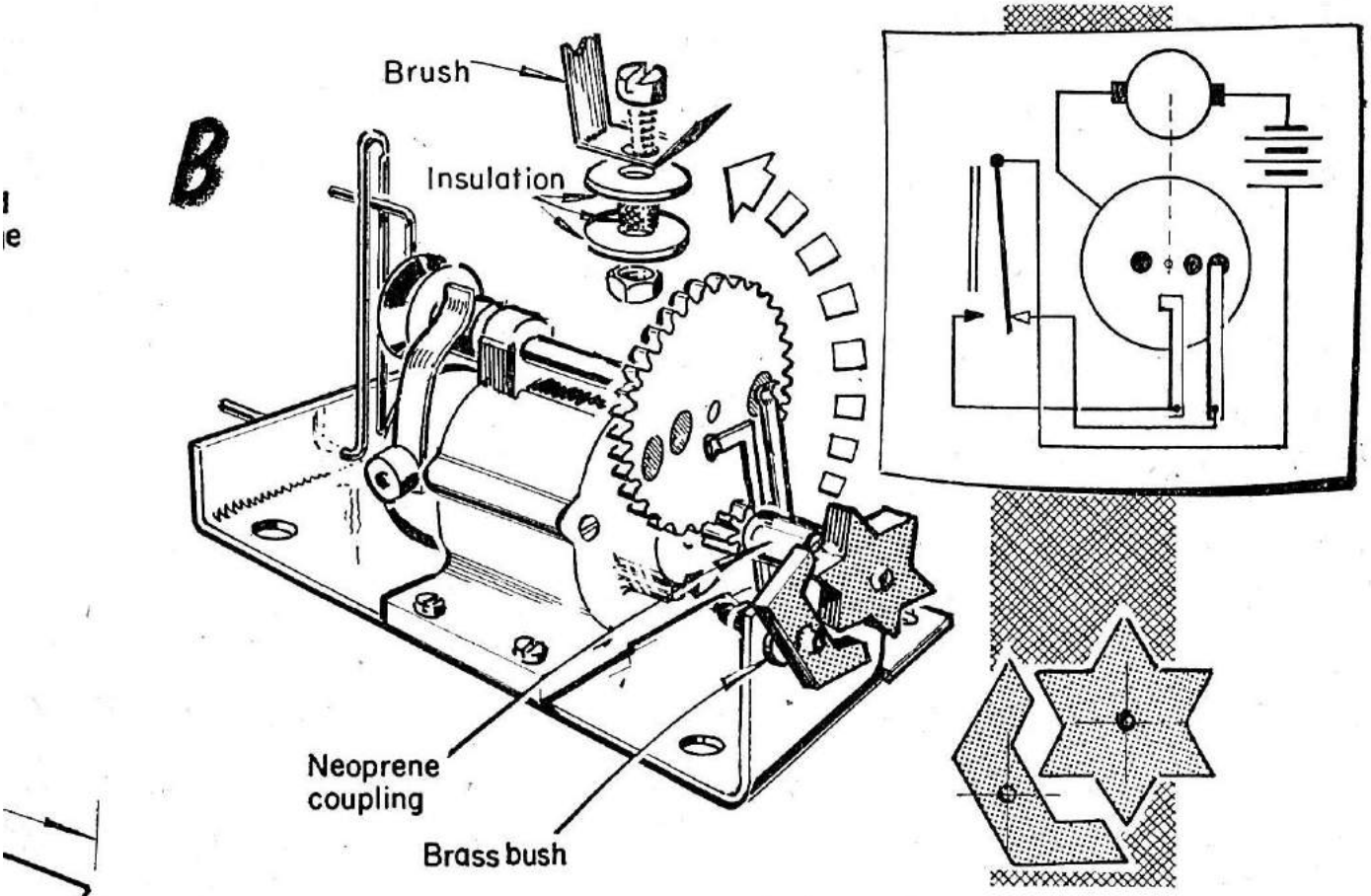
Next we have a motor driven actuator depicted in **B,** by E. Gordon of Southern Rhodesia. It is an ingenious variation of a fairly old type, and probably the only way with some motors of high current consumption and higher inertia. The R.E.P. Omniac is a commercial example of the system on similar lines. Mighty Midget is shown here, but Frog or Ever-Ready would do equally well. The big brass wheel has $\frac{5}{32}$ in. dia. holes drilled as shown and plugged with perspex—these being the insulated parts for contacts to ride over. Shim brass contact brushes of about .015 thickness are bent up and insulated from base to rub on wheel. Star wheel is of brass, rattler of mild steel, size is unimportant provided proportions kept. Both are bushed with 16 gauge 4 B.A. bushes locked to the base. No trouble with missing or over-running has been experienced and operation can be on any convenient voltage up to 9V.—4½ to 6 being sufficient to give good strong movement. Third brush, by the way, is an optional extra, working over a cam for engine control —making three movements covered in all.

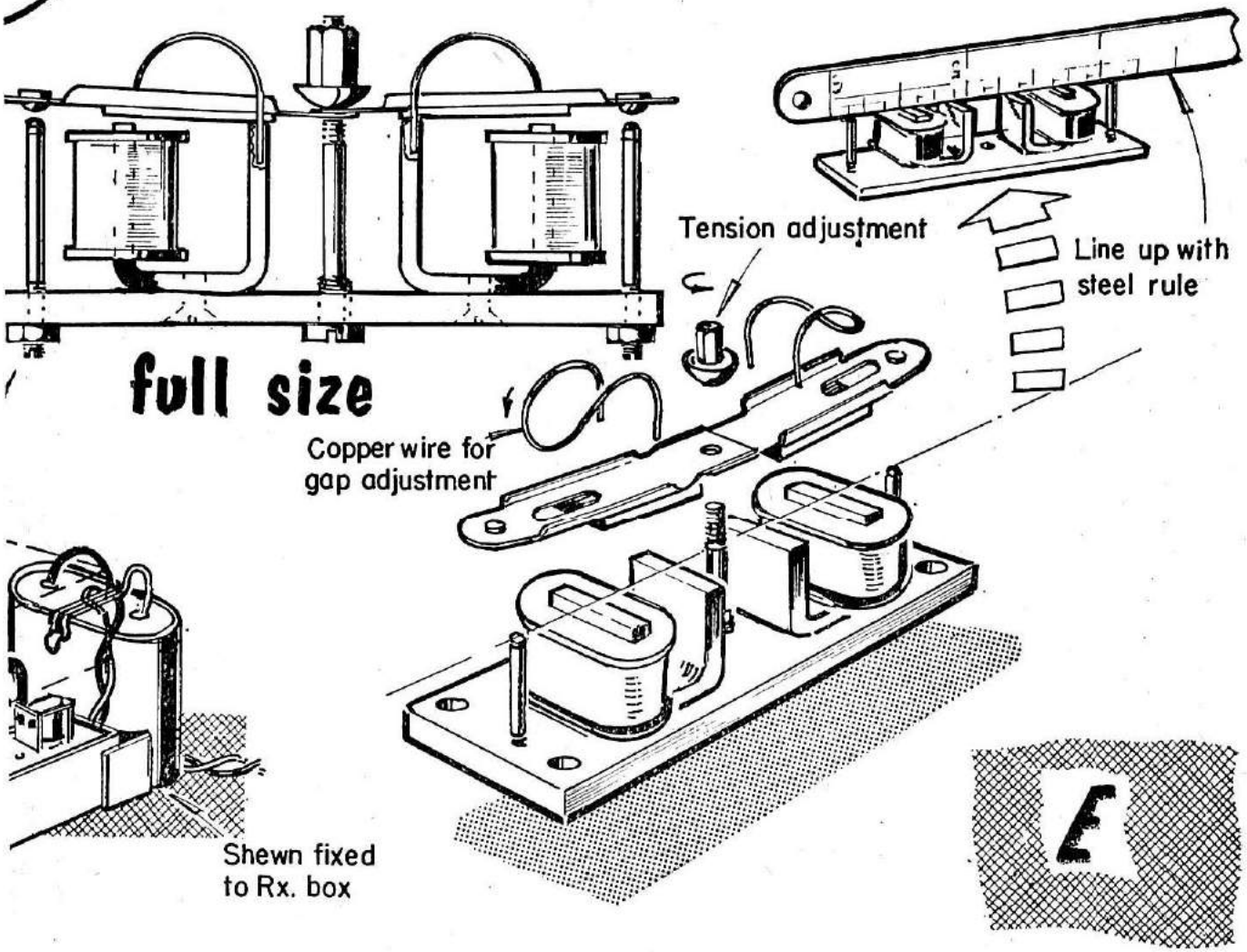
C is by Brian Fry of Abbey Wood and offers aileron control in lieu of rudder for single channel, intended to use the usual rubber driven escapement. In practice, however, length of rubber motor was limited by depth of fuselage, so the ubiquitous Mighty Midget was brought into service. Idea is almost self-explanatory, giving angular movement of about 25° up and down. Whether it is worth the effort is a matter of individual opinion—Brian thinks so, and reports that in action control response was the same with power on or off, turns could be held longer without noticeable loss of height, and viciousness in turns absent. Alas, our reader's R/C skill was unequal to his mechanical ingenuity and model and all were lost before the system could be refined much further.

Cyril Badger of Redruth offers **D,** a useful battery box for the original Hill receiver. As shown in smaller sketch the outfit complete with case, sockets and batteries weighs 10 oz. Installation has proved very reliable, perhaps because of battery policy, viz. L.T. 1—U11 replace every six flights, plus fresh batteries for every session. H.T. 1—B123 replace every month regardless of use. To make battery changing a "lazy man's ideal" box was made up as shown and fixed directly to RX. A single three-pin socket is used for meter insertion and for switching on by inserting a shorting plug.

Finally in **E** we have a bank of relays for reeds devised by A. Birch of Nottingham. He rewound surplus 100 Ω Siemens to 4,000 Ω for the job, but similar types wound to 3,400 Ω can be obtained for 10/6d. from Bold and Burrows, so this part is best left to the experts. He took cores and cut them to a plain U-bolt, centre tapped 6 B.A. and mounted them in pairs as sketched. Round headed centre nut (like spoke nut) adjusts the two relays, giving equal pressure to each side, once set up there is no further adjustment required. Reeds of identical length are jointed in the centre. Silver tipped screws are located through 10 B.A. holes at each end, and adjusted for height as shown. Altogether an intriguing scheme capable of a variety of adaptations and certainly saving money if skilled enough to get results comparable with the ready-made variety. This one is definitely offered for 'hard way' merchants!

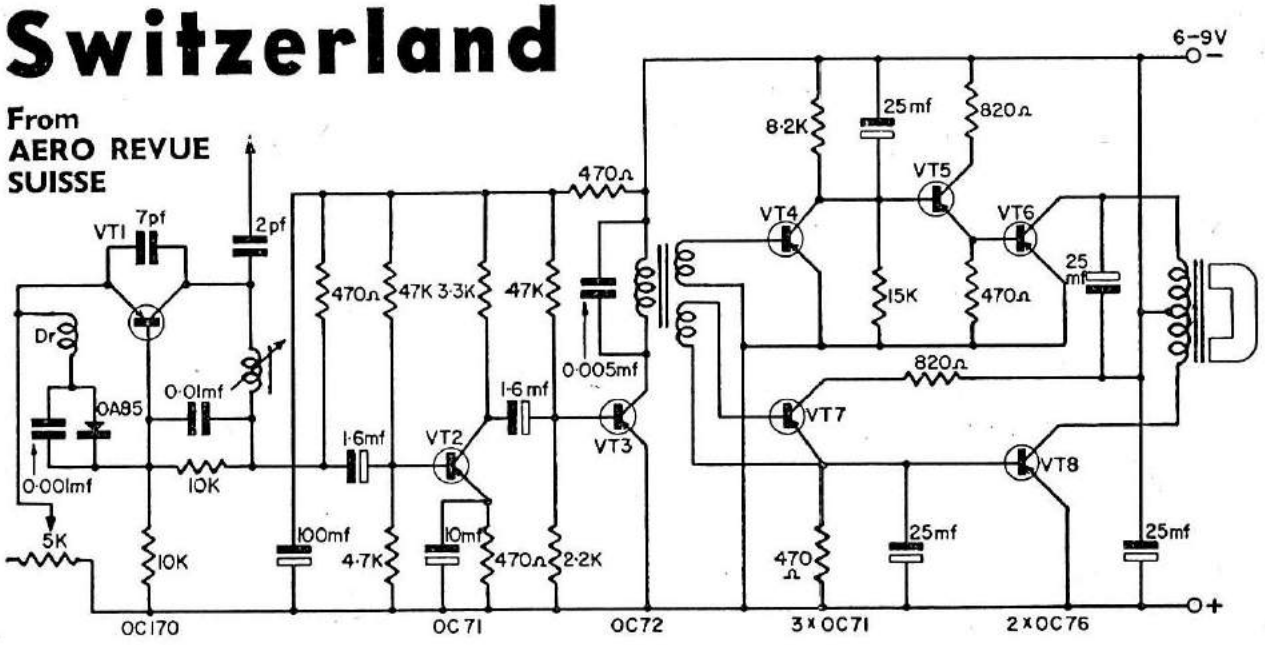

Speed change button
22½V battery
22½V
Rly
•5mf.
Keying leads
Keying button
Relay
A
12"
3"
2"X14"
Pushrods
8"
30"
0°
Servo
15"
25°
25°
60" span
+2°
3°
1°
1/8" ply
C
Sponge rubber
UII
B123
Rubber band
D


B
Brush
Insulation
Neoprene coupling
Brass bush


full size
Tension adjustment
Line up with steel rule
Copper wire for gap adjustment
Shewn fixed to Rx. box
E

Switzerland

From
AERO REVUE
SUISSE



S.C. ALL TRANSISTOR RX FOR PROPORTIONAL

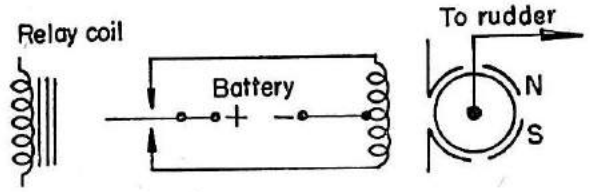
This interesting relayless circuit was developed and built by Hans Keller of Weinfelden based on a circuit by Von E. Nievergelt of Zurich. Many months trouble-free working are claimed for it.

THE pulsing motor around which the receiver is built is similar to the permanent magnetic actuator described by Howard Boys. It has two windings and the use of a single actuator battery is possible. A similar commercial actuator from America is the Sage proportional actuator, and could be used with suitable output transistors.

The front end of the receiver is a three-stage all transistor super-regenerative system and in the form presented is for use on 40 meg. cycles. It is the same front end as the one by Von. E. Nievergelt.

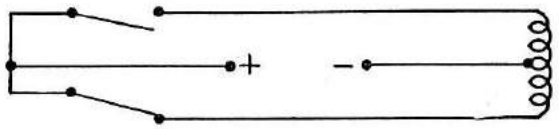
The circuit following is a switching arrangement which energises one winding of the actuator on tone and the other with no tone.

Consider a relay driven system:—



Both relay contacts are used to make a change-over switch. This cannot be done with one transistor as it is only a single throw switch.

However, the change-over relay contacts could be replaced by two single switches if they were ganged and this is what happens in the case of the back end of the receiver.



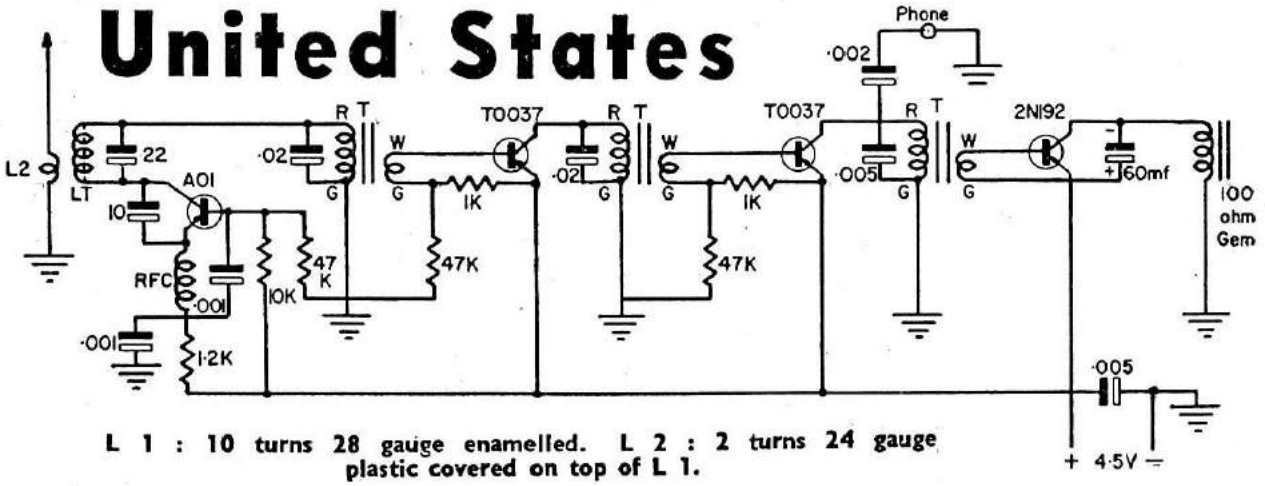
In this circuit VT4, 5 and 6 form one switch (S1) and VT7 and 8 the other (S2).

With no tone (i.e. plain carrier) there will be no base current for VT3 and VT4 so they will both be off (no emitter or collector current). As the base current for VT8 is obtained from VT7 it will be off as no current will be present in the transformer secondary. As the base current for VT8 is obtained from VT7 it will be off also and there will be no current in the actuator winding on that side. However, when VT4 is off base current for VT5 flows via the 8.2K resistor and it is turned on. VT5 base current is the base current of VT6 so that is turned on hard also. The current therefore flows in the other winding of the actuator which moves accordingly.

When a tone is sent VT4 turns on during the negative peaks of the tone

[continued on page 94]

United States



L 1 : 10 turns 28 gauge enamelled. L 2 : 2 turns 24 gauge plastic covered on top of L 1.

British equivalents of principal U.S. components.

AO1	OC 170	or other manufacturers' equivalents
TOO 37	OC 71	
2N 192	OC 76	

Coil former ¼ in. polystyrene.

Transformers : Any good make of subminiature. 4,000 ohms primary. 1,000 ohms secondary. Relay 100 ohms Siemens, etc.

Digested from Paul Runge's GRID LEAKS

TR 4·5 : FABULOUS ALL TRANSISTOR RECEIVER

For transatlantic contrast we present the TR 4·5 in its original form by Red Costlow and Don Kamm. Mullard's Norman Kyte has produced a modified version for P. E. Norman's Delta models.

BEFORE you start assembling your receiver may we pass on some information and a few tips. The TR 4.5 is an all transistor receiver operating on 4½ volts! No expensive B batteries or converters. This is achieved through the use of a low resistance, high current relay. With no signal the receiver idles at approximately 10 mils. Carrier drops this to 2-3 mils and a 400-500 cycle tone produces a rise to 40 mils for really reliable relay operation.

The detector used is equal to or exceeds tube detectors for sensitivity and eliminates the need for high plate voltages.

Probably the greatest pleasure to be had with the TR 4.5 is with temperature stability. The receiver responds perfectly from 15° to 130° Fahrenheit. How much lower in temperature it will go is not known and it is doubtful whether any check is necessary! The final submini receiver weighed 1½ ounces and you should have no trouble at a little better than two ounces with no miniaturization.

In construction we cannot stress enough the proper handling of transistors. Not using *heatsinks* when soldering in the transistors or wrong polarity will ruin them. Use $\frac{3}{16}$ in. lengths of sleeving for 'stand offs' on the transistors. This protects the leads and makes it easier to install them. Install the transistors last and *only* after you've carefully checked your wiring.

Tuning is a simple matter. It is preferable to use a crystal earphone but other methods are okay. Long meter leads are taboo!

Listen for the conventional rushing noise and, with carrier on, tune the slug until the hiss disappears. Key the audio and it should be loud and clear. After this step,. range check and touch up the tuning with tone. Tune for the loudest tone. Most of the conventional tone transmitters of 100 per cent modulation will operate the TR 4.5. In some instances the receiver may swamp within a couple of feet of the transmitter. Back off a few feet. When the TR 4.5 is at idle (no carrier) the relay may occasionally chatter. This is normal and will cease when the RF is on. A crystal earphone is also nice for trouble shooting. Merely touch a tip to various stages of the receiver and you can hear the hiss (or tone). With any high gain receiver any noise spikes caused by rubbing metal may cause interference and can be easily cured by bonding or insulating the offending parts. This will be in rare cases.

If you use a plastic case for the TR 4.5 you can mount four 100 m.A. D.E.A.C.'s in the cover for an integral power supply.

It is quite possible to make the TR 4.5 smaller. This is not recommended for the beginner. The prototype measures $\frac{5}{8} \times 1\frac{1}{2} \times 1\frac{7}{8}$ in a can (smaller than a matchbox) and we pass on this information for those with patience and the need for smaller size and lighter weight. The transformers are fastened to the base with light wire passed over the laminations or with Araldite. Don't crowd them too closely or you will get interaction. Finally, leaving off the can (or plastic case) and gluing the receiver to foam rubber will save space and weight. This leaves the receiver unprotected and should be used as a last resort. By careful planning and good workmanship the TR 4.5 can be built to weigh $1\frac{1}{2}$ ounces.

We feel the TR 4.5 will open many new phases of R/C. The $\frac{1}{4}$A. fan can now build an R/C model well under 10 ounces (in the States they have a Cox PeeWee job at $8\frac{1}{2}$ ounces). The endurance man can really log time. With 450 m.A. D.E.A.C.'s, minimum duration would be over 12 *hours*. This would be with a continuous tone. On the average, you could expect about 20 hours! For just plain R/C we think you'll enjoy the economy and case of operation of this receiver.

S.C. ALL TRANSISTOR RX FOR PROPORTIONAL (from page 92).

at its base and it draws a pulsating current robbing VT5 and turning it off. The 25 mfd. capacitor smoothes this current and ensures that VT5 and VT6 are held off during pulses.

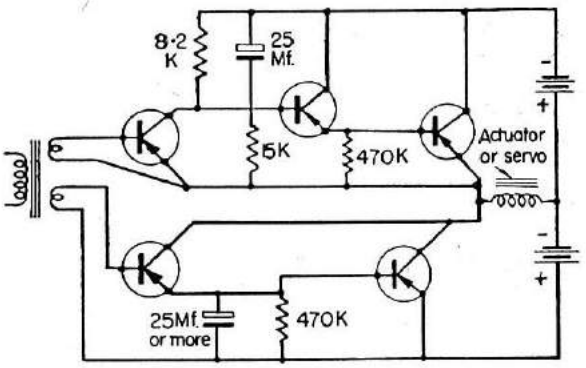
In similar fashion VT7 is turned on by the negatives peaks of the tone and turns VT8 on. The 25 mfd. capacitor in its emitter keeps the base current of VT8 going between pulses. The current then flows in the first winding of the actuator which moves in the opposite direction.

Suggested Improvements

The collector of VT5 can be connected to the collector of VT6 and and similarly the collector of VT7 to collector of VT8. The two 820K resistors are then no longer required. Also the collector currents of VT5 and VT7 are no longer wasted but pass through the appropriate actuator coil.

The coil resistance should be such that 120 ma. flows through the coil when the full supply volts are applied, i.e. with 6 volts. Res. each coil is $6/120 \times 1{,}000 = 50$ ohms. and with 9 volts 75 ohms. With power transistors for VT6 and VT8 lower resistance coils could be used.

The system can also be used with single coil actuators (and servo motors) by the use of two actuator batteries, viz :–



Next Month . . . . . .

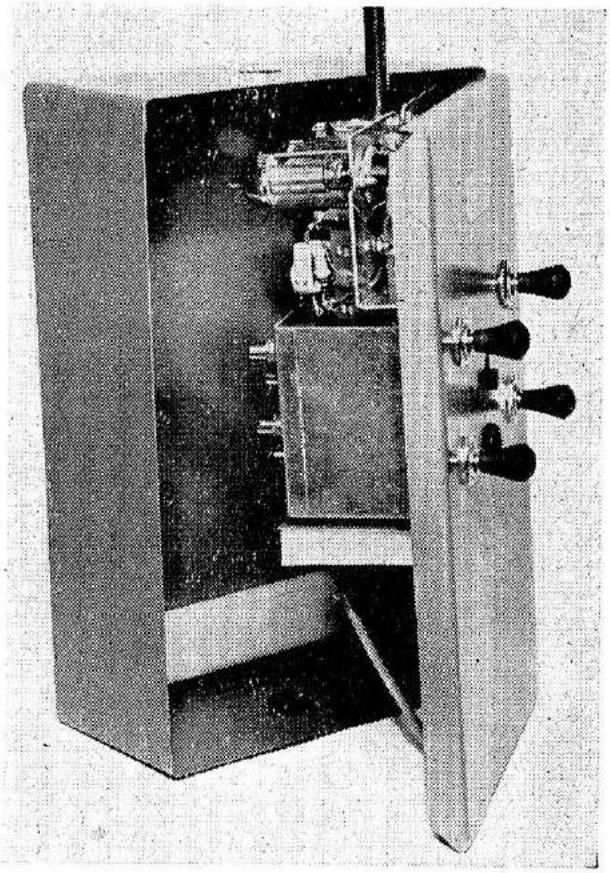
HIGHLIGHTS OF THE ISSUE INCLUDE :

BATTERY EQUIVALENTS AND SOCKET DIAGRAMS DATA SHEET to pull out for wall fixing ★ British All Transistor Receiver Step by Step Construction ★ Lovegrove/Riall Simpl Simul for Inverted Flight ★ Contact Design ★ The Right Battery for Your Model ★ Graupner Polyton 10 TX and RX Reviewed ★ Multi Channel for Beginners ★ Latest Equipment ★ McQuery Column ★ Introduction to Transistors Here, There and Everywhere.

R.C.M. & E. TEST REPORT No. 2

R.E.P. Octone 8-Channel Receiver and Transmitter

Equipment reviewed is considered under aspects of electrical testing carried out by F. C. Judd, A.Inst.E., and from the model operator's point of view by T. H. Ives. This splitting of reports will, we believe, enable us to provide readers with the best possible appraisal of new products.



Neat transmitter has ample room for batteries, is finished in an attractive mottled blue. Rubber knobs for the channel switches make operation sure and comfortable.

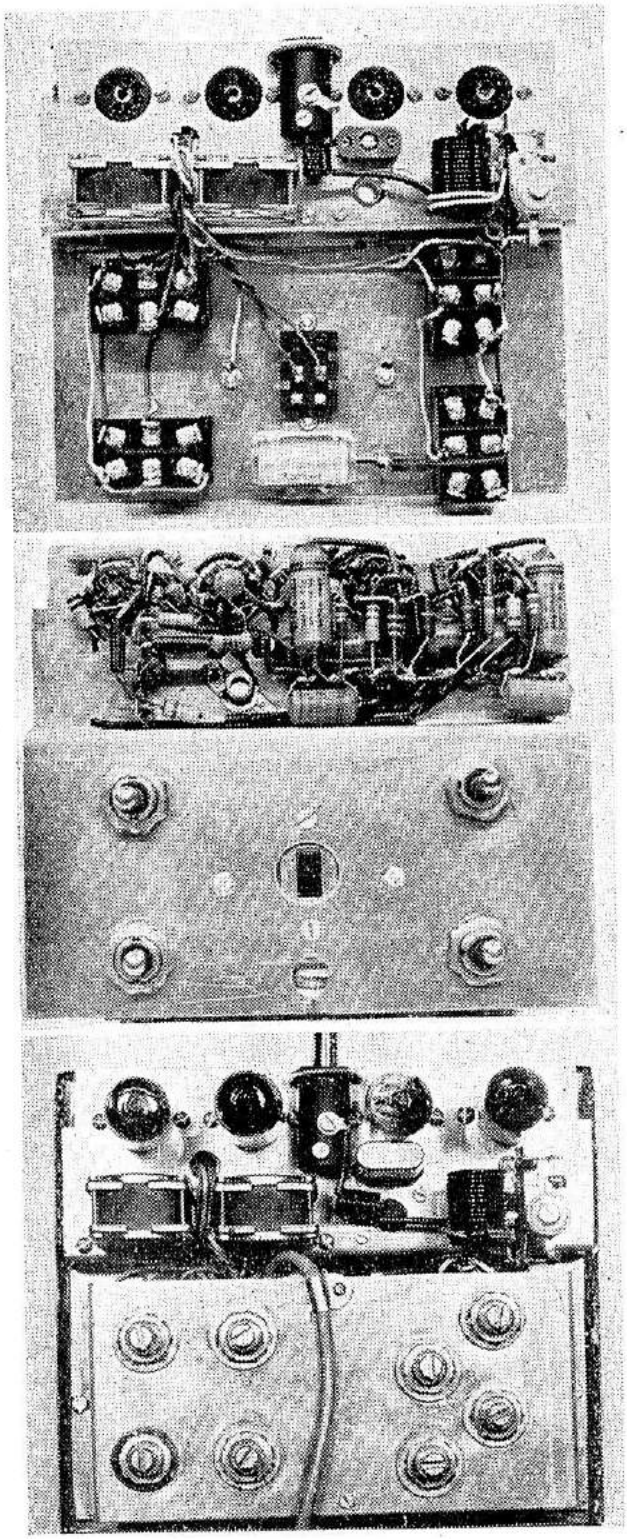
RADIO control has been rather slow developing and since the first temperamental hard-valve receivers, there have been few moves towards the design of really reliable equipment. A name long associated with radio control is that of G. H. Redlich who alone is responsible for not a few of the efficient radio control circuit designs in use today. He is a pioneer of the 'reeds' and tone system has done a great deal to popularise this highly satisfactory method of model control by radio. As G. H. Redlich (Radio and Electronic Products) he has designed and produced a series of tone modulated transmitters and reed receivers which have been given the apt titles of Tritone—Sextone—the latest design from the Redlich factory being called the Octone.

The writer received a complete 'OCTONE' equipment for the electrical review and tests and was a little surprised to find that on connecting up 'everything worked first go'. With electronic equipment this is something rare as any engineer will confirm; if he is honest. The Octone transmitter and its associated receiver are strongly yet neatly put together. The finish is attractive and as I have said, it all works. Eight channels are rather a lot to handle, especially without previous experience of the tone system. Everything possible has been done to simplify things for the most inexperienced Radio Control enthusiast, who should find little difficulty in setting the OCTONE transmitter and receiver to work. In view of the complex operation of eight channels a little help from someone experienced in the use of multi-channel would be advisable though.

The transmitter was first tested for correct frequency operation. It is crystal controlled so there need be no doubt about the signal being the radio control band of 27 Mc/s. A conventional crystal controlled feedback oscillator employs a 1T4 valve which drives the 3V4 power amplifier valve to full r.f. efficiency. With maximum H.T. a power input of 1.5 watts to the r.f. amplifier provides ample range and reliable operation. This is sensible since the full operating H.T. current of 20 to 22 m.A. does not drain the H.T. batteries too heavily.

Modulation is derived from two dynatron oscillators with pot. core high Q inductors. Each oscillator provides four tones thus permitting a total of

eight frequencies between about 250 and 480 c.p.s. Tests showed ample frequency separation between channels and which is sufficient to allow two of the channels to operate simultaneously, providing care is taken over adjustment of the tone controls. Modulation is carried out at the grid of the r.f. power amplifiers which in turn feeds a loaded aerial system. The aerial is a fractional wavelength type nicely plated and which telescopes down to 9½ inches from a total length of 4 ft. 10 ins.



These shots of the transmitter are taken with chassis partly dismantled to show components. Neat layout and workmanlike disposition will be appreciated.

The compact transmitter and the shorter aerial permits 'hand held' operation so that one is free to walk about and 'dodge the crowd'.

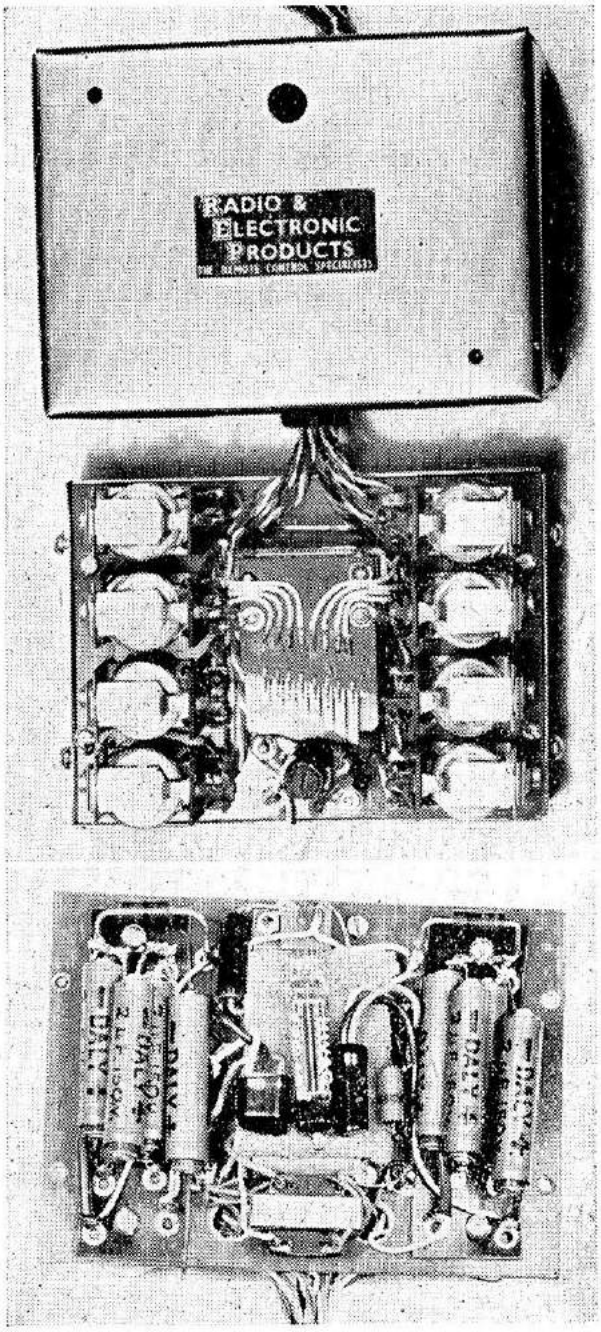
The size of the transmitter case is 9½ in. × 6 in. × 3 in. and there is plenty of room for two (B101) H.T. batteries (total voltage 67½ × 2) and a 1.5V. L.T. battery (type AD4).

Construction

The chassis, two of them, are soundly constructed from heavy gauge aluminium and being secured to the front panel of the transmitter, can be withdrawn as one unit for easy maintenance. All the 'tone controls' are mounted so as to be fully accessible through a small opening at the back of the transmitter case. Components are securely fitted and of well-known manufacture and the battery leads are provided complete with the necessary plugs and connectors.

On the front panel is a mains on/off switch, the channel selector switches and a 'flashing neon' indicator which tells when the H.T. is running low. Each of the channel switches selects either of two channels and are mounted so that two operate up and down and two operate sideways. These movements are comparable with those of a rudder—sideways (left and right)—and elevator (up and down). I have one criticism here, however. The channel switches have no identification labels. Printed or engraved labels quoting the channel number would be useful together with blank labels so that the operator can mark on his own particular choice of command which will, of course, vary with the application of the equipment.

The transmitter functioned perfectly on test and each channel control took only a few seconds to re-set after being deliberately moved out of adjustment. The frequency range of each tone control is more than sufficient to accommodate the reed frequencies. R.F. tuning, should it be required, is simple and requires only the adjustment of the P.A. tank coil capacitor for maximum r.f. output. The transmitter was finally



Aluminium receiver case and the two sides of panel, showing relays and reeds and components. Reeds 1-4 can be operated simultaneously with reeds 5-8. These two banks of four are linked and joined to a common negative via 22Ω resistors.

tested on 90V. H.T. only and functioned quite happily. (I understand from G.H.R. that it will continue to operate with the H.T. at 60V. or less.)

The Octone Receiver

Like the transmitter this unit is soundly constructed, neatly wired and compact. It employs a super-regenerative detector (XFY34) which demodulates the tones from the carrier. Two transistor amplifiers follow and the amplified tone is fed directly to the 8 channel reed unit. Both the reed unit and the eight relays are mounted on the receiver chassis which is completely protected by a light but strongly constructed case. All the necessary leads for the servo units are brought out from the relays and each is colour coded and carries an identification label.

No trouble was experienced on first checking the r.f. tuning and finally the operation of the relays which is fast and definite once the reeds respond to the requisite tone. Both the reed unit and the relays are a G.H.R. design and look robust enough to withstand the usual shocks that arise from misguided R/C activity. An oscilloscope check revealed a fairly sinusoidal waveform for each tone except at the lowest frequency which did contain some second harmonic. However, there appeared to be no interaction from this on the other channels each of which functioned quite correctly within the frequency range of each of the transmitter tone controls. Only the slightest trace of the quench oscillation appeared on the tone waveform which speaks well of the filtering in the transistor amplifiers.

The receiver operates from a 30V. H.T. battery and 1.5V. L.T. battery with no signal the H.T. current is extremely low being only 1.5 m.A. rising to 2–2.5 m.A. when a tone is being received. Each relay takes an additional 4½ m.A. and if two channels are operated simultaneously the current goes up about 10 m.A. Considering that eight channels are provided and that a valve, two transistors and the relays are all operated from the same H.T. supply, power consumption is very reasonable.

If the practical tests, which are to be carried out by another reviewer, prove the Octone equipment as efficient in operation as the electrical tests have indicated they should be, then this equipment warrants a 'type approved' label.

Knowing G.H.R.'s enthusiastic quest for new and better Radio Control equipment design there is little doubt that he has scored again with the production of the 'OCTONE' which should prove a most useful outfit for the most discriminate and ardent radio control man.

Modellers' Report

THE units were tested under conditions which could be expected when used normally for R/C work. A servo was connected and all batteries included.

Transmitter

For use as a normal multi system no setting up was required and the transmitter functioned perfectly from the start. For simultaneous work, however, slight adjustment of the reed frequencies as advised by the makers was necessary. Care is needed for this type of work which must be regarded as advanced R/C operation and should be carried out as advised in the technical report.

For those who are interested it should be noted that rotating the pots. clockwise reduces the reed frequency and should be watched if any adjustment is made. However, the tone system is so stable that no adjustment is required except for simultaneous work.

The switches for control signals have a rubber sheath fitted which makes continuous use much more comfortable and for rapid signalling can only be regarded as essential.

The TX case is now being modified in order to make access to the 'innards' more easy. The front and top are one piece which holds the TX and all batteries. Back, sides and bottom form a case enclosing the unit.

Range with aerial retracted 125 yards; with full aerial over 450 yards.

Receiver

This was very easy to set up and required no adjustment being already tuned to the TX. It was completely stable even with an old H.T. battery.

The reed frequencies were well separated and no evidence of interference was found.

The relay contacts are not suppressed.

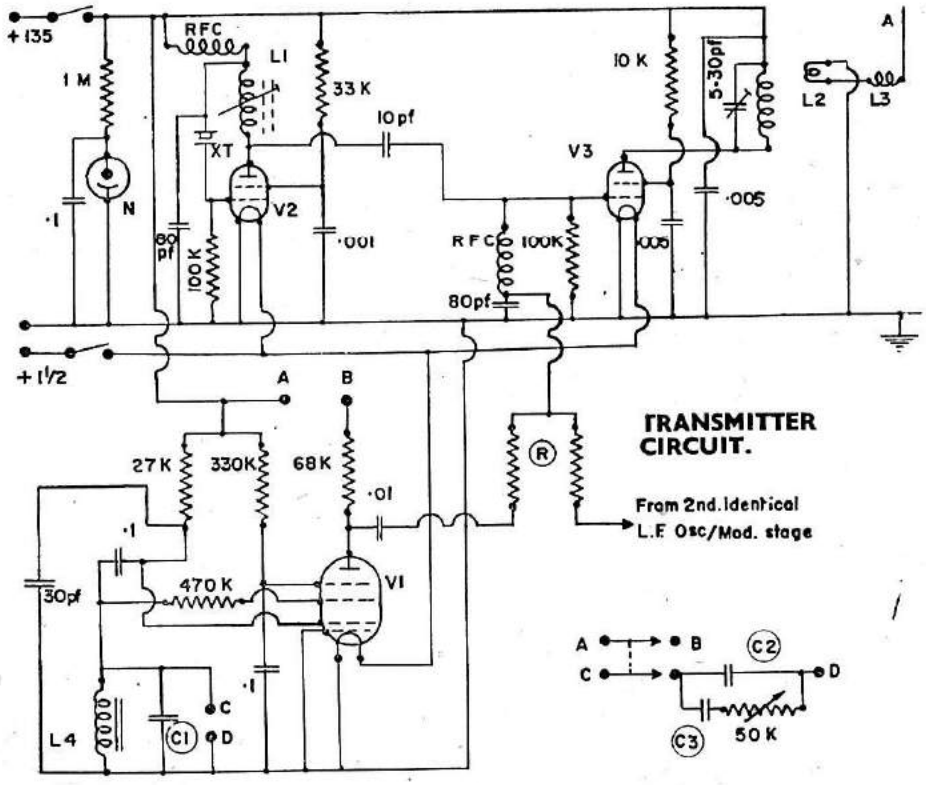
A minor criticism is in the relay adjustment. The adjustment is rather coarse and if attempted should be very carefully done. In the sample tested two of the relays were set rather high and although the current change is ample a setting to make at higher than 3 m.A. is not recommended. The makers are careful in the relay setting, however, and no adjustment should normally be necessary.

There is no doubt that this equipment represents a great advance in commercial R/C equipment and can be installed with confidence. The final results, however, will depend upon the owner's care in installation and time spent on wiring and installing will be well repaid by long periods of faultless operation.

A Year with Octone

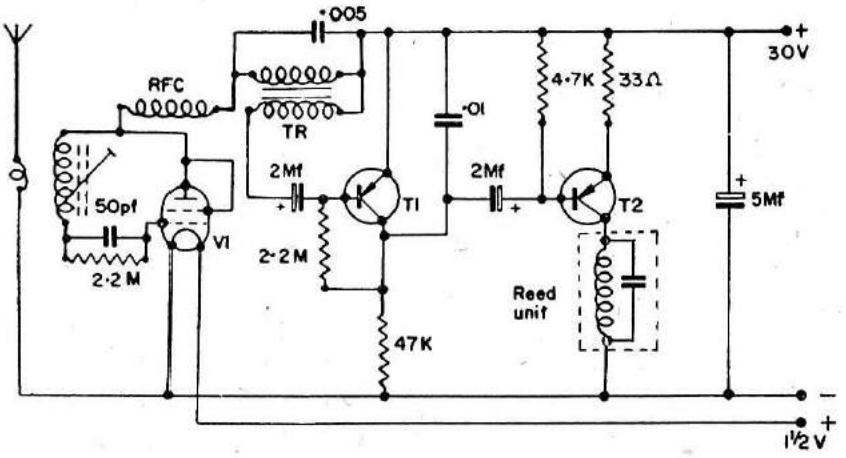
"MY Octone outfit celebrated its first birthday over Easter", states engine designer and manufacturer Dennis Allen, the well-known West Essex flyer whose radio and control-line interests have always stimulated progress in those parts.

We tackled Den on his Octone experiences over what we know to be twelve months of continuous operation (no fair weather flyer Den) and



V1=DK92 V2=1T4 V3=3V4
L1=22T 28G Aladdin ¼ Former
L2=10T 18G ¾ dia. 2T aerial at HT + End
L3=According to length of aerial fitted. For 5ft. A= 10T 20G ¾ dia.
L4=2.5 H LA1 Pot core choke
(C1)=Choose to resonate just above highest reed Fc usually .05 mfd.
(C2)=Choose for individual reed Fc
(C3)=Highest four reeds .01. Lowest four reeds .02.
XT=Overtone Xtal in 27 m/c band
(R)=Choose to give same mod. depth from both stages. Usually 47 K.

RECEIVER CIRCUIT.



his general comments are as follows:—

"Mine was the third set made, and it was initially used in a Smog Hog with Fox 35. It is currently used in a Merco 35 powered model based on the Hog but using flat based aerofoil. Reason behind this is twofold. First, the original Hog wing was warped. Second, it was not easy to control. My first Multi flights were fraught with pilot trouble. At the time I blamed the set, the model, the servos; but, of course, it was really me that was at fault, not appreciating that the down switch must be treated in very brief touches, and that Multi is largely a matter of switch blipping and not holding on.

"In fact, *all* the Octone troubles I have had, have been pilot errors. Only time it ever went off tune on one channel was on a Sunday that turned out warm after I re-set all the pots. earlier on in the garden shed. Damp of autumn had sent it off tune so I decided to set it right. Of course I was lucky that only one channel went sick in flight after such needless adjustment, and you may be sure that the TX and RX are always *kept indoors* in dry air conditions. Anyway the Garden shed is no place for £50 worth of gear!

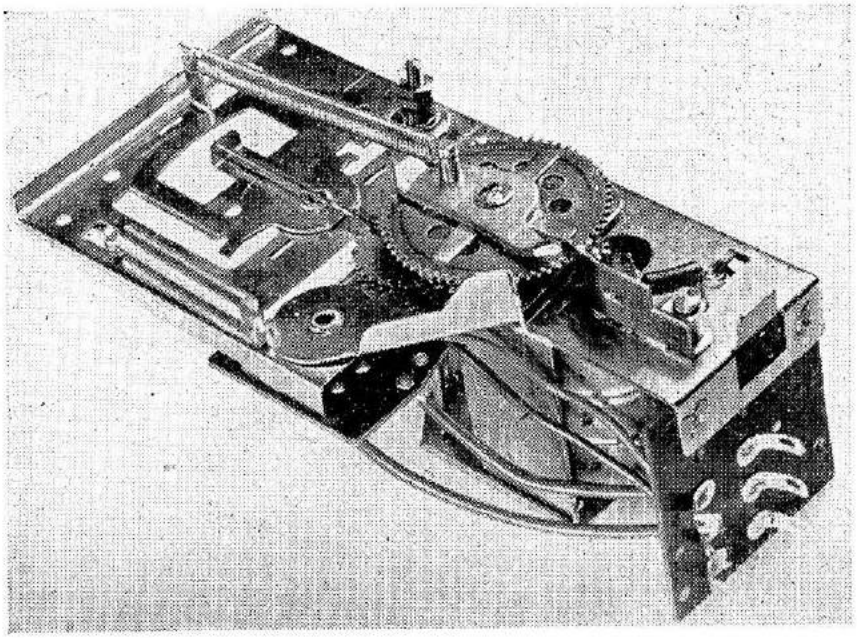
"My TX is also used for Tritone in a Rudder/Engine model so it has a lot of hard work and for that reason I use an external H.T. battery instead of the twin 67½V. internals. This is a "Portable 75", 135 volts, first carried in a shoulder bag but now left on the deck with a wander lead to the TX. An AD 4 is still used for L.T. Typical of the advantages to be gained was my experience of accidentally leaving the TX on for 14 hours overnight. It had a morning's rest, and was used again all the following afternoon. Battery was changed "just in case" but that is the only TX battery change yet made! There have been four RX battery changes, roughly each three months.

"If properly mounted with at least ⅛ in. airspace *all round* the set before it contacts Dunlopillo or foam plastic shock absorber, Octone is not affected by vibration. I have had such bad vibration that parts fell off servos; but the RX and reeds still worked. Keep the RX in contact only on one face at a time with the surrounding rubber, let it flop. Chris Olsen sticks his on four rubber stems to the fuselage floor and lets it swing where shock takes it.

"When field tuning, put the TX aerial down and go as far as one can for marginal range which is about 100 yards. Tune in there, and with the aerial full out, the air range is equal to the model going out of vision. By the way, watch those slide switches—some early ones were suspect.

"For setting up the reeds, Octone as it comes is perfect for continual use, having a good range of tuning on each pot. However if you have need to adjust the reeds I have found that if the reed gap is too large the pot. tuning becomes critical. If it is too small the pot. tuning is far too broad. About ¼ to ⅓ turns is about right. One reason for re-adjustment is when two controls work together.

"My set had no such modern embellishments as Neon flashers. Consequently it soon accepted a milliameter to at least tell me the TX was working. Considering that the Neon flasher is now standard, and that the relays are now improved (though I have had no cause to complain). Octone today is even better than my early purchase. It has served me well, and will I am sure continue to be trouble-free in the hands of those who can be satisfied not to tamper, and will admit their *own* mistakes. Unfortunately it is too easy to blame the transmitter when it's the finger on the button or the Receiver installation that is at fault".



Kinematic Servo Unit

INGENIOUS DEVICE FROM GERMANY

We have had one of these little Kinematic servo units for some time now, and regularly produce it for the edification and astonishment of our more intelligent visitors. It is a beautifully engineered job and must have cost an unbelievable amount in tooling up. Size is just over 4 × 2 × 2 ins., and weight including balance bob about 5½ ozs. Primarily intended for boat use, manufacturers, Graupner, do coyly mention aircraft in one line of their explanatory literature, but we would not suggest it has any real application there.

It combines a dual series of functions which will either give left or right rudder, or provide engine control, according to length of signal given. In standard form a total of eight movements are possible, four from short signal, four from long. An additional four can be built in, making a total of twelve.

The makers suggest the user should rig up the servo with a battery and try it out with a series of bench tests to get the hang of its wide possibilities. Initial set-up should be to fit a 3V. battery via black and white tags with an on/off button connected in, and white tag connected with positive pole. With short signal, wheel (1) moves a quarter turn. Long signal turns the wheel far enough to stop cutoff (2) with lever (4). Meanwhile smaller gear wheel (5) moves the steering arm right or left. Steering setting remains the same as long as signal is maintained.

After this, lever (6) is returned to its neutral position by spring tension, when parts (2) and (4) will be released by the spring. Motor with its drive pinion (3) also resumes its position. A push-rod (10) can be attached to bolt (9) for connection to rudder. Below gear (5) are two ratchet dogs which can be brought in or out of mesh via a clutch plate, moving the contact plate one position for each signal. Reverse is obtained automatically by return spring (7). Stop (11) prevents the wheel going past zero position, and has no other function.

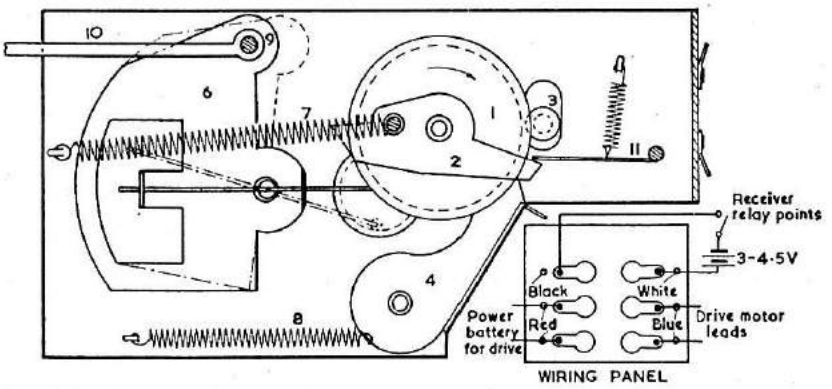
Return spring (8) is used cunningly to assist the motor and thus reduce excessive battery loading. A friction coupling is built in which it permits motor to continue running as long as a signal is being sent.

Four contact springs are connected to the wiring panel—red tags connect to battery and blue tags to motor. The mechanism should then be tried at various angles to study action of the bob weight which brings motor back into position.

Normal movements are turn right, straight on, left, motor on, forward, off, reverse. Further possibilities include lighting of navigation lamps, hoist signals, lower anchor, provided these are such as would only normally be called for with engine off.

Additional holes are already drilled in contact plate to take further connections so that the servo can be fitted with additional motors for further evolutions, and switch panel is laid out for this, though such extras are not included in the unit.

Illustrations show top view of servo, four sequence controls, and, at bottom, wiring for motor, servos, and relays where twelve commands required.



Final range of movements then becomes something like this:

Position 1
1 Engine on full ahead.
2 Left.
3 Right.

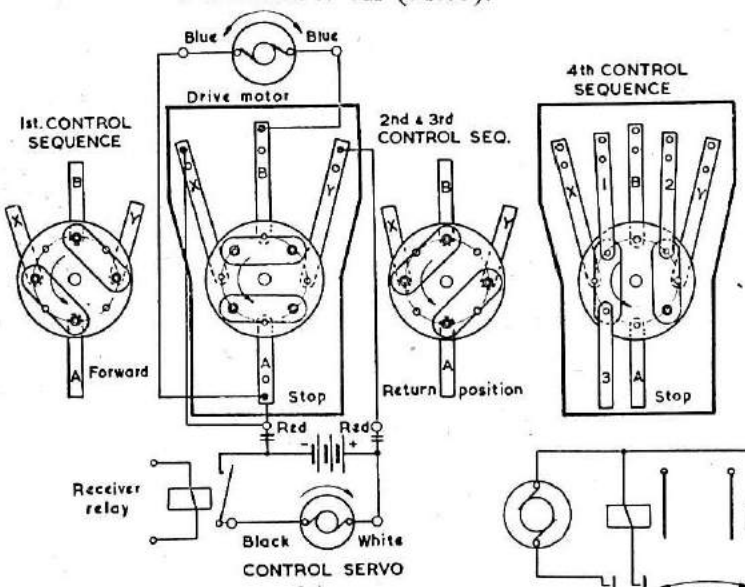
Position 2
4 Stop engine.
5 Switch 1 on (optional control).
6 Switch 2 on (ditto).

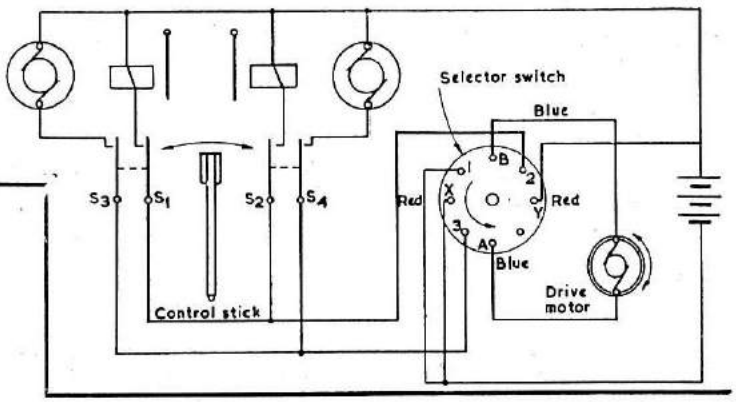
Position 3
7 Reverse engine.
8 Left.
9 Right.

Position 4
10 Stop engine.
11 Switch 3 on (optional control).
12 Switch 4 on (ditto).

Signals 1, 4, 7, 10 (positions 1, 2, 3, 4), are short, others long. Positions 1, 2, 3, 4, are sequential.

Altogether we find the Kinematic a fascinating little unit. Have we fitted it to a boat? Well, no . . . but, of course, we are going to just as soon as we can find something else to amuse our visitors.





Multi - Purpose Actuator

[continued from page 86]

elevators, the switchgear for slave servos is used, such are the combinations offered in Purdy's detailed instruction sheet that it takes an evening to sort out the works.

Advantages over other gear? Firstly it combined several services in one. No drain when on position and low drain when moving offers ideal opportunities for long flights, especially slope soaring where the elevator action is an advantage, or even these distance record attempts. It recognises its power limitations by giving switchgear for slave units of greater power, and is positive in its selection provided the operator keys correctly. When the Micro Controller, with claimed "unique design" for automatically timed selection appears, the single channel fan will have joystick control plus quick-blip for engine, and can even get that simultaneous rudder/elevator spin action through selection of rudder immediately after elevator without pausing in neutral.

We can hardly wait to see how this works out when our test Controller arrives, and already have ideas of a fully aerobatic *Gasser*, with five-channel virtues on only 1.5 c.c.

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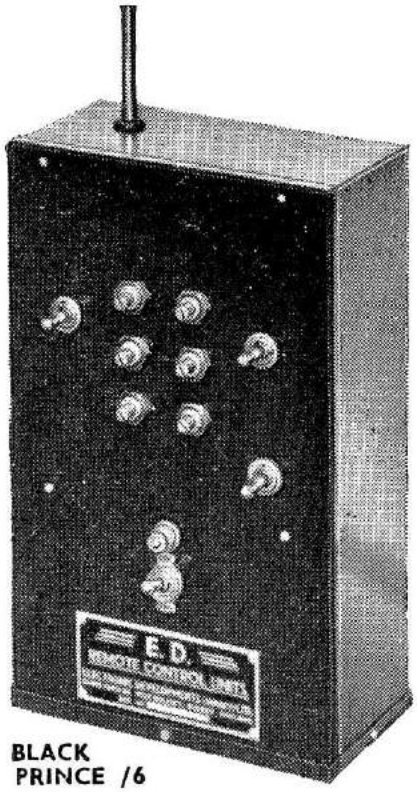

BLACK PRINCE /6

This entirely new transmitter has been produced after months of exhaustive flying tests. The Standard Transmitter, the first of a new series, may be supplied up to eight channels or as a single channel tone or carrier transmitter. Housed in identical cabinets, they are hand-held, using a 5 ft. detachable aerial. The self-biased switches fitted, are easily accessible by both hands. Many unique features have been incorporated, including a neon voltage indicator.

Complete tone stabilization due to feroxcube pot cores. Each potentiometer will only cover 100 cycles and, having set up the transmitter, will operate without further adjustment.

Battery consumption has been cut to a minimum and many months of use are assured. Balanced weight distribution makes perfect handling. A detachable compartment enables batteries to be inserted without disturbing the transmitter.

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The 4 and 6 Channel Receiver is completely revolutionized with a new and absolutely reliable relay and a super-sensitive reed unit capable of operating with an input of only 2 volts R.M.S., using the new high gain Mullard transistors, transformer coupled and temperature stabilized, developing 20 volts R.M.S. into the reed unit. Both reed unit and relays are fitted with fixed contacts, no adjustment being required. A low voltage supply of 30 volts for H.T. and 1½ volts L.T. at extremely low consumption resulting in quite small batteries being used. The complete receiver is mounted in virtually a crash-proof container.

These new models are the most advanced Radio Control Units available and are up to the traditional high quality and value always associated with E.D. Products.

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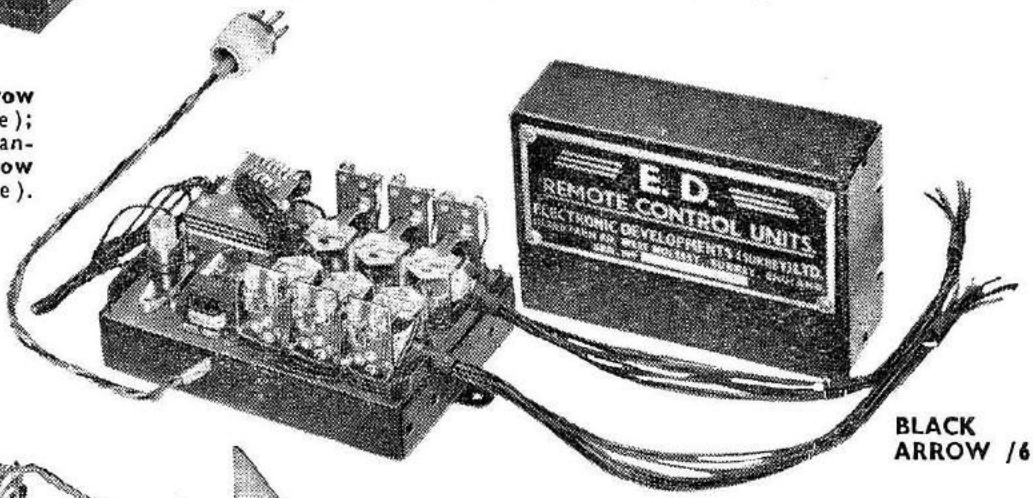
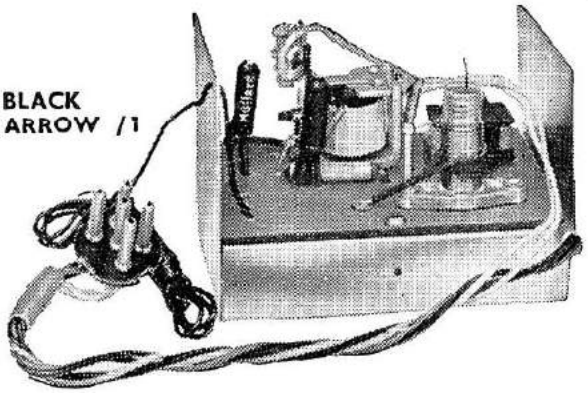
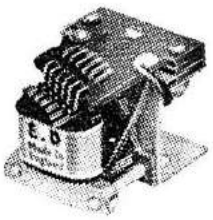
Illustrated Folders giving full technical details of all E.D. products are free on request.



BLACK ARROW /6

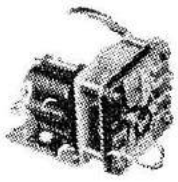


BLACK ARROW /1



OCTAVE Eight Reed Tuned Relay

BLEEP Relay



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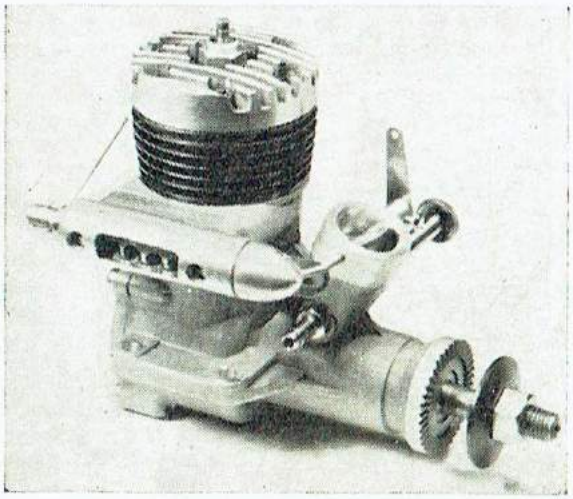

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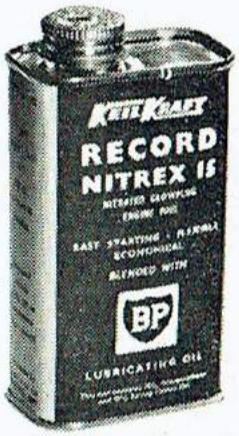

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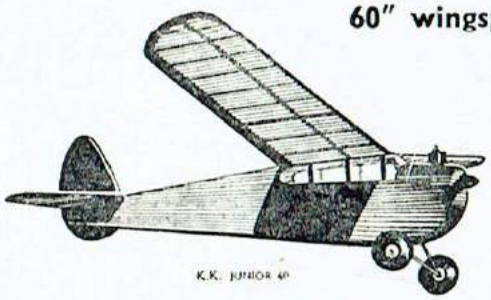

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