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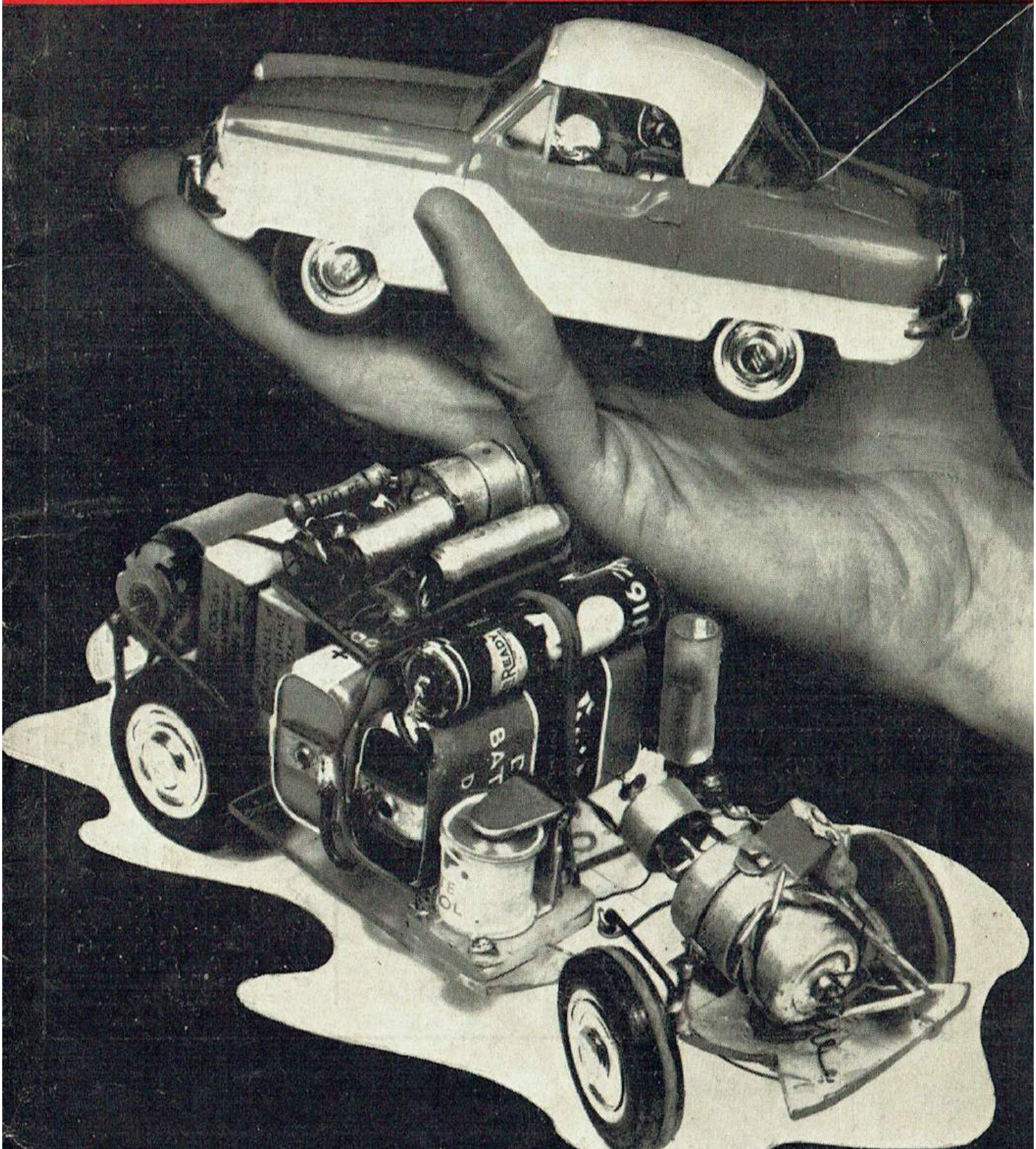

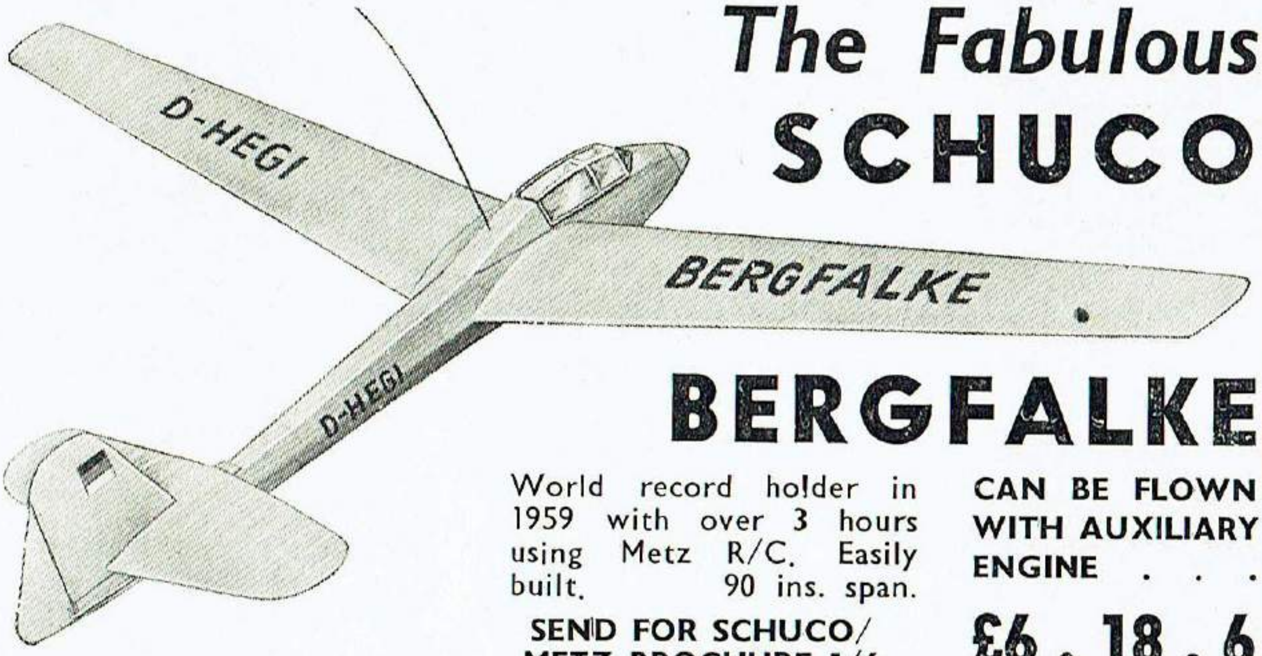

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Radio Control Models & Electronics

VOLUME 2 NUMBER 4 APRIL 1961

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Advertisement Director: C. S. Rushbrooke.
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Here, There & Everywhere

"Rudder Only" Dropped

A CASUAL half line note in S.M.A.E. *Model Flying* (January, 1961) announces deletion of R/C Rudder Only event from British Nationals programme at Whitsun. Rudder Only is now relegated to Northern Gala and Scottish Gala—the latter an event whose future is by no means assured.

We would like to ask whether this programme change has been effected by proper democratic methods by proposition through the " usual channels " or is it in fact the decision of a committee empowered to make such recommendations to council. We believe it to be a committee decision. Members of the S.M.A.E. R/C Sub-Committee are Judges Henry Nicholls and C. S. Rushbrooke, Multi-Flyers Stewart Uwins and Chris Olsen and Manufacturer G. Honnest-Redlich. Where is the single control rep., if any? We do not know.

Why has this contest been dropped? Probably because the *quality* of its past support was indifferent, whilst *quantity* was unpredictable, numbers of entries bearing little relation to numbers *capable* of flying. Entries have been accepted who were often unskilled and intent on using the event as a club type of training outing. Entrants came ignorantly before the judges without a clue either as to the pattern required or how to perform it.

Multi-control flyers tend to look down on their single control brethren as being of inferior "status" though willing to concede from their Olympian multi heights that single control is "too hard" for them. Yet the way into R/C flying is almost universally through the Rudder Only door. Are we to find opportunities for competitive flying amongst the shallow in pocket, though deep in enthusiasm, masses more and more limited? And why? Simply because it offers less of a spectacle, requires a full day's judging to be set aside and interferes with the important business of letting us see our multi gladiators in full flight.

It is easy to criticise. There are possibly a host of good reasons for what appears to be high-handed action, but nobody has told us them. The poor results of previous Rudder Only Nationals can be attributed largely to the method of accepting entries. Would-be flyers should be adequately weeded out by a process of seeding say half the acceptable total of 50 which would ensure that those of known skill had an opportunity of flying before the unknowns. It would not be too much to ask of the unknowns that they show their paces at area level before taking

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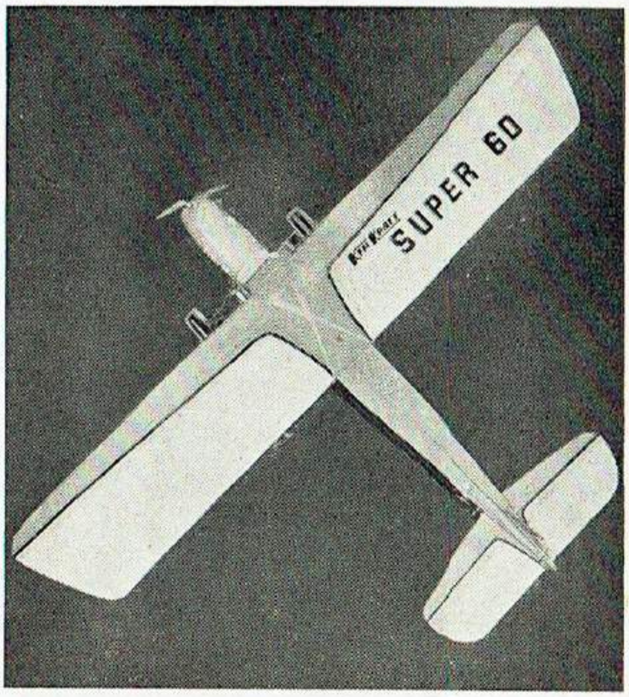


The new KeilKraft Super 60 photographed by Aeromodeller's Ron Moulton at the recent London Toy Fair, which attracted best ever crowd of overseas buyers.

part in a National event, and achieve a certain minimum proficiency, particularly where their presence in a restricted entry contest has meant the total elimination of performers who *could* cope with the patterns required.

The very least we ask, and a host of R/C flyers are with us in this, is that an adequate explanation is vouchsafed and steps taken to avoid this kind of action in the future. There are enough single control fans to deserve something better than contemptuous dismissal in half a line of the S.M.A.E. news-sheet!

Another R/C Kit

Further to our comment on slow trade kittery, we were delighted to find the first production model of the new KeilKraft *Super* 60 on show at the recent London Toy Fair. "Flew straight off the drawing board" so Eddie Keil assured us; a sentiment which KeilKraft designer Ernie Webster echoed with some feeling when he added that said test flights were made by Eddie himself in the presence of some overseas buyers who simply must be impressed, while the worried designer fidgeted in the background and kept his fingers crossed. All was well, in fact much better than well, and there was the model still in its pristine condition to prove it. Span is 63 ins., and price £4 17s. 6d. Release date is not announced, but parts are piling up and it may well be given by time we go to press.

That Caterpillar Tractor

Franz Czerny gives us some interesting gen on the little R/C tractor seen at Ulm. This is apparently manufactured by Arnold of Nurnberg and sold as a toy complete with R/C gear at around £16 under the name of "Radarmaster". Range is about one hundred yards, and some dozen commands are possible working on the sequential principle. With shovel in place it is capable of lifting rocks up to fist size, raising lowering and swinging the shovel. The tractor can also proceed forward, reverse, turn left or right. It has been on the market about two years, and whilst our correspondent has seen it in action, he did not alas take the opportunity of looking inside for any precise investigation of what made it tick.

Advance News of R/C Regattas

Fleetwood M.Y. & P.B.C. are opening the 1961 season on Easter Monday, April 3rd, at 2 p.m. with Speed and Steering events for R3C. Entries will be taken at the lakeside up to 1.30 p.m., so that a decision to participate can be left until the last moment but one, which may be a good thing with spring weather (and at other times) subject to such vagaries! At least four other R/C events are envisaged during the season, including two all-day programmes. Correspondence to: L. A. Fish, 46 Friargate, Preston, Lancs.

The M.Y.A. 1961 R/C Yacht Nationals will take place at the Rick Pond, Home Park, Hampton Court, May 6th and 7th, with none less than Jack Gascoigne as O.O.D. This event is open to registered Q Class yachts and entry must be made on M.Y.A. entry forms only. Radio must be of selective type only, restricted to crystal controlled Tx. and Rx. (superhet) or other radio which will allow simultaneous sailing of any two yachts together. It is by no means too early to get entries sorted out (including the important matter of registration if not yet done!) and enquiries should be addressed to: N. D. Hatfield, 132 Westbourne Grove, Westcliff-on-Sea.

Ready for May 7th. The three handsome trophies to be awarded at Sutton Coldfield's R/C Rally at R.A.F., Wellesbourne, when they will be staging first scale event plus two "normal" contests for single and multi.

The Victoria Model Steamboat Club are proposing to run a R/C meeting on July 23rd, and the aim of one of the two events at this meeting will be to break away from the established routine of these events. This is a particularly worthy effort from Victoria, since, as protagonists of the free running steering event over the years they must have been wedded to one formula for several decades, so that in endeavouring to produce something different for R/C they are drawing on a wealth of experience of the other extreme. Further details will be announced later—but those agog to hear more at the very soonest should write to Hon. Secretary N. G. Phelps whose new address is 17 Jersey Road, London, E.11.

Background to a World Championship

Writing in *Aero Revue Suisse* Rico Niedhart gives an interesting sidelight on the staff work that went on to make the meeting at Dubendorf last summer so trouble-free for competitors. Prior to the event the Swiss Post Office authorities who handled monitoring arrangements discovered a powerful transmission on the model waveband that could have been disastrous. Skilful tracking traced the emission to a Scandinavian news service, a telegram was despatched, and the station agreed to suspend operations on that wavelength for the event. Thus what could have been disastrous interference never happened!

Another comment by Rico refers to the appreciation by the Swiss Aero Club and their local experts of the standard of reporting of this meeting by the model press in general, with particular praise for German and British reports.

Happily, too, the author gives full measure of mention to the fine effort put in by organiser Arnold Degen, who worked on an almost non-existent financial budget, with the very minimum of help, but, thanks to good advertising support in the official programme, plus excellent attendances of the public during the two days of the event, finished up all square and out of the red.

Birmingham Group I.R.C.M.S.

Midlanders will be interested in the open regatta which Valley Parkway Association are running on Whit-Monday, May 22nd, at the Valley Pool, Bournville, starting at 11 a.m. Events include steering, speed and a relay race for teams of three boats, plus an event for two or more boats using crystal controlled superhets racing together. (This, by the way, is a Birmingham I.R.C.M.S. speciality we believe). Further details can be obtained from contest secretary P. Such, 29 Umberslade Road, Selly Oak, Birmingham 29.

What Goes Up . . .

North Weald Aerodrome is no longer the scene of West Essex R/C flying . . . the club has folded its tents and sped, well, not exactly silently, away!

Once is happenchance, twice coincidence, three times enemy action, the saying goes and the unaccountable prangs at altitude went much beyond that, including Chris Olsen amongst the victims. Investigation of the phantom button-pusher makes it appear that Ongar Station (Marconi Cable Radio Tx.) uses a signal which has a harmonic at 27 mc/s! As the control originates from London Office it has not been possible to find means of co-operation with this local station, hence a sad exodus.

Tailpiece . . .

We thank Pat Wheeler for the flattering thought that an anagram of of R.C.M. AND E. is CREAM !

Basic Radio

By G. E. DIXEY - - - - PART VI

Valve Oscillators

ARTICLES which concern themselves with an elementary treatment of valve oscillators usually commence with a mechanical analogy illustrating general principles. This will be no exception since this analogy is extremely useful.

An example of a simple mechanical oscillator is the pendulum (Fig. 1).

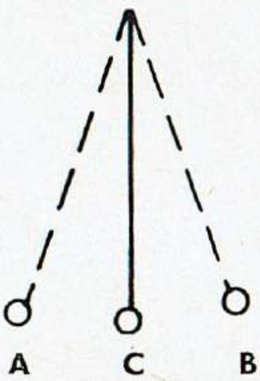


FIG. 1

If the pendulum is stationary at C it possesses no energy, neither kinetic nor potential. If it is moved to A and held there, it now has potential energy due to its position. If it is released it swings back towards C, and, as it reaches this point, it possesses kinetic energy due to its motion. This causes it to go on past C. Ideally, it would carry on to B and then swing back to A, then on to B and so on. In other words, it would 'oscillate' about C swinging between the limits A and B. This would be the case of a perfect system, where there are no losses. However, in a practical system, there are always losses, which cause the amplitude of the swing to diminish progressively until the pendulum finally comes to rest again at C.

Because it is only the losses in the system that prevent a constant oscillation from being obtained, it is only necessary to make good the energy lost to maintain the oscillation. A slight push as the pendulum reaches A or B will achieve this.

The Electrical Case

Fig. 2 shows a coil L and capacitor C connected across a battery via a switch S.

When the switch makes the circuit a current flows into C and charges it to the voltage of the battery. When the switch breaks the circuit the capacitor

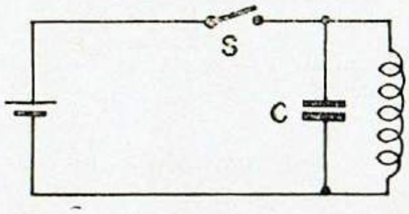


FIG. 2

discharges sending a current through L and when it is fully discharged, all of the energy is stored in a magnetic field around L. This energy now commences to charge the capacitor again, but in the opposite direction this time. As soon as the capacitor is fully charged, it begins to discharge itself through L, and this process repeats, the current oscillating backwards and forwards around the circuit. This oscillation would carry on indefinitely if there were no losses in the circuit, but since the coil must have some resistance, energy is used up and the oscillation fades away. Fig. 3 shows a 'damped oscillation' of this type.

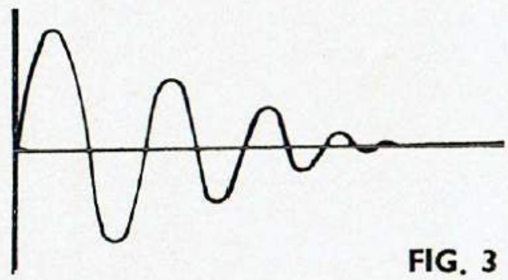


FIG. 3

To sustain oscillations it is necessary to feed energy to the tuned circuit L-C just as we have to give the pendulum a push to keep it swinging.

A Basic Valve Oscillator Circuit

In Fig. 4 is shown a basic circuit of a Meissner oscillator. L and C form the tuned circuit connected between grid and earth, and a feed-back coil L_1 is coupled to L. (The arrow indicates that the coils are coupled).

Assuming that the H.T. is switched on, L and C will start to oscillate, and this oscillation will be amplified by the valve, and appear across L_1. Because

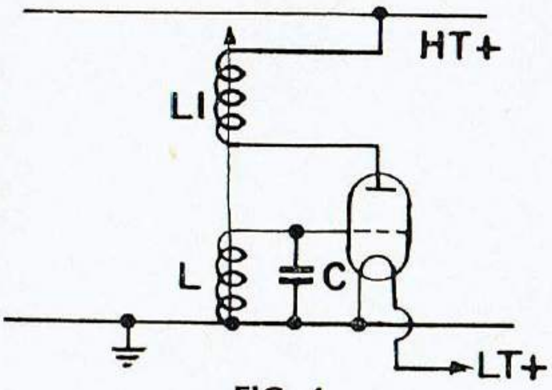


FIG. 4

L_1 is coupled to L, the amplified oscillation will be fed into the grid circuit. It is this energy fed back by L_1 into the grid circuit, which overcomes the losses in L and C, and enables the oscillation to be maintained. It is often asked how it is that oscillations start in the first place. The answer is that there are always very minute random fluctuations in the wires of the coil, capacitor, etc., due to the ever-present movement of electrons, and these give rise to voltages, which, though minute, are amplified by the valve, fed back by L_1, amplified again, and quickly rise to a full amplitude of oscillation.

The voltage fed back from anode to grid must be such that it makes good the losses in the grid circuit. This idea of feeding back energy to sustain oscillation is the principle of all valve oscillators, and practical oscillators only differ in the manner in which this feedback is applied.

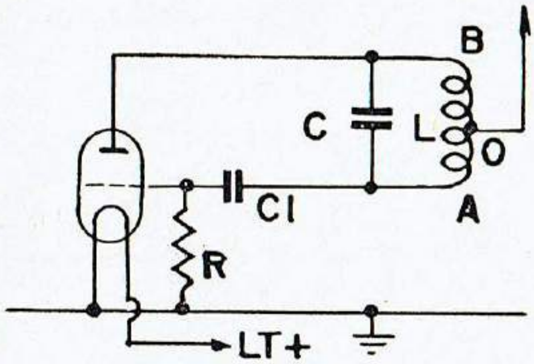


FIG. 5

Practical Oscillator Circuits

1. *The Hartley Oscillator.*

In the Hartley circuit of Fig. 5 L-C is the tuned circuit. When the H.T. is applied oscillations commence in this circuit, and the oscillatory voltage appears across L. Since the end A of the coil L is connected to the grid, via C_1, and the tap O is connected, via the low impedance of the H.T. battery, to earth, the portion of the oscillatory voltage developed across AO is applied to the grid where it is amplified by the valve. This amplified voltage thus appears across L - C to maintain oscillations.

The components R and C_1 provide automatic bias; the action of this will be described later in the article.

2. *The Colpitt's Oscillator.*

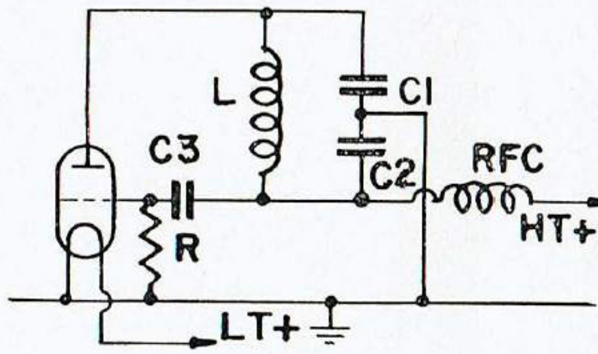


FIG. 6

The Colpitt's oscillator of Fig. 6 is a favourite for high frequencies. Its action is very similar to that of the Hartley oscillator. The difference lies in the fact that the condenser is tapped instead of the coil. The oscillatory voltage developed across C_2 is applied between grid and earth, and amplified to sustain oscillations. The Radio Frequency Choke (R.F.C.) is a coil which offers a high reactance to the oscillatory currents, and keeps them out of the H.T. battery.

Again R and C_3 provide automatic bias.

3. *The Crystal Oscillator (Miller Circuit).*

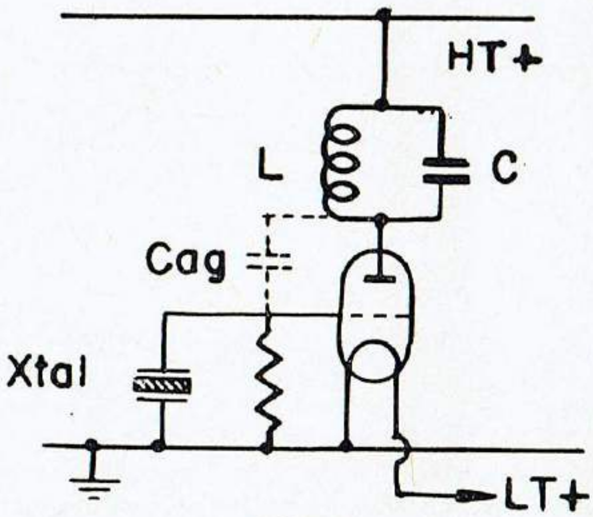


FIG. 7

The Miller crystal oscillator of Fig. 7 is a fairly easy one to understand, but before going into its operation it would be wise to know what a crystal is and does.

The crystal is a wafer of quartz accurately ground to thickness and mounted with two electrical connections in an hermetically sealed case or glass envelope. It depends for its operation on the 'Piezo-Electric' effect. If the wafer of quartz is squeezed it is found that it generates an alternating voltage, whose frequency depends upon the thickness of the crystal wafer. Conversely, if a voltage of the same frequency is applied to the crystal it vibrates mechanically at this frequency, and, here is the important point, this vibration is very stable.

Now for the circuit. L-C is a tuned circuit in the anode. Any alternating voltage appearing in this circuit (which is tuned approximately to the crystal frequency) is fed to the grid circuit via Cag, the capacity between anode and grid. The crystal oscillates, and an oscillatory voltage at the crystal frequency is amplified by the valve and fed back through Cag to maintain oscillation. Thus, the frequency of oscillation is controlled by the crystal and is therefore very stable.

4. *The R-C Phase-Shift Oscillator.*

The oscillators already mentioned are most suitable for generating radio frequency (r.f.) oscillations, and could be used as the basis for a transmitter. Where it is desired to produce audio frequency (a.f.) oscillations (e.g. for tone modulation) a different type of oscillator is usually preferable. A simple type of phase-shift oscillator will be described now, together with an example of the design procedure.

A phase shift oscillator using a pentode is shown in Fig. 8, and, although at first it looks a bit frightening, it is really very simple. It can be divided into two sections, (a) a phase-shift network consisting of R_1 C_1, R_2 C_2 and R_3 C_3 and (b) an amplifier which covers the rest of the components. The idea of the phase shift network is to change the phase of anode voltage by 180 degrees or π radians, so that by the time it gets to the grid, it is rising and falling in the same direction as the grid voltage, and so assists it instead of opposing it. This must be true for any oscillator; the voltage fed back from anode to grid must assist the oscillations and not oppose them.

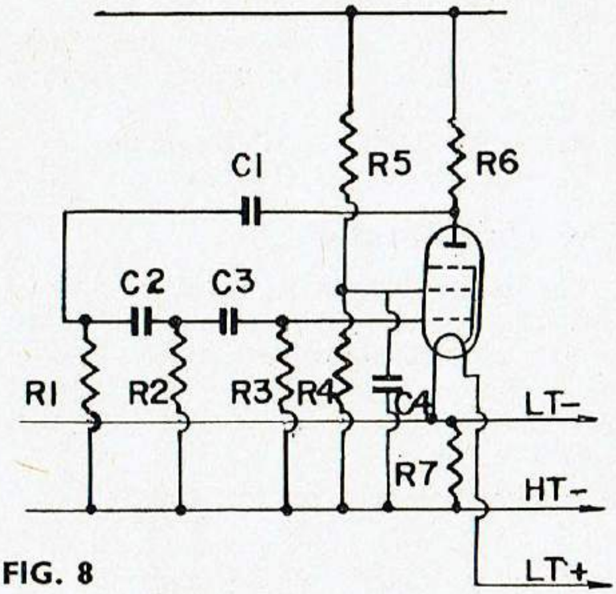


FIG. 8

Each section of the phase-shift network R_1 C_1, R_2 C_2, R_3 C_3 contributes 60 degrees phase-shift.

Any random voltage variation in the grid circuit is amplified and fed-back in the accustomed manner. If the gain of the amplifier is greater than the losses in the phase-shift network oscillations will build up and be sustained.

It is a fact that for this type of oscillator the gain must not be less than 29, and, as we have covered the design of an amplifier in a previous article, and know how to determine the values of R_4, R_5, R_6 and R_7 we have only to design our phase-shift network to complete the oscillator.

Since the phase-shift of each of the sections of the network is 60 degrees, R_1, R_2 and R_3 will be equal as will C_1, C_2 and C_3.

Now if you will accept that $\tan\theta = \frac{X_c}{R}, = \frac{1}{2\pi fCR}$, then $\tan 60 \text{ degrees} = \frac{10^3}{2\pi fCR}$, when C is in μF. and R is in K ohms.

Tan 60 degrees = 1.73 and suppose the frequency f is to be 1,000 c/s,

$$\text{then } 1.73 = \frac{10^3}{2\pi.10^3.CR},$$

$$CR = \frac{10^3}{2\pi.10^3.1.73},$$

$$= \frac{1}{3.46\pi}, = 0.092.$$

0.092 is the product of C and R,
if C = 0.01 μF., R must be 9.2 K. ohms, or 10 K. ohms, which is probably near enough.
$R_1 = R_2 = R_3 = 10$ K. ohms.
$C_1 = C_2 = C_3 = 0.01$ μF.

The Multivibrator

The multivibrator is a rather special type of oscillator belonging to the class known as relaxation oscillators. It does not generate sine waves, but square waves. The circuit of a simple type is shown in Fig. 9.

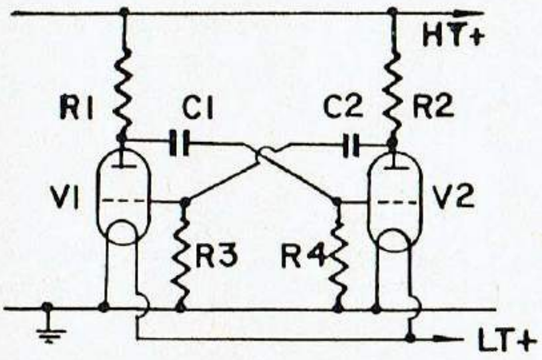


FIG. 9

The multivibrator uses two triodes and is effectively a two-stage R-C coupled amplifier with the outputs coupled back to the inputs.

Suppose that on switching on both valves are conducting normally, and some random fluctuation causes the anode current of V_1 to fall slightly; this causes the anode voltage of V_1 to rise a little and this rise of voltage is transferred to the grid of V_2 by C_1. The increased grid voltage of V_2 increases V_2's anode current, which lowers the potential of the anode of V_2. This drop in voltage is applied via C_2 to the grid of V_1 reducing the anode current, which is where we came in!

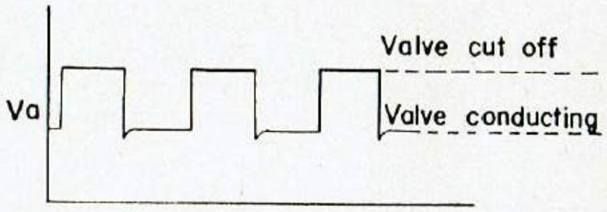


FIG. 10

This goes on until V_1 is cut off, and V_2 fully conducting. The charge on C_2 holding V_1 cut-off gradually leaks away through R_3, the grid leak, until when V_1 begins to conduct again the reverse process happens until V_2 is cut-off and V_1 fully conducting. The waveform at either anode is a succession of square waves as shown in Fig. 10.

Automatic Bias

An oscillator must have bias in order to operate correctly, but if the bias is fixed the oscillator will not start. Provision is, therefore, made to bias the valve automatically referring to Fig. 5, when the L-C circuit starts oscillating, the voltage variations on the grid make it positive with respect to the filament, so it collects electrons just as if it were an anode. These electrons accumulate on the adjacent plate of C_1 and, being negative, reduce its potential. Some electrons leak away through R and a state is quickly reached where a steady bias voltage due to the charge on C_1 holds the grid at the operating point.

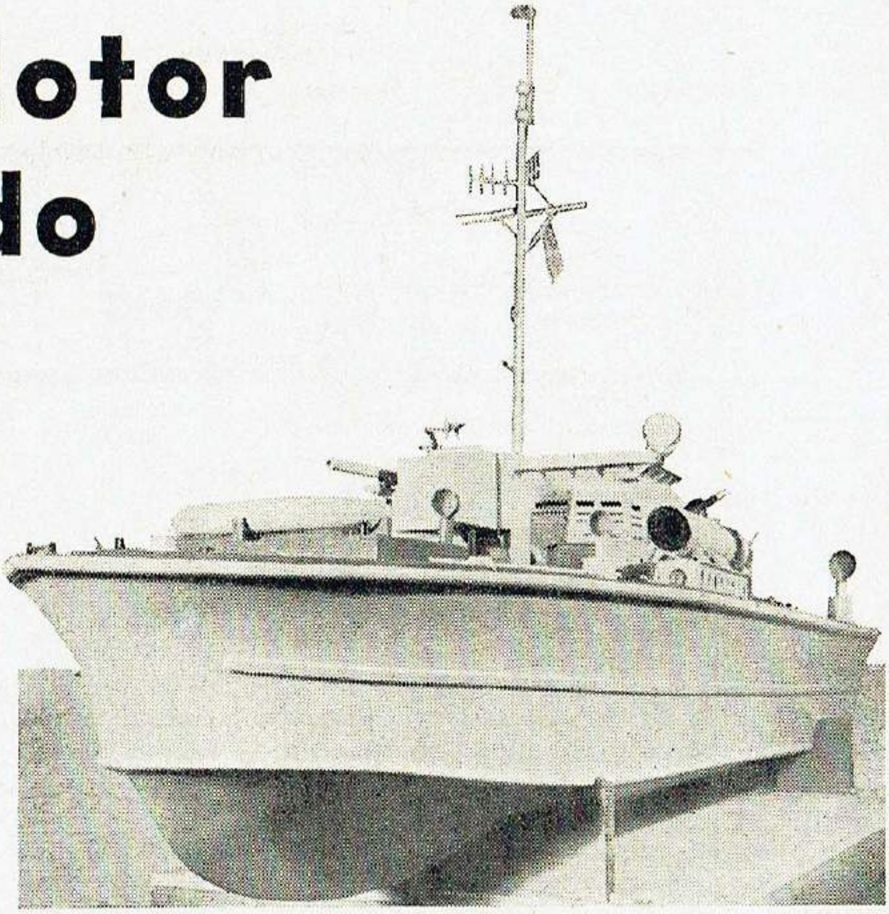
That finishes with oscillators for now; we shall meet them again later on in superhet, receivers and transmitters.

In the next article we deal with the principles of the superhet receiver.

Next Month . . . **HIGHLIGHTS OF THE ISSUE INCLUDE:**

TONE STABILISATION with Pot Cores ★ Miniature Tx. Reviewed Gadget Page ★ Free Transistor Data Calculator ★ Hand Held Transmitter ★ McQuery Column ★ Basic Radio ★ New Equipment ★ Servo Tests ★ Page Plan for R/C Aircraft Here, There and Everywhere.

R.C. Motor Torpedo Boat



Rex Beebee describes his "king size" R/C model, which boasts a couple of working torpedoes.

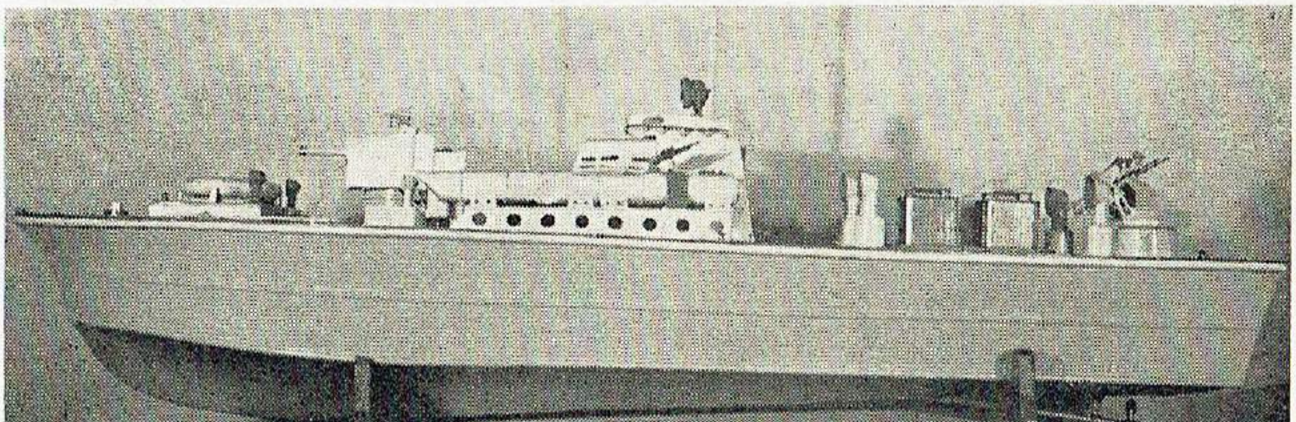
THE model is based on the 72 ft. British Power Boat of World War II, and built to a scale of 1 in. to the foot. However, there are several variations from the original—some made for practical and for operational reasons, others for reasons of purely personal taste (e.g. Oerlikons in power-turret, searchlight, etc.).

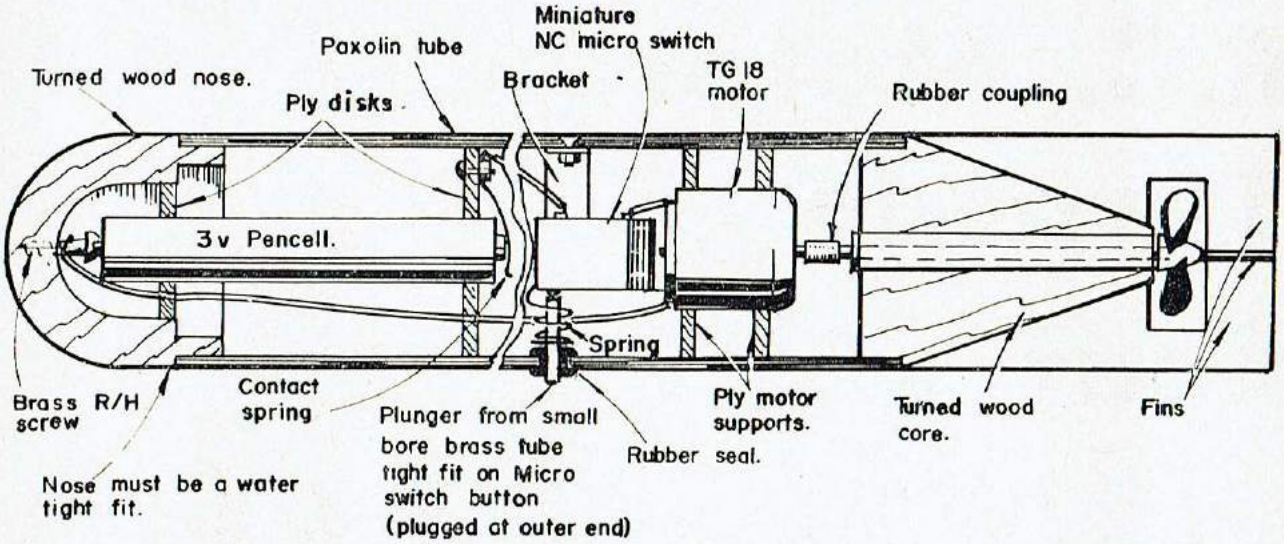
The 6 ft. long hull is made of fibreglass, fully reproducing the "flair" of the originals. Deck is of ⅛ in. marine ply, with three large hatches for access to radio, batteries, servos and engine—the latter being a 34 c.c. J.A.P. petrol engine with a recoil starter and flywheel magneto. Propeller is a three-inch diameter, variable-pitch two-blader, giving 'astern' when required.

Superstructure is riveted up from 16G aluminium, the charthouse roof being milled out from 1 in. thick aluminium plate!

Bridge details include two binnacles, torpedo-throttle and engine-telegraph levers, wheel, voicepipes, gratings, and working searchlight and navigation lights. The latter incorporate Carters "rice-grain" pea-bulbs, and give a really bright light. The mast is a thick-walled dural tube, tapered in the lathe, and radar aerials, crosstrees, etc., are of brass, as are the cleats, towing-post, fairleads, vents, etc. The torpedoes

Heading picture gives an impression of power with the beady eye of the port torpedo tube looking out at one. Below : Broadside view shows the V.P. prop.

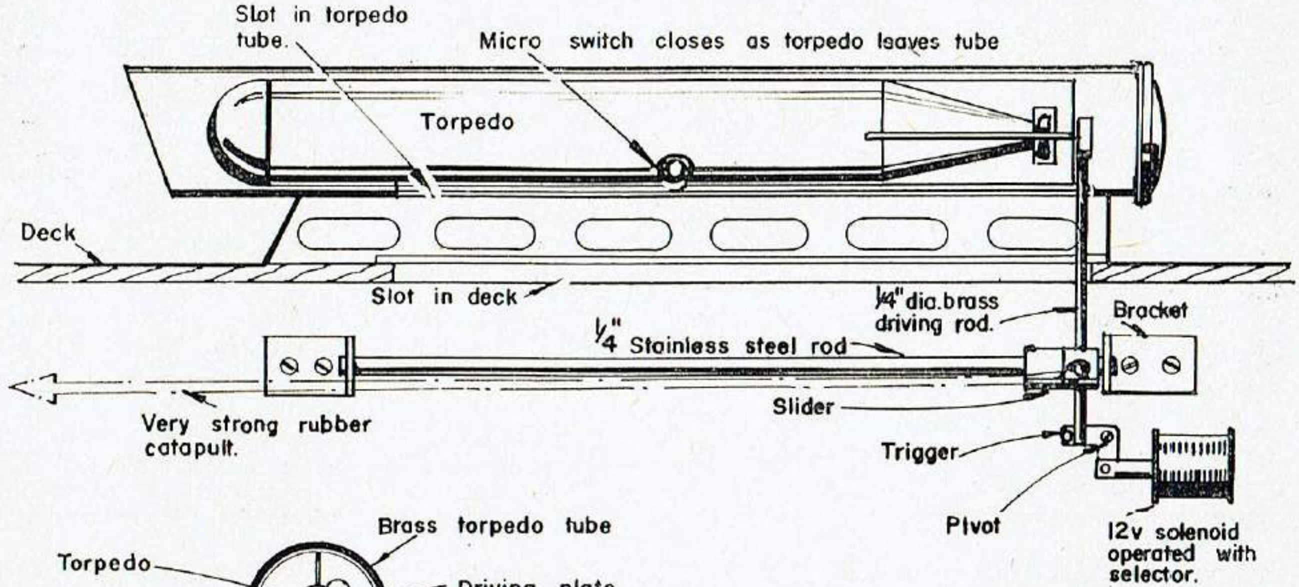


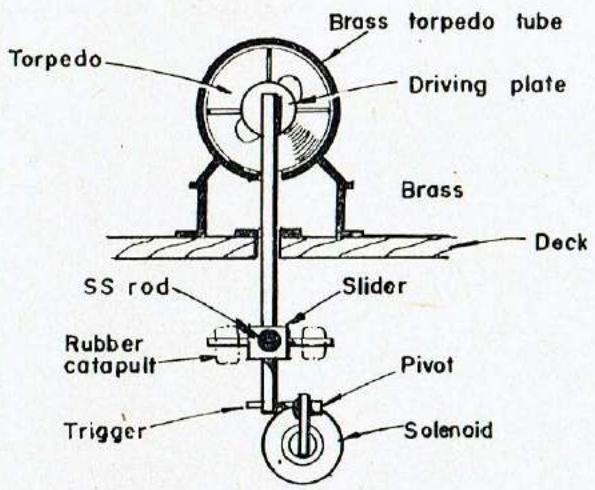


have small motors and batteries inside to drive their propellers!

Construction of the original was all alloy, but in floatation tests proved to be of negative buoyancy, so paxolin tube is used for the main body with a turned wooden end cone and a removable wooden nose cap. This provides access for battery replacement. It will be seen from the diagram that a normally closed micro switch provides a circuit to the TG18 driving motor and is operated via a watertight rubber seal by a plunger which keeps the switch open whilst the torpedo is in its tube. Actual performance in the water is of course very slow by comparison with the M.T.B., they run 9/10ths submerged but as the nose is painted bright yellow they are quite easy to retrieve if the pen cell runs down.

The launching mechanism is located below the deck and comprises a powerful rubber catapult which is re-

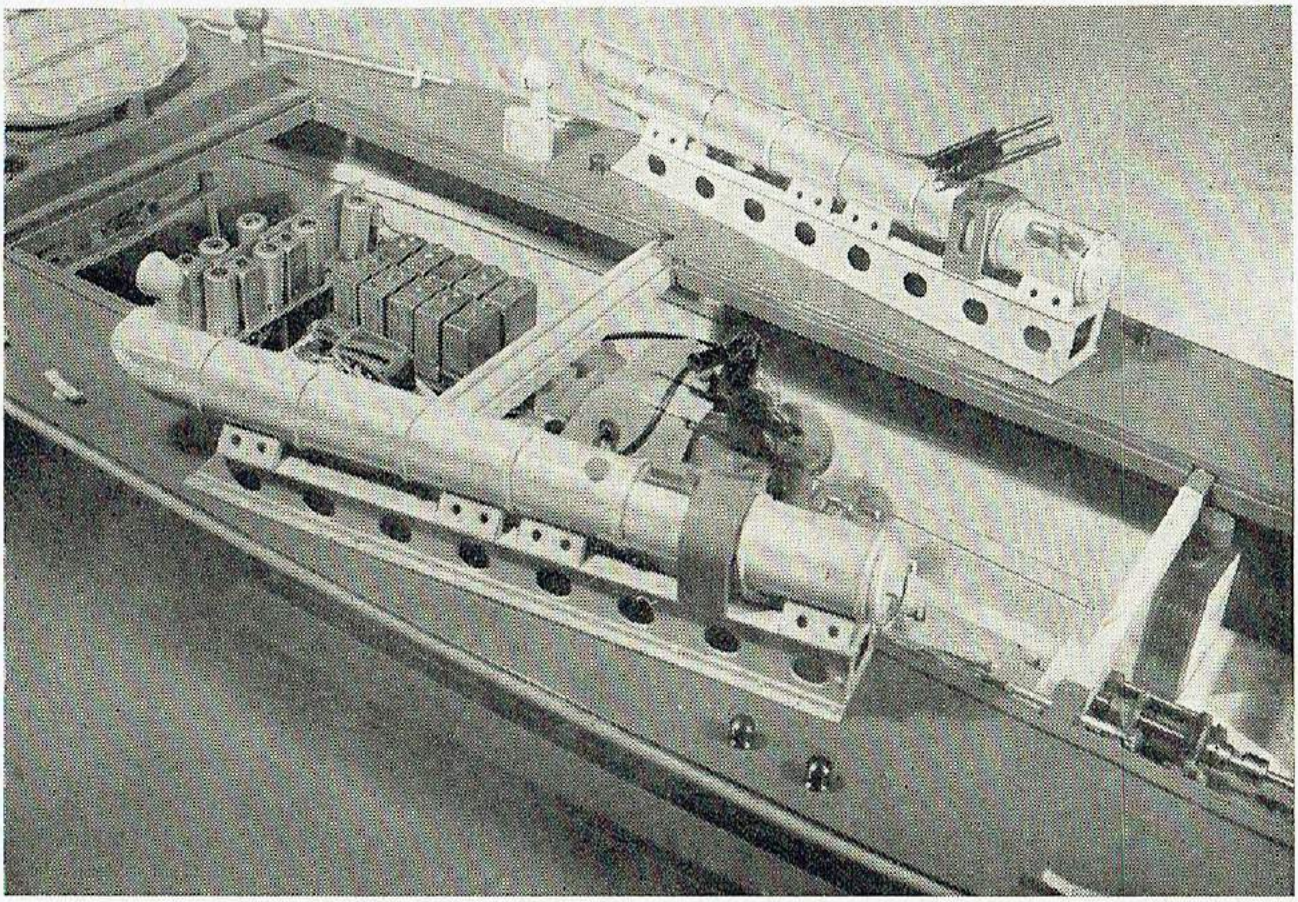




Top of page: Sectional diagram of the torpedo. Above and left: Longitudinal and transverse sections of the torpedo launching mechanism.

leased via a solenoid operated trigger, the torpedo is driven down the tube by a pressure pad at the end of a vertical rod which protrudes through slots in the deck and bottom of the tube.

The semi-automatic six-pounder gun forward and the twin 20mm. Oerlikon canon aft are fabricated of aluminium



Interior shot shows the superhet at extreme left with a large bank of relays. The J.A.P. engine can be seen between the torpedo tubes. Pitch change mechanism is just visible at bottom right.

and brass, with turret-bases turned from aluminium castings. Castings were also used for the saddles over the torpedo tubes to carry the twin Vickers K machine-guns (brass) the torpedo tubes themselves being of thin-wall brass tube, silver-soldered to the brass support-brackets, bases are built up from 16.G aluminium sheet. Tube-ends and fittings are of aluminium, secured with Araldite.

Incidentally, the six-pounder gun shown is a mock-up, although in aluminium, as it was built before true and detailed drawings were obtained from the Admiralty (whose prolific and ready assistance was invaluable), but a fully-detailed and correct model is now nearing completion. Details of most naval armament seem fairly easy to secure nowadays, especially those excellent drawings by Mr. Ough, but the six-pounder was, I believe, confined to two or three M.T.B. types and is relatively unknown, except in its original anti-tank guise of course.

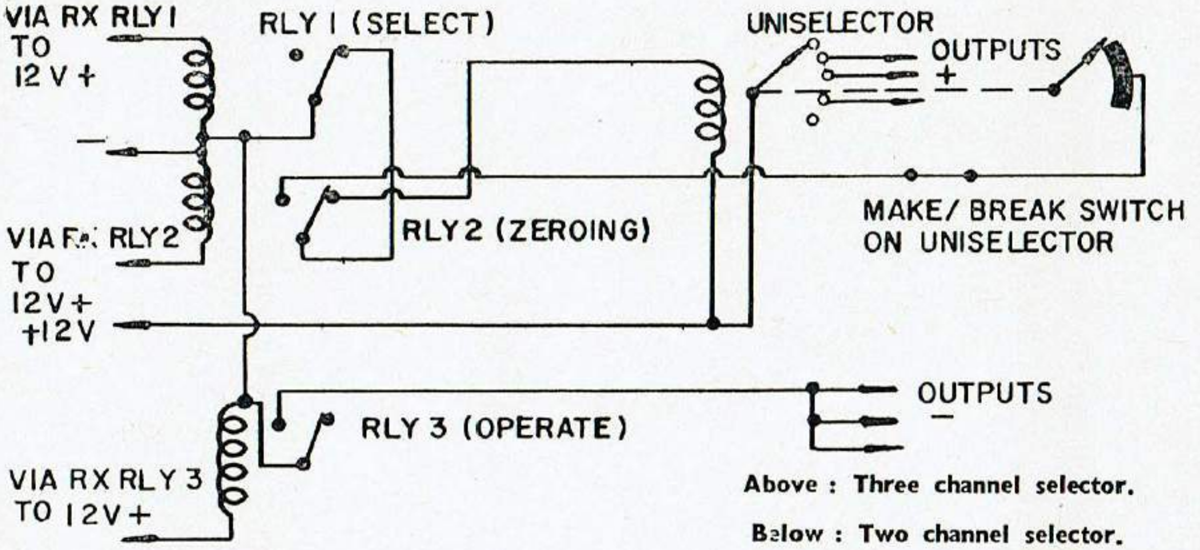
The life-raft in the bows is mounted on a platform (not on the original) to allow sufficient height for the petrol tank beneath it to gravity-feed the AMAL float carburettor. This raft rests free on its chocks, and is connected by a long line to a secure position inside the hull. Thus, should disaster befall the boat, the raft will (I hope!) rise to the surface, providing both a means of location and recovery.

The M.T.B. is finished in light Admiralty grey, with dark grey deck and white mast.

For the radio-control "bods" I must give details of the "works"!

The forward-mounted receiver is a superhet, with crystal-controlled local oscillator. This supplies an A.F. signal to a ten-reed bank, this in turn operating ten Siemens miniature, sealed relays. Owing to the large servos required on a boat of this size, and consequently the more substantial power to be handled, larger secondary relays have to follow the sensitive ones, and these also are hermetically-sealed, double-pole changeover types.

Channels 1, 2 and 3 operate a steering unit, basically a new ex-government geared motor with a split field. This gives progressive steering on channels 1 and 2, with self-centering operated optionally by channel 3. A split-field motor was chosen here to permit self-



Above : Three channel selector.

Below : Two channel selector.

centering with only one accumulator, and single-pole changeover relays. Channels 4 and 5 operate the throttle, 6 and 7 the V.P. propeller mechanism, both mechanisms being normal screwed-rod types built from ex-bombsight-computor components. Channels 8, 9 and 10 operate a Siemens miniature Uniselector, which in its turn controls the "gimmicks"—firing of torpedoes, rotating guns, switching lights on/off, etc.

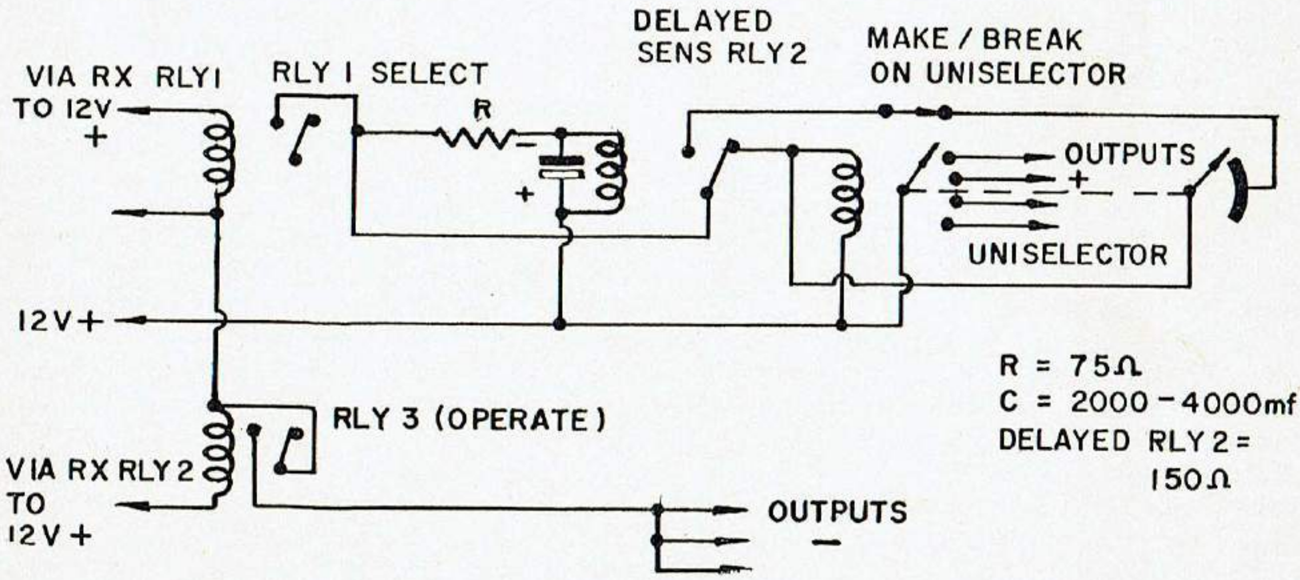
All electric motors used (with the exception of those in the torpedoes) are new, ex-government ones, re-wound for 12 volt operation, and supplied by a 12 volt 4 a.h. accumulator aft. No model motors are used, nor are any "open" or "lightweight" relays.

Past (often bitter!) experience has proved quite conclusively to me that handsome dividends in reliability and worry-free radio operation of a model accrue from the use of the best possible individual components. In such a large, beamy boat as this M.T.B. such items as the large, precision made, and originally very expensive motors and scaled relays are easily accommodated, and their actual cost is no more, often much less, than their new, "model" equivalents!

All inductive loads (motors, large relays, torpedo-firing solenoids, etc.) are suppressed by small-value (47 ohm) resistors across their coils, and the ignition-lead of the petrol-engine also incorporates a resistor, 5,000 ohms in this instance.

As some radio-control enthusiasts may be wondering why I use three channels for the Uniselector, perhaps I should explain my reasons for this apparently wasteful idea!

All Uniselectors obviously take some seconds to move over their range of contacts, and equally obvious is the fact that therefore no operation selected can be instantaneous. With such actions as rotation of guns, switching of lights,



etc. this relay is of little consequence, but it is a very different story with such operations as the firing of torpedoes from a fast-moving boat!

The first channel therefore rotates the Uniselector to the outlet appropriate to the next operation required, and leaves it there. When the particular action is required, channel three connects up the common negative lead, and the torpedo, or other device, operates at once. Operation of channel two now switches in the homing circuit, and the Uniselector returns to "neutral" ready for the next operation. A circuit of the above is included in case any other radio enthusiast should think it worth incorporating, and a further one which requires only two channels. In the latter case operation is very similar, but zeroing is effected by a long 'dash' sent on the 'selection' channel.

A superheterodyne receiver has been used simply to permit simultaneous operation of several boats—such receivers show no practical advantages (for boats, anyway) over conventional super-regenerative receivers (reed type) in either range or reliability, and superhets are, in fact, more susceptible to interference problems, as superregens., have a "built-in" limiting action.

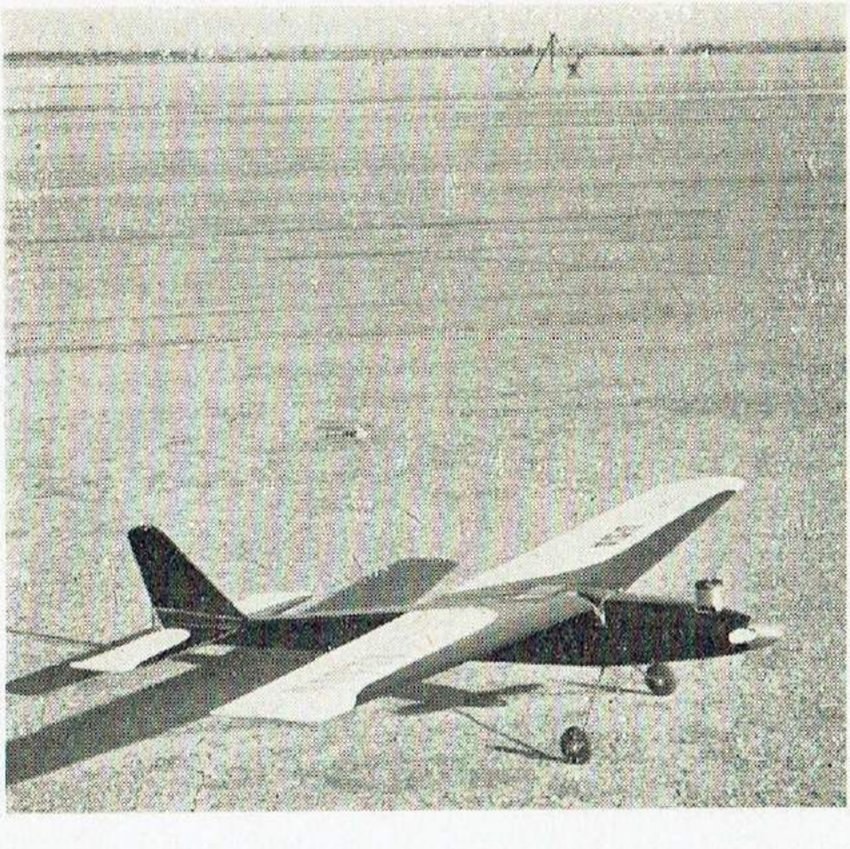
A crystal-controlled transmitter is, of course, essential for use with superhets, and mine is a dual-simultaneous type to Mr. Honnest-Redlich's well-known Octone circuit, with a crystal specially ground to the frequency allotted to me as a member of the I.R.C.M.S. Much of the criticism levelled at reed-receivers in the past has arisen because instability of the audio-generating stages in the transmitter has been such as to cause wandering of the modulated signal, and, of course, complete failure of the reeds to operate. With stability of the carrier ensured by crystal-control, and that of the modulator by either tuned-chokes or phase-shift circuitry, such criticisms no longer apply.

In conclusion, there is still no substitute for meticulous attention to every detail, good workmanship (not only on the radio, either!) and perhaps above all, PATIENCE!

Looking for Oil ?

We have received enquiries from readers who wish to obtain Electrolube . . . The manufacturers address is Electrolube Ltd., Slough Estates House, 16 Berkley Street, London, W.1.

The retailer who supplied our samples was H. Brooks, 67 Oakdene Crescent, Mile Oak, Portslade, Sussex.



Bob Dunham's Speed Model

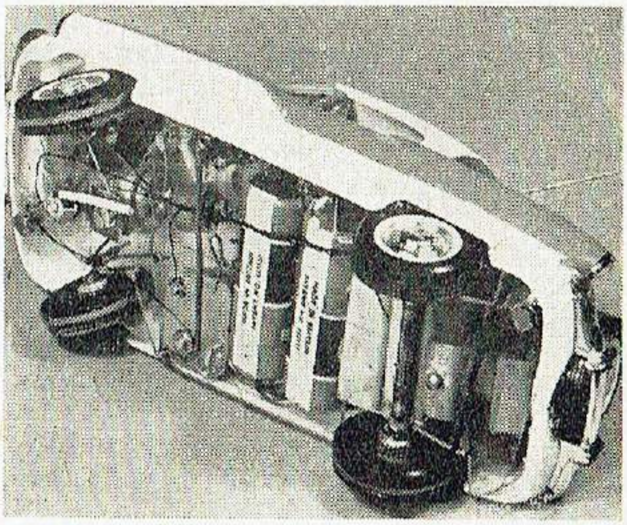
★ ★ ★ ★ ★

HERE IT IS . . .
This shot of Bob Dunham's 124 m.p.h. R/C speed model has just arrived from LARKS. The model has aileron control plus trim elevator only. Notice the speed trap scanner at the top of the picture and refer back to last issue for all the gen on this system of timing.

★ ★ ★ ★ ★

R.C. Metropolitan

By PETER HOLLAND



RADIO control in plastic models seems the answer to the problem of restricted space in the workshop, furthermore the resultant model can be a credit externally to the radio and mechanical gubbins inside. A sleek finish is usually synonymous with an efficient interior, so one may, perhaps wrongfully, conclude that, because a home-built body is a bit hairy, that the same description applies to the "innards", when in fact the skill employed was concentrated in this direction.

Very often one finds that in building one piece of control gear, a new hare has been started (no connection with the above!). So if the model is to be completed at all, it has to be done with all haste in order to get weaving on that NEW IDEA before it cools . . . So, to plastics . . .

The little Nash Metropolitan sat gleaming on the editorial bookcase, just asking for something to be done about the fact that it only had a flywheel powered "Push and Go" mechanism under the bonnet and a horrible empty feeling everywhere else . . . We took pity on it.

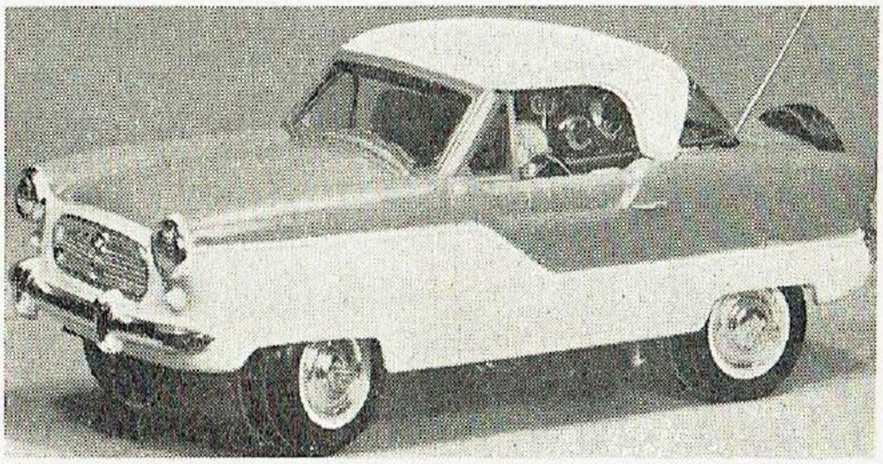
The scale is 1/24th and a little small for really elaborate controls, after all, the full size job is not particularly roomy. A few check measurements were made and a spot of reference to other small models in the attic convinced us of the practicability of the project.

The primary consideration was that proportional steering would be employed. Progressive and even sequential control have featured in early experiments, but unless the vehicle is very slow and the operator endowed with a sense of prediction the progress of the said vehicle would lead its driver straight to the Breathaliser.

Next on the list was a STOP and possibly REVERSE control operated by the steering servo. It was felt that switchcraft with extra relays would take up too much of the valuable space.

A number of hook-ups were tried to ascertain the best type of receiver, here the gremlins appeared; with a length of only 5¼ ins. inside the car, proximity of the driving and steering motors caused rather a lot of interference, in spite of suppressors on the brushgear.

Now, let's see . . . we made a 5 in.



Heading picture shows the advantages of a perspex chassis, most helpful when checking clearance inside the bodywork. Right : Ready for the road, the car model itself is produced by Hubley. (Model Toys Ltd. distribute in U.K., and include attractive Dauphine and Floride in the range.)

long tugboat for R.C. some time ago; that motor was about ½ in. away from the receiver, no trouble at all. The circuit? A very simple soft valve job.

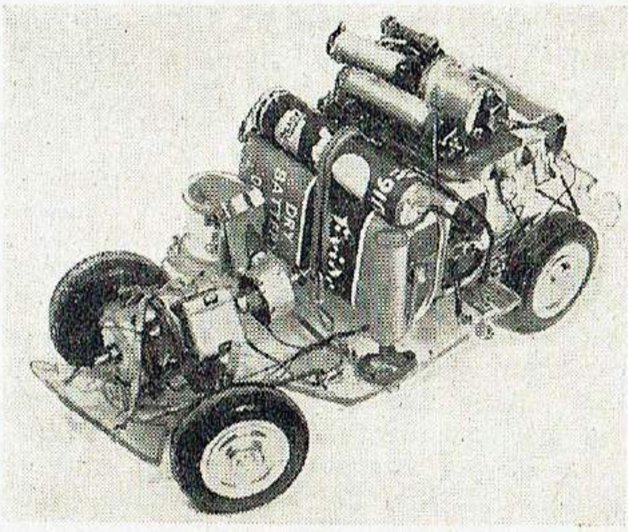
The valve had aged and whilst the sensitivity had been set low, range was adequate.

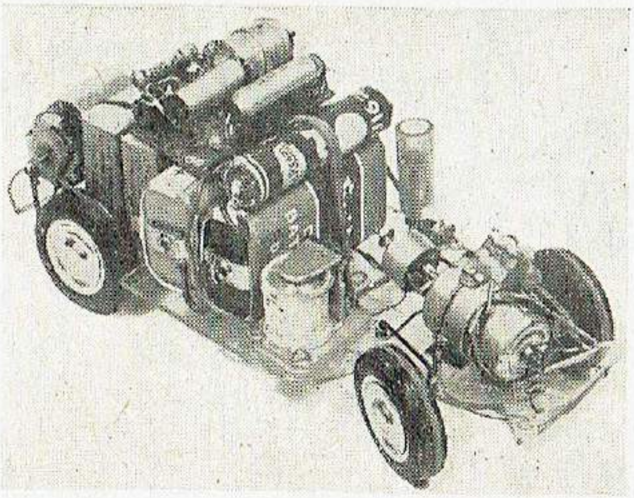
Meanwhile Tommy Ives tried a simple diode detector circuit which, whilst delightfully insensitive to motor noise, was similarly disposed towards signals at a range of more than six feet. This would be fine for table top driving, but we felt that a twelve foot diameter circle was too small a field; of course, we may have a model later which would be small enough to make full use of this area.

The Method

Several mechanical steering mechanisms were developed in the course of experiment! Battery consumption being the foremost consideration. Mark/space at a fairly high rate was necessary to obtain a smooth steering action, but because a high rate draws more power due to a stalled condition brought about by rapid reversal of the motor, a rather "lopsided" method was tried; power ON—left, power OFF—spring return to Right. This means that a sick battery will cause a predominance of Right turn, however, battery drain is so much less when the motor does not actually stop, as we find when using a flyball servo, indeed a flyball would be quite satisfactory were it not for the extra control facilities required.

There seemed to be no reason why a simple form of motor control should not be fitted, this would have to be of a mechanical/electrical type and driven from the steering mechanism. Reverse would, it seemed, require a sequential selector but as this would have taken





Above and below : The compact arrangement of the batteries and components on the chassis is evident from these views.

up valuable space and battery power it was put aside until further developments permit its inclusion.

At first a straightforward (no pun) STOP/START normally closed switch was built, opened when the steering motor received full power from an off signal. This had the effect of causing the whole steering unit to swing in the opposite direction to the wheels and in so doing, open a pair of contacts in the driving motor circuit. However, it was apparent upon test that if one pulsed the signal at a slow rate the unit oscillated slightly, causing a make and break of these contacts, which in turn pulsed the drive motor proportionately to the lower rate range of the signal. The effect was, of course, speed control in forward gear, in fact at a very low rate, a somewhat humorous effect similar to that achieved by a "clutch happy" learner was to be observed.

There just had to be a fault in this apparently rosy state of affairs; slight interaction between steering and speed, only to be noticed when it came to "Road Tests". The application of hard left (at 75/25 mark space) tends to provide slow speed whereas there is no such reduction in speed for right turn unless under intensional rate change, this too interacts in a right turn, causing an opening up of the radius.

The fears of steering wobble which we imagined might occur when on low rate proved unfounded in actual driving, in that at low speed the car travels such a short distance per steering deflection, that the directional change of the car is practically undiscernible.

So there we have it; fully proportional quick acting steering, forward speed control and stop, all on single channel. Now let us examine the steering mechanism . . .

Steering Servo

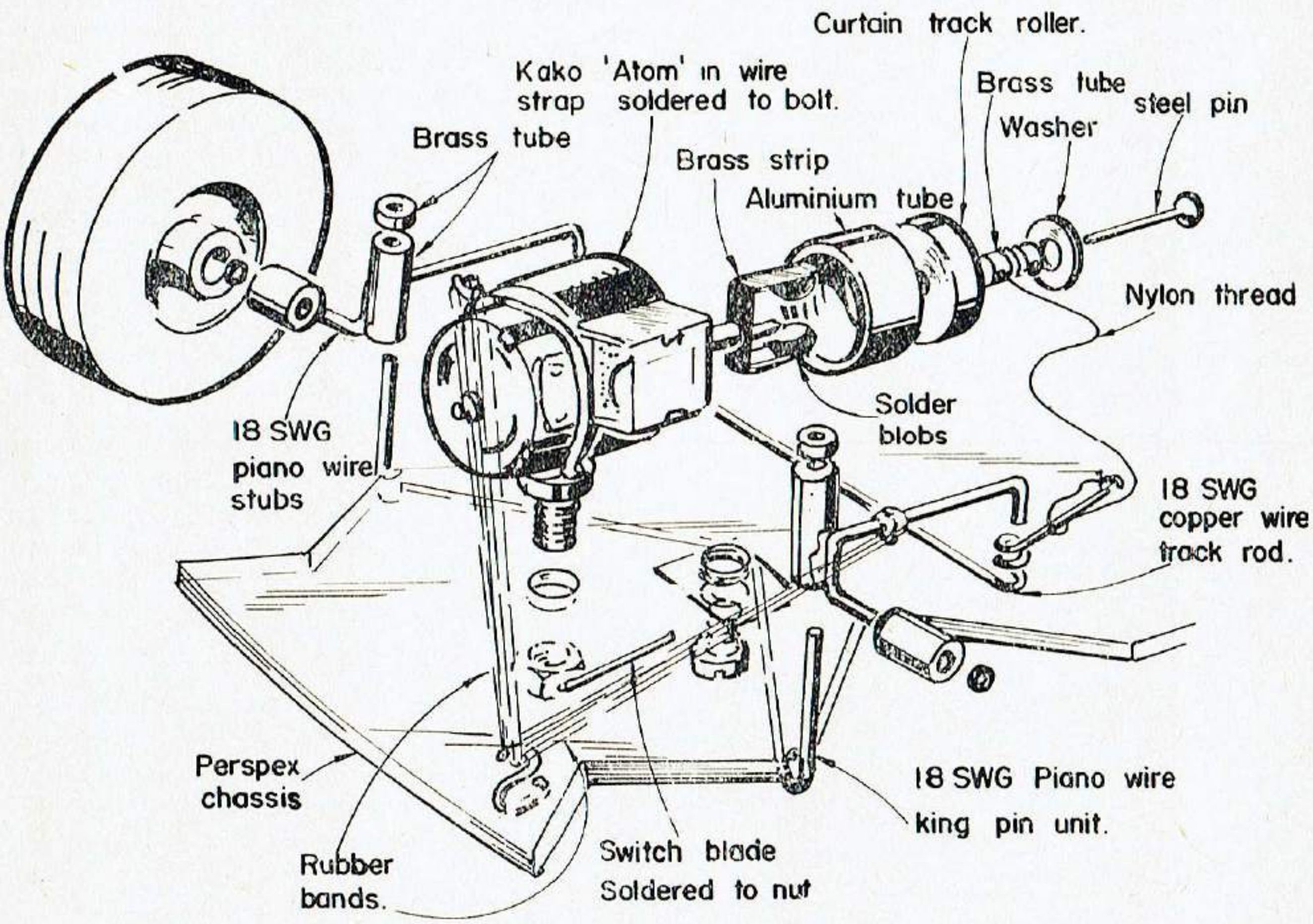
A Kako "Atom" provides the power (Micromax would have been very nice, but is slightly larger). The shafts are cut short and the drive end filed to a "D" shape, the flat part having been cut just past the centre line of the shaft. A steel pin carrying a clutch unit is soldered to this flat and forms a small dia. extension. For those modellers with suitable facilities, we would recommend turning or grinding the shaft. The soldering proved adequate on the original in view of the light duty of the servo.

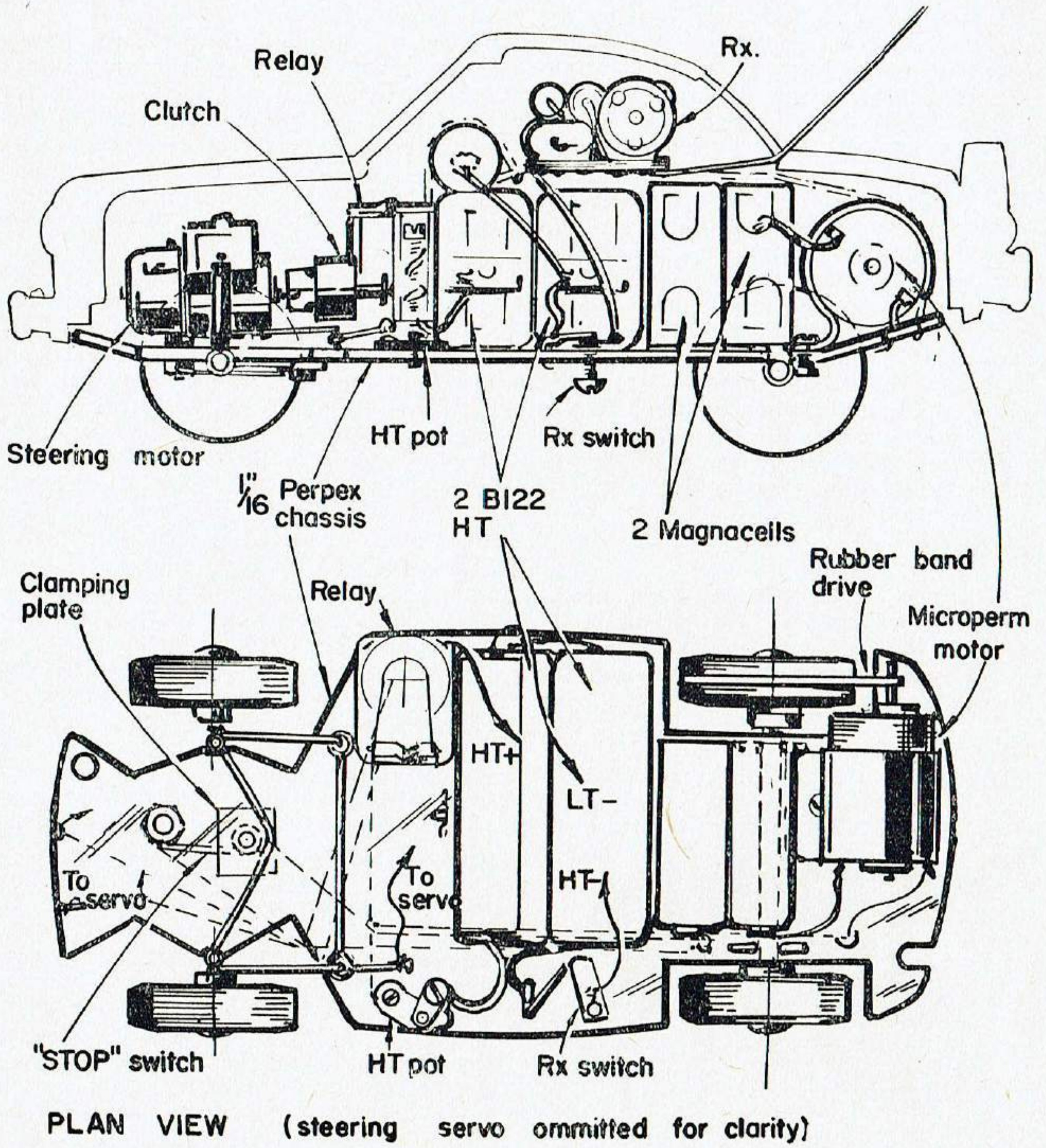
The next step is to make a small centrifugal clutch. A ⅛ in. strip of .005 in. brass is bent to form a "U", drilled and soldered to the unfiled part of the motor shaft. Solder blobs provide the weights, and the strip is filed to a radius at the ends. These engage in a short length of aluminium tube which is a force fit on a roller obtained from a curtain railway runner. The roller is soldered over a piece of 20 s.w.g. brass tube which runs on the pin section of the shaft. The object of this is to provide a very small dia. winding drum, capable of winching in a length of nylon sewing thread attached to the end of the track rod.

By adjusting the shape and position of the brass "U" piece so that the clutch is disengaged at rest, the return action of the trackrod is unimpeded, but as the motor speed increases due to mark/space signals which have a predominance of "space", the drive is engaged, the track rod is wound over to LEFT against the return "spring" (actually a rubber band). As the M/S controlled servo motor speed is matched to the return counter-action, the wheels remain in the appropriate position. Upon reducing the motor speed, the return action wins and the clutch casing and winding drum reverse, steering the car in the opposite direction.

Speed Control

The whole motor and clutch unit is retained by a wire clip which passes around the motor and is soldered to a bolt passing through the chassis. A re-





Chassis layout. These views are slightly less than three-quarters full size. Hole and slot at the chassis ends are for body retaining bolts.

taining nut is locked to this bolt with solder so that the steering unit is free to pivot. A second rubber band ensures that the unit is biased in the opposite direction to the winch pull, and the tension is carefully adjusted so that the application of slow rate or off signal *only* causes the unit to swivel slightly whilst the car is in action; *bench testing will not do.*

A wire contact arm attached to the nut on the motor pivot makes contact with a bolt in the chassis, serving both as a mechanical stop for the servo and a switch for the main driving motor.

The actual steering mechanism track rod, stubs king pins, etc., are simply fabricated from wire and tube and the plastic road wheels are force fitted on plastic sleeving on brass tube stub bearings. Small rubber bands are secured to the treads with rubber solution to provide better adhesion on polished surfaces.

Chassis

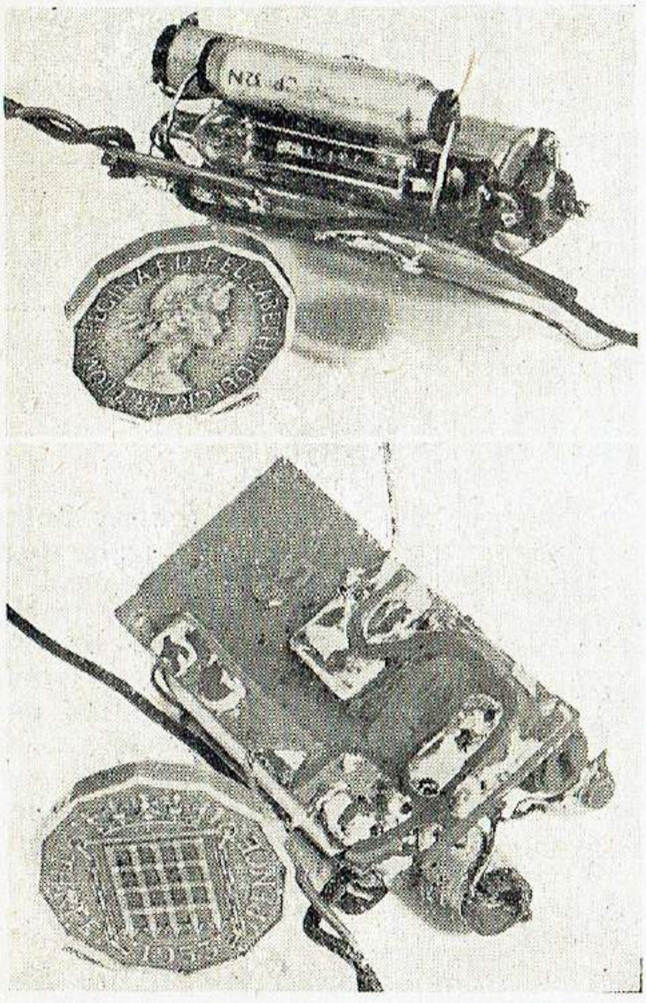
Perspex $\frac{1}{16}$ in. thick is used for the chassis. The choice of this material is threefold; it provides insulation, one

can trace connections and locate the position of components on the opposite side and it may be bent by application of heat in the appropriate place.

The chassis ends are, in fact, curved upwards slightly to suit the body, cutouts are made to clear the wheels and wire "U" shaped clips pass through the chassis to form rear axle bearings. An aluminium clip carries the main drive motor; a German "Microperm" which drives the offside rear wheel via a rubber band directly off the bare armature shaft. The wheel in question has a groove cut in the thread so that the band does not increase the effective diameter. Thanks to the all enveloping body, this primitive but effective transmission passes unnoticed.

Receiver

There is very little comment necessary on the receiver, except that it is similar to the well-known Pike soft valve type, often unjustly criticised for having a short valve life and requiring adjustment as the valve aged or H.T. voltage dropped. Both these effects could have been minimised by giving a continuous signal and OFF keying for control, by this means, the standing current would be low for the major part of its operational life. Unfortunately, XFG1 valves are now out of production, so the junk boxes will have to be searched carefully.



Heads or Tails . . . two views of the tiny receiver.

The particular valve used in this receiver had aged and was rather insensitive, but having been used successfully in the R/C tugboat with such close proximity to the motor, was selected for this miniaturised receiver. This could be built even smaller by using a fixed condenser for C1. The printed circuit is hardly necessary as regards connections, but serves as a good anchorage for some of the components. The relay, and R.E.P. ½ oz. × 5K is bolted to the chassis, its case had to be discarded to save space and the centre and normally open contact used to operate the steering motor. This ensures that the steering motor runs at full speed when the Tx. is off so that the drive motor is out of circuit and the car stationary.

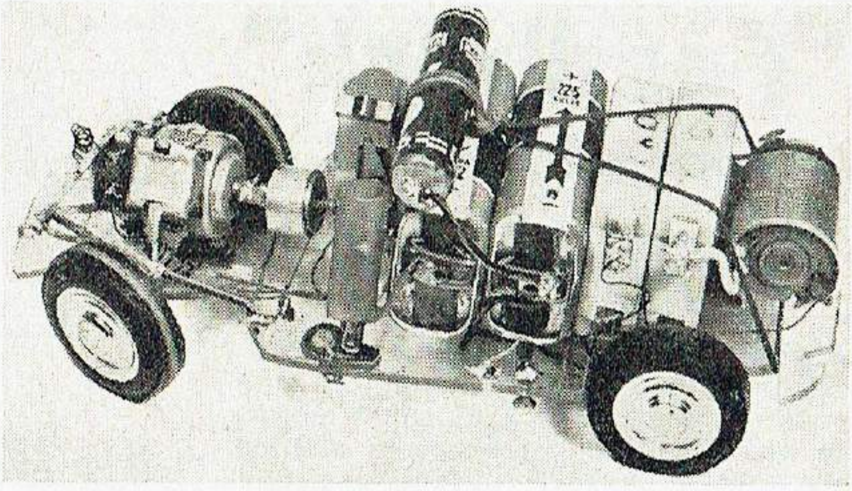
A variable resistance has to be incorporated in the H.T. pos. lead to ensure a standing current of not more than 1.5 m.A. Here again space dictates the pattern so a home-made pot. is fitted. This comprises a bolt in a tapped hole in the chassis carrying a wiper which moves over a scrap of carbon track cut from a discarded pot. of a larger variety. A piece of plastic sleeving insulates the bolt from accidental contact with the batteries.

An ON/OFF switch of similar construction has a pair of wiper and static contacts and is passed through the chassis so that the car may be switched on from outside.

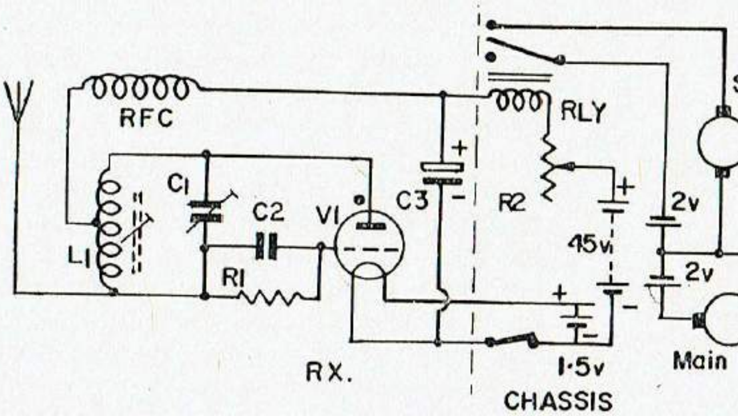
No switch is provided for the main drive motor, instead a piece of insulated sleeve is passed over the switch contact arm which is on the bottom of the chassis. Similarly shorting plug and meter socket have been dispensed with and instead the test meter leads are fitted with a battery clip for positive and a discarded battery end plate for negative connections.

Power Supply

Batteries themselves are, of course, two B 122's in series to provide 45v.



Receiver removed to show the battery retaining bands. The main driving motor in its clip may be seen at the extreme right. Pot and Rx. switch are on the edge of the chassis. Note anti-skid bands on the front wheels.



COMPONENTS :

L1 20 turns 26 g. on ¾ in. dia. slugged former, Tap 9t from anode end.
C1 3-30 pf.
C2 100 pf.
C3 .01 mfd. electrolytic 100 v.
R1 3.3 meg.
R2 3 K pot. (home-made).
RLY 5 K.

H.T. and one U16 for L.T. for the receiver, which dwarfed by them, perches on top. One Magnatex cell provides 2 volts for the drive motor and a second one for the steering servo. It should be stressed that these cells are being heavily loaded and may not take many recharges.

Should one wish to use extra batteries in parallel, there is room to accommodate two or three more Magnatex cells below the chassis where all but the worm's eyed scale fanatics would miss them, alternatively two extra U16 cells may be fitted in mounting clips, one each side of the steering servo so that they line up with the recesses in the front wings just clear of the wheels.

A pulse box at the transmitting end is essential, provision should be made for a rate of approximately 5 p.p.s. max. with a full signal button for STOP. Variable rate is required if speed control is to be attempted, this will, of course, be adjustable down to a low rate of approximately 1 p.p.s.

Readers will have noticed by now that no spark suppressors are fitted to the motors; this in fact proved quite unnecessary in view of the performance of the receiver. A spot of "Electrolube" on the brushgear and switch provides protection of a mechanical nature.

Having completed the car and looked through its transparent chassis we find a few odd corners in the body which could be filled up. Further experiments are in progress and we hope to publish more gen later. It may even be possible to use a smaller model!

"Feedback"

COMMENTS FROM OUR READERS

M.S. Seaman suggest some speed control variations.

ON page 407 of the December, 1960, issue you show a circuit for controlling the speed of D.C. shunt motors in which the speed is varied by altering the voltage applied to both armature and fields.

This method is, in fact, incorrect: although it may appear to work quite well with relatively inefficient model motors, it would be almost ineffective if applied to a large motor (say, 10 h.p. or more). The correct method is to keep the field energised at full voltage, and to reduce the voltage applied to the armature.

SPEED CONTROL USING EXTERNAL RESISTORS

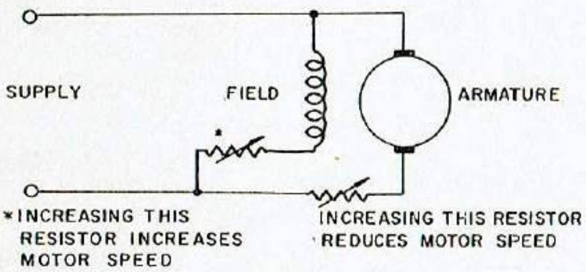


FIG. 1

This can readily be understood by the use of the formulae for the D.C. motor.

Let V = voltage applied to armature.
Ia = current through armature.
ra = armature resistance.
T = motor torque (neglecting losses).
N motor speed.
ϕ = magnetic flux per. pole.

K1, K2, are constants determined by the mechanical design of the motor (number of poles, number and arrangement of armature conductors).

Then:

$$N = k1, \phi \frac{(V - Iara)}{}$$

$$T = k2. \quad Ia. \phi.$$

Thus, we can reduce speed by:—

(1) reducing the armature voltage, V.
(2) increasing the armature resistance, ra (by adding external resistance).
(3) increasing the magnetic flux, ϕ (by increasing the current through the field windings).

SPEED CONTROL USING VARIABLE VOLTAGE ARMATURE SUPPLY

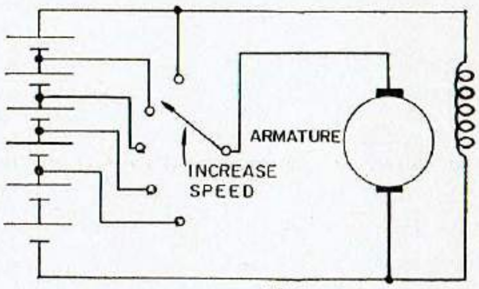


FIG. 2

If we adopt the latter course, then it will be seen that the same torque can be obtained with a lower armature current.

If the field current is decreased (as shown on page 407), the speed of the motor will increase, but if the armature voltage is reduced as well, then the speed should remain more or less constant. However, more armature current must flow to supply the same load torque, so the increase in the Ia ra term results in a drop of speed. This has the disadvantage of increasing the armature losses (Ia^2 ra) under worsening conditions of motor ventilation. At the same time, more power is being drawn from the power source than is really necessary, since the field current is much smaller than the armature current.

The two basic circuits for running shunt motors at reduced speeds are shown in Figs. 1 and 2 which is best for the application concerned can be decided from the torque—speed characteristic desired (see Fig. 3).

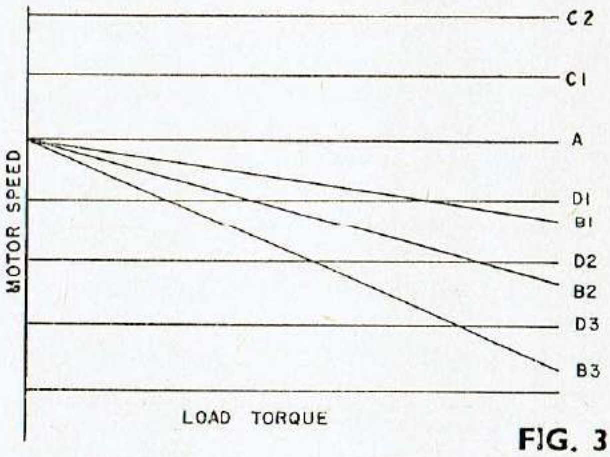
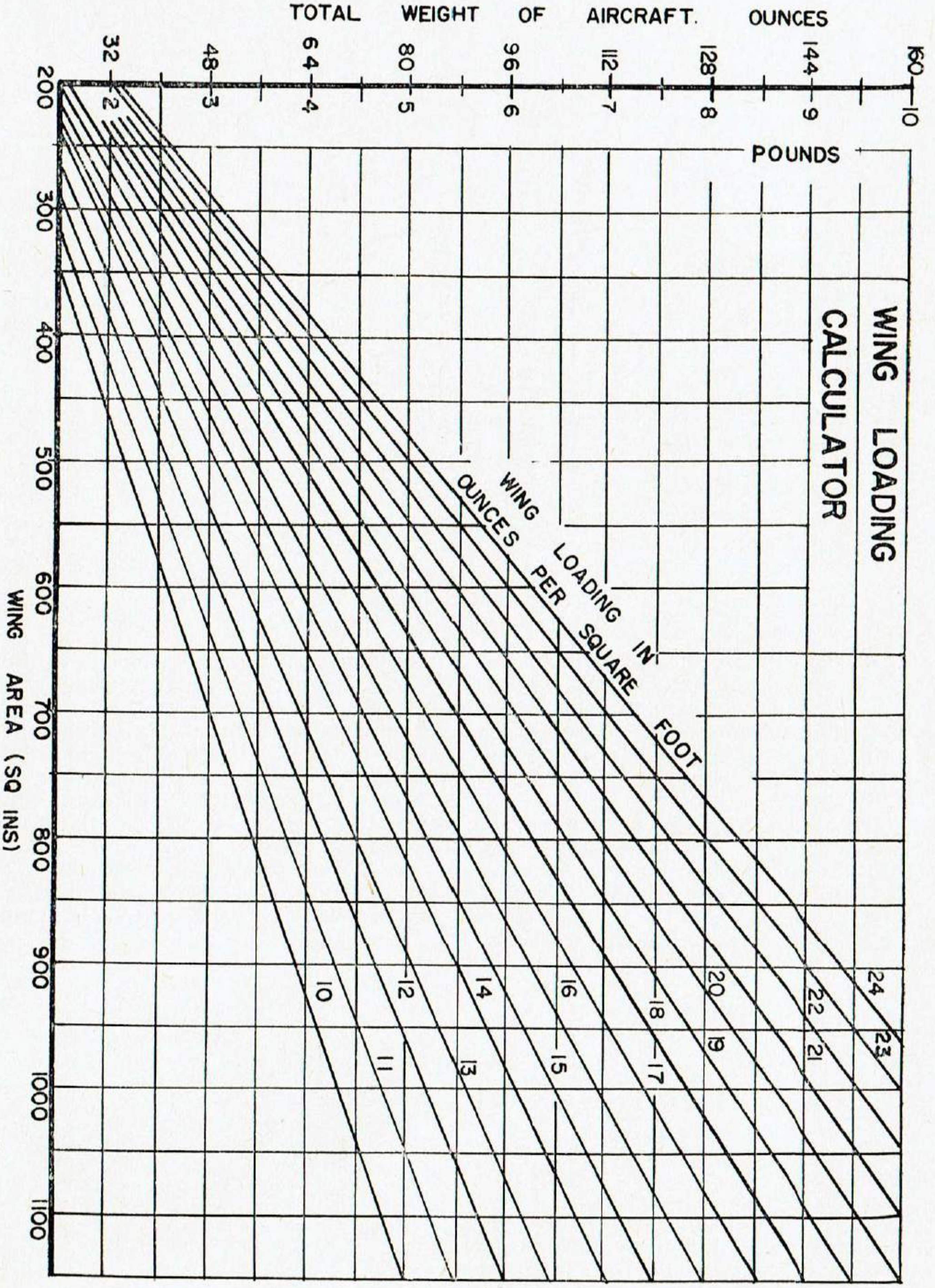


FIG. 3

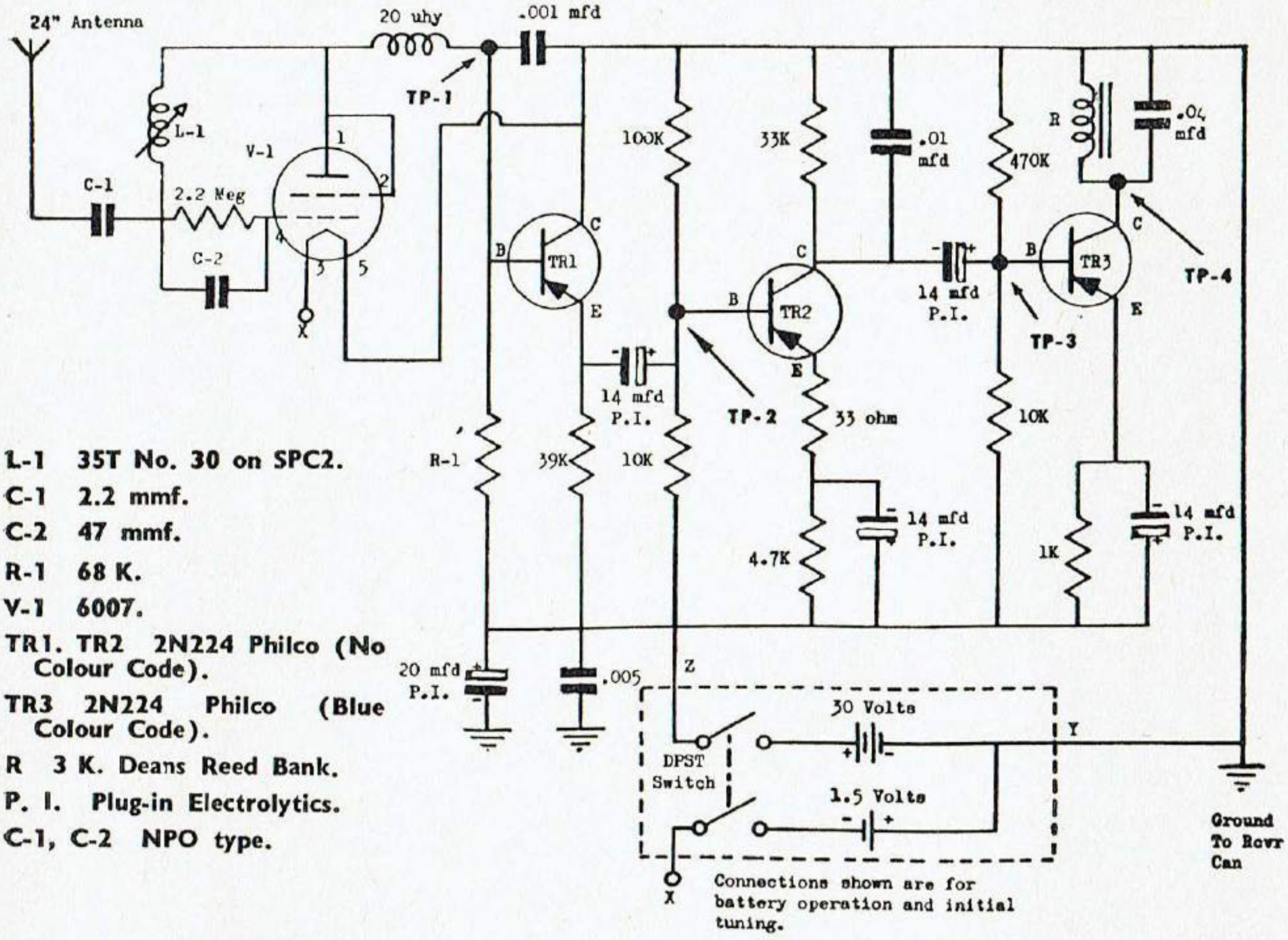
A: Normal characteristic; full voltage both armature and field. B1, B2, B3: Effect of adding extra resistance on the armature circuit. C1, C2: Effect of adding extra resistance in the field circuit (or reducing field voltage). D1, D2, D3: Effect of reducing voltage applied to armature; full voltage across field.

Will It Get Off The Deck?

Check your wing loading with this graph before finalising the R/C payload . . . it pays!



Kraft Relayless 10 Kit



L-1 35T No. 30 on SPC2.
C-1 2.2 mmf.
C-2 47 mmf.
R-1 68 K.
V-1 6007.
TR1. TR2 2N224 Philco (No Colour Code).
TR3 2N224 Philco (Blue Colour Code).
R 3 K. Deans Reed Bank.
P. I. Plug-in Electrolytics.
C-1, C-2 NPO type.

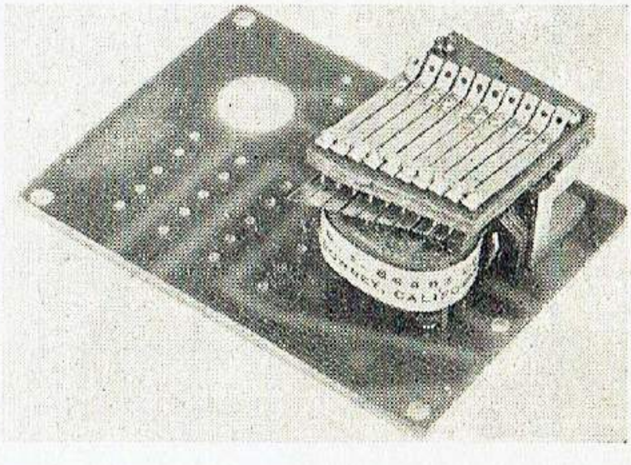
WE have had the opportunity of examining the kit for Kraft Relayless 10 receiver. Upon examination of the nicely packed sets of components in their polythene bags the neatness and care which has gone into this kit was easily apparent.

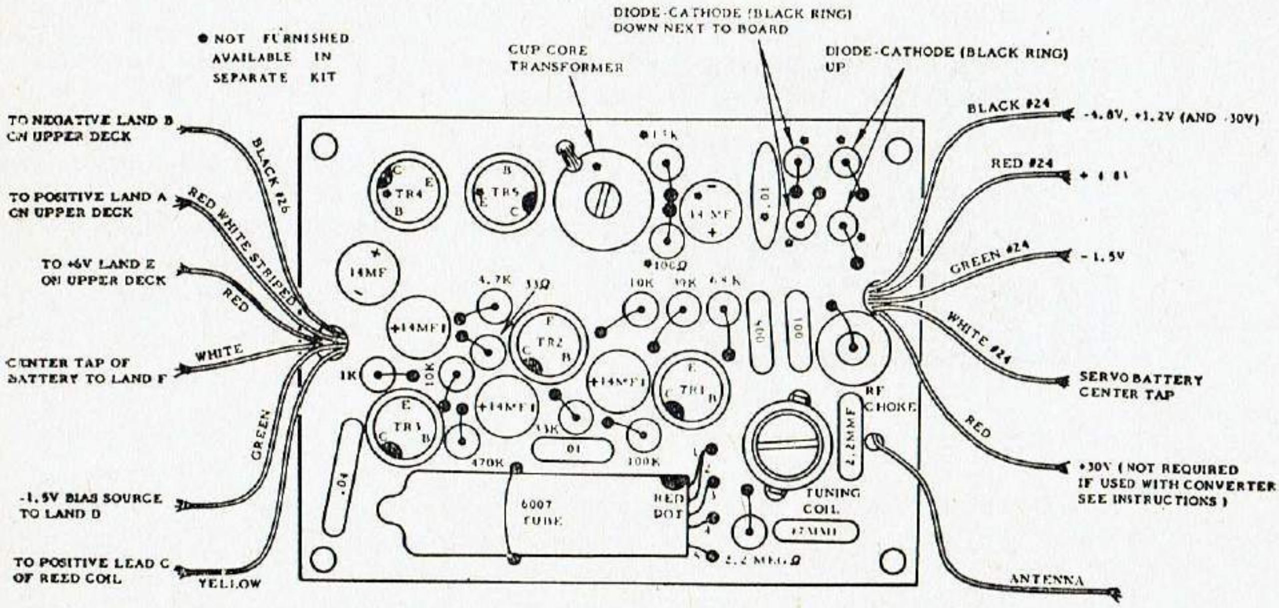
Two beautifully executed pieces of printed circuitry form the receiver and reed panels; glassfibre baseboards carry the rhodium plated copper circuitry, there is provision on the receiver panel for a power converter circuit: but components for this are not included in the kit.

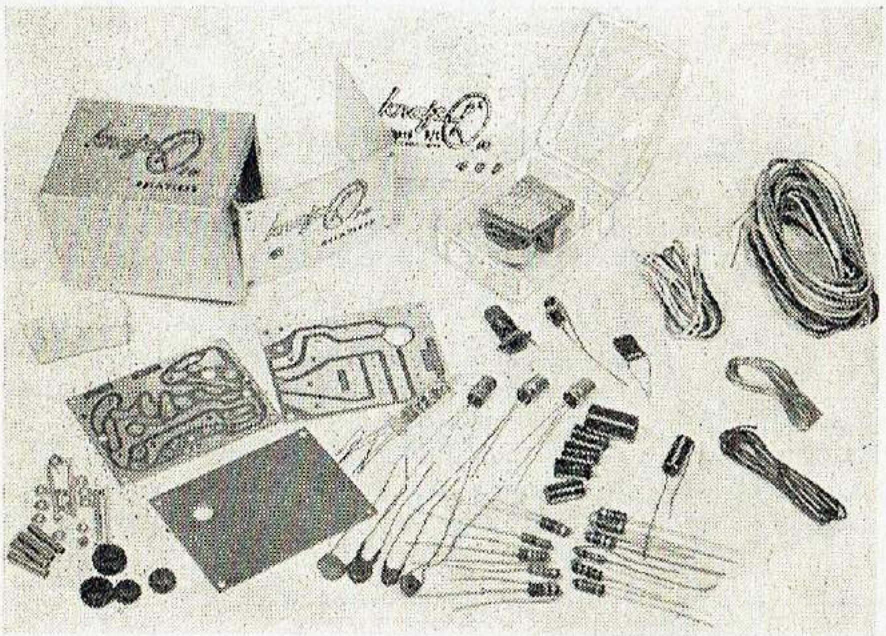
Krafts pay attention to every detail; screws, grommets, wire, even a coil of solder. The instruction book deals with the work in a clear and concise manner, extracts from the circuitry are illustrated here.

It will be seen from the theoretical circuit that in keeping with their preference the receiver incorporates superregenerative detector employing subminiature valve for a detector stage, directly coupled to the first transistor amplifier and this is operated as an emitter follower to match the high impedence of the detector to the low input of the next transistor stage. This second stage is R—C coupled to the reed driving stage which results in a rise of 25-30 volts across the reed core; this should be ample for the tri' simultaneous operation.

As the example we had was on loan we did not have the opportunity of building and testing, however, the com-







★

Top : Diagrammatic layout including power converter. Left : The basic kit. Below : A'uminium case. Facing page: Deans reed unit on its P.C. deck.

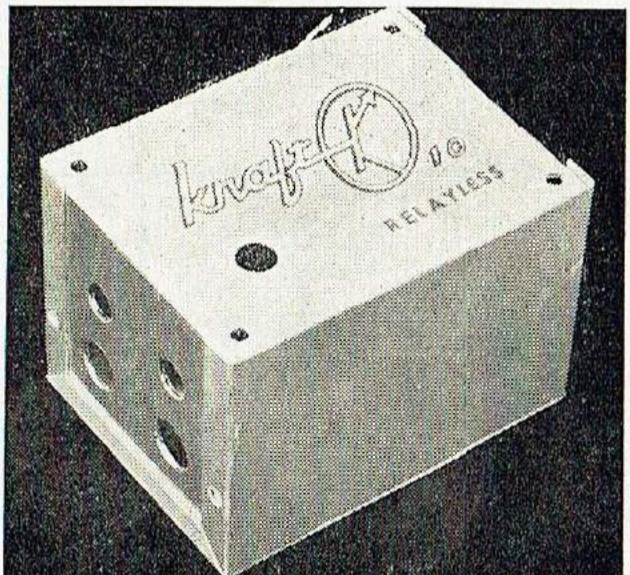
★

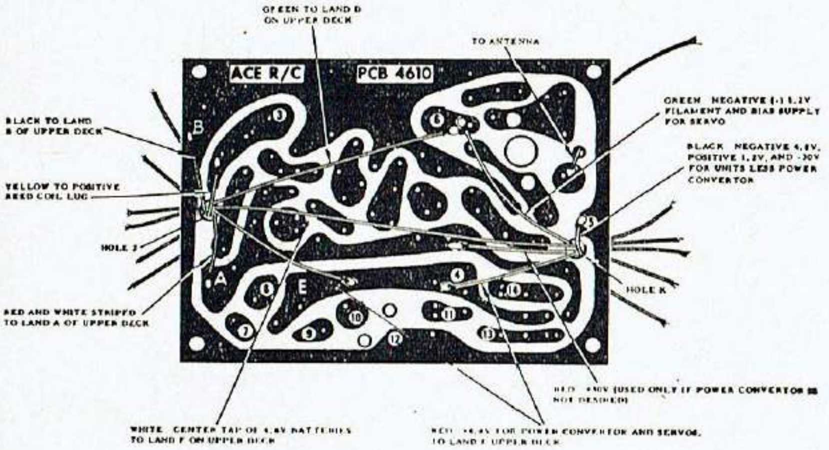
ponents are of close tolerance and pre-assembled parts such as the choke and tuning coil are of high standard of workmanship. A standard Deans 10 reed bank, which responds to audio frequencies of 235, 265, 290, 310, 330, 360, 385, 415, 440, and 470 cycles per second, comes complete in its own plastic box.

An aluminium two-piece case encloses the receiver and the reed deck providing adequate crash resistance and screening.

This is what you get for your £20 :

1 Printed Circuit Board 4610 (for Rx. and power pack).
1 Printed Circuit Board R10 (for reed deck).
1 Paxolin Board.
1 Kraft Transfer.





Left : Printed Circuit board and external connections. Below : Power converter circuit for use with extra converter kit.

★

★

1 Deans 10 Reed Bank.
1 Alloy Rx. Case.
1 6007 Valve.
1 Plastic Pkt. (cont. all components).
1 Plastic Pkt. (cont. Screws, Grommets, etc.).
3 Coils, Wire.
1 Coil Solder.
1 Instruction Book.

Radio Components in packet consist of:

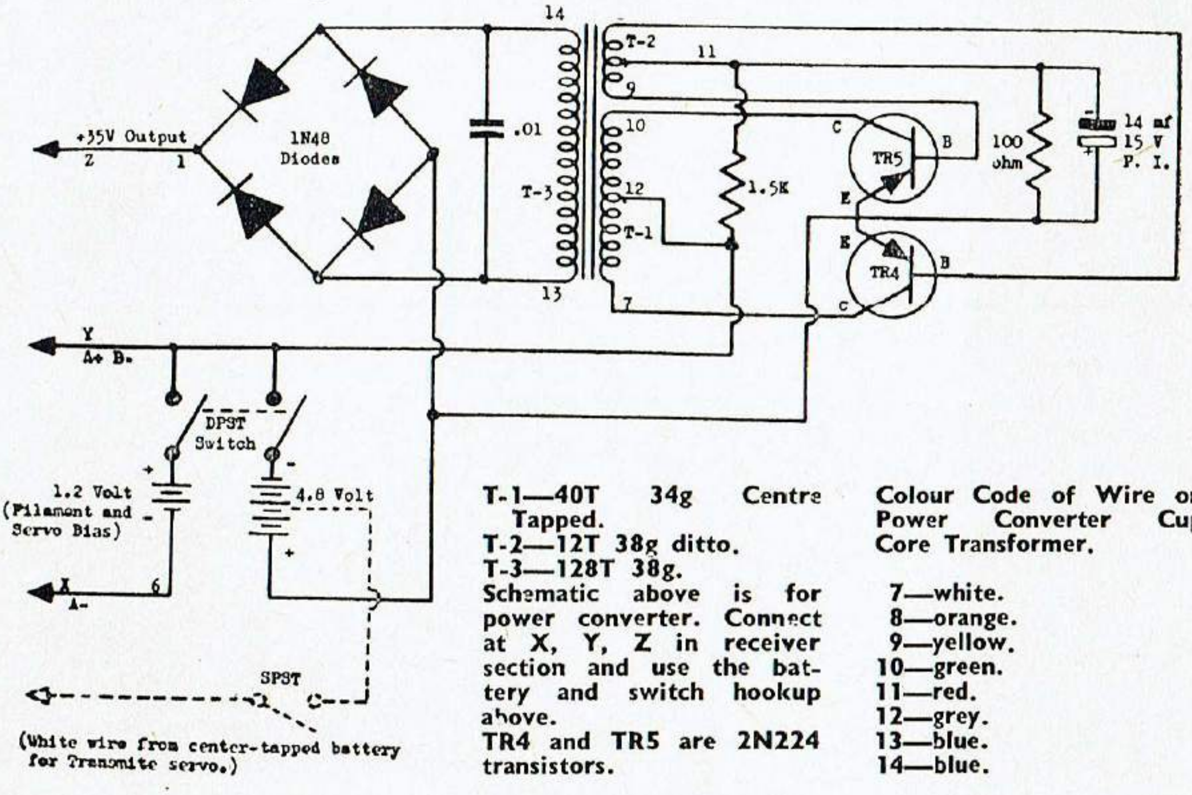
11 Asst. Resistors.
4 Red Disc Caps.
1 Green Cap.
3 Transistors.
1 R.F. Choke.
1 Tuning Coil & Slug.
6 Condensers.

Power convertor kit for Rx. may be purchased for a further £4. It should be remembered that the extra cost of relayless servos must be taken into account when budgeting.

We understand that a kit has just been made available for a matching ten channel transmitter capable of supplying tri-simultaneous signals at a cost of £43.4.0.

Having received *two* sample kits from different sources, we felt positively "pluto Kraftic" . . . both Messrs. Malcolm Douglas and Southern Radio carry stocks of the basic kit. We understand that Southern Radio will build the kit before dispatch if requested. Such a procedure carries no guarantee and the extra assembly fee brings the price up to £22.0.0

Since the first batches of kits were supplied, as published here, some manufacturers' modifications have been made to the circuit. Information relating to these modifications can be obtained by purchasers on receipt of a s.a.e. Enquiries should *not* be sent to these offices.



T-1—40T 34g Centre Tapped.
T-2—12T 38g ditto.
T-3—128T 38g.
Schematic above is for power converter. Connect at X, Y, Z in receiver section and use the battery and switch hookup above.
TR4 and TR5 are 2N224 transistors.

Colour Code of Wire on Power Converter Cup Core Transformer.

7—white.
8—orange.
9—yellow.
10—green.
11—red.
12—grey.
13—blue.
14—blue.

Aerial Loading

By HANS HECK

Hans Heck is well known for his Electronic A.B.C. series in "Modelle". His explanation of the art of aerial loading should make the penny drop, and the absolute beginners brain cogs slip smoothly into gear.

WHAT arrives here from there, that is the question, not only in R/C but in every form of radio communication. What voltage can our transmitter produce in the receiver aerial at greater distances? The voltage produced by the transmitter in the receiver is dependent on the strength of the electromagnetic field produced by the transmitter, the fieldstrength. Obviously one wants as high a voltage as possible in the receiver aerial, in other words one wants a transmitter which produces the largest possible electromagnetic field.

However the strength of the electromagnetic field is not only dependent on the transmitter performance, but also on the ability of the transmitter aerial to radiate this performance. Everyone will understand that the most powerful transmitter will not produce any field strength without an aerial, for example, the most powerful motor will not be able to make a model climb without a propeller. What may not be so clear to most people, however, is the extent to which the practical radiation of the transmitter fieldstrength is dependent on the transmitter aerial. By improvements to the aerial alone the fieldstrength can be increased five to tenfold. A transmitter aerial with ten times better radiation will have the same effect as a tenfold increase in the performance of the transmitter, without alterations to the aerial. Or in other words, with a transmitter with an output of 1/10 watt one can achieve the same fieldstrength (and range) as a transmitter of 1 watt output if the radiation performance of the aerial of the weaker transmitter is ten times as efficient.

We have made many tests on aerials and fieldstrength over the last few weeks and every time have come to the same conclusion, one which is well known from theory and the experience of radio technicians and radio amateurs.

The practical tests have shown that small transistorised transmitters with only 1/20 watt output and improved aerials are superior to all normal valve transmitters with their usual rod aerials and ½ watt outputs. And, of course, a small transistorised transmitter, with two small torch batteries for power, is easier to carry, draws less current and costs less than a valve transmitter with transformer, accumulator and case. Whereas the improved aerial should cost only a few pence.

Hence the economy of better aerials. With most, if not all, R/C amateurs the tendency is to have as powerful a transmitter as possible. Little thought is given to the aerial and the fact that it should radiate the full output of the transmitter and that it will only do so under certain conditions. This is really not to be wondered at because even in the circle of people who work with radio communications over hundreds and thousands of kilometres, the hams, newcomers always have to be told that a length of aerial wire costing 3s. 6d., suitably used, will give the same effect as increasing the transmitter output from 25 to 100 watt, with a cost of over £17. And the successful ones are those who understand this.

Perhaps you will not believe me when I state that most R/C transmitters in use today can radiate only a small part of their inherent output and that most of the voltage supplied from the heavy accumulator is wasted.

Improving the performance of the transmitter is therefore an easily appreciated, though expensive answer. What happens in the transmitter aerial may not be too clear to most. In this article we will discuss the why's and wherefore's of the transmitter aerial; the performance of the aerials depends primarily on two factors:—

1. *Tuning.* The aerials must be tuned to the transmitter output, as it must be capable of taking the HF output.

2. The aerial must be capable to radiate the transmitter output and transform it into electromagnetic field energy. This, however, is not achieved by just fitting the correct aerial.

The half wave aerial (Dipol)

Aerials are not simple metal rods, but electric oscillators, on which, if they are properly constructed and tuned, electric oscillations will take place as in a tuned oscillator. Every metal rod will radiate, but the radiation of an accurately tuned aerial is many ten if not hundred times as much as a metal rod, which is either too long or too short for the particular wavelength. To understand the working of an aerial we will have to start with the half wave aerial. Such an aerial is a wire or rod exactly half as long as the wavelength which it must radiate. With a frequency of 30 mc/s which equals 10 m., the aerial length must be 5 m. (In reality such a half wave aerial must be a few per cent shorter than half the wavelength due to capacitance shortening effects, but that does not interest us here.) Such a half wave length aerial works exactly as an oscillator, when it is activated. It is in resonance with the wave length, for which it is calculated. The electric charge flows continuously from one end of the aerial to the other end and back, at a speed equal to the speed of light (300,000,000 m/sec.) and hence takes

$$\frac{300{,}000{,}000}{2 \times 5} = 1/30{,}000{,}000 \text{ sec.}$$

At a frequency of 30 mc/s or 30,000,000 oscillations the aerial is tuned, i.e. in resonance.

But this will only be the case if the aerial for 30 mc/s is exactly 5 m. long. If it is somewhat longer then the charges will take longer to travel backwards and forwards and the aerial will not be tuned for 30 mc/s, in the same way as a tuning fork will be de-tuned if we fix a lump of solder to one of its legs.

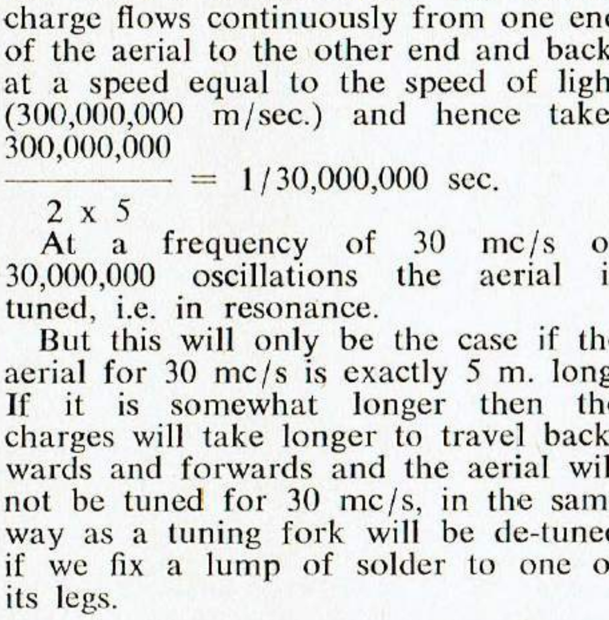


FIG. 1. Current and voltage distribution on a ½ wave aerial. At 1 (dotted) current is at max. At 2 (full line) voltage is highest. Note the "electrons" at one end before rushing back !

Fig. 1 shows the standing wave, current and voltage for a half wave aerial in resonance. It can be seen that in the centre of the aerial the current is highest, here the electric charges achieve their largest oscillation on their way from one end of the aerial to the other and back. The charges cannot flow any further than the ends of the aerial wire or rod. In the same way, one can climb a ladder only as high as it is long. At the aerial ends the charges stagnate. Stagnated charges means voltage. Hence, on the half wave aerial the highest voltage and the lowest current is reached at the aerial ends, while in the centre the highest current with the lowest voltage occurs.

Note.—The electric length of a transmitter aerial must be exactly equal to the wavelength. On every aerial the highest voltage occurs at the ends, while ¼ wave length from there the highest current occurs.

Aerial tuning

From current and voltage we can calculate the resistance, even when there is no resistance in the form of a resistor. In these cases we speak of AC or apparent resistance, as the resistance is operative and has the same reducing effect on AC current. As we have high voltage and low current at the aerial ends, they must have a very high resistance. In the aerial centre, however, we have a high current and a very low voltage, hence a very small apparent resistance. Theoretically the resistance in the aerial centre should be zero, the aerial voltage is zero and the current x, divided by zero equals zero. In fact, however, the resistance in the aerial centre is not zero, as the aerial radiates energy, it loses oscillation energy to its surroundings (this is exactly what we want) and every electrical energy loss can be considered as a resistance value, as in every ohm of resistance, electrical energy is destroyed.

The losses in output in a half wave aerial, which is held high above the ground, is, through radiation, just as high as the electrical output which is destroyed by an actual resistor of approximately 73 ohm. Therefore radiation resistance of a half wave aerial is 73 ohm. This 73 ohm is, however, an actual ohm resistance, which expresses the loss in output, and not an AC or blind resistance, as occurs

at the aerial ends.

The radiation resistance of 73 ohm is only active at the exact centre of the aerial. If we cut the aerial here the resistance across the ends will be 73 ohm. When connected to a transmitter, for example through a double connection of 73 ohm resistance and a coupling coil, the transmitter will work exactly as if a 73 ohm resistance is connected to it. This is shown in Fig. 2.

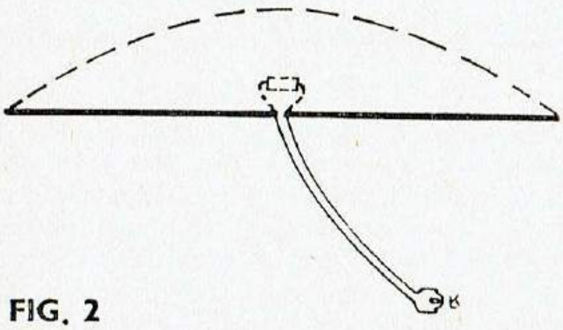


FIG. 2

In this form the half wave aerial has found practical use as the so-called dipol in radio technique. Its tuning resistance is exactly equal to its radiation resistance, i.e. 73 ohm. The radio amateur will appreciate that, when the transmitter 'looks' through the leads into the aerial, it 'sees' a resistance of 73 ohm.

The quarter wave aerial (Marconi)

For 27 mc/s R/C transmitters or hand transmitters of about this frequency the aerial length will be some 5 m. It is not really practicable to carry this length about. Instead we use $\frac{1}{4}$ wave aerials. When placing the $\frac{1}{2}$ wave aerial of Fig. 3 in a vertical position, the lower branch of the dipol can be omitted and in its place use made of the earth as an electric counterweight, which will then act as the second dipol branch. This will still retain the oscillations as the vertical end of the $\frac{1}{4}$ wave length is mirrored in the earth. An almost ideal earth as counter weight would be a large copper plate laid flat on the ground.

The coupling coil is fitted between the aerial rod and the counterweight as shown in Fig. 4. On portable outfits we can use the metal case of the transmitter as the counterweight. This is not, of course, ideal and will only work if the housing contains enough metal mass and sufficient surface area. It is impossible to get the $\frac{1}{4}$ wave aerial to

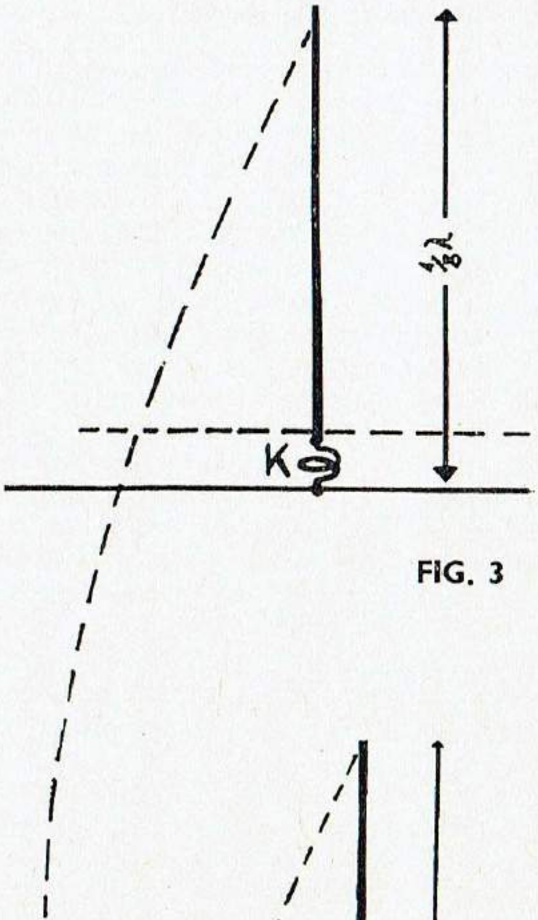


FIG. 3

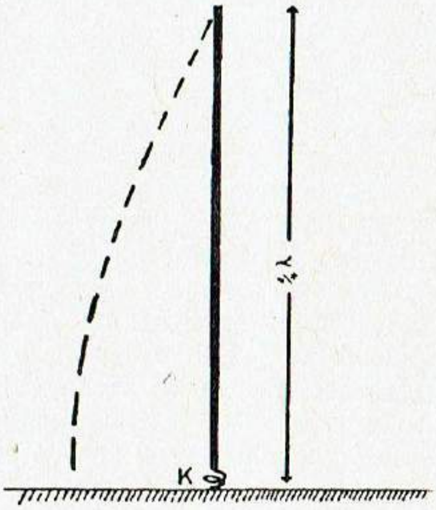


FIG. 4

work correctly without a metal case unless we put a wire at least one metre in length at the bottom of the transmitter to act as a counterweight. With the $\frac{1}{4}$ wave aerial the radiation resistance between the aerial rod and the counterweight reduces to approximately 40 ohm, as the counterweight contributes very little to the radiation. In principle everything remains the same as with the $\frac{1}{2}$ wave length aerial. The $\frac{1}{4}$ wave aerial is an excellent radiator for broadcast as well as short wave telecommunications, due to the hemispherical radiation of its vertical rod, flat over the ground. (The high aerial masts are mostly vertical radiators.)

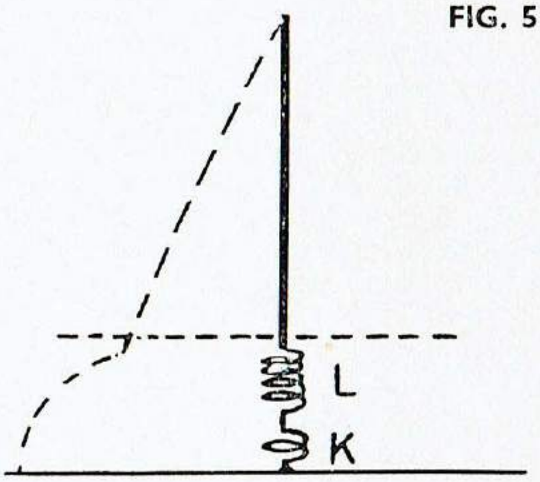
This is called the Marconi aerial, for Marconi used such an earthed vertical aerial to produce the first real radio link.

The shortened rod aerial

For the portable transmitter of 27 mc/s, the Marconi aerial is still not ideal as the length must be approximately 2.6 m. Wonderful telescopic aerials are available which extend to about 1.2 m. and which from the practicle angle are just right. From the electrical angle, however, they are not so good, that is, in their original form. Such an aerial for 27.12 mc/s represents about ⅛ of the aerial length. What happens if we fit such an aerial to the transmitter? Everything possible except what a proper aerial *should* do. Because a considerable part of the aerial is missing, neither the ¼ phase of the current nor the voltage can be obtained on the aerial; the aerial is no longer in resonance, the missing parts of the current and voltage phases are "transformed" to the transmitter via the coupling coil and de-tune its output. An aerial shorter than ¼ wave length works as a capacitance or as a condenser. With its connection we are, electrically speaking, no longer sitting at the bottom of the aerial but higher up the rod where there are considerable apparent resistances. The bottom end of the short aerial has no longer an actual resistance of 40 ohm but a considerably higher blind resistance, which prevents the aerial from taking the full output of the transmitter. Only a small part of the transmitter output goes to the aerial, the largest part is wasted. And what the aerial does not receive it cannot radiate. The aerial radiates more when it receives more, but the ratio between what the aerial receives and what it radiates, its efficiency factor, is not increased by the extension coil in the aerial base.

In the aerial with an extension coil in its base, the highest aerial current flows in this coil, which represents the most active aerial part. But the coil with its tight field has no practical radiation and even if it had, it would be of no use, as the coil is contained within the transmitter housing. Only the aerial part above the dotted line in Fig. 5 projects with its meagre aerial current above the transmitter housing. It is clear that this set up is unable to radiate the same energy as an aerial of double the length, with its larger current in its lower half. Obviously the case is not so bad that R/C is impossible; all the commercial R/C transmitters had such aerials until recently. However it does not alter the fact that such aerials have a low efficiency and even when carefully tuned waste a large part of the transmitter output. With better aerials we could use weaker, easier to handle small transmitters. But how can we do this?

FIG. 5



The central loaded aerial

Often the correct technical solutions are to hand, they are known to countless people who still do not use them where they are needed most. They are often so simple and well known that when someone finally uses them you wonder why it was not done before.

For years now the radio amateurs have been using shortened aerials, with extension coil in the centre instead of at the end.

Kurt Schumacher, however, was the first one as far as we know, to use this system for R/C transmitter aerials. He had good reason to do so, he was designing commercial fully transistorised transmitters (which are now available as the Bellaphon 3 and 10) with which he planned to get the same or stronger radiation than with the normal valve transmitter, in spite of the lower output.

Schumacher/Graupner call these aerials central loaded aerials, by which is meant that the coil, which is called load or inductive loading, is placed in the centre of the aerial instead of at the base.

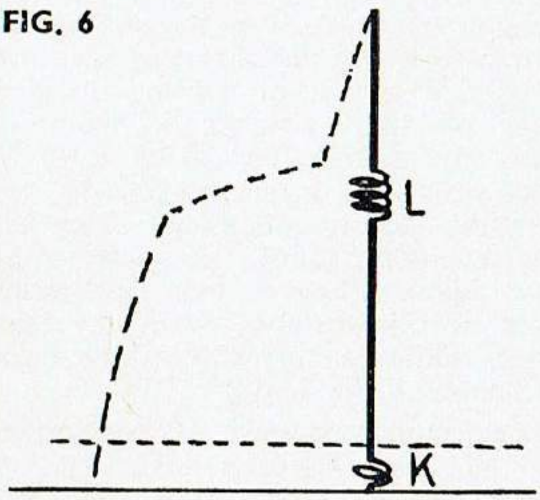
The placing of the coil in the centre instead of at the base is the only thing that distinguishes the central loaded aerial from the normal rod aerial.

But the results we get with it are amazing. The effective radiation per-

formance is 8 to 10 times the radiation of an equally long aerial with the extension coil at the base; we can check this quite simply with a fieldstrength meter. On comparing Fig. 6 with Fig. 5 we can see why this is so. In the central loaded aerial, the lower aerial part, in which the strongest current flows, projects a bit more above the transmitter case, in fact the aerial starts at the base as if it was a full ¼ wave aerial.

From the larger distance of the dotted current curve from the bottom part of the aerial we can see that it projects a much stronger current carrying aerial part than the aerial in Fig. 5. The extension coil which compresses the current curve, follows the aerial part above this, with its low current flow is really only fitted to ensure that the whole of the aerial is in resonance, but this part contributes little to the total radiation.

FIG. 6



In Fig. 6 as in all the other figures only the current curve is shown.

The central loaded aerial shows a considerably larger voltage difference between the counterweight (case) and the aerial tip, so it is small wonder that the electromagnetic field it produces with equal transmitter output, is so much greater than that produced by an aerial with the extension coil at the base. The central loaded aerial shows that the old saying "that a good aerial is the best amplifier" is quite true. It is obviously better to make a weak transmitter and to use its low output through a central loaded aerial to a high degree, than to use a powerful transmitter with a bad aerial.

The central loaded aerial will increase the useful radiation of any transmitter many times when compared with the usual aerials, its use is not confined to fully transistorised transmitters only; if there is anyone amongst our readers who is thinking of increasing the output of his transmitter we can only advise:—Leave the transmitter as it is and make yourself a central loaded aerial, because in that way you will gain more, spend less and have the job finished the next half hour.

Building a central loaded aerial

In the commercial type of telescopic aerials the extension spool is fitted somewhat above the centre of the aerial and is cast in plastic. When making your own this is not advisable as it would mean that the coil would have to be made with an extremely accurate diameter, placing it in exactly the right position on the aerial which must be a rod of exactly the right length, you will not have the opportunity to tune the coil to bring the aerial into resonance. This is an essential feature, especially on home built transmitters, due to the variation in length of the leads from the aerial contacts on the transmitter to the aerial itself, which will effect the coil. For home built central loaded aerials, it is therefore better to use coil with ferrite cores, with whose help one can alter the inductance of the coil. This means that the coil will stand at right angles to the aerial, looking perhaps a bit comic, but entirely practicable when it comes to tuning.

Fig. 7 gives the dimensions and the position of the extension coil for a telescopic aerial with central loading. The dimensions should be approximately adhered to, to ensure that the coil will work correctly. The aerial can be up to 1.4 m. long but must not be shorter than 1.2 m. One leg of the telescopic aerial is cut in the appropriate place. The best way of doing this is by filing round the circumference.

Connect the two halves again by means of a piece of Pertinax or similar insulating tubing of the most accurately fitting diameter or a ceramic tube for resistance windings. The two halves are then pushed together with plenty of cement, keeping at least 1 cm. distance between the ends of the aerial halves. When using ceramic insulating tubing or if you do not want to wait 12 hours for the cement to set, it can

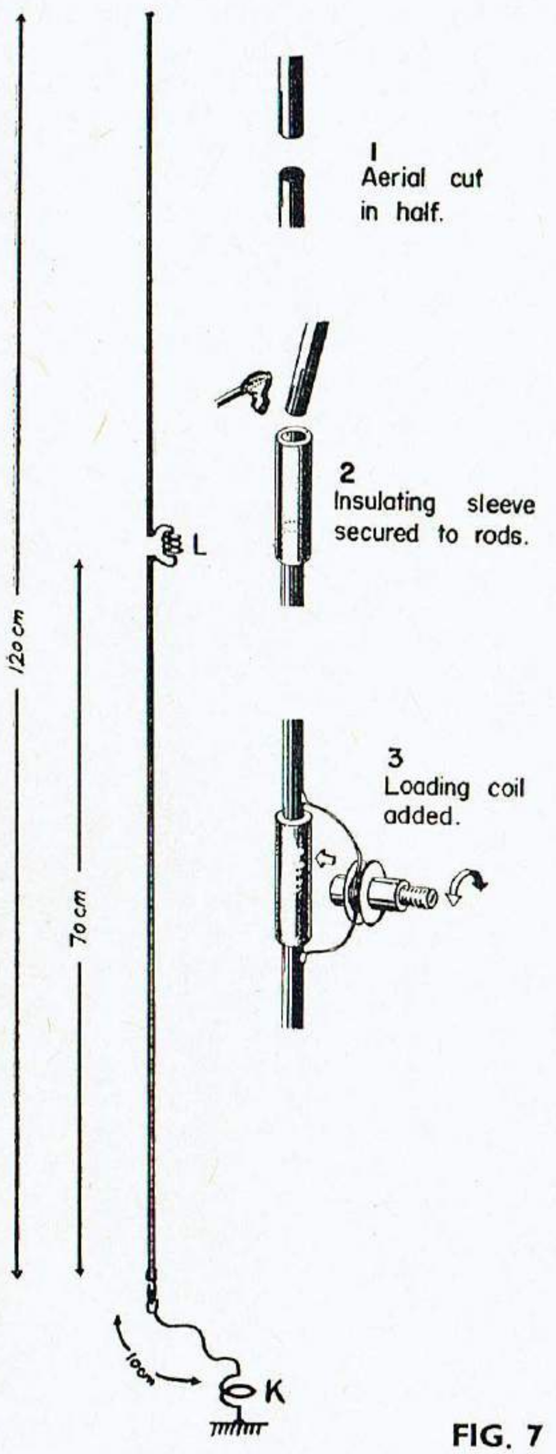


FIG. 7

be dried in a few moments by holding a soldering iron on the tube. This will fix the two halves permanently in no time.

Next we want a coil of 10 mm. outside diameter with a ferrite core, preferably a hollow one. The body can be shortened. Wind on 16 turns of lacquered copper wire of approximately 4 mm. diameter, the winding direction is immaterial. Cement the coil to the insulating tubing and solder the ends of the wiring to the top and bottom aerial halves. The central loaded aerial is now finished but not yet operational.

The aerial must be tuned. Only after tuning will its full efficiency be obtained. To have just the coil on the insulating tubing is of no use whatsoever. Tuning of the central loaded aerial is done like any aerial with a simple small fieldstrength meter. The field strength meter is no more than just an ordinary small Diode receiver (formerly called detector) for the transmitter frequency with a small connected aerial. The high frequency which enters the aerial changes to D.C. and flows through the measuring instrument (milliammeter set to the lowest D.C. range). The stronger the field strength of the transmitter, the larger the aerial current in the fieldstrength meter, the larger the deflection of the instrument. The fieldstrength meter is shown schematically in Fig. 8.

It is a very cheap and useful instrument, which can also be used with tone modulated transmitters at short range, by replacing the meter with a pair of earphones. First of all tune the fieldstrength meter to the transmitter frequency. Extend the aerial of the transmitter and switch on. Now bring the aerial of the fieldstrength meter towards the transmitter aerial until the meter shows the largest deflection. Now move the fieldstrength meter away from the transmitter until the meter shows zero again. Leave the fieldstrength meter at this distance from the transmitter, while making the following adjustments to the aerial.

The tuning consists of turning the core of the extension coil, with the transmitter working, until the fieldstrength meter gives the largest deflection. You will find that the meter needle responds quickly as soon as the coil core gets in the region of the aerial resonance. The tuning of the aerial is very critical and half a turn of the core will make quite a difference.

The radiation of the aerial decreases rapidly as soon as the aerial is touched, so when tuning the core turn it through a quarter turn and take the hand well away from the aerial, before noting the effect on the meter.

In the case of hand held transmitters, the transmitter case must be held in the hand while tuning. Considerable radiation variations can occur in small transmitters when the hand is removed from the case. This effect can be considerably reduced if one increases the aerial counterweight, by adding a wire of

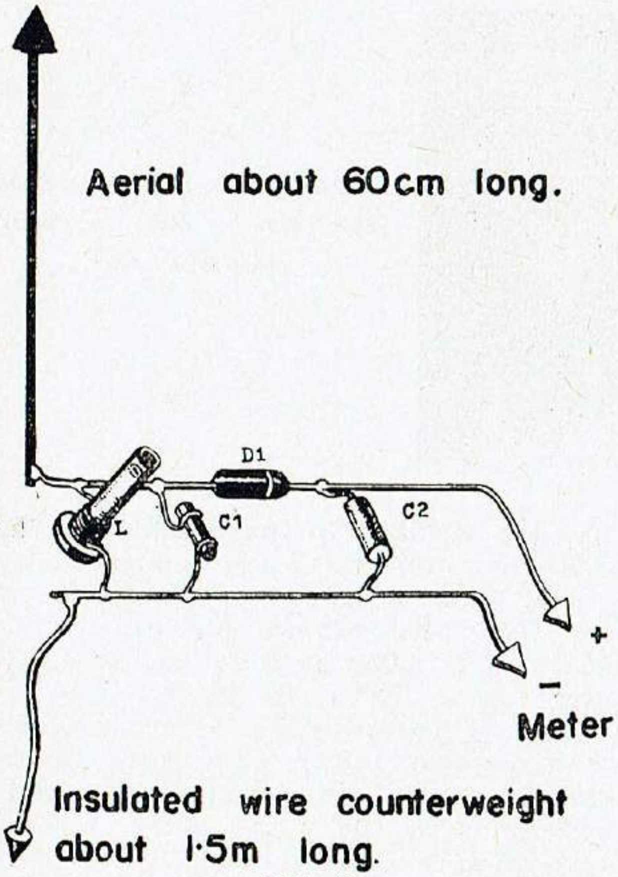


FIG. 8

approximately 1 m. length below the transmitter case. This is, of course, not very elegant or practicable when moving around with the transmitter. However try it to see how much effect it has on the radiation.

When fitting a central loaded aerial to an existing transmitter, the extension coil at the aerial base must be removed or bridged with a wire. Do not remove the base aerial coil if the set is still under guarantee and you do not want to invalidate this.

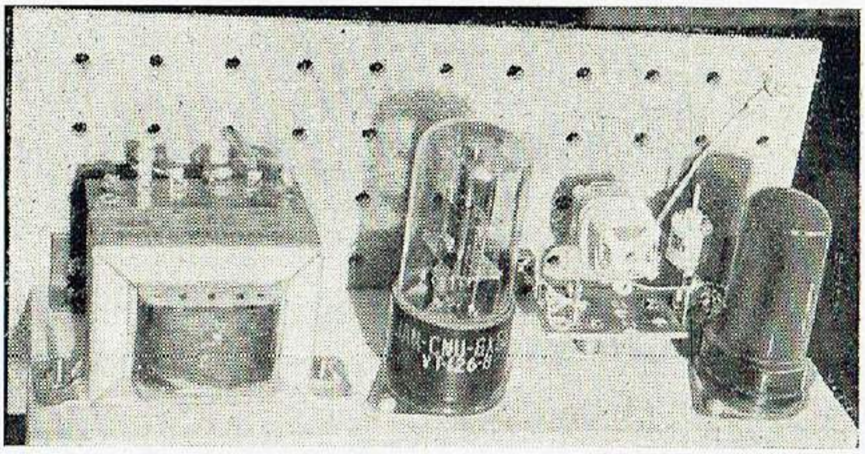
The building of a central loaded aerial is so simple that even those who are not fully conversant with radio technique can undertake it with complete assurance of success, the result of which is the cheapest and most effective method of increasing their transmitter radiation.

L : coil 7.5 turns of 0.4 Cul on 5 mm. dia. former with Ferrite core. C1 : 50 pf. C2 : 1,000 pf. D1 : (Diode (OA 85).

Mains Powered Transmitter

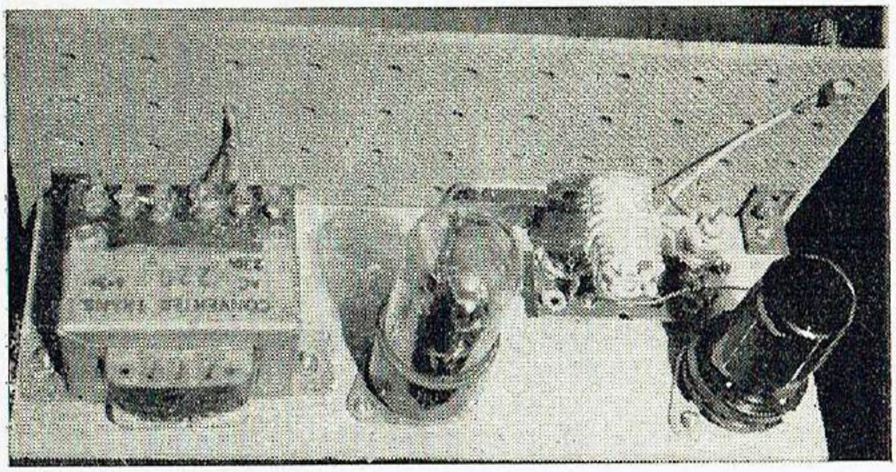
By F. G. RAYER

Why spend money on batteries; this transmitter is ideal for workshop, home or garden operation. In fact any mains supply of suitable voltage such as public halls etc. . . . No NOT lamp posts !



THE unit described here is a self-contained 27 mc/s transmitter which operates from A.C. mains. It is particularly useful for those occasions when it is necessary to adjust a new receiver or model at home, especially in view of the quite high cost of the batteries needed with a battery operated transmitter. The mains transmitter can be cheaply built from surplus components, and can be used whenever mains supplies are available. The usual battery transmitter is then retained for actually sailing or flying the model.

If land models are used in the house or garden, the mains driven transmitter can be employed to control them in the normal way, and a battery run transmitter is then unnecessary. It is intended for use with home-built or commercially manufactured C.W. type receivers of any usual design.



★

Simple layout is obvious from this view. Note pegboard ventilating panel.

★

The circuit is shown in Fig. 1 and consists of a self-excited oscillator. A 6J5 is used in this stage, but a 6C5, CV1932, CV1934, or L63 may be inserted instead, with no wiring or circuit changes. Component values are not very critical, and some deviation from those given is unimportant. Cathode keying is employed, a small push-button switch being fitted on the panel. This switch is of the type used for table lamps, etc. If depressed and released, it remains closed; if again depressed and released, it remains open. This is convenient, since it leaves the hands free, and the carrier can be on or off, as required, without any need to hold down a switch which only makes contact when depressed. Quite rapid keying is also possible.

High tension is obtained from the 6X5GT rectifier, and a CV572, EZ35, or U70 may be employed here instead. A small metal rectifier is equally suitable. If used, it should have a rating of 20 m.A. upwards, at 250 v. Its negative tag is connected to the point marked 220 v. in Fig. 1, and the positive tag is taken to the junction of the 2.2 K resistor and 8 μF condenser.

The mains transformer provides 6.3 v. for the valve heaters (or 6J5 heater alone, if a metal rectifier is fitted). It also has a H.T. secondary. This is shown as delivering 220 v. because this is a popular rating with small mains transformer of this kind. Any H.T. voltage from 100 v. to 250 v. will in fact be satisfactory.

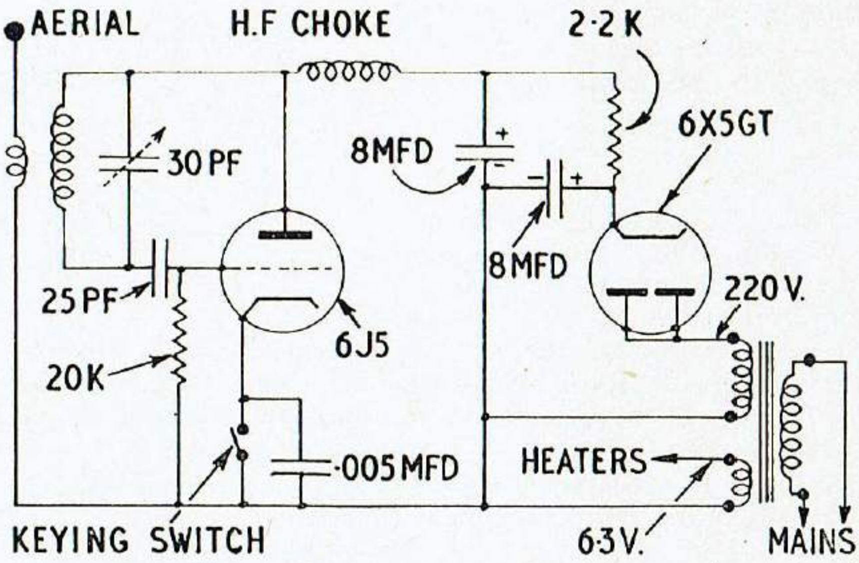
No mains switch is fitted—when the transmitter is required, it is plugged into the mains, and the heaters run continuously. The carrier is then put on or off, as required, by means of the keying switch described.

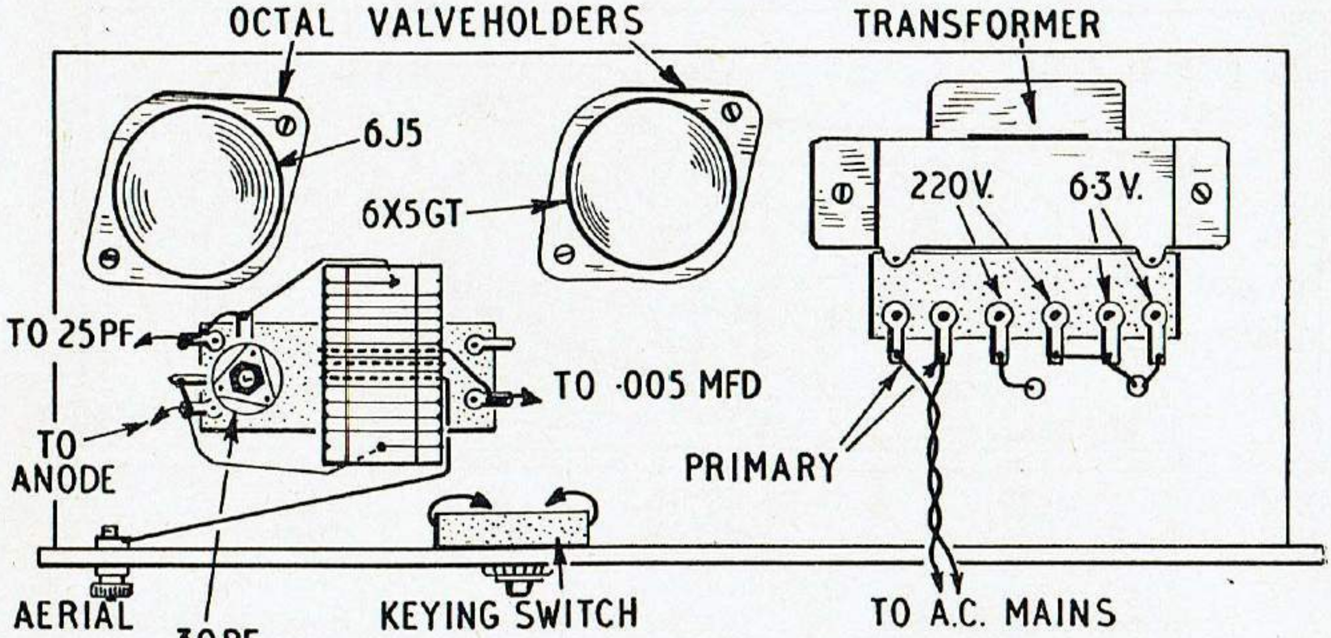
Construction Details

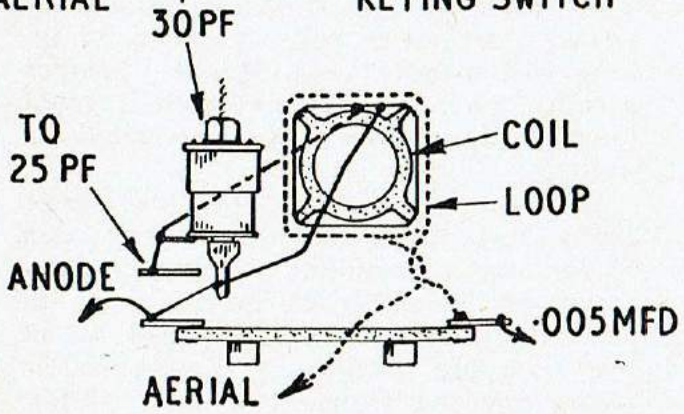
If a wooden box or case is to hand the transmitter can be arranged to fit this. The panel actually employed was 9 in. x $4\frac{3}{4}$ in. and made from pegboard (perforated hardboard) to allow a little ventilation. Plywood or paxolin, etc., will be equally satisfactory.

LIST OF COMPONENTS

6J5 and 6X5GT valves.
Two octal holders.
Converter or similar transformer with 6.3 v. 1A. and 220 v. 20 m.A. secondaries.
30 pF. air-speed trimmer.
Fixed condensers : 25 pF., 0.005 u F, 8 plus 8 u F 350 v.
1-watt resistors : 20K, 2.2K.
Push-button on/off switch.
Short wave type high frequency choke.
Coil, etc., as described.







Top view of chassis, coil details (left).

Two rows of holes (about half a dozen holes $\frac{1}{4}$ in. or so in diameter) should then be drilled to allow air circulation.

The baseboard is 3-ply, $8\frac{1}{2}$ in. x 3 in., and secured to the panel by small angle brackets. These dimensions were to fit the box available, as mentioned, and can easily be changed if required. A metal case is not used because this would make more care necessary with insulation. In addition, quite good signal strength is available without an aerial, when using a wooden case.

The baseboard is about $1\frac{1}{2}$ in. from the bottom edge of the panel, to leave space for the H.F. choke and other parts. Fig. 2 shows the location of components on top of the baseboard. Clearance holes are cut for the valveholders.

Tuning Coil

This is also shown in Fig. 2, and consists of 11 turns of 20 s.w.g. bare or enamelled wire, on a ribbed former about $\frac{3}{4}$ in. in diameter across the ribs. The winding has spaced turns, so that it occupies about $1\frac{1}{4}$ in. of winding space. There is, of course, no need to use this exact size of former or gauge of wire, provided the number of turns is adjusted, if necessary, to allow tuning the transmitter into the permitted band.

The aerial coupling loop has two turns of insulated wire, or bare or enamelled wire covered with insulated sleeving. Do not rely on enamel insulation only. The loop is wound round the middle of the coil, and its ends twisted together.

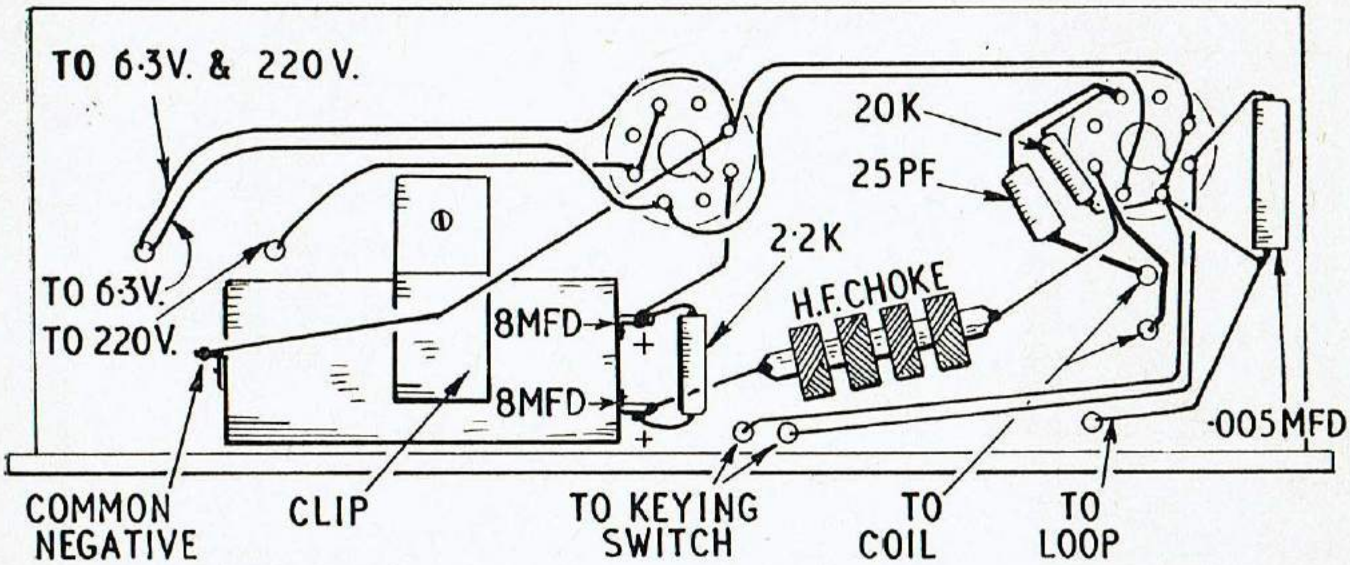
The coil is mounted by cutting its ends to a suitable length, and soldering them to the tags of a small tag strip. This is secured to the baseboard, with spacers. The 30 pF. air-spaced trimmer is joined across the coil as shown.

Leads from the coil to tags should be quite short and direct. If a notched former is used, this will keep turns secure. If not, touches of adhesive will prevent any possibility of movement here. If turns move about, this will influence tuning.

Wiring Details

All connections are shown in Figs. 2 and 3. Leads pass from the coil supporting tags to 25 pF. condenser, anode, and 0.005 μ F condenser, as indicated.

Two connections from the key switch go through holes, and to tags 1 and 8 of the 6J5 holder, as in Fig. 3. Tags are counted clockwise from the keyway on the valve holder.



UNDERSIDE OF CHASSIS.

The primary of the mains transformer is connected to a good length of twin flex, fitted with a plug for the mains socket to be used. The 6.3 v. secondary is wired to tags 2 and 7 of both holders. The H.T. secondary goes to sockets 3 and 5 on the 6X5GT holder. The other H.T. secondary tag is wired to the 6.3 v. tag, as in Fig. 2.

A twin 8 μF condenser is shown in Fig. 3, but separate condensers are equally satisfactory. Positive tags on this component must be wired to the 2.2 K resistor. A clip cut from scrap metal holds the condenser in place. Other parts are held by their wire ends.

R.F. Indicator

It is wise to make an indicator to show when the transmitter is radiating. This can consist of two turns of insulated wire about 1in. in diameter, with a 6 v. .06A. or similar bulb soldered directly to the ends.

If this loop is brought near the tuning coil, the lamp will light, when the transmitter is operating. It will be convenient to place the lamp loop on the panel, fairly near the coil, so that it will always show when the transmitter is on. This will avoid mistakes, such as trying to tune a receiver when the transmitter is in fact not radiating.

Aerials

For general receiver adjustment, and working indoors, no aerial is required. For better signal strength, as when working with an insensitive receiver, or controlling a model in a small garden, a short vertical aerial can be added. A piece of stiff wire some 9 in. to 18 in. long will usually be sufficient. Longer aerials, such as those erected from interlocking rods, may be added if wanted.

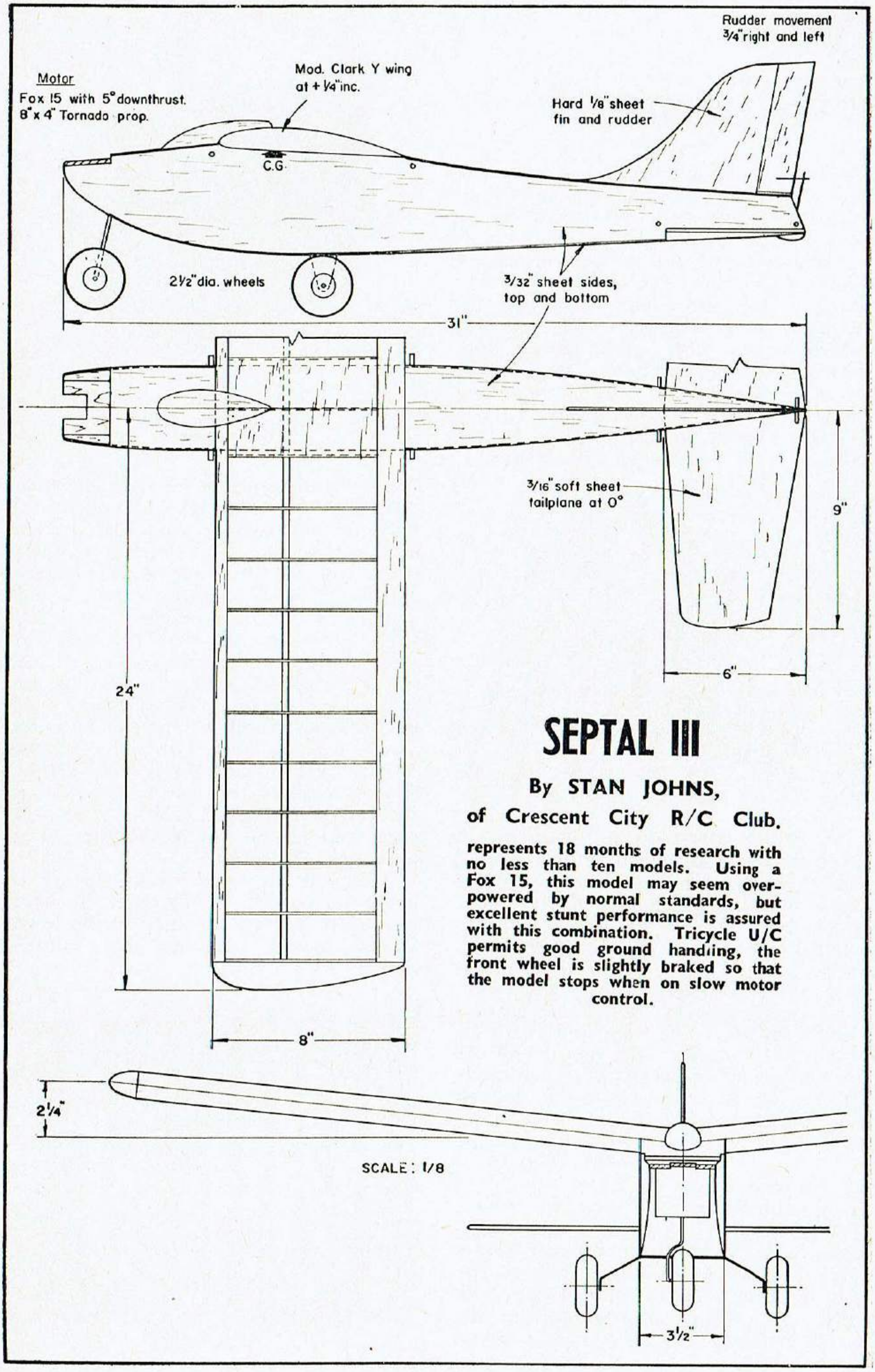
Any changes to the aerial will make slight re-tuning necessary. For this reason it is convenient to adopt a short aerial, or decide to use no aerial at all, according to circumstances, and retain this, to avoid re-tuning. If no aerial is used, tune the transmitter as it stands. If an aerial is employed, tune the transmitter with this connected in its usual manner.

Tuning

The usual type of model control frequency meter, which consists of a coil, tuning condenser, and indicator such as a bulb or meter, may be employed. A length of ebonite or other insulated tubing is cut to fit the end of the 30 pF. trimmer. The lamp loop described should be used, to assure that the transmitter is working. The trimmer is then slowly rotated, to obtain best indication on the bulb or meter in the frequency indicator.

When approximately the correct tuning spot has been found, remove the frequency meter as far as possible from the transmitter, if it has a lamp indicator. The exact tuning spot can then be found more easily.

Care should always be taken to assure that the transmitter is working in the permitted band. If not, harmonics may cause interference to television reception. Do not add an aerial until the transmitter has been tuned approximately into the band.



SEPTAL III

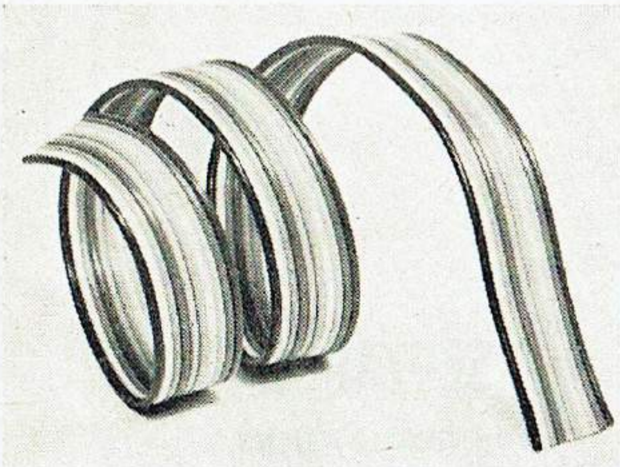
By STAN JOHNS,

of Crescent City R/C Club.

represents 18 months of research with no less than ten models. Using a Fox 15, this model may seem over-powered by normal standards, but excellent stunt performance is assured with this combination. Tricycle U/C permits good ground handling, the front wheel is slightly braked so that the model stops when on slow motor control.

New Equipment

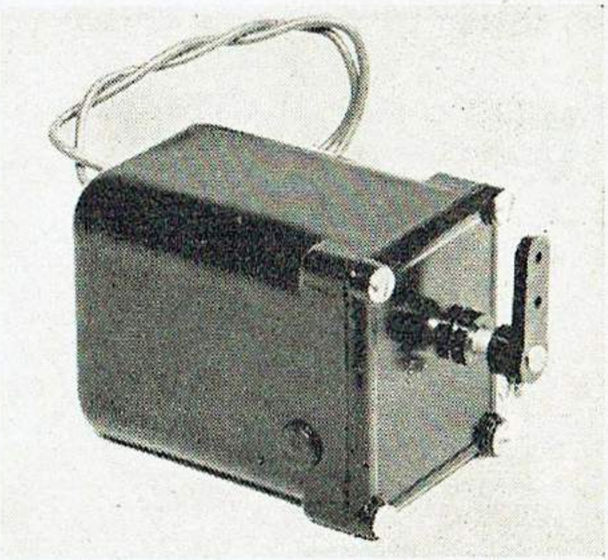
MALCOLM DOUGLASS sent us some Spectra Strip, a flat wire only $\frac{1}{2}$ in. wide which contains 10 pieces of 19 strand wire, in this photograph it looks good enough to eat in fact harnessing with Spectra Strip can really add something to the appearance of a neat installation the price is 1/10d. per ft., which may at first appear rather high, however if one compares the price of 10 separate pieces of wire there is less than 10d. per ft. difference. It is possible to part off individual or groups of strands to suit individual sockets.



A British invention in the form of printed circuit strips on drilled paxolin matrix known as Vero Board provides an excellent medium for bread board work and complete installations and is supplied in 4.8 in. × 18 in. long the holes are .105 in. diameter at .2 inches pitch in accordance with British standard recommendations. The parallel copper strips .1 in. wide and .2015 in. thick are bonded to the board and are pierced to correspond with the holes in the board. It is possible to cut through the copper to break what would otherwise be an unwanted connection.

The price of the standard sheet is 21/-, this provides 21 strips with a .35 in. margin down each edge.

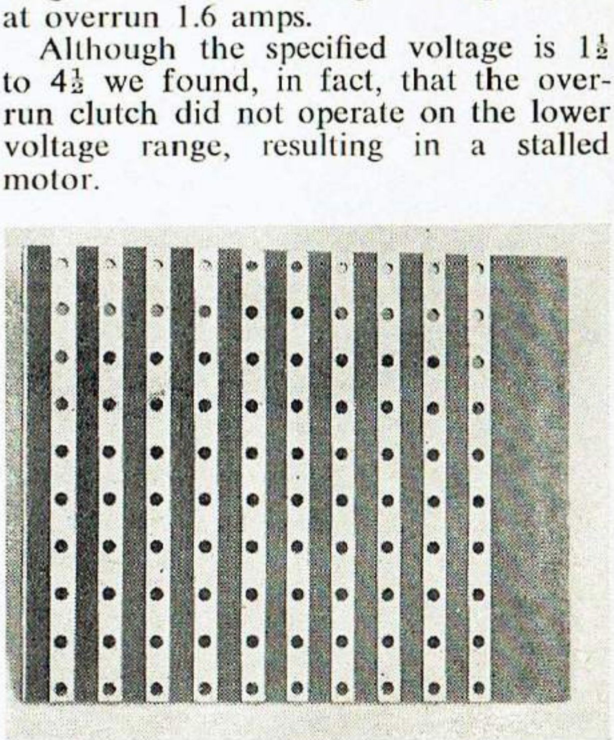
We thought we would have a look at the Hillcrest Motor Control Servo. This is priced at 48/- weighs $1\frac{3}{4}$ ounces and is $2\frac{1}{8}$ in. long, $1\frac{3}{8}$ in. × $1\frac{1}{4}$ in. cross section. A lever protrudes from the end plate and it is necessary to mount

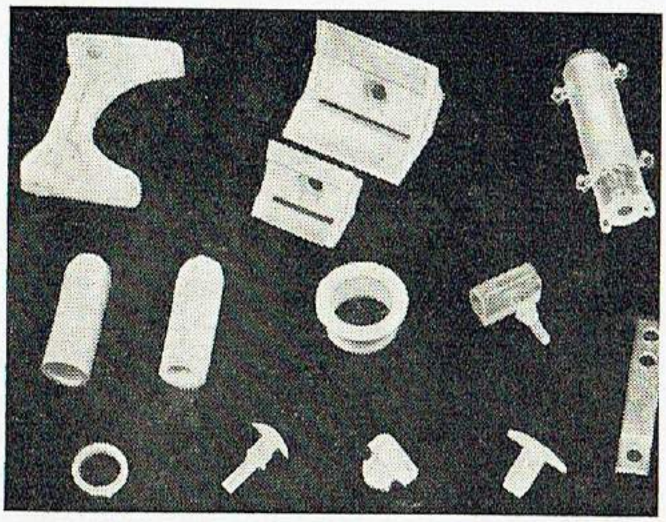


Above : The Hillcrest engine control servo. Left : Spectra Strip. Below : Vero Board.

the servo on a ply panel through which protrudes the driving shaft, there are no limit stops so that when operated the arm simply rotates in a direction determined by the polarity of the battery. A spring loaded overrun clutch avoids damage to the motor upon reaching the stop. One can then arrange one's own limit positions at will and adjust the throttle position without operating the radio. We were unable to examine the internal mechanism or the motor as the case is a sealed unit, however we ascertained the following data: 90° travel 1 second a thrust of just over 1 lb. on reduced throw at $4\frac{1}{2}$ volts. Free running load at the voltage 4 amps., load at overrun 1.6 amps.

Although the specified voltage is $1\frac{1}{2}$ to $4\frac{1}{2}$ we found, in fact, that the overrun clutch did not operate on the lower voltage range, resulting in a stalled motor.

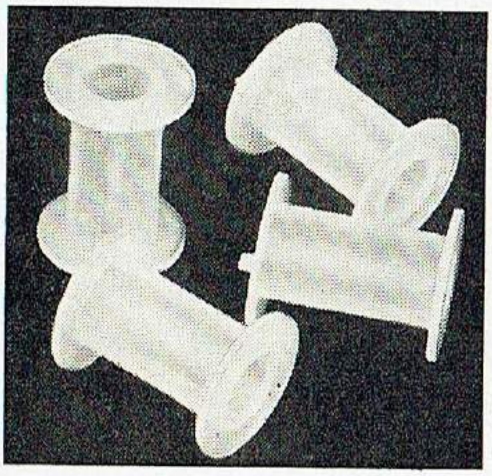




A comprehensive range of plastic components with numerous applications in the model world arrived from Messrs. Hellermann of Crawley, Sussex. The photographs illustrate a selected range as follows:—

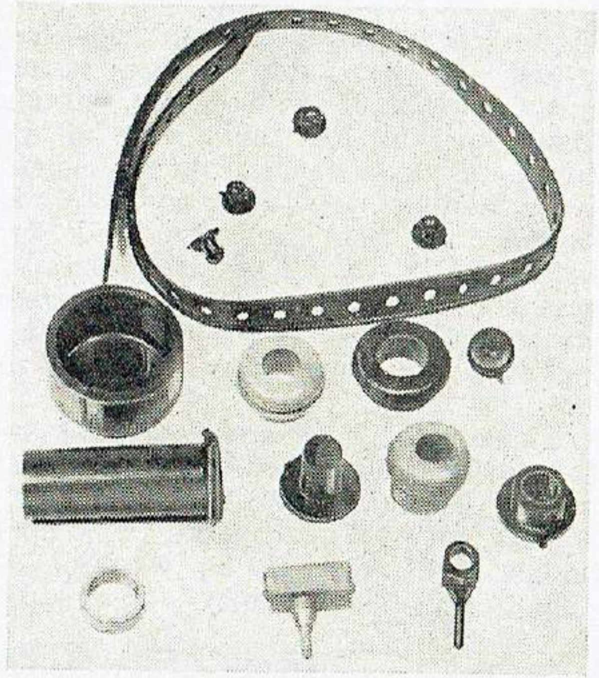
Upper picture, top line from left to right: nylon U pieces would form excellent control horns for bell crank when sawn in half, this and most other components carry part numbers, in this case the number is 12133. Next we have 18195 which appears to be a pair of corner pieces although they might be used as cleats for wiring harnesses, PS 12004 is a very nicely moulded polystyrene coil former with pegs for securing the wire ends.

Now to the centre line, left. Two types of soft plastic caps which would be useful on switch levers or at the ends of cables (HV 4641). Centre shows PS 12151; hard plastic bushes $\frac{7}{16}$ in. i.d. which would form a base for drum contact (or portholes in ship models). Right HV 4518; something which has previously eluded us, clear soft plastic transistor straps or supports, press fit



into a hole in the chassis and enable one to read of the transistor number; fractured leads do not now seem so likely under shock conditions. Now on the bottom line PS 12016 hard plastic rings slipped over a wiring harness are much neater than thread binding. The next three HV 4522, OP 11148 and 18181 are press fitting studs which would make excellent feet for the equipment boxes; first two being in soft plastic, the third in nylon. At extreme right this nylon strip might do service as a contact carrier (18146).

Next to those photographed on the white background; at the top, black Helavin cable strapping and studs. HV 3070 are polyvinal caps which



would fit a B7G plug to protect the pins. Now three assorted grommets HV 3109 ($\frac{7}{32}$ in.), HV 485 ($\frac{5}{16}$ in.), HV 3035 ($\frac{3}{32}$ in.). Next line $1\frac{1}{8}$ in. long soft bushes $\frac{5}{16}$ i.d. HV 3036. Three smaller bushes $\frac{3}{8}$ in. $\times$ $\frac{3}{16}$ in., $\frac{5}{16}$ in. $\times$ $\frac{7}{32}$ in., $\frac{3}{16}$ in. $\times$ $\frac{3}{16}$ in. which is blind, are numbered respectively; HV 4057, HV 3906 and OP 11148. Bottom row, 12013; wide plastic rings $\frac{5}{16}$ in. i.d. might be used in place of PS 12016 following up with two slightly different transistor holders in red plastic HV 4518 $\frac{3}{16}$ in. $\times$ $\frac{1}{2}$ in. and in black $\frac{3}{16}$ in. $\times$ $\frac{1}{8}$ in. HV 4734.

Some excellent nylon coil bobbins $\frac{1}{2}$ in. max. diameter. $\frac{7}{32}$ i.d. $\times$ $\frac{9}{16}$ in. long (NY/18182) are illustrated separately.

Whirr and Click

A series for the mechanically minded and followers of switchcraft.

Pat Wheeler of South Africa has a novel approach to the selector problem . . . He uses a Bonner Varicomp escapement to switch his servos, and has devised a simple set of switchgear which he adds to the standard unit.

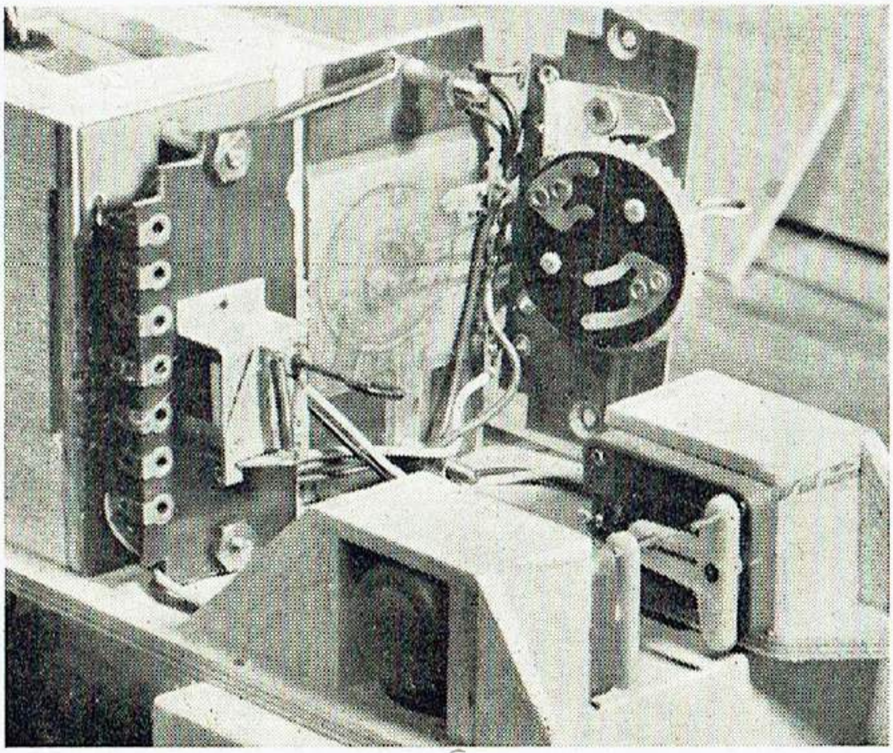
Hawk-eyed readers will have spotted this "Mystery Item" in his EASY SERVICING photographs in the last issue. Stop guessing, here is the Gen!

THE single-neutral escapement is the most economical control mover yet devised but inevitably it has power limits associated with pulse timing variations. The less the torsion of the driving rubber the easier it runs, until it is loaded; the balance required between the bearable load and the rubber power, resulting in a parallel balance of battery power against armature spring tension, is the most frustrating thing for even some 'experts' to find.

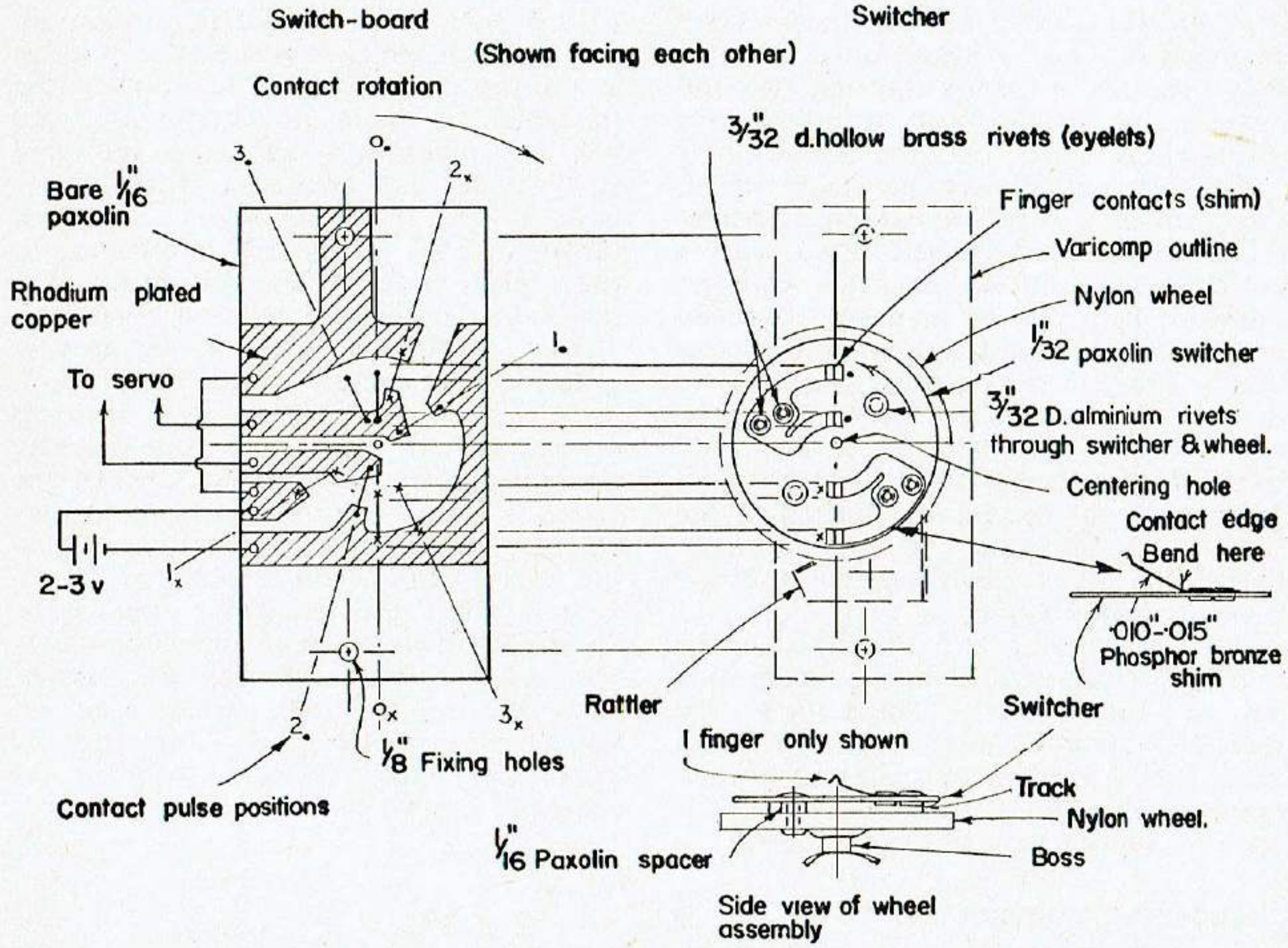
Most of this disappears as soon as the escapement is unloaded, such as transforming its duties into a low-friction switcher for a small servo, a system thought until now to be wasteful of weight, space—and money. Today the famous Varicomp and its variations and the Graupner Bellamatic are in free supply; if they are electrically linked, preferably with separate battery supplies, we have as much power as we want, no pulse timing troubles and control movements without cycling provided the pulsing is reasonably fast. By routing one lead of the servo power supply in common with the escapement relay lead, the time the switcher completes the servo circuit while passing over a control position is even shorter, the risk of servo cycling smaller and the servo battery drain less.

Construction Notes

The switchboard shown is made from standard $\frac{1}{16}$ in. copper-clad Paxolin sheet or similar; rhodium plating by the local jeweller helps to suppress arcing. The finger contacts are made by first filing and drilling a template of Paxolin, Tufnol or steel; an approximate shape is cut from phosphor-bronze shim stock, clamped in the vice to the template, filed and drilling done with a piece of scrap sheet behind finger. Scribe contact circles on switcher plate using drawing dividers, mark centre lines; lay cut fingers in place before



Left: The switching Varicomp shown unbolted to expose the switch board, the unit is installed on the "Easy Servicing" chassis described last month. Facing page—Top: P/C switchboard and switcher details. Below: Ian Clark's Control Box.



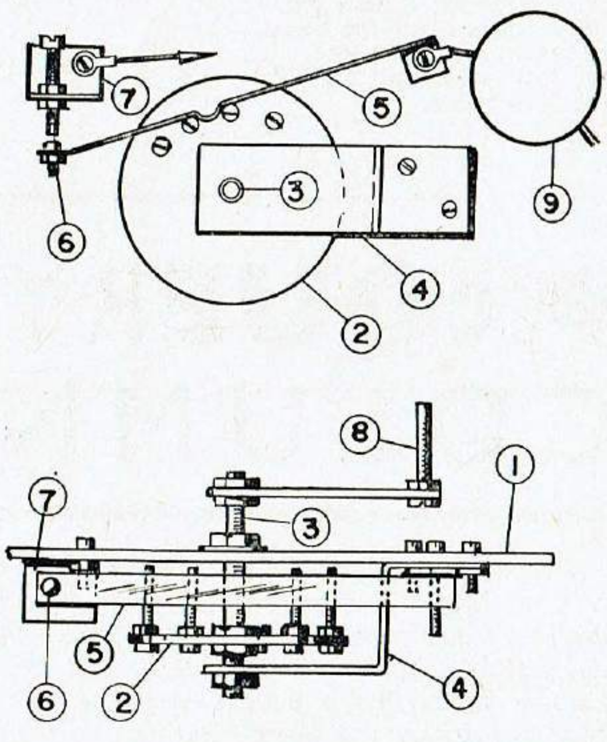
bending, mark rivet holes on switcher. Rivet fingers in place *before* bending; use centre lines to sight positions of contact-edge bends in shim. Bend fingers up so that contact edges rest $\pm \frac{1}{4}$ in. above switcher.

Drill centre hole, use to place switcher correctly on escapement wheel; clamp carefully and drill $\frac{3}{32}$ in. rivet holes through switcher and wheel taking care to stay away from track edges. Drill and cut a small block from $\frac{1}{16}$ in. Paxolin to support the rivet on outside of the track. Insert rivets from top and peen over under wheel using a small drift; an extra hand to hold assembly steady on vice top will help.

Solder wiring to switchboard; assemble to face the modified Varicomp using $\frac{1}{8}$ in. d. brass machine screws and $\frac{1}{8}$ in. i/d aluminium tube spacers $\frac{7}{16}$–$\frac{1}{2}$ in. long. Bench test. Dissemble and adjust fingers with long-nose pliers if necessary.

Now Ian Clark supplies details of his boat control selector mechanisms.

The transmitter "Control-Box" is merely a single throw rotary switch, whose contacts close twelve times per revolution (or four times, if used with an E.D. clockwork escapement or similar). If used to switch the transmitter, it will obviously work the sequence selector in such a fashion that the selector arm will maintain the same position relative to the switch-handle, *provided*



KEY : 1, Panel; 2, Wheel with bolts (only 4 shown); 3, Threaded rod (2-4 BA); 4, Aluminium bracket; 5, Springy brass strip; 6, Moving contact screw; 7, Fixed contact (adjustable); 8, Handle.

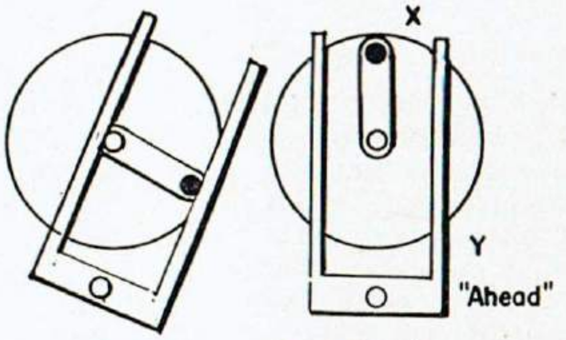
the latter is always turned in the same direction. This means, that if this switch-handle is turned through two 180 degrees, the selector-arm will also turn through the same arc, and so on.

The Controller may be made up in the form of a ship's telegraph or something similar, and is best fitted with a cut-out press-button, in which case an indicator light can be arranged to go on in the model in a known selector position. Then, if the selector is suspected to be out of step with the control box, the handle of the latter is turned until the indicator lights up, the cut-out is depressed, and the handle turned to the "indicator" position, if not already there. The selector and control-box will then be in step again.

At the receiving end the basis of the unit is a twelve-volt selector, operating five pairs of contacts. The cams on the rotating spindle are replaced with home-made paxolin or cellulose acetate ones, to give the desired sequence. The spindle supporting - bracket is also replaced with a heavy-gauge aluminium one through which the threaded portion at the top of the spindle to projects and to which is fixed an aluminium arm "X" (see diagram). The unit is mounted so that "X" can engage a "fork" ("Y") with prongs a little wider than the length of "X". This fork is attached to the rudder-post. This will mean that the rudder is applied only on positions: 3, 4, 5, 9, 10 and 11, as shown in diagram, leaving positions: 12, 1, 2, 6, 7, 8, in which to permute the five contacts on the selector (when the boat is going straight ahead). In my boat, two of the contacts are in the motor circuit to give stop and slow, another works a reversing relay, also in the motor-circuit, together with the indicator bulb, the fourth controls a motor-powered delay mechanism which switches the searchlight, leaving the fifth to be used for some extra control, i.e. "lowering the boat" or "flares". These work in the sequence described.

SUGGESTED CONTROL POSITIONS

1. **Stop.**
2. **Reverse (indicator light).**
3. **Full speed; Half Port.**
4. **Slow; Full Port.**
5. **Full speed; Full Port.**
6. **Full ahead; Extra control.**
7. **Full ahead.**
8. **Full ahead; Search'ight.**
9. **Full ah-ad: Full Starboard.**
10. **Slow; Full Starboard.**
11. **Full speed; Half Starb'd.**
12. **Slow ahead.**



Position 5 Position 1

McQUERY COLUMN

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

I have recently built an Aeromodeller No. 1 hard valve receiver, but am having trouble with it. Normal standing current is 2 m.A. on 45v. H.T. but this refuses to drop by unscrewing the beehive condenser. I have read the "Aeromodeller" leaflet on the subject and tried changing the two condensers to the values given in the leaflet plus a few other values besides. The result? A steady 2 m.A. ± perhaps 0.2 m.A. if values are changed, which refuses to drop even with the aerial completely removed.

Can you please suggest any other changes I can make from the recommended layout to make the receiver sensitive? Since I imagine the receiver is fairly popular. Your answer may be of interest to other readers of Radio

Control Models & Electronics.

Leaving the problem now I would like to say thank you for the way your magazine is catering for the novices. I found the series on the working of transistors most enlightening (after reading it several times!) I am also glad to see the series on the Fundamentals of Radio.

I would like to suggest that there may be scope for a useful article or articles on the working of crystals when used for controlling frequency. There must be many readers to whom the words "fundamental", "overtone" and "harmonic" mean very little. I personally would like to know how crystal frequency can be doubled, trebled, etc. when used in radio circuits.

J. J. BUDDELL, REDLAND.

I am sorry to hear that you are having trouble with your Aeromodeller No. 1 receiver. Are you certain that the valve is oscillating? It should be with a standing current of 2 m.A. but try touching the grid pin and the current should rise as the valve stops oscillating. If it does not you certainly have a fault in the RF circuit. Check the tuning coil, the grid resistor and capacitor for bad connection.

If it is oscillating the fault may be in the quench arrangement. If you have constructed it *exactly* as specified have you connected the coils the correct way round? Try reversing the connections of one winding. Short out both windings of the quench coil and again try the test of touching the grid.

Replace C4 (.01) or C3. Check R1. It must be 3.3 meg. ohms (colour orange, orange, green). Check the H.F. choke and see that the windings are not damaged.

C1 when fully screwed home should stop the valve from oscillating and the standing current is then about 2 m.A. With C1 disconnected the circuit should oscillate (and quench) and the current would then be 1 m.A. or less.

I hope this helps and as regards crystals we hope to include an article later.

CAN you tell me please, if there is any technical reason why I should not operate an "Aeromodeller" Transistor Receiver on 30v. H.T. instead of the stipulated 22.5v.?

The reason I make this query is that I have just "pensioned-off" my regular model, which is fitted with the Hill two valve receiver, and my spare (brand new) model is fitted with the Transistor Rx., but no batteries. I have a brand new 30v. battery which I intended using on the Hill, and being Yorkshire I hate to waste "brass", so thought I would use the 30v. battery as H.T. for this set, provided as I say, that there is no technical reason why I should not do so.

K. BROWN, ACOMB.

With reference to your letter the use of a higher voltage in the case of the "Aeromodeller" Transistor Rx. may cause the valve to oscillate more fiercely thus upsetting the sensitivity adjustment.

There is no reason why it should not be used and, in fact, it will give a greater current change, but you may need to modify the circuit.

Try it out and if the sensitivity control is not effective vary the fixed resistor up or down in value (to nil or 1.5 K. max.). If you then obtain control, but it is too fierce, further circuit modifications will be necessary and I would then suggest that you scrap the battery.

COULD you please suggest a circuit for a single-channel, 3 or 4 transistor, radio control receiver, having a ground range of from ¾ of a mile to one mile and using the popular red spot transistors. The receiver must be extremely compact and be able to run on 3 pencells, i.e. 4½ volts.?

D. GOODYEAR, HORNCASTLE.

Thanks for your letter and request for something which we would all like to have but may not achieve for some time yet.

Firstly, let me say that if the receiver is required for model work a range of ¼ mile is the maximum which any controller is likely to need in order to be able to see his model sufficiently to enable him to give positive control. A tolerance of 100% would be ample for such purposes.

Secondly, our June issue does include an all transistor receiver which has achieved great popularity in the States, but it is not one which I would recommend to the novice. If you have the know-how I suggest you try it out.

Thirdly, I would not recommend the surplus red spot transistors as they vary considerably and you might have samples with a low gain. A really good gain is essential in this type of receiver.

Coil Winder

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

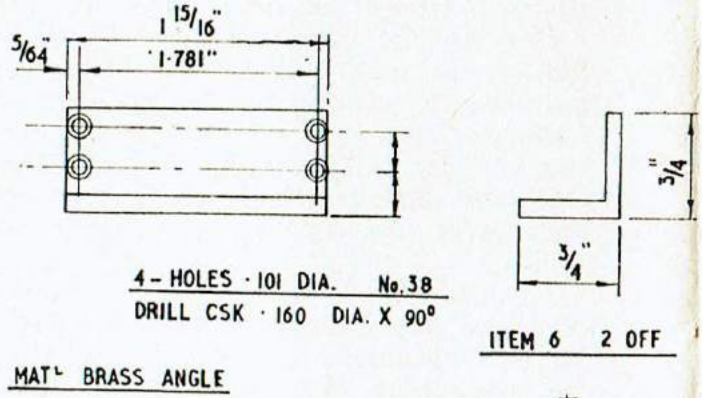
Hon. Secretary I.R.C.M.S., in whose Bulletin this feature first appeared.

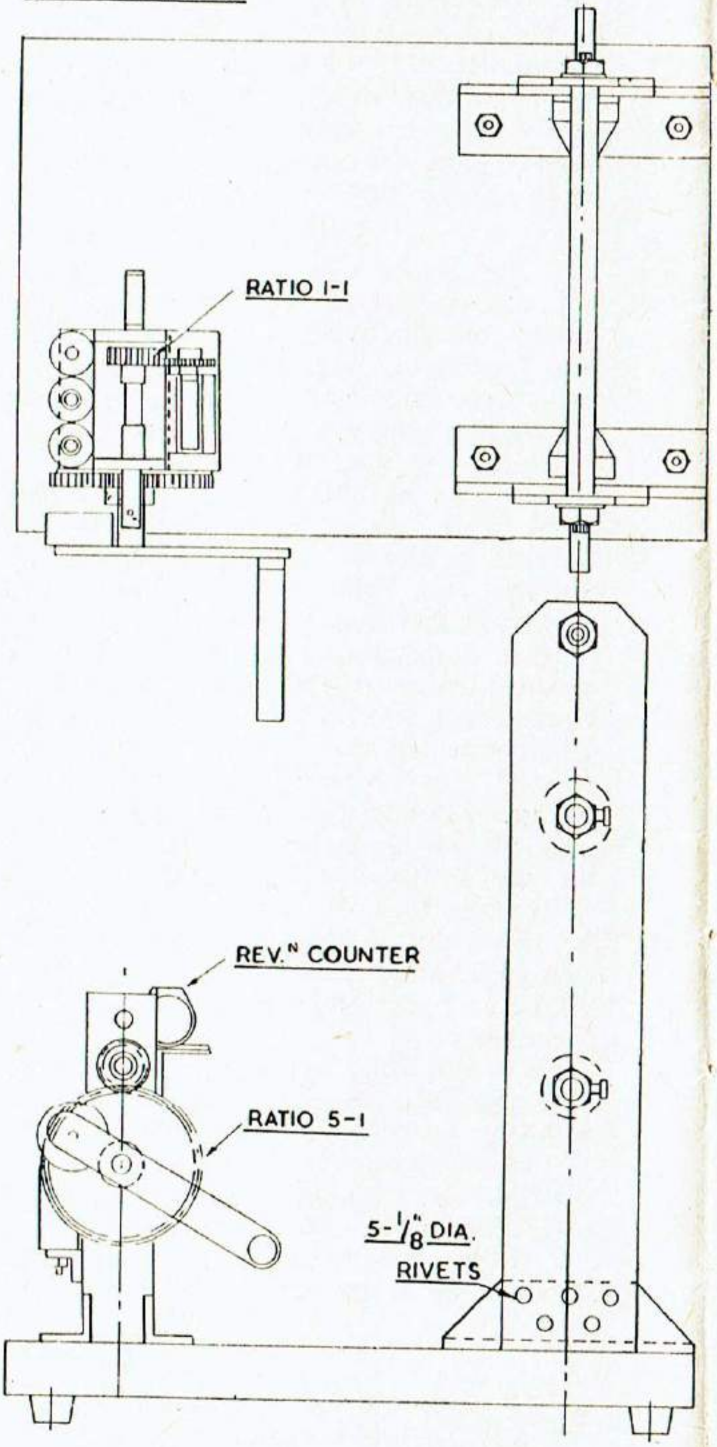
REALLY accurate coil winding is an essential part of the workmanship required for the construction of R/C equipment, badly applied turns have the effect of reducing the efficiency of the particular component.

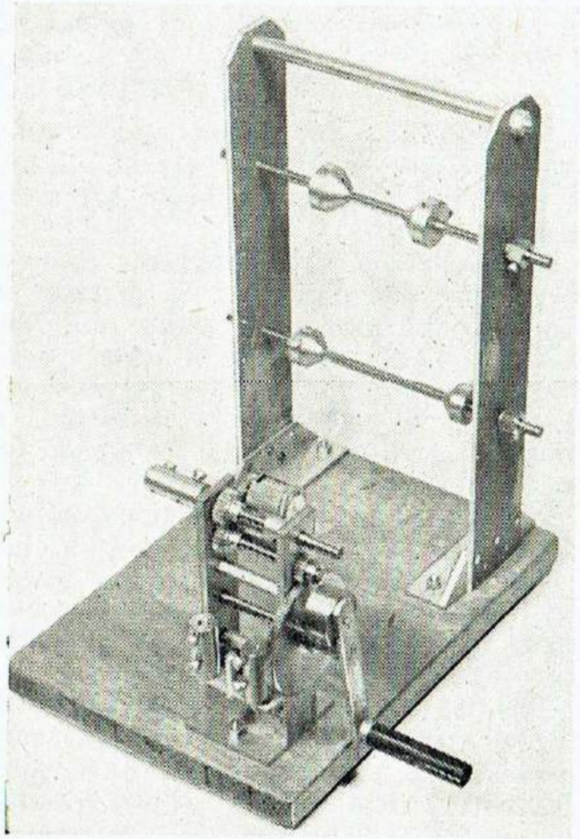
It is, of course, possible to wind accurately by hand, but unless one has a delicate touch and infinite patience, fine wire tends to become not only uneven in piling but damaged by excess tension.

How much easier it is to fit the bobbin to a winding mandrel, turn the handle and feed the wire on with the other hand. No longer does one search in vain for that third hand, three or four hours of complete isolation and the patience of Job!

Generally, if a bobbin has a large number of turns on it, then the gauge of wire will be small and conversely, if the gauge of wire is thick, then there will only be a few turns. This led to the design shown where there is a 1:5 winding ratio for fine wires and a 1:1







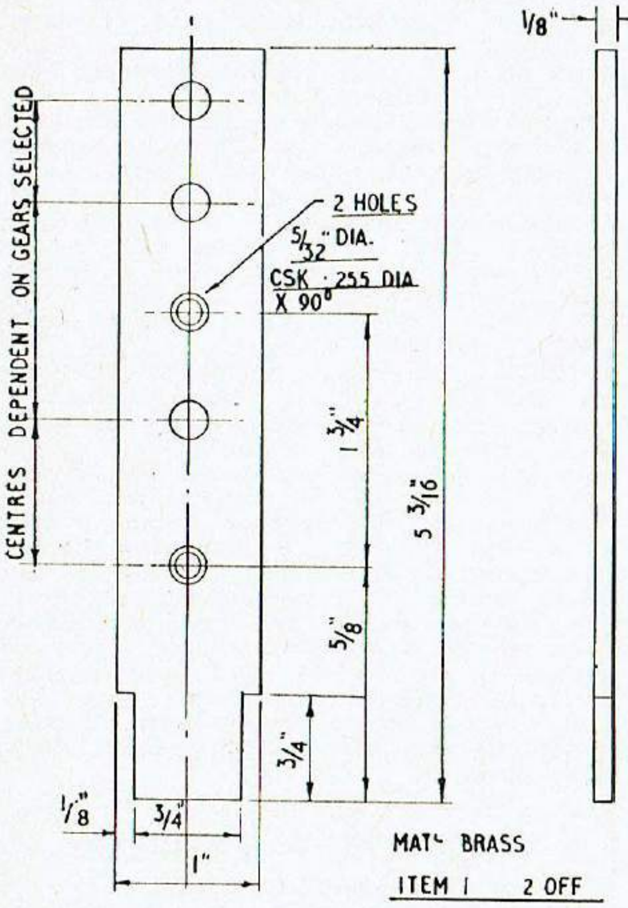
Photograph and ½ size drawings show the winding handle in the high gear position.

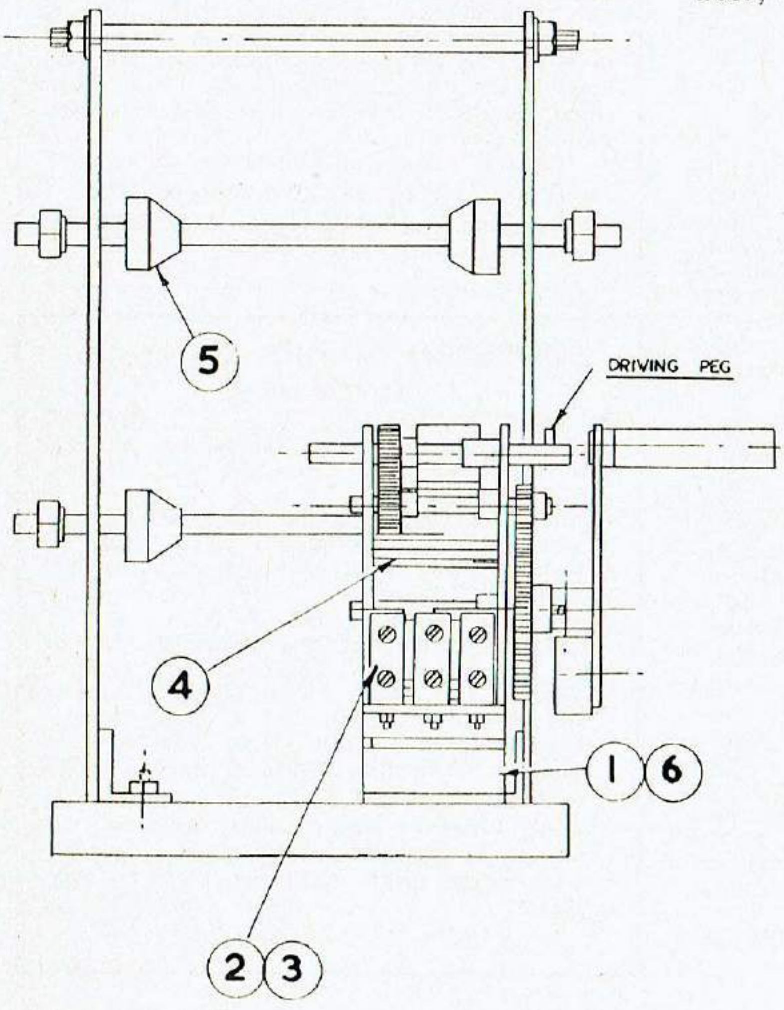
ratio for heavy wires. The winding handle can be fitted to either the direct shaft or the 1:5 step-up shaft. The rev. counter is coupled to the direct drive shaft by means of a train of 1:1 gears. This is done to get the correct direction of rotation. The output shaft can be fitted with one of three couplings threaded with 0, 2 and 4 BA, which are used to facilitate easy coupling to mandrels for different size bobbins.

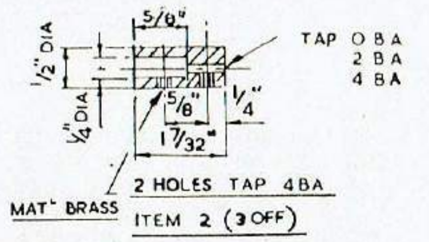
The 1:1 gears which drive the revolution counter may be 40 D.P. and are obtainable from Bonds, as are the 5:1 gears used for the step-up drive.

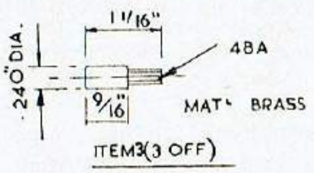
It will be noted that the spool stand for the wire has provision for two spools. This is so that bifilar winding can be done easily, also if windings are to be distributed, then the two different gauges of wire can be fitted which saves time. No wire feeding arrangements have been made because the complexity is not really worth the trouble—it is almost as good to feed the wire by hand.

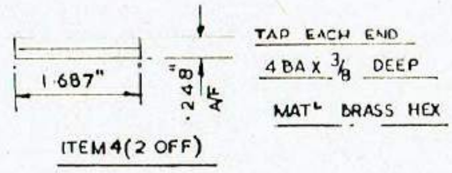
The counter was bought for 12/6d. from a tool merchants, and does not have a trip device. The rest of the machine, apart from the gears, was made from scrap metal found around the workshop. No exact dimensions are given on the drawing because depending on the gears and material available, so the dimension will alter.

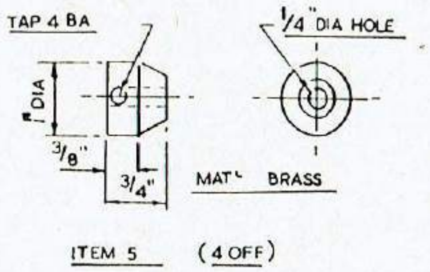












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