JUNE 1962

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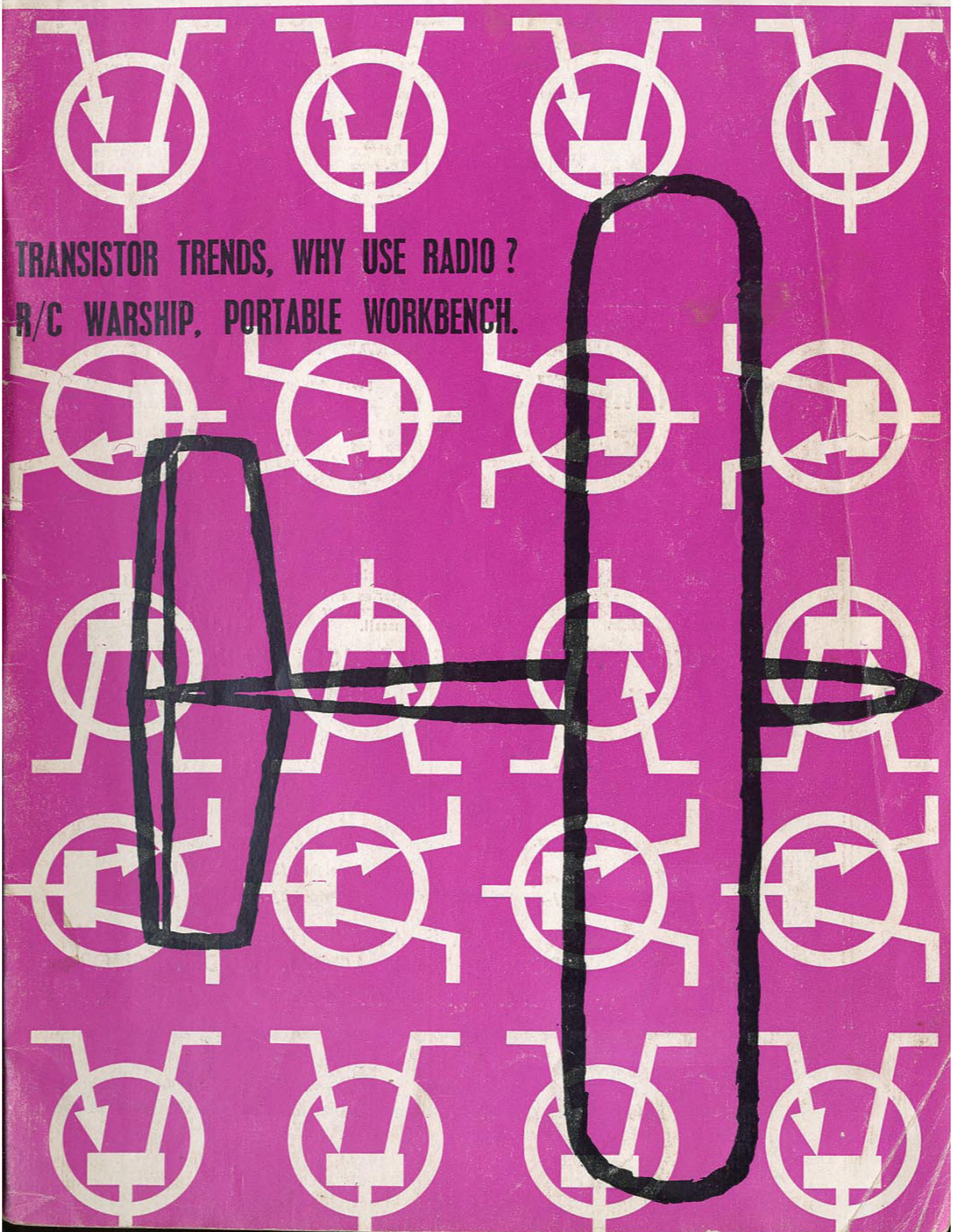

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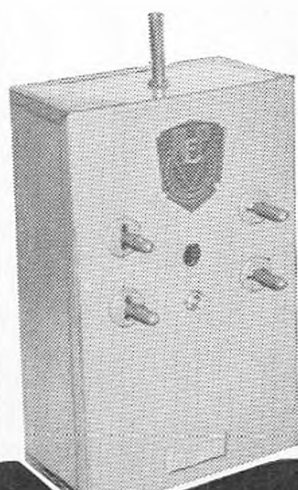

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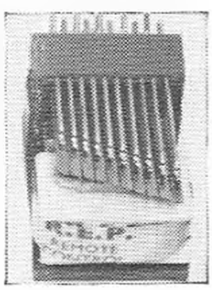

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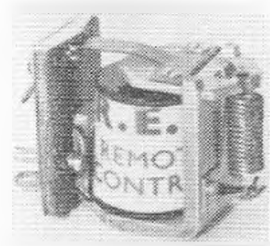

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JUNE 1962

RADIO CONTROL MODELS & ELECTRONICS

VOLUME 3 NUMBER 6

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CONTENTS

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Author A. R. CASE-BROOK enjoys a wide reputation as a practical expert, and in this book covers a wider range than has ever before been attempted for MODEL BOAT RADIO CONTROL. In explicit and non-technical terms he explains all that the beginner must—and the expert should — know with a wealth of valuable detail. The chapter contents listed give an excellent idea of the scope of this book which has proved a worthy companion volume to our best-selling "Simple Radio Control".

MODEL BOAT RADIO CONTROL

CONTENTS : INTRODUCTION : THE MODEL : PROPULSION : COMPONENTS : RELAYS : COMMERCIAL EQUIPMENT : SOLDERING QUENCH COIL & CHOKE WINDING : SOFT VALVE RECEIVER : HARD VALVE RECEIVER : HAND TRANSMITTER : PORTABLE TRANSMITTER LOW POWERED CRYSTAL CONTROLLED TRANSMITTER : INSTALLATION OF EQUIPMENT IN THE AUTHOR'S SEA COMMANDER : AIDS TO TUNING & TESTING : TUNING : INTERFERENCE & SUPPRESSION DO'S & DON'TS : FAULT FINDING : APPENDICES : GLOSSARY : USEFUL TABLES : ABBREVIATIONS.

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Here, There & Everywhere

American Bouquet

THE U.S. market, looked upon by some as the provider of all things good, may examine British kits a little more closely in the light of this report received from *Mars Pulse* on the "Veron Viscount" of which Ken MacKenzie writes: "It is the most beautiful, complete, highly pre-fabbed kit I have ever seen. The balsa is the best I have seen in a long time. The die cuts are clean and perfect. Finished nose blocks, leading and trailing edges, etc. Included are 2½ in. wheels, rudder and elevator horns, finished landing gear a-la de Bolt with mounting nuts and bolts for engine, wheels, horns, etc., also an aluminium spinner. In fact there is nothing to buy in the box but glue, because if the box was shaken up too much the 'plane would be assembled. . . . The instructions say this kit is for advanced builders only. I would like to see what they put up for beginners!"

Flying 'igh

J. R. Denning sent a number of aerial photographs, one of which we reproduce here, taken with a Woolworth camera carried in his "Uproar". The camera was fitted with an automatic wind-on device to take about six frames per flight. The camera is triggered by

radio control and further experiments are being carried out with a 16mm. camera fitted with a similar winding mechanism. We understand a veteran "Smog Hog" has also been equipped with a box camera and awaits trials. This is an interesting side-line to the straight forward type of flying.

We recall a very sick making experience as we watched an 8mm. cine film shot from Geoffrey Pike's huge radio model.

Retune for 465

Just when we anticipated a little more enthusiasm for the 465 Mc/s wave-band, signs of slight retuning requirements have been issued by the G.P.O. This represents a change in the U.H.F. band previously allocated to us at 465 Mc/s, and will from January 1st, 1963, be re-allocated as 458.5 to 459.5.

The alteration seems unlikely to have any great effect on circuit design for the experimenter; quite a wide R.F. range is already possible by very small adjustments of the L/C at the moment.

Surplus Meters

Thomas Best Ltd., Avon Street, Bath, who supplied the Government surplus meters in support of the article in our October, 1961 issue, inform us that their stocks are exhausted; we suggest that readers investigate their nearest electronic surplus shop for an alternative source of supply.

Mass Production

Leeds M.B.S. certainly went in for training new members in a big way, to get as many of their boats afloat and operating successfully under radio control.

The winter programme of monthly meetings was designed to progress from the explanation of the theory of simple radio transmission, reception, and intergear operation, to simple practice. For the actual practical evenings—during which *sixteen* Hill Mk. I receivers, and *twelve* Aeromodeller Transmitters were constructed—a great deal of preparatory work by the Committee was entailed. Chassis were pre-drilled, valve bases mounted, coils pre-wound and mounted, and all components made available. Large diagrams were prepared on wallpaper and blackboards, and the practical work carried out with step by step instructions in the Club Room (which is rented only once per month). Six electric soldering irons were used, supplied from a fuse protected central point. At a later meeting, all transmitters and receivers were checked and 100% success was achieved.

1962 Radio Control World Championships

Venue: R.A.F., Kenley. 19 miles from Central London.
Dates: Tuesday, 14th, to Monday, 20th August, 1962.
Schedule: August 14th, afternoon, assembly of competitors.
Wednesday, 15th, test flying and checking of frequency, etc.
Thursday, 16th, test flying and checking of frequency, etc.
Friday, 17th. Round 1.
Saturday, 18th. Round 2.
Sunday, 19th. Round 3. Prizegiving in evening.
Monday, 20th. Dispersal after breakfast.
Public Days: Spectators only welcome on the Saturday and Sunday.
Charges: Spectators: 5/- for the two days. Parking: Cars—2/6 per day. Motor Cycles: 1/- per day.

It must be stressed that absolutely *no* unofficial flying can be allowed. If a spectator takes along a model he will be asked to leave it in his car . . . any attempt to *fly* it will lead to immediate removal from the Station.

It must be pointed out that this is a World Championships—not just another place for the R/C fliers to get in some time. We are under definite flying hours (9 a.m. to 6 p.m.) by the R.A.F. authorities, and evening flying can only take place if a competitor can show justification due to model or radio troubles. This can only be granted via the Chief Steward, who will be suitably briefed on the restrictions.

Travels of the Corn-Cob

Our photograph sent by A. Fujimuro shows Harold de Bolt as usual behind the corn-cob pipe. His model on the ground is powered by a K & B 45 R/C and was taken at Tachi. A.B. (Tachikawa Air Base) which he visited for the Far East Air Force Contests, Japan.

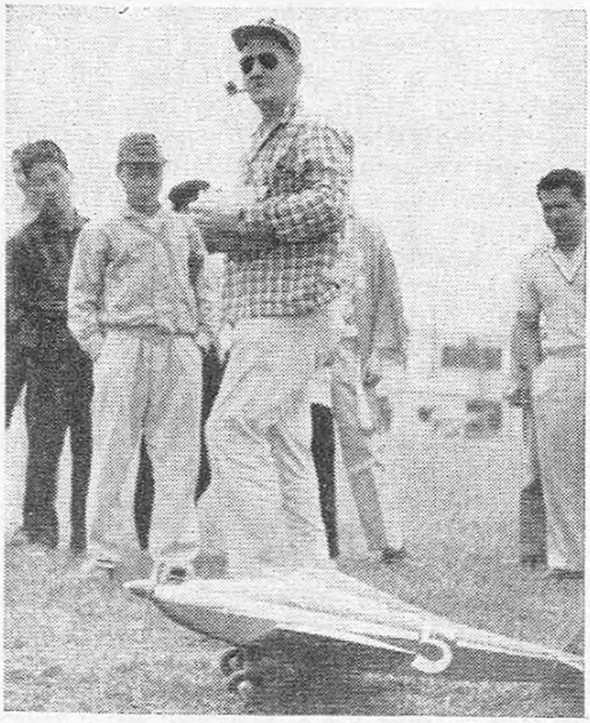
New Manufacturer

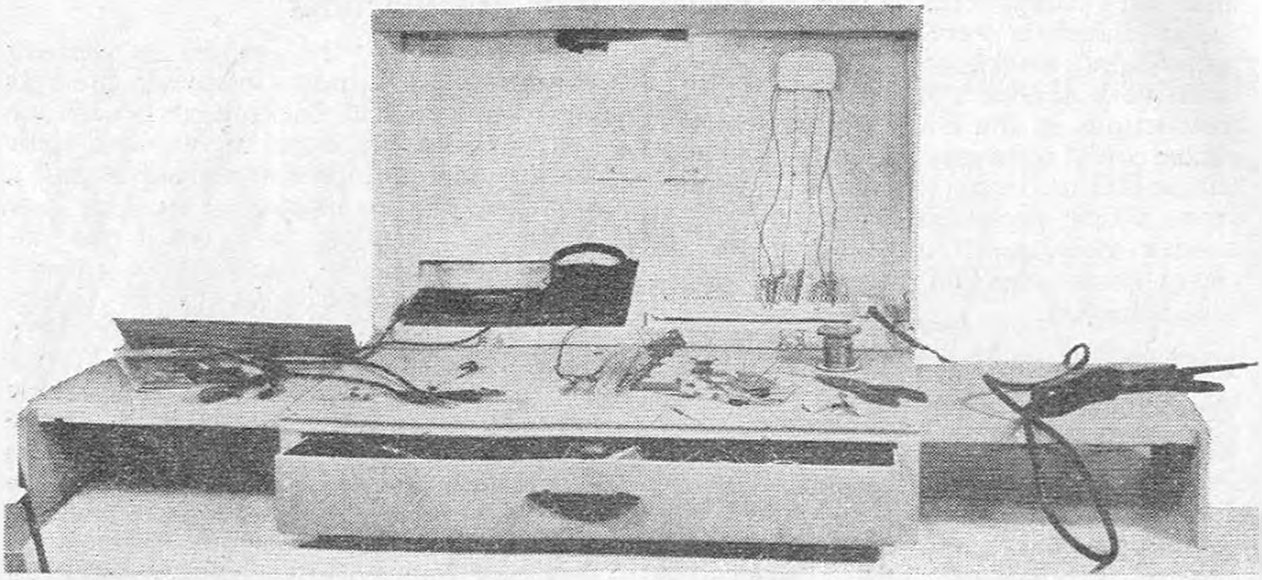
Followers of the model movement who embark upon business projects with the practical backing of experience gained from the experiments with their own model equipment should stand a very fair chance of success in their new ventures. Readers will recall the interesting series on basic radio in our earlier issues written by G. E. Dixey, A.M.S.E., who is now in partnership with J. A. Skingley and who are known as "Transitone Electronics". Electronic equipment for the modeller is the prime consideration and we look forward to inspecting their handiwork as soon as samples are released. We understand that one of their first units will be a tiny half ounce, fully encapsulated plug in *transistor oscillator* which should be stable within 1% from 0° to 60° C.

The fundamental idea is to provide complete individual units for the home constructor so that multi equipment may be built up channel by channel as funds permit. Complete transmitters will be produced for less experimental minded modellers. An advertisement appears in this issue.

New Club

Manchester Radio Control Models Club whose club symbol is a variable capacitor is one of the latest additions to our lists. The secretary is A. Copper, 1 Gorsey Road, Wilmslow, Cheshire.





Modeller's "Carrylot"

A complete, portable and closable workbench

By PETER HOLLAND

Show this to the wife . . . She may even buy you the wood!

THERE must be hundreds of unfortunate modellers whose constructional activities are restricted to the use of the kitchen table or a piece of plywood on the best coffee table. It was felt that something really should be done to ease the situation; a risk, firstly of interrupted construction, secondly of fully transistorised apple-pies and thirdly ruination of domestic bliss.

As those modellers without workshop facilities know only too well, undisturbed modelling space in the home is at a premium, one has to pick-up, pack-up and hide away, often at a moment's notice, pieces of construction which under normal circumstances would remain undisturbed for weeks. Electronic hook-ups are particularly vulnerable to this sort of treatment; sub-miniature components get lost during transfer from the coffee table to the top of the piano and the tones generated by the female members of the household are anything but stable, when the signature of a hot soldering iron is left on a carefully polished surface.

Portability

An essential part of any tool-box or test rig should be its portability; neither the coffee table or the shelf in the garage can be considered sufficiently portable for our purposes. The area on which we work needs to be three or four feet long, and yet pass easily through doors and even fit into an odd corner of the car boot. It is at this point that we introduce "the modeller's carrylot". Whilst the central part of a bench needs to be relatively undisturbed, as it carries the piece of gear under construction, the ends are used only for resting tools on, drilling and accommodating bits to be absorbed in the main job.

It is quite in order to slide these away under the main bench for "travelling" making the overall length almost half that of a continuous bench. One needs tools and a supply of bits and these are accommodated in a divided drawer, trays in the side tables and a rack in the lid.

Closability

It goes without saying that dust, household pets, the domestic duster and small inquisitive hands should be kept away from valuable radio gear especially at the hook-up stage. Furthermore, packing the bench up like a suitcase and carrying it sideways can turn the neatest arrangement into chaos, so we must arrange for a tight fitting lid sufficiently high to clear the project under construction as it sits undisturbed on the central part of the bench. This lid must be strong enough to take the weight of the whole box when it is lifted by a handle in the top of the lid. We turn the depth of this lid to advantage by making provision for meters and even test batteries in its thickness. These do not suffer if correctly stowed when closing the lid and are in a convenient position when the lid is open.

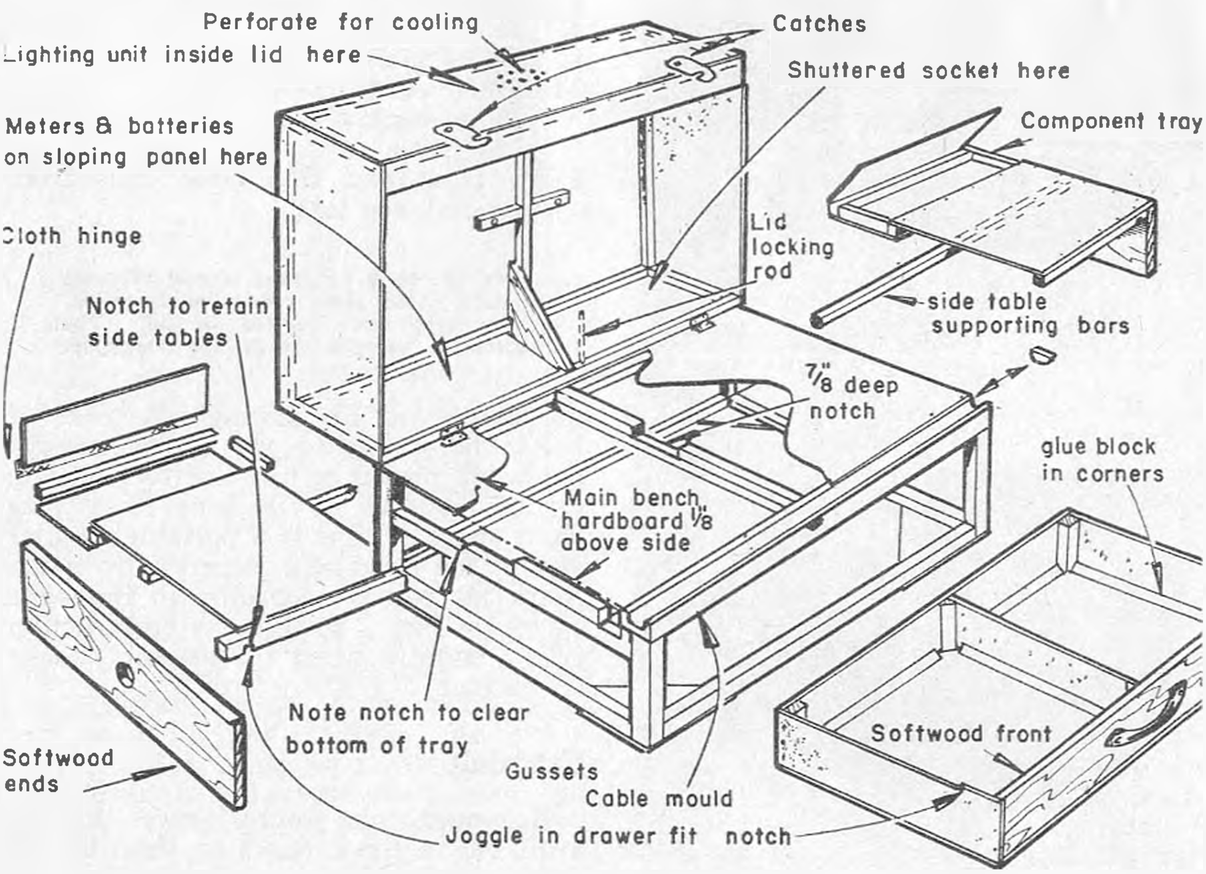
Extra Facilities

The box is wired for connection to a convenient power-point and carries a socket for plugging in a soldering iron or mains operated equipment—such as a battery charger and has its own light in the lid. A small trough at the front edge of the main bench carries small components and ensures that valuable parts are not swept on to one's lap or the floor by the modeller himself. These parts, and those lying on the bench are quite safe during transit; a strip of soft sponge plastic, even self-adhesive sponge draft excluder strip fixed around the edges of the lid and in the lids of the side trays will prevent parts sifting out if the box is accidentally shaken.

Construction

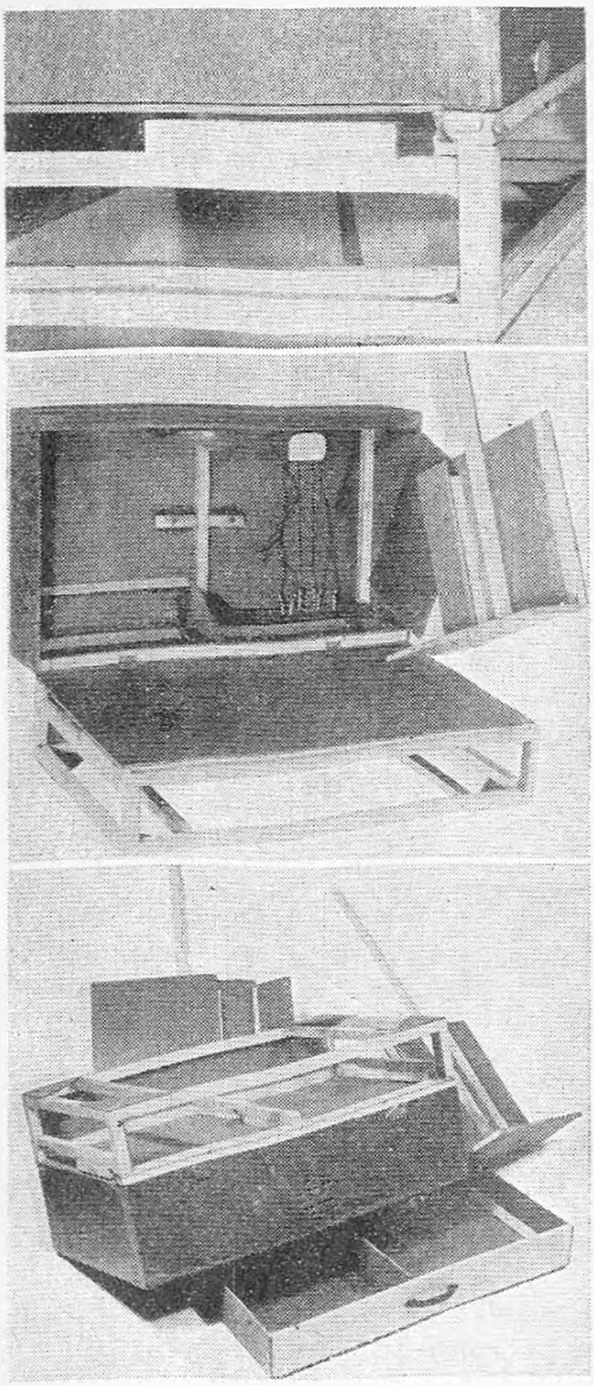
The construction has been kept as simple as possible, no difficulty should be experienced during the assembly; in fact, there is hardly more to it than a spot of simple aeromodelling or boat-building. One does not have to be an expert or carpenter to produce this strictly functional addition to the stock of modelling equipment. Simple butt joints, a certain amount of gluing, screwing, nailing and the application of a little paint should be all that is required. The materials themselves should be available from your nearest timber merchant and amount to some 60 ft. of ¾ in. square prepared softwood,

FIG. 1



30 in. of $\frac{3}{8}$ in. x $4\frac{1}{2}$ in., 22 in. of $3\frac{1}{2}$ in. x $\frac{1}{2}$ in., 24 in. of $1\frac{1}{2}$ in. x $\frac{3}{4}$ in. cable mould and a four foot square of $\frac{1}{8}$ in. hardboard. Hinges, handles, catches, a lampholder, shuttered socket, screws and panel pins should complete your shopping list.

The original $\frac{3}{4}$ in. sq. timber was purchased in 12 foot lengths to minimise any waste and a glance at Fig. 1 should show the best way of marking out hardboard so the panels may be cut with the minimum of saw-cuts. Modellers unfamiliar with joinery procedure should allow $\frac{1}{16}$th of an in. between each panel when marking out



Left (T. to B.) : Joint at end of cable mould. Side table ready for insertion, note test leads parked in lid. The complete carrylot ready for assembly.

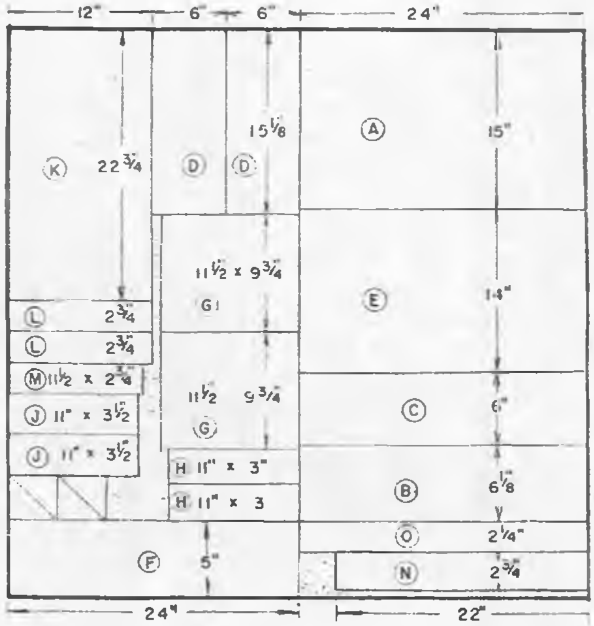


FIG. 2

KEY TO PANEL

A Lid top.
B Lid back.
C Lid front.
D Lid ends.
E Main bench top.
F Back.
G Side tables.
H Component tray lids.
J Component tray bottoms.
K Draw bottom.
L Draw sides.
M Draw partition.
N Draw back.
O Lid fascia.
Draw front and side table ends from softwood, see text.

the hardboard for sawing. A piece of batten helps one to get a nice straight cut when placed on the line to be sawn. Of course the job is done in a very short space of time if a portable circular saw of the hand-held variety is to hand. Mark all panels according to the code shown in Fig. 2 so that the construction goes smoothly when the assembly stage is reached.

Framing

It would take more space than is available in these pages to describe the

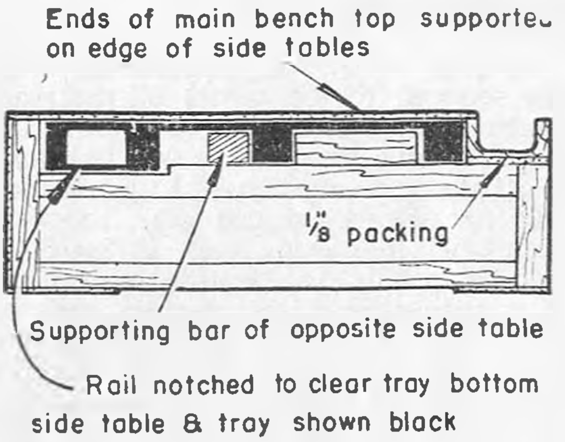


FIG. 3

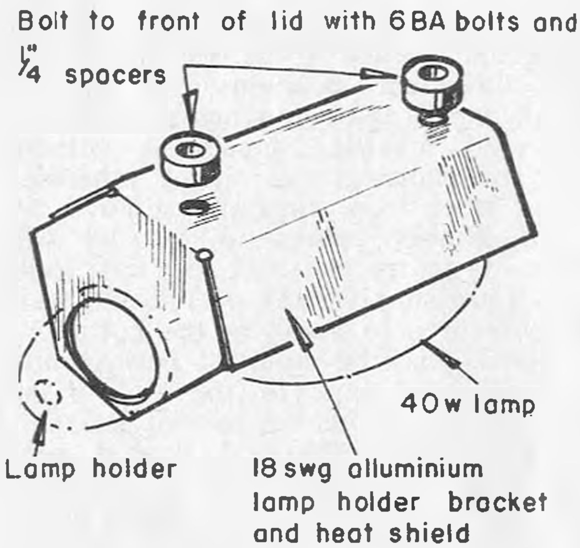
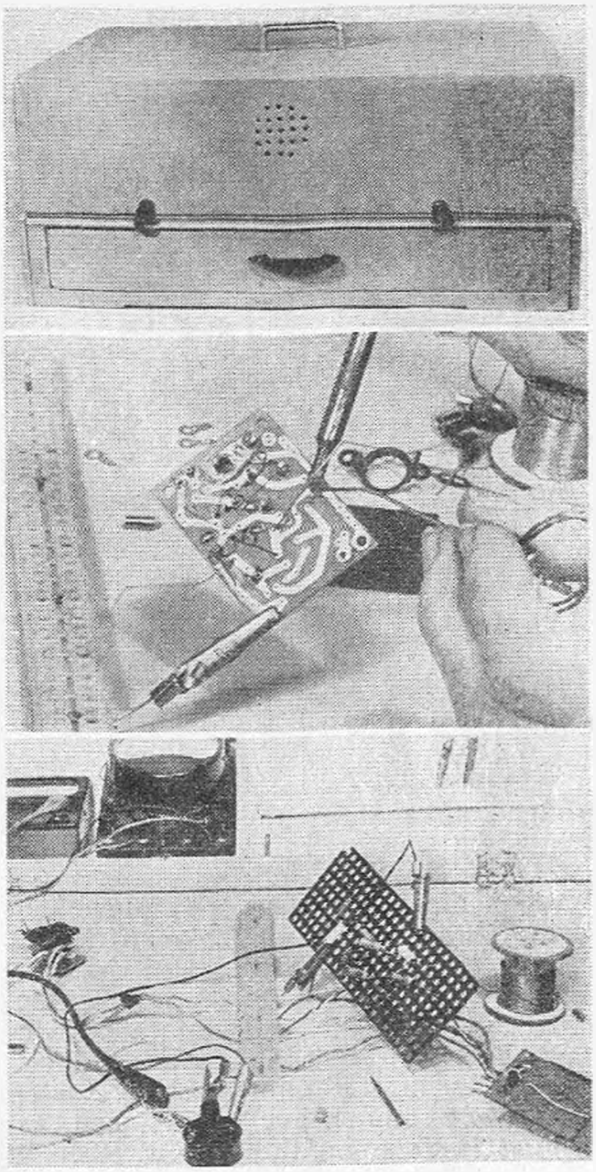


FIG. 4



T. to B.: All locked up and compact. The third hand in use. A test panel held in the same way.

construction in great detail. However, Fig. 1 should be worth more than a thousand words. Much of the jointing may be done on a make-to-fit basis now that the panels have been cut out. The original used pearl glue brewed up in the good old traditional manner. If one remembers to pin and glue the framing members to the hardboard and allows sufficient time for each assembly to set, the joints will not become disturbed when the panels are brought together for final assembly. No. 4 wood screws may be used to secure the relatively unsupported frame of the main bench at the front and ends in addition to gluing. Spare pieces of hardboard are employed to form gussets beneath this framing to make the whole central unit rigid.

Interlocking of Units

Further reference to Fig. 1 and the photographs will show how the two side units with their supporting bars interlock when folded, the tight fit between the top of their component tray lids and the under-surface of the main bench ensures that no parts spill when the side units are retracted. The sides of the drawer are cut so that they engage in notches in the front runner of the side tables when the latter are pushed in and the drawer closed. This ensures that they cannot move out when the drawer is shut. The drawer itself cannot open when the lid retaining catches are hooked in place, the front

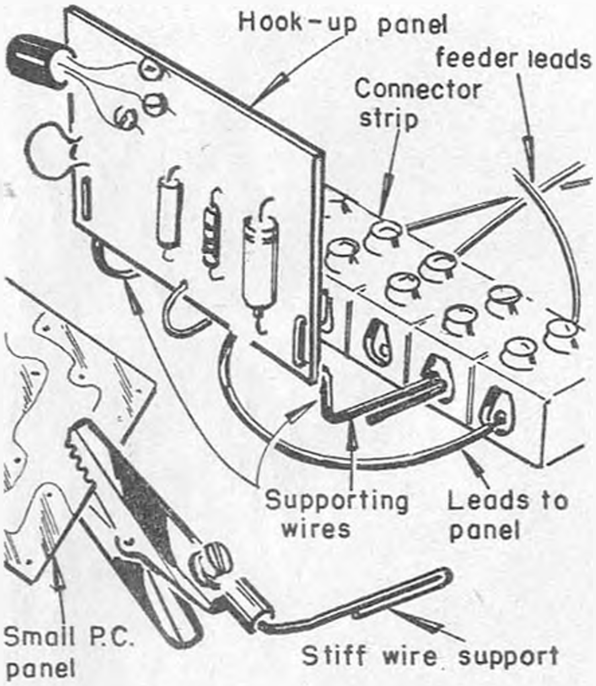
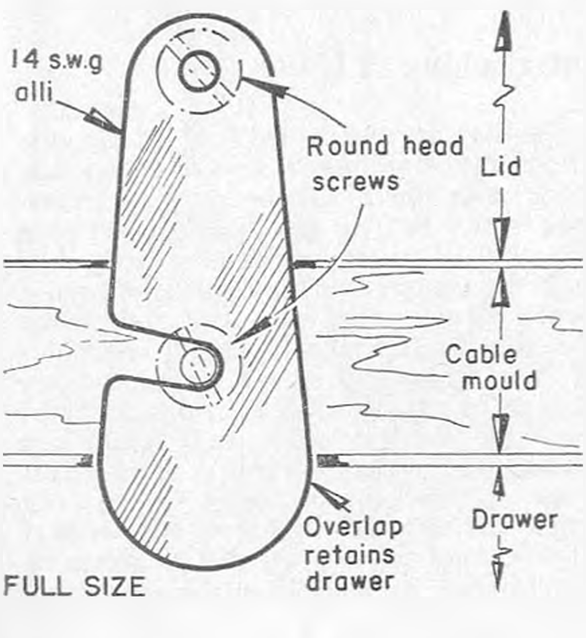


FIG. 5

trough is sealed by the lid fascia and the whole unit may be lifted up quite safely by the lid handle.

When the lid is open it is prevented from falling right back by a 10 s.w.g. piano wire rod which is passed through the framing. The side tables may be supported for light loads on their own bars, but it is advisable to allow their end pieces to rest on the coffee table, etc., when any heavy work such as drilling is done on these units.

FIG. 6



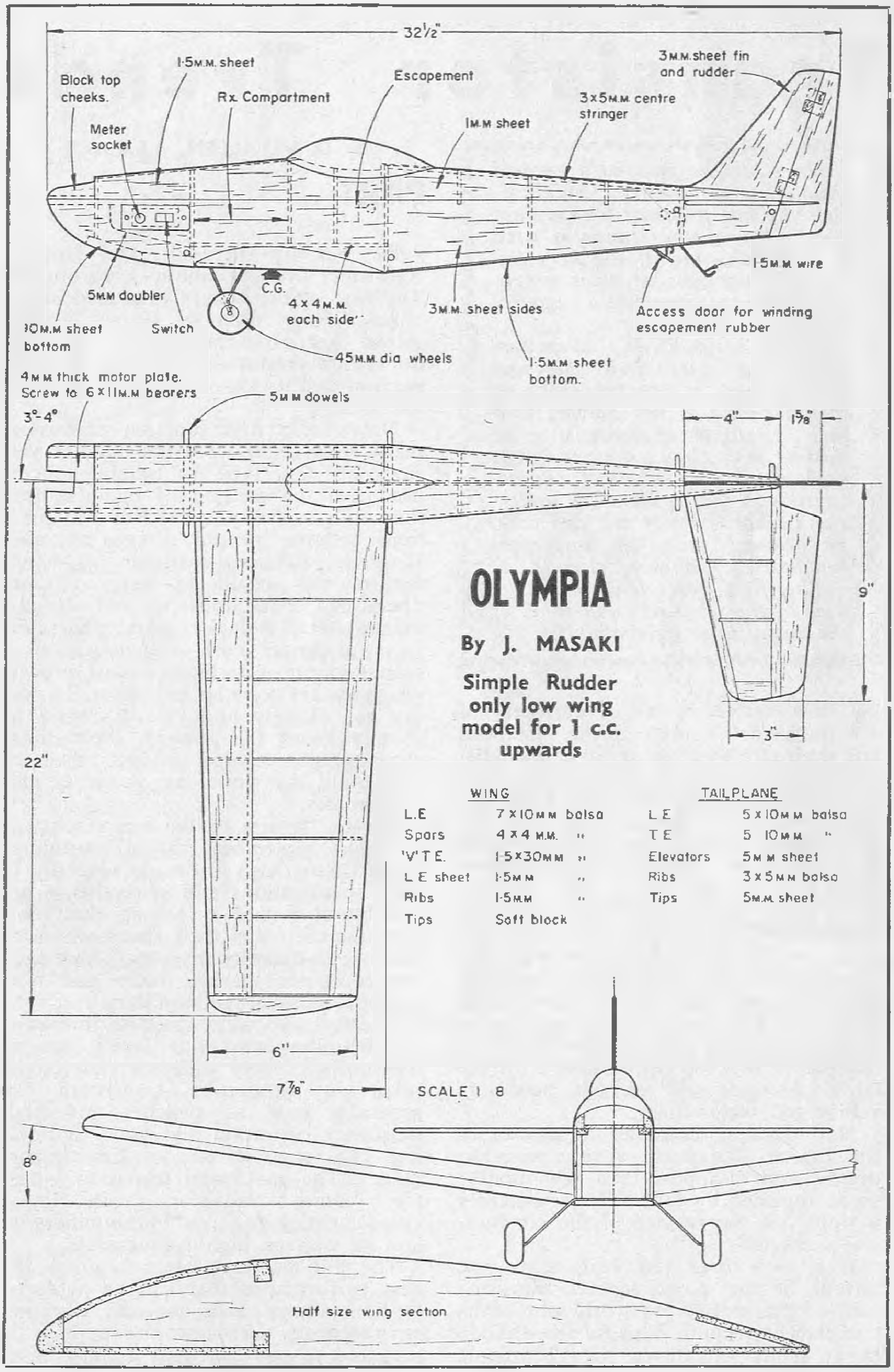
Useful Additions

A pair of 12-way connecting strips are screwed to the centre of the main bench (taking care that no screws foul the side table bars), these will be found to provide a most useful distribution unit for setting up test gear, mock-up installation harnesses, etc. A series of paxolin panels, tag boards and pieces of conveniently drilled perspex may be fitted with wire plugs for insertion into the connecting strips. One or more of these may be arranged in this manner so that both sides are accessible, it requires no third hand to support it while experimental circuits are wired up and the connecting strip is of course, close at hand for connecting input, output and test circuits. Further useful units are crocodile clips, fixed to pieces of stiff wire and inserted in the connecting strip in convenient positions for holding small panels and components for soldering and making connections without fear of shorting that might otherwise occur when loose clips are employed. A "half bobbin" glued to the lid will serve to carry a stock of test leads which are simply hung over it and their clips secured to a rail at the bottom.

Meters may be mounted permanently in place on a panel on the back of the lid which may be cut to suit the particular meter used and angled conveniently for easy reading. Readers may like to add their own special pieces of gimmickry for example, a battery supply distribution panel switched to permit the metering of inputs of pieces of test gear such as our latest Wheatstone Bridge. Care should be taken to ensure that the lid is not filled so that there is insufficient clearance over the bits and pieces on the workbench when it is shut.

Finish

The "Carrylot" should have some form of preservative to protect it from the weather, it is intended not only for use indoors but outside at the flying field or by the pond-side itself. Emulsion paint was used as a basis on the prototype, a grey outside and on the bench tops, to show up any small components, white inside the lid to reflect the light. Considering the close proximity to soldering iron it is best to avoid using cellulose. A really de-luxe version could have a fablon covered box.



OLYMPIA

By J. MASAKI

Simple Rudder only low wing model for 1 c.c. upwards

WING		TAILPLANE	
L.E	7 X 10MM balsa	L.E	5 X 10MM balsa
Spars	4 X 4 M.M. "	T.E	5 10MM "
'V' T.E.	1·5 X 30MM "	Elevators	5MM sheet
L.E sheet	1·5MM "	Ribs	3 X 5MM balsa
Ribs	1·5MM "	Tips	5M.M. sheet
Tips	Soft block		

From KOKU FAN, JAPAN.

Transistor Trends

By D. W. ALLEN, A.E.R.Ae.S.

PART - - - 1

Dave McQue gave us a taste of simple transistor theory and P. T. Bellamy has followed with a very good idea of the transistor used as a switch; one of the very important functions of this component in modern radio control systems.

In this series D. W. Allen describes transistors, their uses and the various manufacturing methods. He is not delving into their electrical characteristics or dealing with circuit designs but is explaining their physical characteristics so that readers can understand what is inside the tiny case, performing such an important function in electronic circuits.

The first part deals with the uses of the transistor and some of the manufacturing methods.

A DESCRIPTION of the development of transistor manufacturing methods and their effect on operating characteristics will be dealt with in this series. It is suggested that the Silicon, Epitaxial, Planar transistor comes very close to the desired 'ideal' device and it will be produced by most manufacturers shortly.

Introduction

Transistors have been with us for some time now and the subject of semi-conductor physics has become a vast one. New papers are appearing at such a rate that it is rapidly becoming impossible to keep up to date with the latest developments without becoming submerged under them.

New devices, hailed as the answer to the circuit designers prayer, seem to appear and disappear in a few months to be replaced by others, leaving hardly a ripple on the surface of the commercial markets.

It is now over ten years since the advent of the point contact transistor startled the electronics world out of its complacent vacuum. This modified diode never really threatened the thermionic valve but its successor, the junction transistor, brought about a revolution. The first of these were produced in the U.S.A. using what is known as the grown junction technique, that is, junctions were produced in a crystal of germanium as it was being formed from the melt.

Now these first junction transistors really only differ from the modern versions in the type of semi-conductor used and the method of manufacture: they still, basically, consist of two junctions between 'p' and 'n' type material. However, different methods of manufacture can result in very different operating characteristics, and if the manufacturer is lucky, better characteristics at lower cost. Obviously if a manufacturer introduces a new process which makes a better transistor, he will say so — loudly and clearly, while he usually keeps fairly quiet about those characteristics of his products that are not quite as good as those of his competitors.

But in fairness to the manufacturers, we must remember that all customers would like transistors made specially to their specifications and since this is not possible it is not surprising that most manufacturers aim their specifications at the largest quantity markets. These are: the computor market, radio and television, industrial and military.

The first two, although both interested in obtaining low price levels, require transistors of very different characteristics. In computors transistors are generally used as switches and high frequency operation and good 'bottoming' characteristics are of first importance. The radio and television industry require transistors with linear characteristics for use in amplifiers at low as well as high frequencies.

The military user often requires the best performance that can be achieved to be maintained in hot and vibrating environments. Because the military is prepared to pay for what it must have,

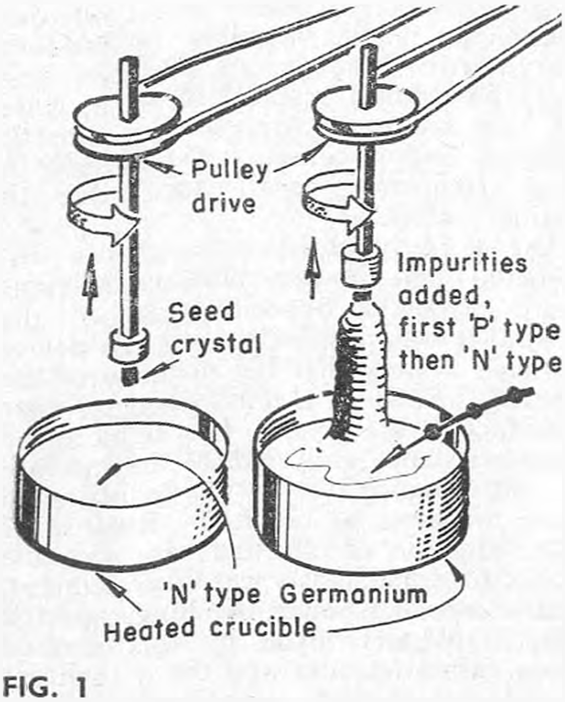


FIG. 1

it is sometimes responsible for major developments in the semi-conductor industry.

So while some users are constantly urging that the frontiers be pushed forward towards the goal of the ideal transistor, others are content to continue using cheaper existing devices, if they meet their needs.

All this has resulted in a mass of available transistors with greatly differing characteristics and if this article helps to pilot the reader through the maze and assists him in choosing the device for his purpose, it will have achieved its object.

Grown Junction Transistors

The first commercially available junction transistors were made by this method which, in its simplest form, consists of changing the impurity concentration in a crystal while it is being formed and withdrawn from the melt. How this is done is shown diagrammatically in Fig. 1. The result is a crystal with correctly formed junctions across its width.

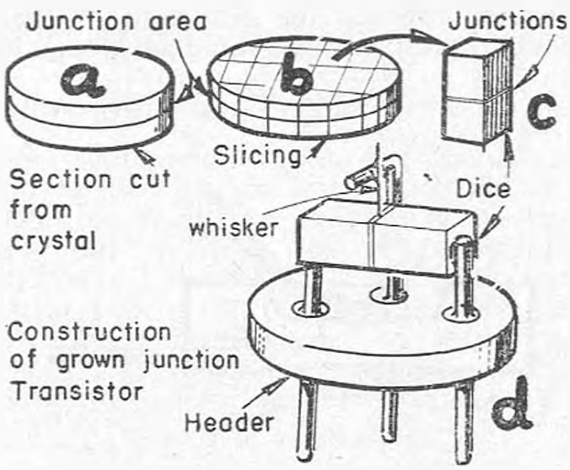
After cooling, the useful portion of the crystal is removed and cut up into suitably sized pieces known as dice. A dice is of the form shown in Fig. 2. Contact to the emitter and collector ends of the dice is usually made by soldering the end faces directly to stem wires. These wires are then used to mount the dice on its base, or 'header'. Attachment of the base lead is a much more difficult problem, this region being only about 1 mil. wide. Since it is desirable to use a connecting lead of at least 2 or 3 mils. in diameter some interference with the junction is unavoidable. Usually the base lead is made of some suitable material doped with an impurity of the same type as the base, this lead, or 'whisker' is then lowered to touch the bar so that it overlaps the base/collector junction. Current passed through the lead energy is dissipated and the whisker bonded to the germanium. It does not short out the base collector junction, but rather reforms it by locally extending the base. Transistors of this type are characterised by the 2N35.

Alloy Junction Transistors

In Europe, the first junction on transistors were made by an alloying technique, here the junctions are formed by melting indium pellets into the surface of a piece of 'n' type germanium. The arrangement is shown diagrammatically in Fig. 3.

It so happens that it is easier to make grown junction transistors of the n.p.n. type, while alloy transistors are nearly all p.n.p. Because of the method of adding impurities to the melt the grown collector junctions differed in character from the emitter junctions whereas in an alloy transistor they are similar. Alloy junctions had better reverse voltage characteristics, while grown junctions at first tended to produce higher gain transistors.

FIG. 2



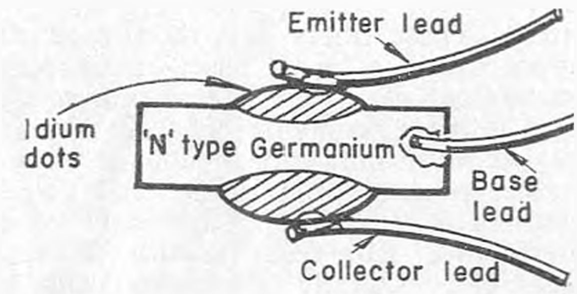


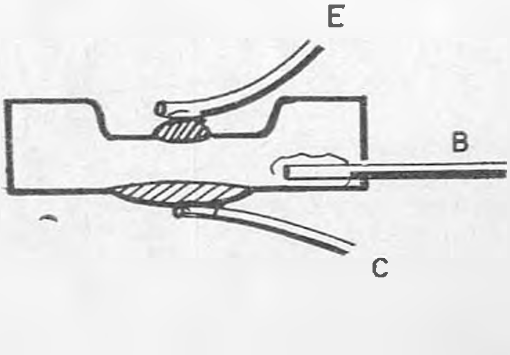
FIG. 3

When this stage of development had been reached it became clear that the extensive application of transistors awaited the availability of devices which would have improved performance in respect of power, frequency and temperature. It was at that time felt that it was not possible to combine all these features in the same device, so development proceeded in three directions. The most intensive development was directed towards the production of types with adequate gain at high frequencies and this was done without any special attempt to improve, or even maintain the power handling capacity. On the other hand, work was being carried out with the intention of increasing the power dissipation although the resulting transistor might only operate at relatively low frequencies. Transistors of both types were being made from Silicon which offered good high temperature characteristics.

High Frequency Transistors

In general, the high frequency performance of a transistor depends upon the values of the collector capacitance C_c, the base resistance R'_{bb} and upon the thickness of the base; at the same time the gain α of the transistor should not be sacrificed. The main effort was directed towards the reduction of base width, here there was some advantage in a grown junction device since with this technique it was possible to produce very narrow base regions. However, this very narrowness resulted in an increase of base resistance for purely geometric reasons and a consequent reduction in high frequency performance, due to 'Miller' effect.

FIG. 4



At a fairly early stage it was discovered that if two base connections were made to opposite sides of the crystal it was possible to bias the device in such a sway that the majority of the current flowed in a narrow region near one face of the crystal. This reduced the base resistance and enabled the increase in performance due to the reduction in base thickness to be used. Because of the reduction of effective base area the collector capacitance was also reduced, but so was the power handling capacity. The transistors made by this method were called tetrodes and for a time enjoyed considerable popularity in the United States.

Because of its different geometry the alloy junction transistor for high frequencies developed along different lines. The aim was still to improve the high frequency performance by reducing the base width, the base resistance, the collector capacitance and Fig. 4 shows the method used. The base dice was thicker than normal to reduce resistance but it was locally reduced in thickness at the point where the collector and emitter junctions were alloyed in. Transistors made in this way are nowadays termed medium frequency devices and are characterised by the Mullard OC 42 and OC 44 series. The OC 42 with its average frequency cut-off of 15 Mc/s probably represents the upper limit of frequency obtainable in quantity production using this technique for the simple reason that it is not possible to control the thickness of the dice with sufficient accuracy. Most devices formed from both sides of a slice suffer from this difficulty.

Since there exists no 'n' type impurity that is as satisfactory as indium in respect of physical properties, the development of alloy transistors has, so far been confined to the p.n.p. type.

The Surface Barrier Transistor

A rather special form of germanium transistor can be made by using an electronic etching process to remove

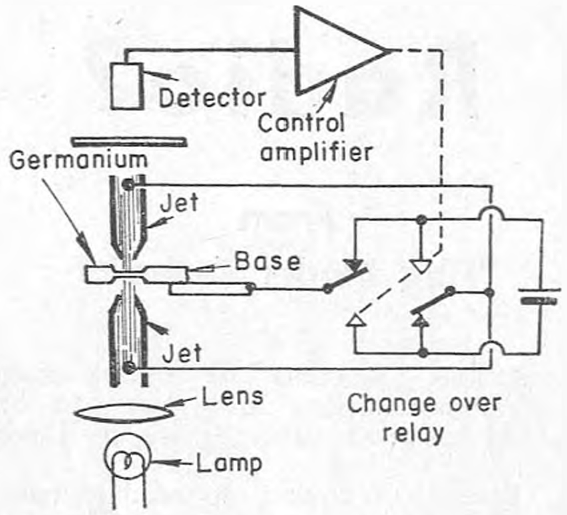
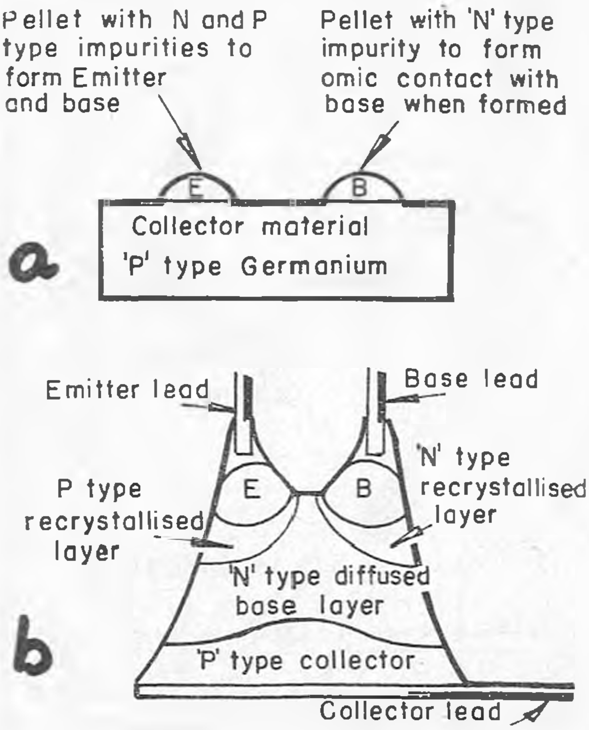


FIG. 5

material from small areas on each side of a thin slice. The method is shown in Fig. 5; if an indium salt solution is used for etching it is possible, by reversing the applied voltage, to electroplate indium on the same area to form compact collector and emitter junctions.

Because germanium will transmit infra-red rays the etching process can be monitored and stopped when the required base width has been obtained. Transistors made in this way have an

FIG. 6



After diffusion and etching

excellent high frequency performance but do tend to be limited in terms of maximum collector voltage and power dissipation.

Subsequently the alloying technique was combined with etching to produce the micro-alloy transistor, and this process increases gain and power dissipation while preserving the high frequency capability afforded by the narrow base width.

Diffused Transistors

All the devices so far discussed have abrupt junctions, much better high frequency performances can be obtained by the use of graded junctions, that is junctions in which an impurity concentration gradient in the base region provides an accelerating electric field. Instead of being left to meander across the base in random fashion, carriers in a graded base are gently urged in the right direction and consequently take less time in transit. Graded junctions can be produced by the diffusion process where impurity atoms are allowed to diffuse into one side, the slice of semiconductor material at elevated temperatures. It is a slow process taking hours and sometimes days depending on the depth required, but it can be carefully controlled by the transistor designer and overcomes the disadvantages of forming from both sides of a slice.

In diffusion the slice usually becomes the collector and it is necessary to form a base and then an emitter region. This can be done by a single diffusion process for the base with the emitter alloyed in later. It can also be done by double diffusion. The base is diffused first and then a mask is applied to reveal only the desired emitter region and a second diffusion takes place. Devices of these types are sometimes known as drift transistors.

Alloy Diffusion Techniques

A combination of alloying and diffusion is used by Mullard for the OC 170 series of transistors. These transistors are built up on a slice of germanium which is later used as the collector. Metal pellets for the base and emitter are placed on the slice as shown in Fig. 6. The assembly is then heated to alloy the pellets into the surface until

[Continued on page 301]

Why Use Radio?

HOW TO SIMPLIFY SHORT RANGE CONTROL BY USING SOUND OR LIGHT

From "Flug Model Technik"

THE following interesting experiments were carried out on the Continent and reported in "Flug Model Technik". R/C has, in the past been the principal way of controlling models even at short range, the systems offered below offer a new outlook for those who operate models at short range. Naturally, nothing in the forseeable future can replace the radio signal for bridging fairly large distances and with one or two exceptions is established as the only correct one.

Short distance control as applied to small model ships and cars seems to demand an unnecessary expense and complication, rather like using a steam hammer to crack a nut. Some alternative systems naturally enough, have limitations, whereas in other cases certain peculiarities in system can be turned to good effect as we shall see later.

There is, of course, no need to have a G.P.O. licence for sound or light control, so there can be no qualms of conscience as to the accuracy of one's radio frequency. Remote controlled boat models, especially when operated simultaneously are becoming increasingly popular, so of course some kind of independent control is necessary as may be seen from Fig. 1. We assume that this case is self evident when operating several model cars on one road or racetrack.

At the present time it is, of course, possible to operate up to six models simultaneously but this procedure involves the use of expensive superhets. Some filter equipment has been tried successfully; for example the Mecatron

FIG. 1

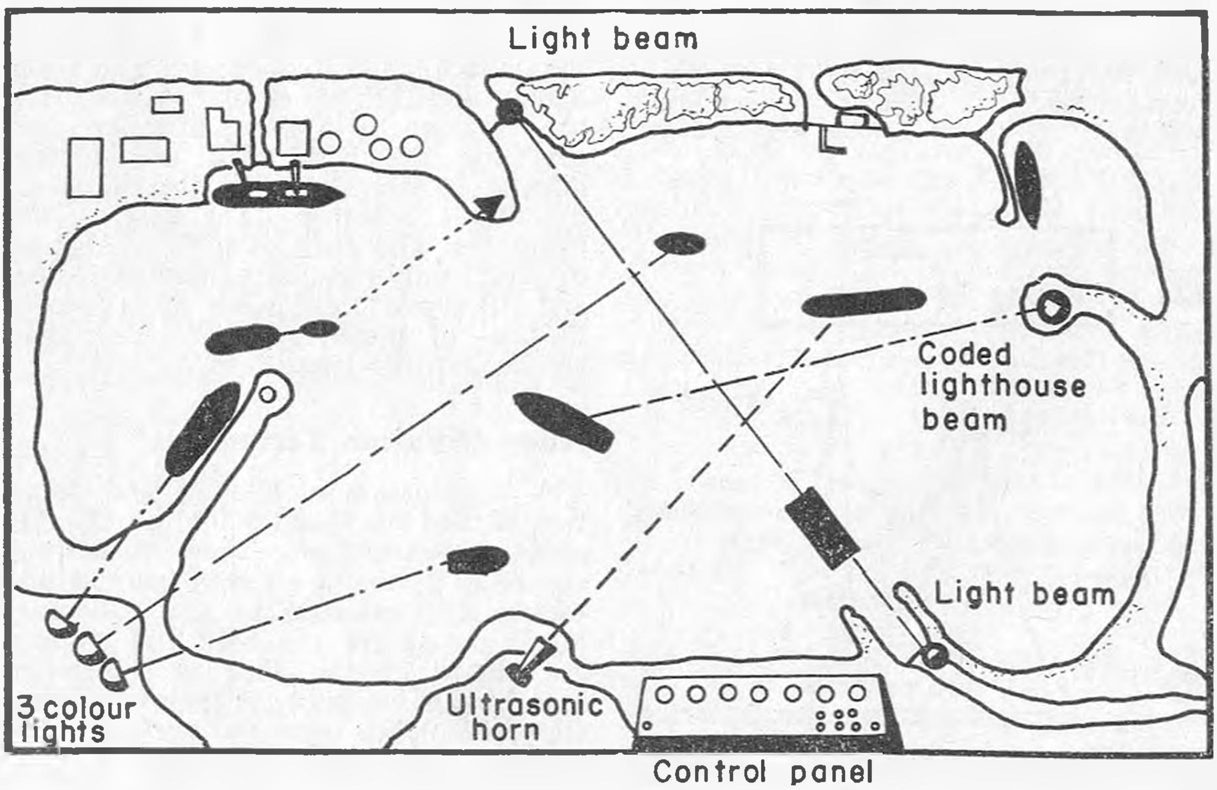
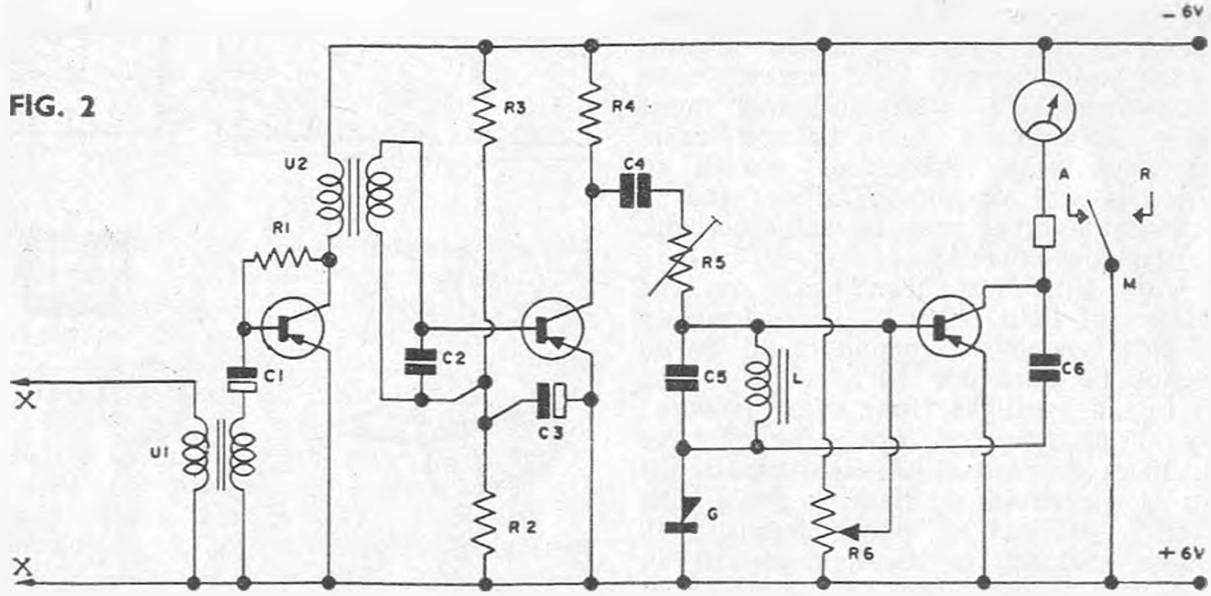


FIG. 2

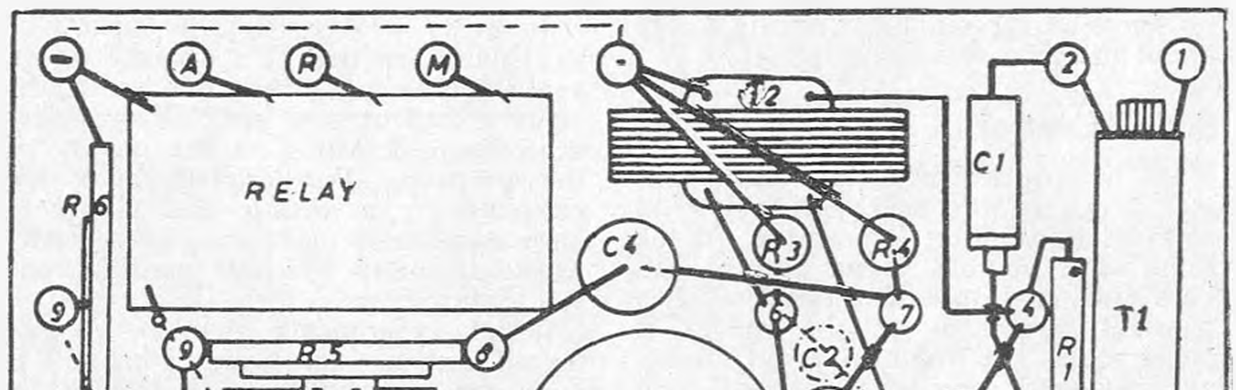


three channel transmitter and separate receivers. Any systems in the 27 and 465 Mc/s bands will, of course, operate quite independently, but if owned by one operator two licences might be necessary.

Alternative Control Systems

Control is relatively easy with direct sound transmission, that is to say a loud tone is sent by means of a whistle or motor-horn without the use of any radio frequency carrier. This is picked up by a microphone in the model and amplified to operate the controls. Why not try a reed system? There must be quite a number of reed relays collecting dust in their boxes by now. Sound controlled model ships can be controlled very well up to 300 or 400 feet and even further with a powerful horn from a car, but for the moment we are not so much concerned with distance as with sound selection in order to operate as many craft as possible at the same time. Three models will be seen in the illustration, these operate on sound control. In addition to these there is a high frequency model controlled by a whistle, the frequency of which lies on the threshold of audibility. Such whistles are used for the purpose of directing sheep-dogs (*we should hate to see a flock of sheep arriving at the pond-side unexpectedly*—ED.). One needs

FIG. 3



an oscilloscope when making measurements in this frequency range. Underwater sound signals have not yet been really successful although short range tests were made in a closed basin of water with satisfactory results, so there is still reason to believe that a reasonable range may be achieved with further developments.

Very little has been heard on the subject of light control. The setting up of this type of equipment could by no means be described as a work of art, in fact a spotlight from a car powered by an accumulator should be effective at 30 or 40 yards. The light can be set up as a constant or flashing beam. The model carries a photo-electric cell which responds to the light signal. In this case it is shown as a ferry boat with automatic steering so that it comes down the beam from bank to bank. One may also employ the flashing beam coming from a lighthouse to operate the rudder proportionally. In both these cases a normal amplifier circuit is used in the model to operate the control relay.

This already represents a whole range of possibilities, even if one does not include the induction coil which is again approaching radio control but produces annoying interference. Common to all these methods of control is the receiver in its basic form as illustrated in Fig. 2. Whether there is a microphone, selenium cell or diode at the input makes very little difference. There must always be a relatively strong amplification in order to improve the selectivity so that only those receivers respond that are really intended to, and that we do not have all the models careering wildly about in response to one signal.

Sound Control

Let us now deal with pure sound control which is effected by the simplest form of transmitter; the whistle. At the same time audible sound control can be a noisy and disturbing business when constant movement of the rudder is being made. In order to avoid annoyance we must consider slightly different forms of rudder-control. The escapement or servo must be constructed so that short whistles move the rudder to position and a further whistle sends it back to neutral.

This is an interesting field for the experimenter who will find certain parallel

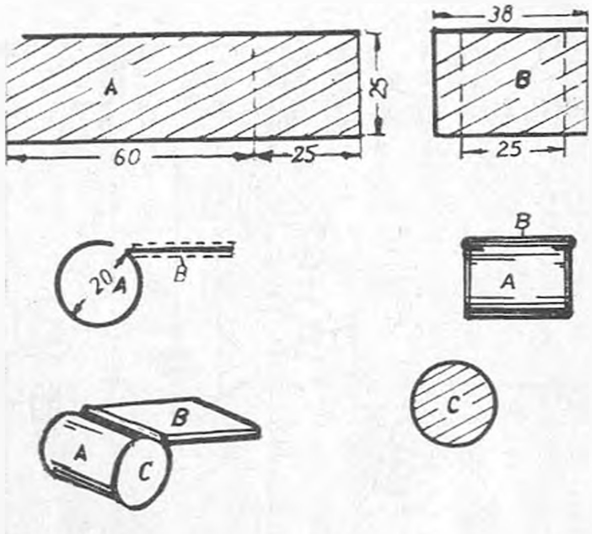


FIG. 4

between these and single channel R/C developments. The ordinary compound escapement might be adapted so that a short pulse positions the rudder and a slightly longer pulse returns it to neutral. Small models have already been developed for use with short control signals and are quite successful in restricted waters.

Selectivity

Selectivity is of no less importance with this system than with R/C reed outfits. It is well known that selectivity is reduced when a strong signal is received; R/C modellers will have noticed two reeds operating together under these conditions. Range is another difficulty, for whilst an R/C receiver loses signal quite rapidly at the extreme edge of its range, free sound transmission grows weaker with the square of its distance, so that at a distance of ten yards it has only one hundredth the value it had at one yard. This places exceptional demands on the quality of the selection. Furthermore the sound produced by a whistle has far more harmonics than the pure electronically produced sound which is used in tone R/C transmitters.

Initial experiments should be conducted with a single tone. First this is necessary to produce a simple whistle (see Fig. 4). It should be noted that the note becomes higher as the radius is reduced. First the whistle is closed on both sides with thumb and forefinger and the note tested. It may be

[Continued on page 301]

Simple Servo

By J. T. JACKSON

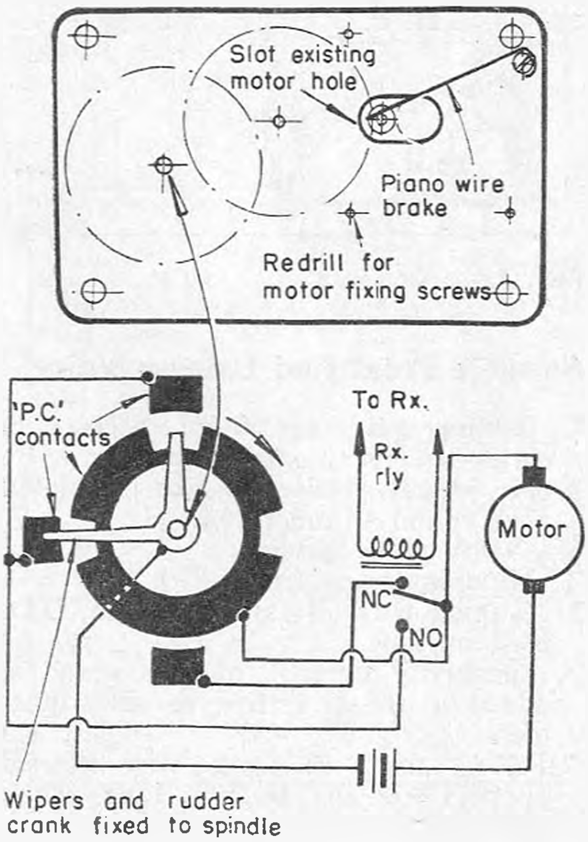
HERE is a simple rudder servo made from a modified gearbox/motor unit as advertised by Messrs. Pearsons Surplus Shop in December, 1961, *R.C.M. & E.* When used with a single channel receiver it gives selective right and left rudder, the transmitter signal being short pulse for right, short pulse again for neutral, hold signal for left and release for neutral. The gearbox motor works most successfully from a 1½v. battery current consumption approximately 300 m.A.

The following modifications are made to the gearbox to give a lower ratio suitable for driving the rudder.

Drill out the three alloy spaces and dismantle the gearbox, remove the first two gear wheels, and unbolt the motor from the plate and enlarge the motor wheel, this enables the motor to engage with the third gear wheel, mark and drill new fixing holes for the motor.

It was found necessary to "brake" the motor to prevent over-run on the switch contacts. This was done by fixing a length of 20G piano wire (approximately 1 in long) to the top corner motor fixing bolt and bending it to give a slight pressure against the motor spindle. The gear box is reassembled with tubular spacers and 6 B.A. nuts and bolts. (See Fig. 1).

FIG. 1



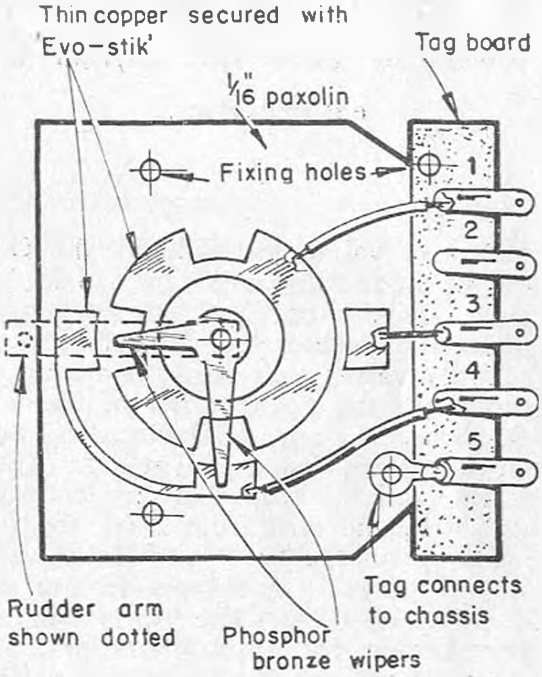


FIG. 2

The position selecting switch is made out of scrap plastic sheet approximately ⅛ in. thick and the contacts and wipers of a switch wafer.

After the fixed contacts had been cut to shape they were embedded into the plastic sheet with a little heat from a soldering iron.

The wipers also made from the parts of a switch wafer, are fixed to the gear box driving spindle together with the rudder operating arm. (Fig. 2).

The switch plate is bolted to the gear box with the two end bolts.

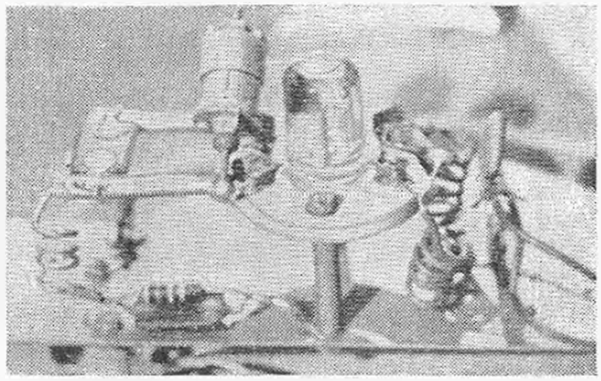
A tag strip for the switch connections is bolted to the original switch wafer mountings.

Total cost of this unit is about 12/-.

Valve "Front End" for 465 Mc/s

Even though new transistors are available for this waveband, a valve R.F. stage could be used in boats, where the extra H.T. payload is not important.

By M. J. GINGELL



ORDINARY valves just will not do. One of the few that will is the 6J6 double triode. This is only suitable for transmitters as it is heavy on heater current. The only valves that really come up to scratch are the acorn types in the 954—9 series. Their characteristics and connections are listed in Table I. They are all available from Government surplus shops and cost from 2/6d. to 10/- depending on the type (and the shop!). For our purposes the types to use are 955, 957 and 958A. The 955 is a mains type suitable for transmitters and receivers. I use the 958A which is a battery valve being fairly economical on power requirements. This is suitable again, for transmitters and receivers. The 957 works best in receivers.

I shall describe first a front end for a receiver. This can be followed by a transistor amplifier and reeds or tone filters according to normal practice. The current change in the anode line is too small to operate a relay directly. A modulated tone must be used which can be amplified and detected.

The receiver shown in the circuit of Fig. 1 is very simple but care must be taken in construction to ensure the shortest possible leads.

Power requirements are 135v. @ 1 m.A. and 1.5v. @ 100 m.A. The H.T. can be supplied from a transistorised D.C. converter. Very great care must be taken in smoothing the H.T.

It was found that this particular circuit worked very well without any aerial, and in fact any aerial will place too great a load on the oscillator and the circuit will refuse to function. As can be seen the basis of the circuit is the super-regenerative detector.

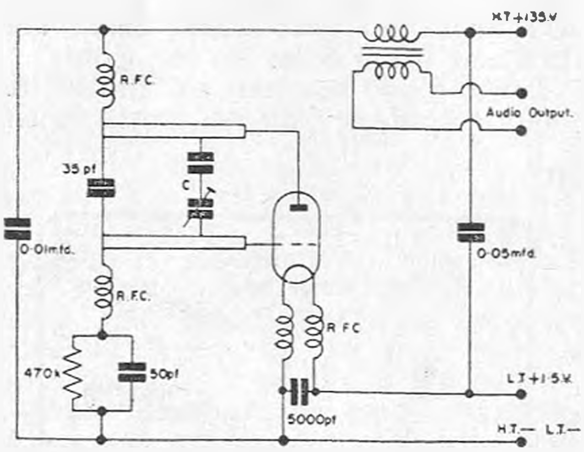


FIG. 1

Suitable Front End Using a Valve

C. Tuning condenser. 0-6pf. beehive in series with very small capacitor. ½-1pf. Made from one turn insulated wire round trimmer tag.

V. 958A acorn triode.

T. Matching transformer.

L. Tuning bars. Brass tube. ⅛ in. O.D. by 1 in. long.

A sensitivity control of 50K can be added in the H.T. line to aid adjustment.

R.F.C. 4 turns 18 s.w g. wire (tinned copper) ⅜ in. dia. by ½ in. long. Make them self-supporting.

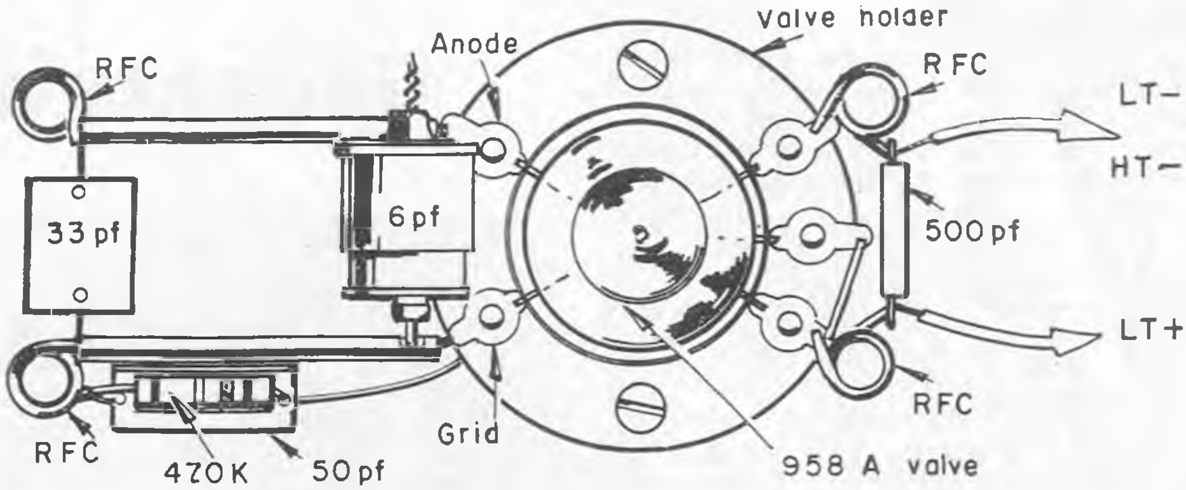


FIG. 2

Silver plating of the brass tubes was not found to make much improvement and as it is difficult to get small items plated anyway, this is an advantage.

The tuning capacitor is made from a 0-6pf. Phillips Beehive Trimmer. The basic range of this trimmer is too great and must be reduced by a small series capacitor—say 1pf. This can be done by making one connection to the trimmer with a piece of insulated plastic covered wire wound once round one of the connecting tags.

Coarse tuning of the receiver is effected by moving the 35pf. fixed condenser along the tuning rods. This necessitates unsoldering and resoldering each time. Fine tuning is done with the beehive trimmer.

Readers may be interested in a 465 Mc/s all transistor receiver published on page 248 of May, 1962 issue. It should be noted, however, that the theoretical circuit in Fig. 1 contains an error; at the R.F. end the aerial and base or T.R.1 should be connected to the 10K and 25K resistors and not bridged as shown and VHF and UHF in the text have been variously referred to as VNF and VMF. The 25K value is correct, placement sketch shows 3.3K. T.R.4 bias resistor should be 27K.

Table I

Valve	Type		Heater volts	mA	Anode volts	mA	r_a K ohm	g_m ma/V	Connections
954	Mains pentode	...	6.3	150	250	2.0	1000	1.4	A
955	Mains triode	...	6.3	150	250	6.3	11.4	2.2	B
956	Mains pentode	...	6.3	150	250	6.7	700	1.8	A
957	Batt. triode	...	1.25	50	135	2.0	20.8	.65	C
958A	Batt. triode	...	1.25	100	135	3.0	10.0	1.2	C
959	Batt. pentode	...	1.25	50	135	1.7	800	0.6	D

Connections

	1	2	3	4	5	top pin	bottom pin
A	G_3	G_2	H	K	H	A	G
B	G	A	H	K	H	—	—
C	G	A	H+	5	H—	—	—
D	G_3	G_2	H	—	H	A	G

NOTE.—*In C pin 4 is connected to pin 5.*

Octal Plug Wiring

Charles Riall sent us a neatly wired octal plug which he had drilled to provide a safety locking system for the leads. Sketch **A** shows how two holes just large enough to take the wire are drilled next to each pin. Drill right through both pieces of Paxolin and thread each wire down through one hole, double-back at the pin side, up through the next hole and down to the hollow part of the pin, where it is soldered.

In this way all the leads take their fair share of loading and no strain is imposed on the soldered joint. Just one lead has been shown in the sketch for clarity, but the plug in its socket with a rubber-band hooked up over a couple of dowels is shown providing a "belt and braces" arrangement. The top of the plug is discarded unless insulated protection is required, resulting in a slightly lighter installation with the advantage that a probe may be placed on any pin for checking voltages on load.

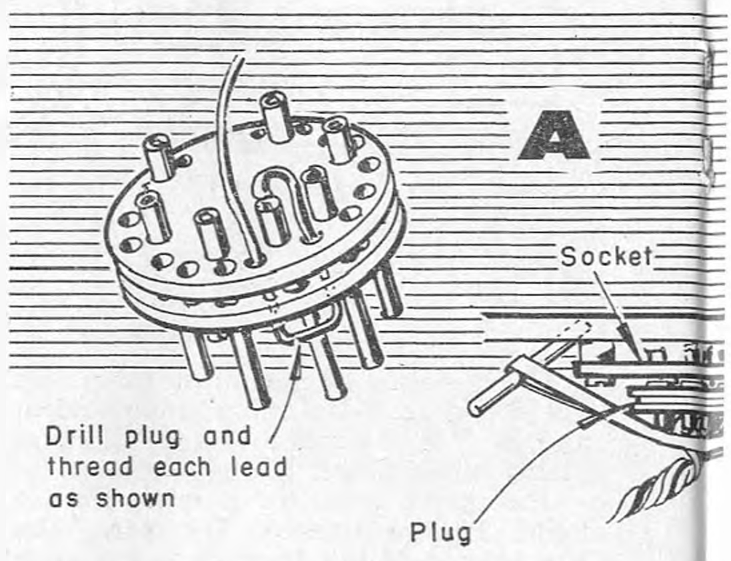
Keep Cool

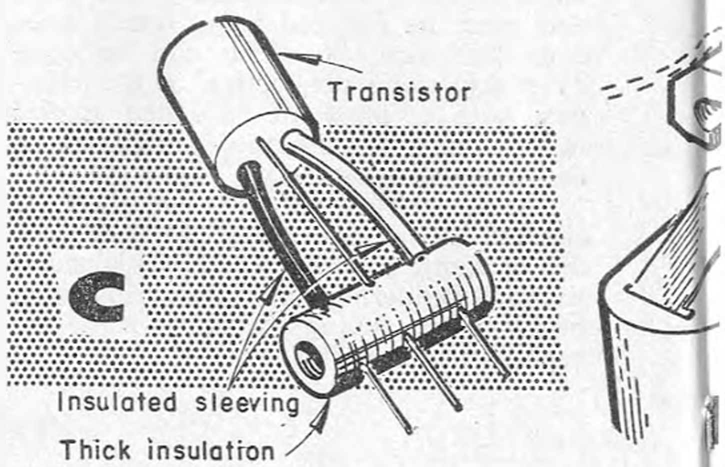
Sketch **B** comes from "American Modeller" and shows a Vernon Van Diver, Jr. idea for heat sinks; felt or blotting paper (we should say about three layers of the latter) is carefully pressed on to the transistor leads so that they pass through it on their way to the printed circuit. Immediately prior to soldering, dope thinners or acetone is dripped on to this pad. Their evaporation keeps the leads cool as they enter the transistor, and if blotting paper is used it may be torn away later. We should point out that the pad should be a tight fit on the leads for maximum efficiency.

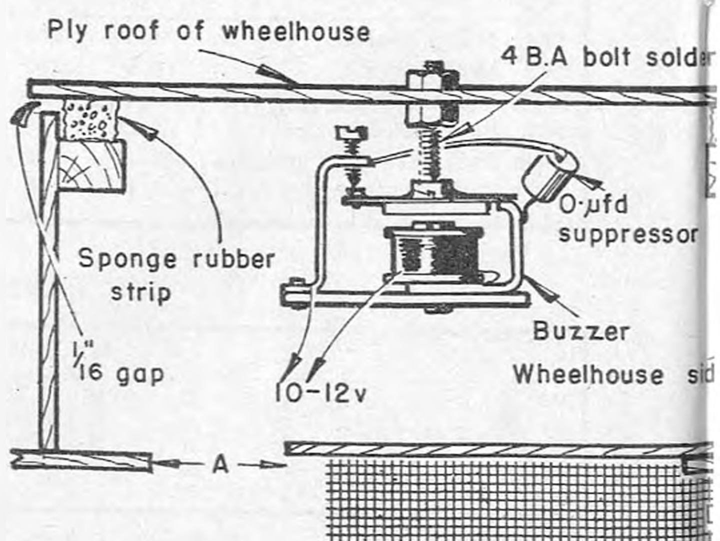
Lead Protection

G. L. Paterson uses the gimmick shown in sketch **C** on test transistors used in hook-ups. The advantage of this system is that the long leads are not damaged and it is unnecessary to shorten them for use with transistor holders in such a set-up. The leads, of course, may be shortened when wiring the transistor permanently in. First, the two outer leads are covered with short pieces of wire sleeving, which may be of different colours for quick identification and all three pass through

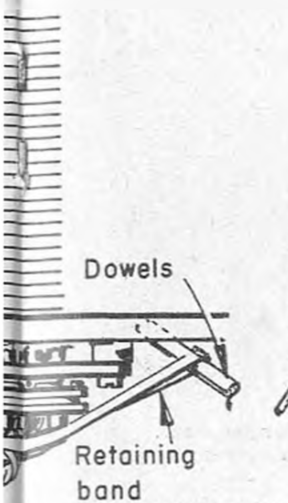
Gadgets and

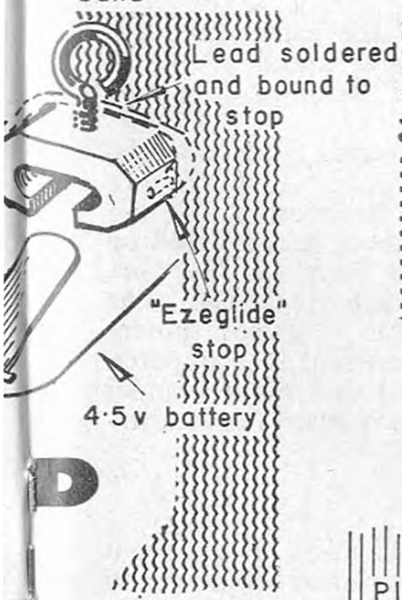


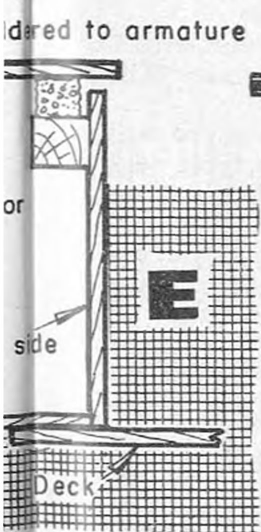


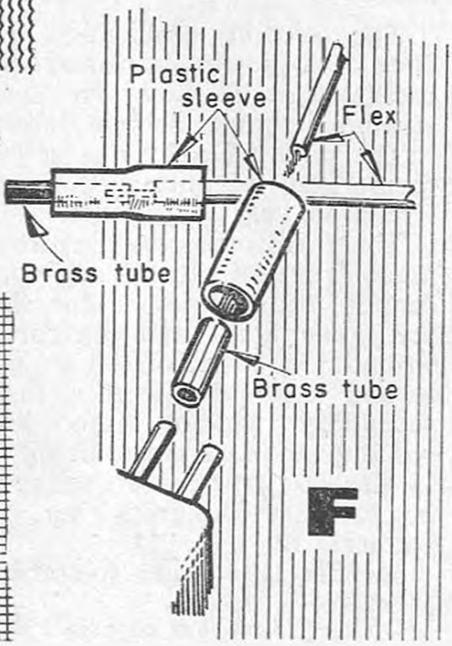


Gimmickry









a piece of fuel tubing which has been previously pierced with a pin, thick wire sleeving could also serve the same purpose.

Battery Connections

Really noise-free connections to batteries are important; the 4.5 volt flat battery may be treated as in sketch **D**. J. W. Mathews uses "Ezeglide" curtain rail stops at a mere 4½d. per pair. The battery leads are soldered and bound to these and the thumb screw is tightened up when the stop is slipped on to the battery lug.

Deep Tone Siren

Boat modellers would welcome this idea from which gives that deep-throated note so difficult to obtain in a small model. Sketch **E** is a cross-sectional view of a wheelhouse on the model and shows how the whole unit acts as a resonant chamber with the roof acting as a diaphragm. The size of the port A between the deckhouse floor and the hull may be varied to improve resonance.

A sponge rubber strip permits the roof to vibrate fiercely as the whole buzzer rattles around, suspended only by a bolt soldered to its armature. A suppressor is required as shown in order to reduce the interference produced by the buzzer contacts, this should be securely lashed to the frame of the buzzer to avoid vibration damage to its connections. The designer suggests 6 to 12 volts output for a really hearty fog-horn noise.

Neat Pin Connections

Sometimes one finds the need for individual wire connections to the pins of a component such as a relay or valve. These may be on test-leads, experimental gear or in actual installations. J. R. Gray suggests the use of a suitably tight fitting piece of brass tube (which could even be split for extra springiness) soldered on to the end of the lead. The tube should be long enough to accommodate the wire and which is soldered inside without interfering with the component pin on to which it is pushed. A piece of tight fitting plastic wire sleeving insulates the outside of the tube, provides colour coding and supports the lead at the otherwise weak junction, sketch **F** shows how it is done.

Transistors in Boats

Two Extra Applications

By R. MITCHELL

NATURALLY enough, power transistor applications are numerous. Only two applications are named below, however this should not limit the constructor's ideas, but contrarily, should spark off new ideas.

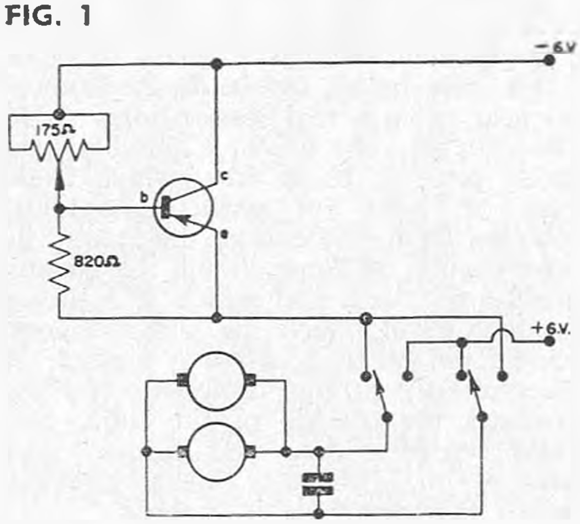
Speed Control

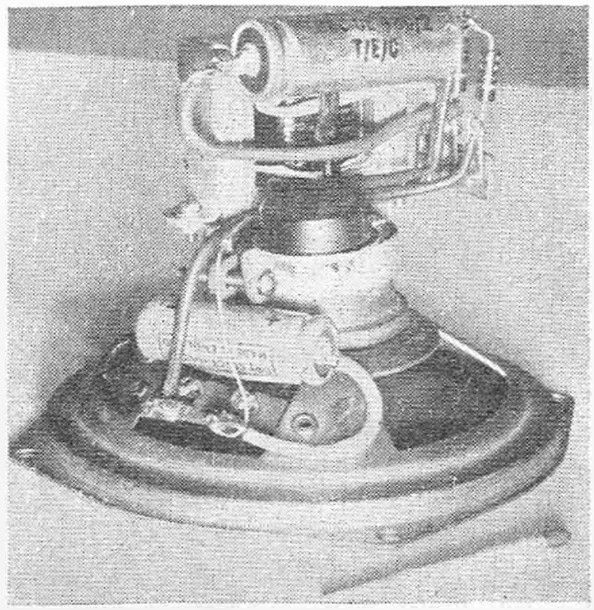
The first application involves speed control of electric drive motors without the use of heavy rheostats. A circuit is given below using 2 x 6 volt motors, the ones used in the prototype circuit being Kako fives.

Fig. 1 shows the wiring of the potentiometer; this control and the two position switch are linked so that the switch changes position when the slider of the potentiometer is midway between the two limits of its range. The switch and potentiometer are linked via a suitable reduction gearing system to a servo motor. The mode of operation now becomes:—

1. Potentiometer slider on one of the limits of its range. The motors run at full speed.
2. Slider between one of the limits and the mid position of its travel. The motors still run in the same direction, however, at a reduced speed.
3. Slider in mid position. Motors stationary.
4. As in cases 2 and 1 respectively, but
5. in the reverse direction.

FIG. 1





Compact assembly of transformer, etc. on the speaker. Matchstick gives an idea of the size.

The transistors should be mounted on a heat sink of at least 50 sq. ins. area and of 16 gauge thickness. The maximum permissible collector potential is 15 volts and current is 3 amperes.

It should be noted that motors under load consume more power than otherwise.

Sirens

The second application is a boat siren. A power transistor is made to oscillate at a low frequency in a standard circuit, shown below.

The circuit employs a feedback transformer but no output transformer. The circuit is very adaptable.

The transformer in the prototype was made from an old battery portable set's output transformer. The laminations are taken apart and the former is unwound; 35 turns of 28 s.w.g. wire are wound onto the former to form the secondary winding; the direction of winding in each case being the same. If the constructor is feeling ambitious he can try designing his own transformers.

In this case wide tolerances can be allowed.

[Continued on page 295]

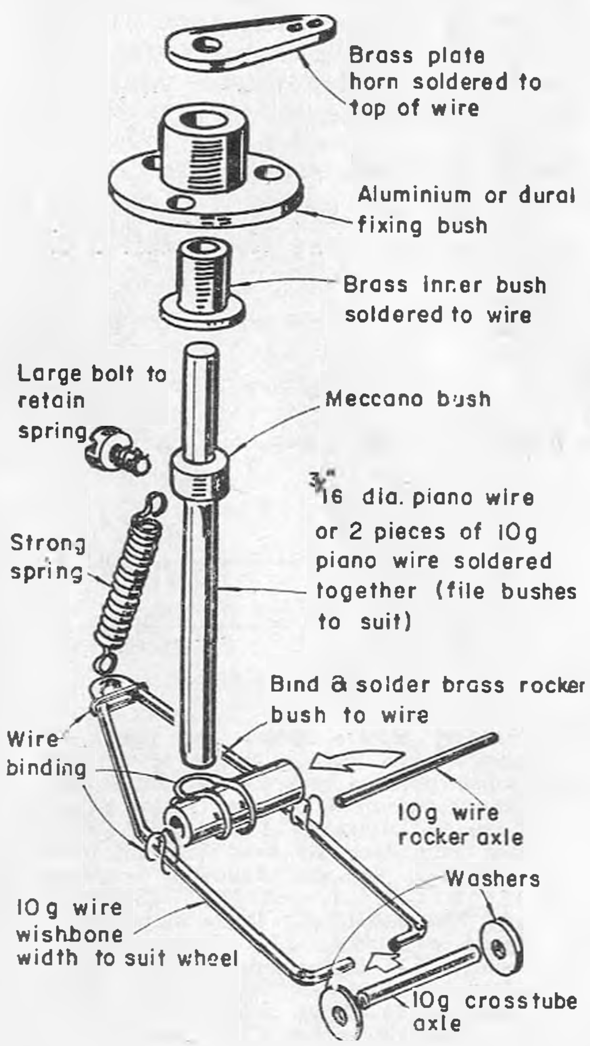
Swinging Arm Nose Wheel

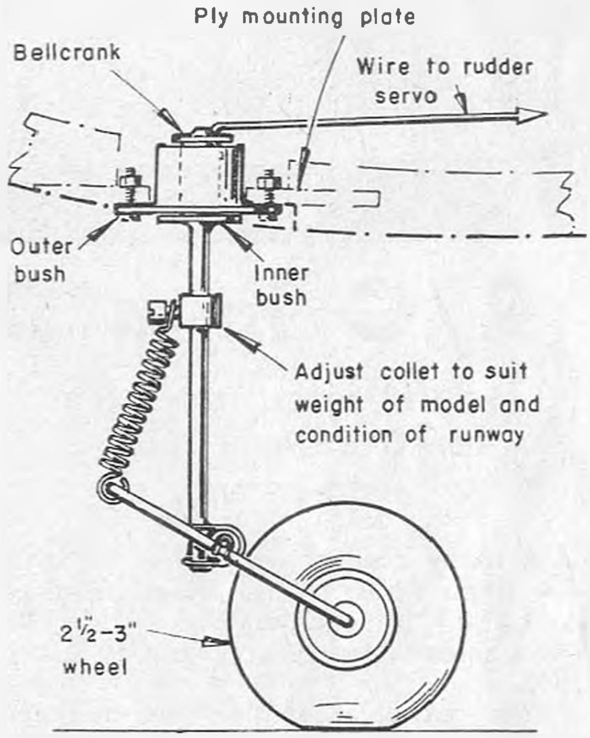
By M. FRANKLIN

Steerable suspension for nose wheels has long been a source of much brow wrinkling with the problem of getting fairly deep springing without affecting the steering facilities so necessary on a multi model today. M. Franklin devised a cunning system for his "Reflex" which obviates the difficulties of bending accurate spirals in ten or twelve s.w.g. piano wire.

THE Voltswagen nose wheel unit seemed to start the trend over here for coil spring suspension, designers of subsequent models and those adapting

FIG. 1





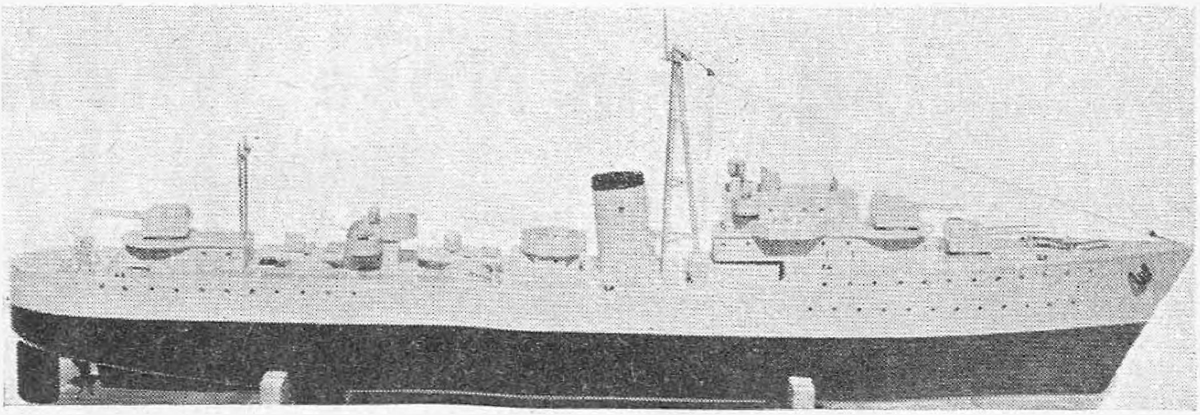
Note wheel hangs loose in flight, allow for shorter length when compressed in order to retain prop. clearance

FIG. 2

two wheel machines to tricycle have hitherto been content to follow that lead. Consequently, commercial units have been the only main source of suitable units. Restricted supply and limitations of the pocket may have curtailed the numbers to be observed today.

The reasonably simple do-it-yourself nose wheel is shown here; exact dimensions will depend on the use to which it is put although the material sizes should be adhered to, ensuring a strong structure. A big advantage of the system is that various springs and tension thereof may be tried to suit different models or different runway conditions. The most important points to watch during construction is the soldering of the bush to the lower end of the leg; silver soldering or, if one has the facilities, brazing would seem to be the best proposition. Most of the bits and pieces may be found in the junk box although there may be difficulty

[Continued on page 303]



R/C in a Destroyer Kit

Helpful installation gen for 6 channel radio equipment

By
C. J. COLLARD and
P. WELLS

As many readers will know, the ship upon which this kit model is based is H.M.S. "Meteor", one of several 'M' Class ships completed between 1940 and 1942.

This particular model was designed by Mr. H. May who is to be congratulated upon producing a model which combines a pleasing near-scale appearance, with reasonable stability and sea-worthiness.

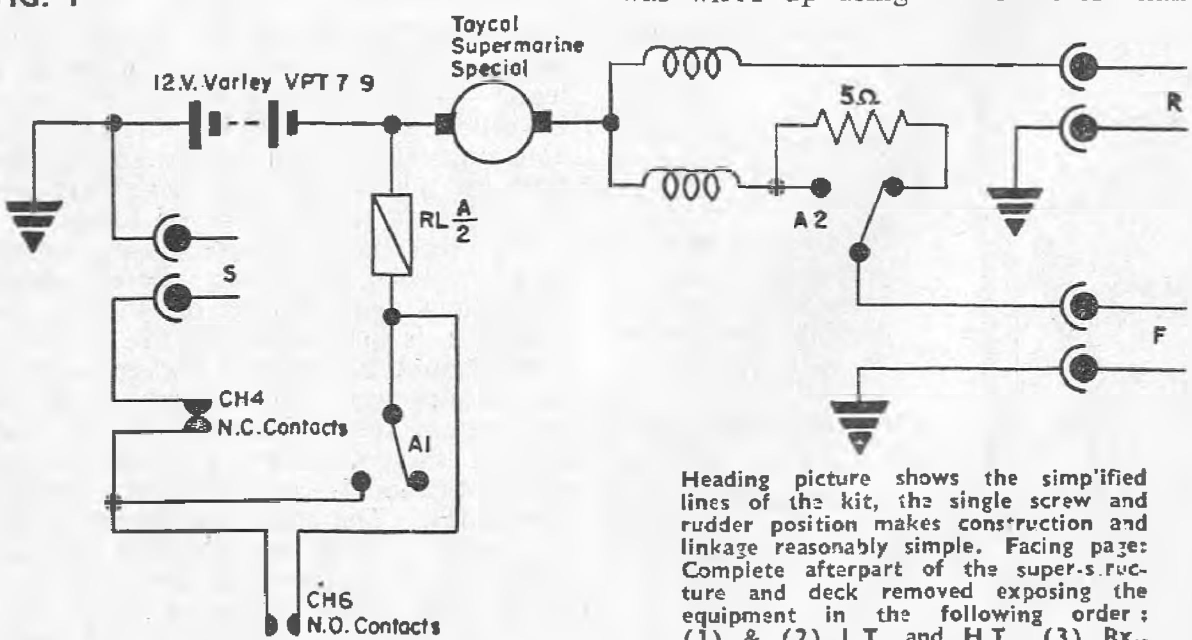
Radio Link

Control of the destroyer is effected by means of an E.D. Black Arrow, 6-channel transmitter/receiver, linked up to the necessary switch gear. The final circuit employs 2-channels for rudder control, three for motor control and one for the hooter.

Speed Control

For the test run the motor control was wired up using two receiver chan-

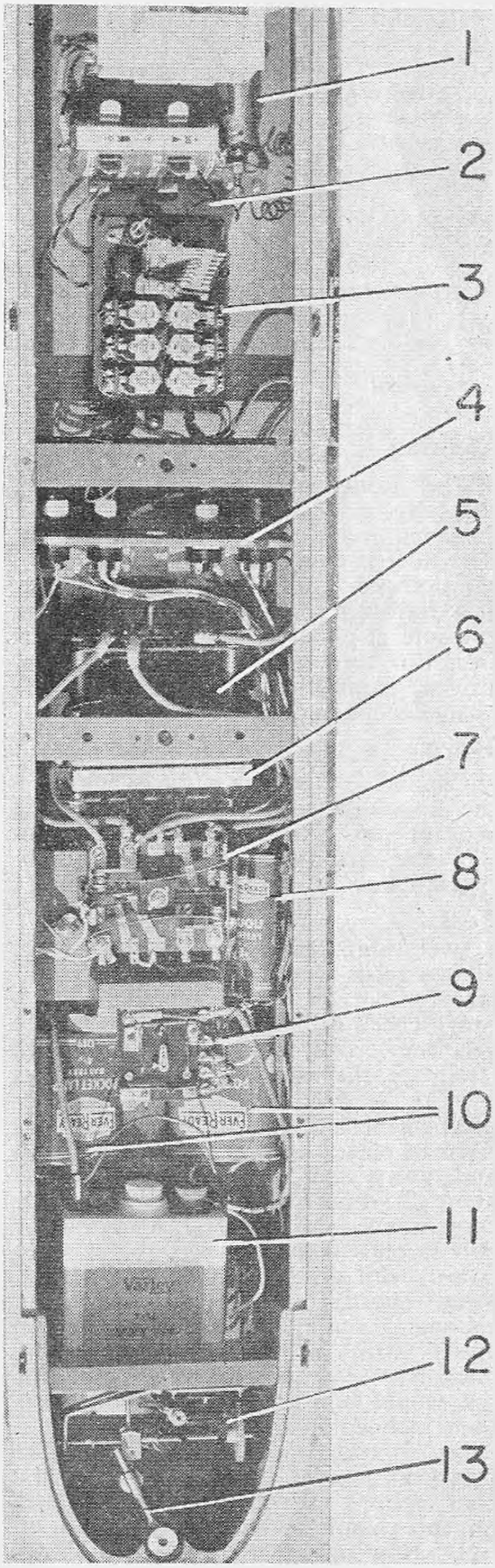
FIG. 1



Heading picture shows the simplified lines of the kit, the single screw and rudder position makes construction and linkage reasonably simple. Facing page: Complete afterpart of the superstructure and deck removed exposing the equipment in the following order: (1) & (2) L.T. and H.T., (3) Rx., (4) Plug panel, (5) Drive motor, (6) Speed resistance, (7) Speed escapement, (8) Escapement battery, (9) Steering escapement, (10) Servo batteries, (11) Drive accumulator, (12) Steering servo, (13) Tiller.

nels 6 and 5. Channel 6 operating a Fred Rising 4 position escapement with a switch unit built up on $\frac{1}{16}$ in. Paxolin sheet. The forward and reverse contacts were made up in pairs at first but the actuator power was insufficient to close a pair of contacts (5 amp) with 100% reliability so the actuator crank was used as a rotating contact which makes with the forward and reverse spring contacts as it rotates. This has proved reliable so far with no expensive blue sparks from the escapement gearing, which carries the motor current. The sequence of the escapement switch gives position 1—Stop; 2—Half ahead; 3—Stop; 4—Reverse. Position 2, half ahead, complete the motor circuit to earth via a 5 ohms resistance from part of a cooker element mounted in a ceramic box above the motor. This is partially cooled by armature windage of the Taycol "Supermarine Special" motor. Position 3 is stop. The motor supply is broken as soon as the rotating contact leaves the half ahead contact but with the rotating contact in position 3, a pair of N.C. contacts are broken and this is made use of when the motor is running at full speed as will be explained later. Position 4 completes the motor supply to earth via the reverse field winding. Channel 5 is used for full ahead operation and incorporates a heavy duty 12 volt relay with three pairs of change-over contacts. The relay in question is a government surplus job costing 8/6d. and includes a current saving device which cuts consumption to 90 m.A. when energised. Two pairs of change-over contacts are used here. Contacts A.1 are used as hold on contacts after the initial blip from channel 5 receiver relay. Contacts A2 change over and bypass the 5 ohms dropper resistance.

As the four position speed selector carries the motor current for half ahead and full ahead it follows that full ahead can only be achieved once half ahead has been selected. Hence operating the selector to the next position (STOP) cuts the motor supply and also breaks the contact 5. These contacts are in series with the full ahead relay so ensuring that the relay drops out, contact A2 drops back, leaving the 5 ohms resistor in circuit for the next forward operation (half ahead). This was the set up for the trial run on the pond.



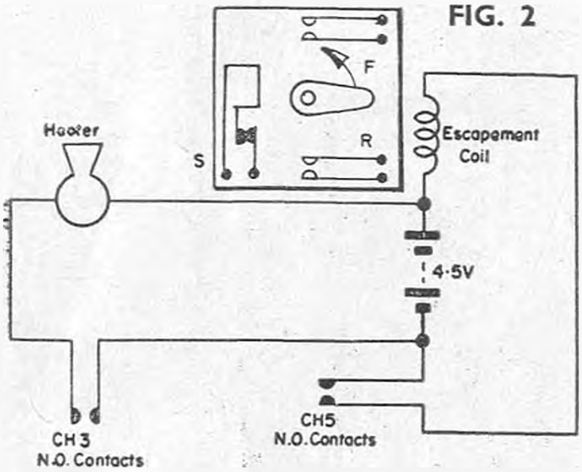


FIG. 2

Steering

The rudder servo is a Ripmax unit, basically a Mighty Midget driving a threaded rod through a reduction gear. The tiller is connected to a carriage running on the threaded rod. The carriage just runs off the thread against spring pressure at either end so eliminating the need for limit switches. The M.M. is driven from two 4.5v. batteries via channels 1 and 2 in the receiver.

Horn

Channel 3 operates a cycle horn via the 3 volt battery used to operate the selector escapement, this arrangement left one channel spare for any additional items, after the initial test run.

Test

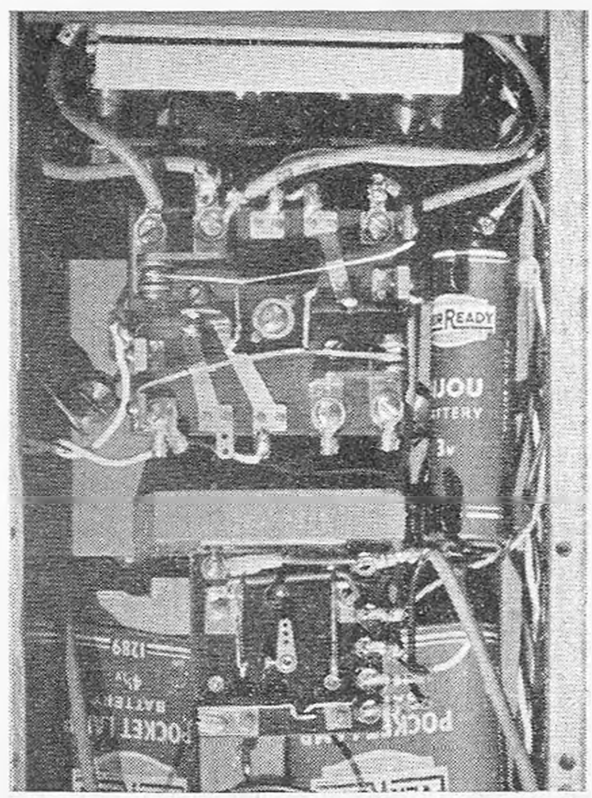
Everything was set up for launching; all the reeds were checked at the pondside for correct operation and finally a range check using the horn. (This handy accessory saves much arm waving and strain on the vocal chords at 200 feet plus!) A final wind on the selector escapement and the superstructure was fixed in place. A firm jab on channel 6 and away she went, building up to about 2-3 knots on half ahead. Rudder response was fairly fast (approximately two seconds from full port to full starboard) with slight heeling on full rudder. Dead ahead, half ahead, a blip on channel 5 and the destroyer was at full speed with a bow wave washing anchors. (A conservative estimate for this would be 6 knots). The rudder was then inclined over in case of any tendency to turn turtle or ship water, but maximum rudder was reached with the boat heeling at about 15°. Another blip on channel 6 brought the motor to rest. Now for reverse. As soon as the motor received the full reverse current the torque produced an alarming list to port but this soon righted itself as the motor reached maximum speed. The ship quickly picked up speed until water was slopping over the stern—obviously a modification was needed here to reduce the power in reverse.

Having seen the model perform, we decided that the spare channel we were saving for any additional items not essential to the running of the ship would be wasted on rotating gun turrets, etc. as the superstructure detail diminishes to virtual invisibility at 20 ft. plus.

Spare Channel

With the existing motor control set up, reversion to half ahead from full ahead could only be achieved by blipping the selector through 360° and so dropping out the full ahead relay. This is where our remaining channel was used. By wiring the normally made (de-energised) contacts of channel 4 relay in series with the full ahead relay supply, full ahead could be selected as usual by channel 5 with reversion to half ahead by channel 4.

With three channels for motor control and two for steering, our one remaining channel is the hooter. This channel can



Escapement switchers—Upper: Speed and reverse control; Lower: Steering selector.

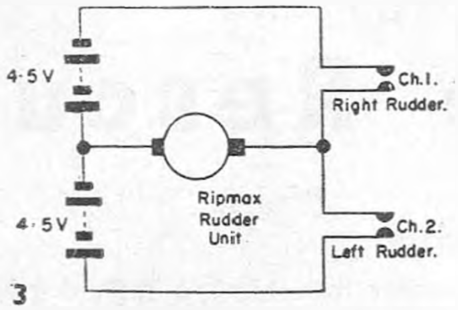


FIG. 3

be used for driving "extras" if necessary, the functions being accompanied by a blip on the horn. Any extras though will have to be very light as at 25 lb. weight there is very little freeboard left to play with in safety. At least, at the time of writing, there is a full season ahead for experiments!

The six Varley dry accumulators are laid flat in the bottom of the model (only two are visible in the photo) and the E.D. 6-channel receiver and batteries are mounted on a removable panel amidship. All control connections from the receivers relays are taken out via four Bulgin 3-pin plugs and sockets so that the Rx. unit is completely detachable, providing easy access to the accumulators.

TRANSISTOR CHARACTERISTICS OF SOME TYPES USED IN RADIO CONTROL.

Make and Number	*Cut-off Frequency Mc/s.*	*Gain at 1 Kc/s*	*Max. Vce (V.)*	*Max. Ic (mA)*	*Max. Diss at 25°C*	*Typical use and type other than switching/or Oscillators*
Mullard						PNP—
OC23	2.5	180	–40	–2amp	15W	High Freq. Power Output
OC44	15	100	–15	–10mA	70mW	Osc./Mixer RF Amplifier
OC45	6	50	–15	–10	70mW	RF and IF Amplifier
OC70	—	30	–30	–50	125mW	Audio Amplifier
OC71	—	50	–20	–50	120mW	Audio Driver Amplifier
OC72	—	50	–32	–250	125mW	High Gain Audio Amplifier
OC76	—	45	–32	–250	125mW	Radio Control Switching
OC170	70	100	–20	–10mA	50mW	Short Wave up to 100 mc/s
OC171	100	100	–20	–10mA	80mW	SW. FM. up to 200 mc/s
OC200	1	20	–25	–50	250mW	Silicon Audio Amplifier
Newmarket						
V30/10P	—	15	–15	–3amp	10W	Medium Gain High Power
V30/20P	—	22	–3	–3amp	10W	Higher Gain Power Output
V30/30P	—	30	–30	–3amp	10W	Push-Pull up to 10 Watts
V15/20IP	—	30	–15	–2amp	2W	1 Watt Single End
Surplus						
Red	—	30	–15	–50	100mW	PNP Audio Amplifier, etc.
White	3	40	–15	–15	100mW	PNP RF and IF Amplifier
Green/Yellow	—	30	–10	–20	125mW	PNP Audio Amplifier, etc.
Red/Yellow	2-6	40	–10	–20	120mW	PNP RF and IF Amplifier
Semi-Conductors						
SB305	30	25	–6	–2	10mW	SB Radio Control & Short Wave
SB231	40	40	–45	–3	10mW	SB Radio Control & Short Wave

TRANSISTORS DESCRIBED IN "TRANSISTOR TRENDS"

T	*Type*	*Max. Vce*	*Power Dissipation*	*Max. Frequency*	*Collector Leakage Current*	*Current Gains*
OC 71	Alloy	20V.	120 mW.	0.6 Mc.	4.5μa	40
2N35	Grown Junction	25V.	50 mW.	0.8 Mc.	5μa	40
SB345	Surface Barrier	5V.	20 mW.	50 Mc.	3μa	30
OC 170	Alloy Diff.	20V.	50 mW.	70 Mc.	1.5μa	80
2G101	Mesa	15V.	60 mW.	300 Mc.	7μa	15
2N708	Planar	40V.	1.2 W.	300 Mc.	0.025μa	80
TK253A	Epitaxial Planar	40V.	0.6 W.	300 Mc.	0.05μa	40

Table giving approximate characteristics of representative transistors.

R/C to the Rescue

By T. O. PEPPIATT

and

R. A. G. PADDON

R/C or engine failure? Use an R/C "Retriever"

We wonder how many R/C enthusiasts, like ourselves, have had the unpleasant experience of having to stand and watch one's boat describe small circles or drift helplessly having developed mechanical or electrical faults whilst running. Although there are several recognised methods of recovery, we consider that our recovery system is the quickest and the most novel, since only one person is involved. In order to do this it was decided to construct a second boat, this boat to be as simple as possible and required to take a thin buoyant line (i.e. fishing line), around the distressed vessel and then to head back towards the operator. When the Rescue Launch has headed "home" the operator winds in the other end of the line, hence recovering the distressed vessel.

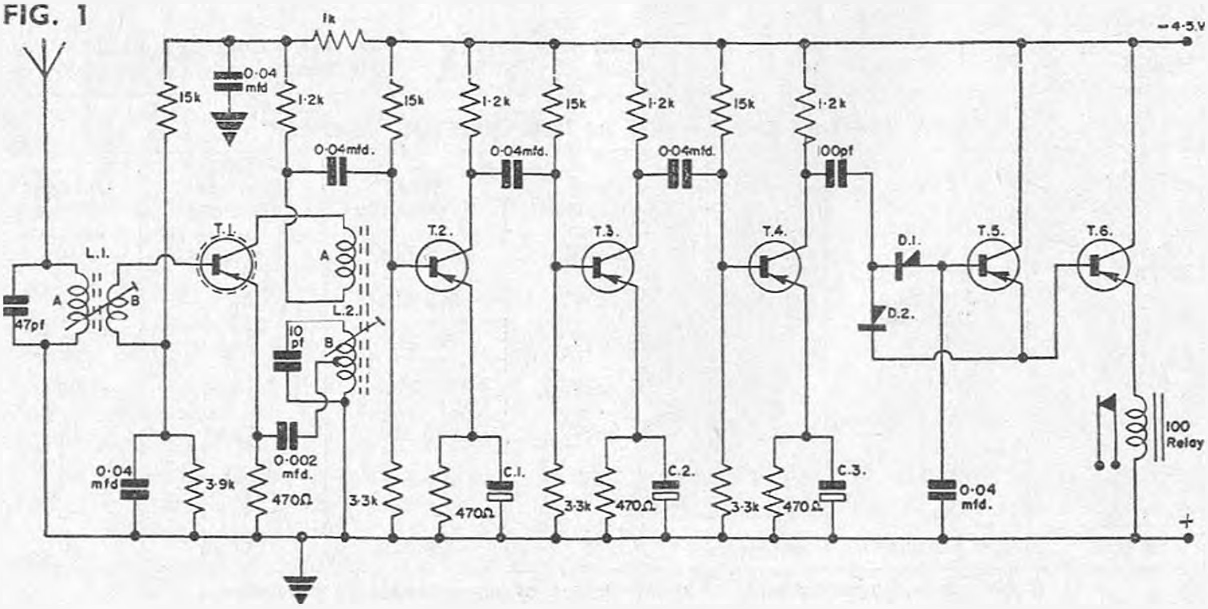
Receiver

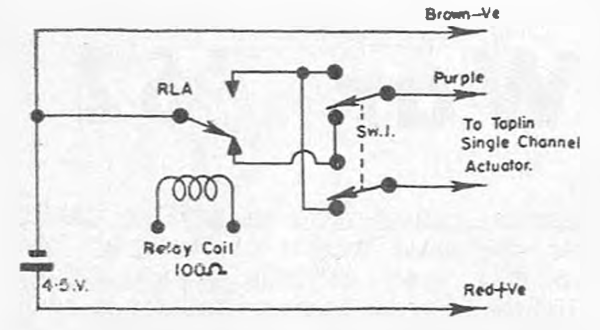
In order to achieve a high degree of reliability the compact lightweight receiver designed by J. W. Ford in *R.C.M. & E.* May 1960 was ideal for use, since it is carrier wave operated. This enables one to use the same transmitter for both carrier and modulated tone transmissions, consequently permitting the independent operation of two boats.

Once again stressing reliability the power for the boat was supplied by a Taycol Meteor electric motor run by two 6 volt accumulators in switched series-parallel connection to give a choice of two pre-set speeds.

Before proceeding to our modifications and adaptions of J. W. Ford's circuit we should like to point out an error shown on the component layout diagram illustrated on page 41. The layout showed the emitter of T6 joined to a .04μf capacitor but it is evident from the circuit diagram that the emitter of T6 should be joined to the relay coil and the 04μf capacitor to the base of T5. Secondly the wire used for winding the oscillator coil as mentioned in the article (10/47 Litz), is not readily obtainable in England but 9/45 Litz was found to be a satisfactory substitute.

FIG. 1

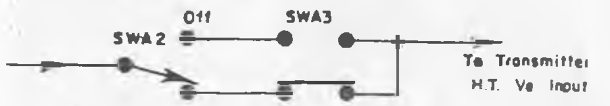




SWI. Is Set For Two Boat Operation.
RLA Is Shown In Energised Position.

FIG. 2

FIG. 3



SWA2. Continuous Carrier Wave for Two Boat Control
In Off Position Carrier Wave Boat Control Only
SWA3 Push Button Switch Shown in Unpressed Position

Modifications

In order to operate J. W. Ford's receiver and at the same time run a powerful electric motor in close proximity, it was necessary to attenuate interference generated by the motor as this was sufficient to actuate the relay. Suppressing the motor was not a cure. This attenuation was obtained by substituting a 100 pf. capacitor in place of the .04μf coupling capacitor between transistor, T5, and the diodes, D1 and D2, forming a high pass filter thus preventing low interference pulses from actuating the relay.

Adaptations

For two boat control it was necessary to overcome the effect of a continuous carrier wave being transmitted whilst operating a tone receiver. This was effected by fitting a switch, which reverses the action of the relay permitting the carrier wave to be left on and then by switching the carrier wave off the rescue launch can be controlled or by adding modulating tones, the other vessel can be controlled.

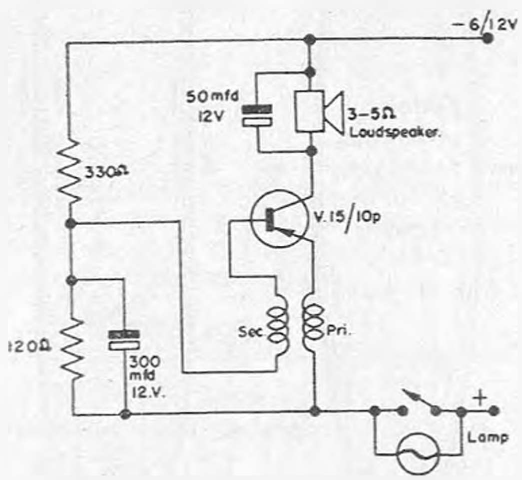
TRANSISTORS IN BOATS

[Continued from page 288]

The two resistors can be replaced by a preset potentiometer which can then be adjusted for optimum results; however the circuit as shown in Fig. 2 works admirably, with plenty of noise.

One criticism is that the siren starts

FIG. 2



too abruptly. One remedy is to include a light bulb of the ratings 6 volts and about .75 ampere current capacity. This tends to "slurr" the note at the beginning. The small electrolytic across the loudspeaker terminals tends to soften the note.

The same precautions apply as to maximum values of potential and current and as to the correct polarity of the leads.

List of parts for the speed control:—

1 820 ohm ½ watt 10% resistor.
1 175 ohm ½ watt linear potentiometer.
1 v15/10P power transistor.
1 suitable heat sink.
1 two-pole two-way switch.
1 servo motor and reduction gearing.

List of parts for the siren :—

1 Loudspeaker 3-8 ohms.
1 50mfd. 12 VDC capacitor.
1 300mfd. 12 VDC capacitor.
1 330 ohms ½ watt 10% resistor.
1 120 ohms ½ watt 10% resistor.
1 V15/10P power transistor.
1 battery portable output transformer (see text).
1 bulb 6 volt .75 ampere.

Gremlin War '62

FAIR OR UNFAIR WEAR AND TEAR MAY RUIN THE GEAR. REDUCE THE RISK WITH INSTALLATION PLANNING

WELL, it can happen to anyone no matter how carefully the "electronics" are constructed and the aircraft designed, there will inevitably be a lapse when the pilot miscalculates. If you have been lucky in this respect so far, have patience, the time will come when the model bites the dust. Anything you can do while installing the equipment to reduce the possibility of damage in this event is to be welcomed. Not only can equipment become ruined by incorrect fixing but the effect on the airframe can also be responsible for severe damage to the latter when the equipment tries to race the tailplane to the runway.

Fuselage Design

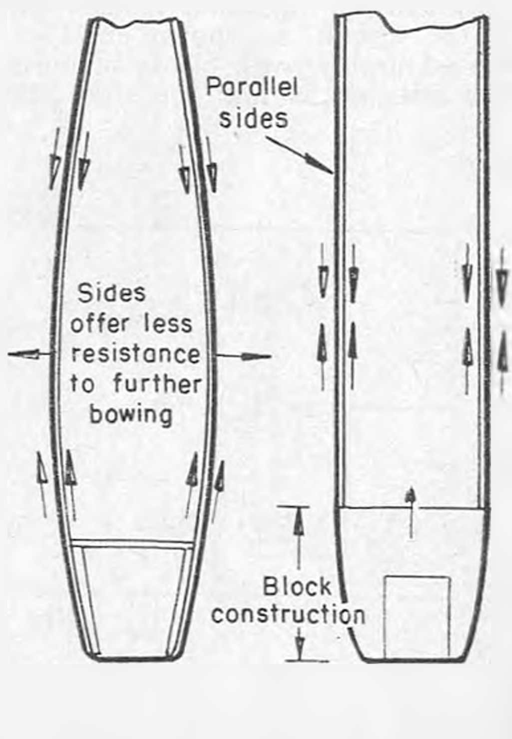
Although the appearance of a parallel sided front part of the fuselage leaves something to be desired from an aesthetic point of view, the stressing of such a fuselage is considerably easier. Study Fig. 1: note how sides which are already curved are halfway towards collapsing when a comprehensive load is applied to their ends. The consequent bursting of a fuselage in this way is already apparent with free-flight models, especially where the curvature occurs at the wing seating, where there is very little by way of a fuselage top to support it. Radio models, some of necessity, some for convenience are without vital formers at this station.

With parallel sides the compressive load travels through the centre of the material providing far greater rigidity when subjected to a compressive load. Pick up a sheet of balsa and subject it to this test, it is surprising how easily the wood bends even further when it is slightly bowed initially. Parallel sides also permit a slightly curved *cross-section*, providing even greater rigidity for the same weight of material; pick up that sheet of balsa again, curl it slightly in cross-sections and try it again (if you have not already broken it). Only a slight curve is needed and the constructional difficulties should not be insurmountable. Such refinements are more applicable to the larger sized model, and the wider nose of the parallel sided job may be faired in by the use of plenty of block so that the loading is transferred straight on to the end of the parallel part. Naturally, the rear part of the fuselage may be tapered, as this is not laden with the heavy part of the equipment and is consequently lower in inertia.

"Potato Sack" Theory

If the model is allowed to "arrive" like a sack of potatoes one must expect any batteries or loosely stowed pieces of heavy equipment to act in a similar manner to the potatoes in the aforementioned sack, that is to say instead of remaining comparatively neatly in line astern, those behind try to get to the front and those at the front are forced

FIG. 1



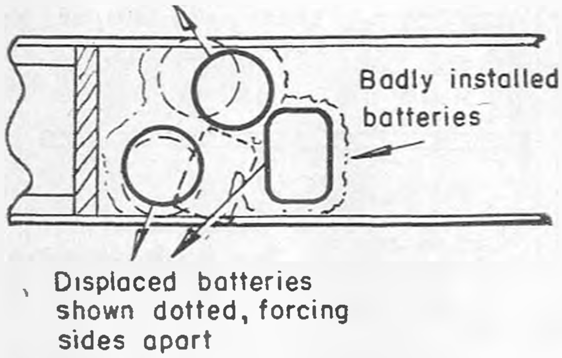


FIG. 2

out sideways. This often proves too much for the sides of the fuselage, which, unlike the potato sack, are not intended to be flexible.

Study the shape of your batteries, etc. when wrapped in foam rubber and arrange those which are not stuck or clamped down so that they bear directly on a strong former in such a way that no wedging action occurs. Fig. 2 shows the incorrect and Fig. 3 the correct placement of batteries.

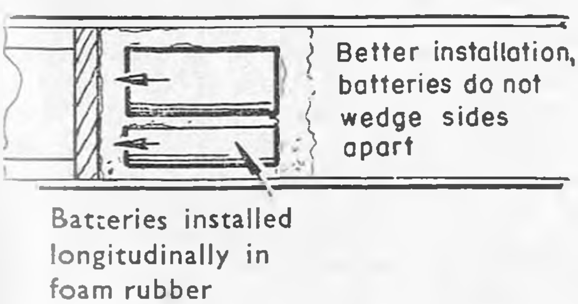
Transferring the Load

If the equipment is fixed to parts of the structure, then the weights of these units is taken by that particular component of the air-frame. There are two schools of thought, both of which may be influenced by the need for accessibility, transferability and by the type of equipment used. We will investigate the relative merits with regard to resistance to damage of both equipment and model.

Distributed Installation

Locally weak, stressed skin construction would seem to be best treated by fixing the servos separately to the sides and bottom of the fuselage, thus the loading of each servo is distributed via suitable vibration absorbing attachments. It will be seen from Fig. 4 that taking a couple of servos at a total of say four ounces, the loading is only half an ounce per fixing point so that the total weight of the servos is distributed over a larger area of the sides though the total weight is still felt on the forward end of the fuselage. The receiver, in a sponge rubber lined compartment transfers its loading to the fuselage sides via a bulkhead and the batteries, forward of this on to the main front former which usually takes most of the shock.

FIG. 3



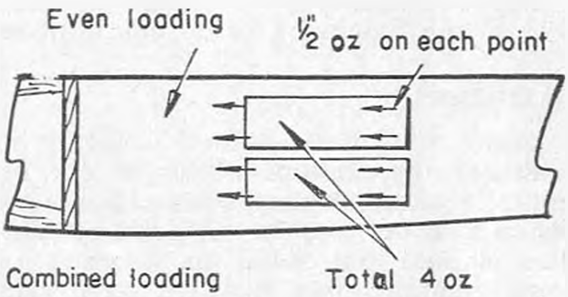


FIG. 4

Concentrated Installation

A popular method of installing servos is that of a plate which may also be held with vibration, absorbing fixings to short bearers on the fuselage sides. (Fig. 5).

The sides of this point must be reinforced so that the loading on the fixing points, now about twice that of the previous installation is distributed over a wider area or taken forward on to the main bulkhead. Batteries and receiver may be installed according to this method but there is a chance that the complete servo installation will damage the receiver if it breaks away. Perhaps a better method is the complete installation plate which transfers most of the loading straight on to the front former and may even be used to hold the sides of the fuselage together at the same

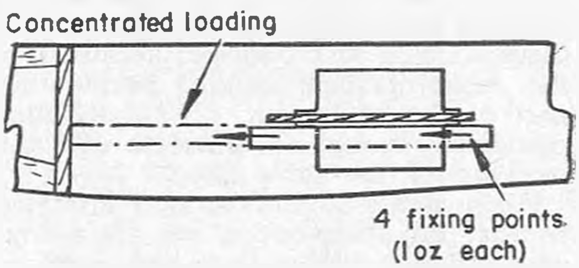


FIG. 5

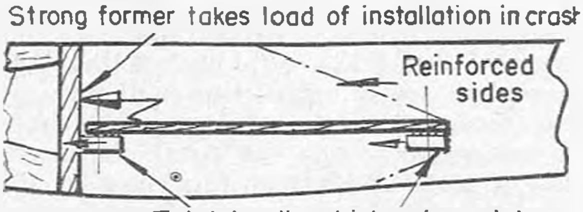
time. Weight and space considerations may not always permit the use of such an installation although it scores on grounds of transferability and the fact that the plate may be made strong enough to prevent the servos striking the receiver. Batteries may still be carried separately if space does not permit installation at the front end of the plate. Try to balance the weight of the equipment on both sides of the plate so that there is less chance of the latter bending due to uneven inertia caused by having all the weight on one side. Fig. 6 shows fuselage requirements for this type of installation and Fig. 7 the balancing of a typical plate.

Harnesses

Some modellers find it difficult to estimate the amount of stress put on plugs, sockets, connections and harnesses when a model crashes. A good installation should not suffer as a result of such treatment, in fact we have seen such gear picked out of the remains of a model like so much discarded Christmas tree decoration with everything still working. Naturally if plugs and sockets are used it is better to employ the free socket type in preference to one bolted to the structure, this enables both sections to move when stressed, avoiding loads on leads to the socket which would otherwise occur if this was of the fixed variety. Furthermore, there is a chance that the plug will remain in place and its pins will be protected. It might even be helpful to glue a thin layer of sponge plastic on to the servo cases so that less damage is caused in the event of them striking some other part of the equipment. Naturally such refinement should not interfere with the working of the servo itself.

All switches should be well insulated so that no shorts occur on their connecting tags. Where these are close together it is necessary to insulate each

FIG. 6



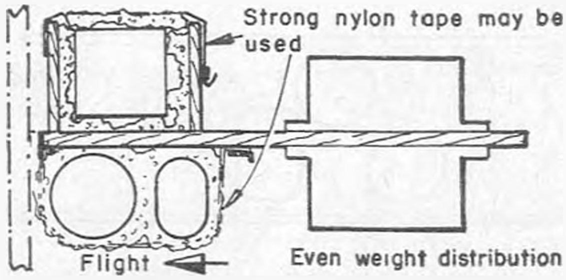


FIG. 7

tag separately before covering completely with a layer of plastic adhesive tape. It might be helpful to mount the switch in balsa rather than ply so that it tears out if the harness is pulled hard. Alternatively a rubber grommet in an oversize hole will provide a suitable pop out fixing for throat mounted switches. The length of wiring harnesses is most important; there should be sufficient wire to permit the equipment to move to the fullest extent short of coming right outside the fuselage, so that there is no strain imposed on the junctions. Nevertheless, it should be possible to support all the gear on the harness before insulation without any damage to the connections. Careful inspection is essential before applying supporting coverings and insulation to the ends of the harness, batteries and equipment. Making a really foolproof job of this protection is of more value than having everything open just to see if a wire is fraying, the chances are that it will be alright on one pre-flight inspection and fall apart in the middle of a "touch and go" part of the schedule.

Conclusion

Attention to layout, installation and wiring should result in less damage to the structure by radio equipment and less damage to the equipment itself either mechanically or electrically if a model prangs.

Lesser precautions are necessary for boat installations although the sudden sensation of forward motion in this case when the helmsman comes ashore at full bore could result in similar damage to the equipment even if the hull remains comparatively unscathed. One naturally supposes that a gear is protected from the intake of water in the event of a boat "going down", in fact we shall deal with wetness and the effect of the elements generally on equipment in our next issue.

Super Finishes for R/C

VIC. SCHWEGMANN

describes the use of a sealer for R/C models

A GOOD R/C model deserves a super-finish with the ability to withstand many hours of flying. Here is one way to produce such a finish.

1. Sand all surfaces to be covered with No. 150 paper followed by 220 until smooth.
2. Dissolve one teaspoon of Emultex D.S. 1034* in half a cup of water, stir well and brush this mixture over all sanded surfaces, *lightly* on thin balsa sheeting.
3. When *properly* dry, paper again with No. 220 followed by 320 until *very* smooth.
4. Apply Emultex D.S. 1034 liberally and *well* brushed in
5. Smooth with fine steel wool.
6. Apply second coat of Emultex D.S. 1034 sparingly but well brushed.
7. Smooth with fine steel wool, followed by No. 220 paper.
8. With brush, flow on good coat of Sanding Sealer. Not on exposed edges of ribs of wings and stabiliser or on cap stripping.
9. Rub lightly with fine steel wool.
10. Wet fabric, squeeze a *little,* and stretch well over surface.
11. When well stretched and taut, with no creases, brush thinners lengthwise along one side and with fingers keep smoothing until dry. Now wet remaining surface with thinners and keep stretching and smoothing, working away from such down side, until dry. It is *essential* that fabric is *well stretched and taut,* both on fuselage and wings, etc. If model is to be left in natural fabric colours, ensure that no thinners creep into fabric panels as this leaves watermarks.
12. Hold surface up to light and if wrinkles or slackness are visible, remove by wetting affected part with thinners and pulling and smoothing fabric.
13. With razor-blade, trim off surplus of fabric and secure with thick clear dope, smoothing to edges with fingers while drying.
14. With thinners, wet about 12 sq. ins. of wood covered surface, and with first two fingers of right hand, rub rapidly with a circular motion, until dry. Continue this procedure until all wood covered parts have been treated. Fabric panels and rib edges are not treated in this way as there is no sanding sealer to be brought up into the fabric. Drawing the sanding sealer up into the fabric this way, substitutes for one coat of dope.
15. Spray or brush lightly, *entire* fabric with amyl acetate.
16. Brush in one coat of undiluted clear tautening dope. In fabric panels, dope should first be stippled or dabbed on, and then brushed smooth. This lessens tendency for dope to seep through the pores of the fabric and accumulate underneath. If blushing appears spray or brush lightly with amyl acetate.
17. Rub with fine steel wool, lightly over fabric panels.
18. Brush on final coat of Emultex D.S. 1034 freely on fabric panels, sparingly elsewhere
19. Rub with fine steel wool, followed by 320 paper. Firmly on edges trimmed off with thick dope in stage 13.
20. If the model is to be left in natural fabric colour, then at this stage apply trimmings, such as stripes, etc. When thoroughly dry, spray one *good* coat of clear tautening dope.
21. Spray or brush fuel proofer.

or

20. If model is to be finished in coloured dope, spray one *good* coat of coloured tautening dope, masking for trimmings.
    If model is not overweight and a high finish is desired, spray one coat clear dope.
21. Spray or brush fuel proofer.

**Superceded by Emultex D.S. 1075/5, a ready mixed version in liquid form.*

Servo Report

By T. H. IVES

MICROPERM motors power these two new servos.

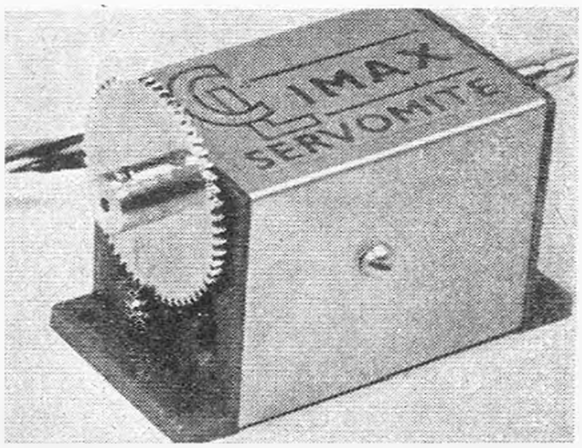
These servos are attractive on account of size and weight and are suitable for the smaller multi aircraft now appearing. It is designed for use with reed receivers and include a printed circuit switchboard which performs the normal functions of limit switching and power neutralising. Transistor amplified versions are also available.

Climax Servo

Motorised servo units for multi control are not cheap, and when up to five servos are used in an aircraft the cost can be quite high.

The Climax Servo just received for test, retails at 59/6d. (amplified: £7.19.0) and is therefore attractive on account of price alone. The unit is reasonably well made and should perform satisfactorily over long periods, provided normal attention is given to maintenance.

The Microperm motor forms the basis of the unit and due to its small size and weight a compact and light servo is the result. The motor is mounted in a flexible plastic case and drives a Mighty Midget type of gear which in turn drives a shaft threaded into a tubular push rod. A small block of Tufnol is fixed to the push rod and this carries the spring nickel silver wire fingers along the P.C. switch board. A metal case surrounds the screwed rod and the switch board and this should eliminate some of the troubles which



Weight: $1\frac{1}{3}$ oz., relayless $1\frac{2}{3}$ oz. Size: $1\frac{15}{16}$" long x $1\frac{1}{16}$" wide x $1\frac{7}{16}$" high ($1\frac{5}{8}$" relayless).

occur in the case of unprotected mechanisms. However, it would be a good idea to examine the works occasionally and clear any dust from the screwed rod.

The voltage recommended by the makers is 3 to 4.5. We tested on 4.5 volts and obtained the following results:

Load	10 oz.	16 oz.	32 oz.
Current	300 m.A.	360 m.A.	480 m.A.
Transit time—			
On signal	.7 secs.	.9 secs.	1.25 secs.
To neutral	.6 secs.	.7 secs.	.7 secs.

Switching efficiency: 100%.
Travel: $\frac{5}{16}$ in. approximately.
Centring: Accurate.

We have no hesitation in recommending the unit to the modeller who requires a reasonably efficient servo at a low price. Sole distributors, R.E.P. Ltd.

★ ★ ★

Annco Multi Servo

THE makers are Annco Engineering Co., 6621-10th Avenue So., Minneapolis 23, Minnesota. The unit is offered in four models No. 2R for relay operation—normal speed, 2RL relayless and 3R slow speed relay operation, 3RL slow speed relayless.

The unit submitted for test was the 2R and the makers specification is as follows:—

Weight 1.3 ozs., relayless 1.7 ozs.
Size: $1\frac{3}{4}$ in. long x $1\frac{9}{16}$ in. high x $\frac{3}{4}$ in. thick.
Travel total: o.d. $\frac{5}{8}$ in. straight linear motion.
Transit time: $\frac{1}{2}$ sec. from neutral average.

Drain: 110 to 250 m.A. no load to 600 m.A. stalled at 2.4 volts.

Thrust: Over two pounds on standard models. Four pounds slow speed.

The motor is the now familiar Microperm, which drives a train of nylon gears to a final nylon toothed rack. This provides the straight linear motion claimed by the makers, and with a projection each end of the case provides a convenient method of attach control rods for different types of installation.

An extension on the rack provides a fixing for the phosphor bronze fingers which do the actual switching operations. Provision is made for adjusting the neutral position.

The servo was quite efficient in operation but on heavy loads the rack tended to skip the gears. This was due to its flexibility allowing the small teeth to disengage as it bent under load. Slightly larger teeth on the rack, final gear and some form of guide to prevent bending would cure this. However on normal loads there should be no trouble in this direction.

Figures obtained on test at 3 volts were as follows:—

Load	6 oz.	14 oz.	32 oz.
Transit time—			
Current	200 m.A.	240 m.A.	300 m.A.
On signal	.6 secs.	.65 secs.	.8 secs.
To neutral	.5 secs.	.55 secs.	.3 secs.*

*At point * the rack skipped.*

Switching efficiency: 100%.

Travel from neutral: $\frac{5}{16}$ in.

Centring: Accurate.

The units are distributed in U.K. by Ed. Johnson and the prices are 2R: £5 4s. 0d.; 2RL: £12 0s. 0d.; 3R: £6 0s. 0d. and 3RL: £12 15s. 0d.

TRANSISTOR TRENDS

[Continued from page 279]

saturation is reached but the heat is then maintained and the impurities in the pellets diffuse into the slice. The 'p' type impurities in the emitter pellet diffuse very slowly and penetrate only a negligible distance: the 'n' type impurities that it also contains have a high rate of diffusion and so penetrate further into the slice to form an 'n' type layer. This layer forms the base and it is possible to limit its thickness to only five microns.

When the assembly cools a layer of germanium recrystallises out in the same way as it would by any alloying technique. The layer beneath the emitter pellet is predominantly 'p' type because the 'p' type element used is more soluble in recrystallised germanium than the 'n' type present. This forms a p.n.p. junction with the diffused 'n' layer and the original 'p' type collector slice. The recrystallised layer under the base pellet is predominantly 'n' type and forms a non-rectifying contact to the thin base region. Surplus material is now etched away and the transistor is ready for encapsulation.

WHY USE RADIO?

[Continued from page 282]

necessary to remove some metal before the side pieces are soldered on.

You have now made yourself a transmitter. We will publish more information when we have carried out tests with further models including gliders.

Receivers

First the microphone; this may be of the carbon type, but as this is so sensitive to vibration it is likely to pick up vibrations from the drive motors or escapement despite padding in sponge plastic. Mechanically induced response was amplified producing unsatisfactory results in earlier models. The more expensive crystal and dynamic microphones are a better proposition. Extra weight is the penalty one must pay when using crystal microphones, matching transformers also result in a little extra payload. A further stage of amplication must be used if the transformer is omitted. Study the circuit diagram in Fig. 3, note that a dynamic microphone of 2,000 ohms should be connected at x-x. The tuning to various tones is achieved in the circuit L/5 where L/1 consists of a ferrite pot with about six hundred turns while C5 may be anything up to 100,000 pf.

Electronic Workshop

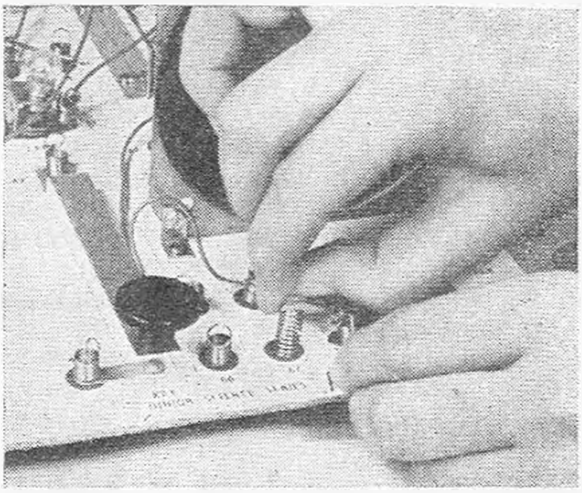
A Review of the Daystrom Junior Science Series Kit

WE had the pleasure of examining and experimenting with Model EW-1, one of the Daystrom Science Series kits. The kit makes an excellent instructional and experimental piece of equipment. An ideal form of initiation into the electronic field for members of the younger generation.

The basis of the kit is a form of breadboard which carries a complete set of components necessary for the various experiments. These are held in place by nuts and bolts and inter-component connections are made via clever coil spring connections enabling several flexible leads to be clamped between the spirals.

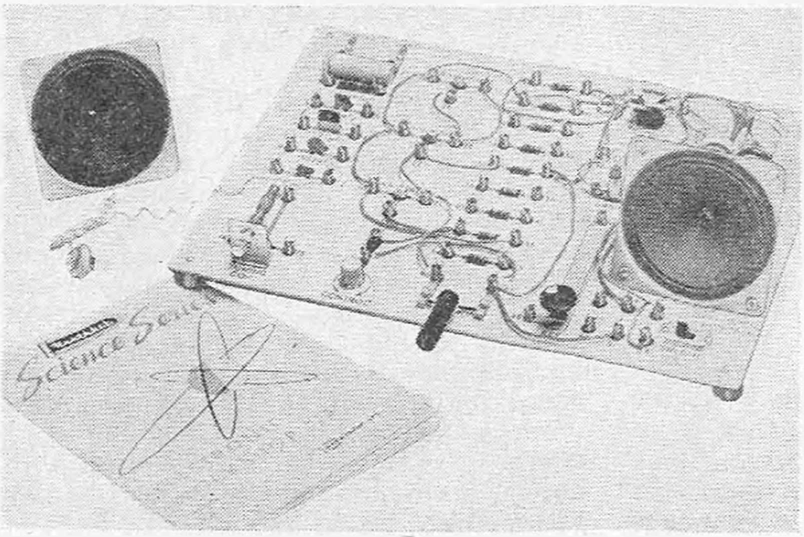
It took approximately an hour and a half to assemble all the springs and components on the board. Everything necessary is provided with the exception of the little men themselves who grace the 72 pages of an extremely well explained and clearly illustrated instruction manual. Various nuts, bolts and washers are easily identified by comparison with full size silhouettes in the manual.

The various experiments (21 in all) are made by taking lengths of insulated flex, thoughtfully provided with



pre-soldered ends between the numbered springs. A theoretical circuit diagram, a practical layout and a table of wire connections giving the length of each wire required are combined with explanatory notes on the operation of the circuit. It took less than 15 minutes to set up an audio signal injector experiment.

One of the rather more complex circuits (public address unit) comprising about 32 connections was soon operating after correcting one error. This particular experiment was carried out



Above : Stretching one of the connecting springs to insert a solder tipppd wire, quite a number of wires may be accommodated in the coils. Left : All the springs and components assembled on the chassis and the connecting leads in place for an experiment. A tiny photo-cell, an ear - piece, an additional speaker and a profusely illustrated hand-book complete this comprehensive kit.

by one of our positively non-electronic secretaries. We would advise thorough checking between the connection chart, the theoretical diagram and the actual experiment before making the final battery connections as it might be possible to damage the transistors by connections of incorrect polarity.

A number of experiments are for short range radio transmitters and which as far as we are aware, are not permitted by the G.P.O. and are in our opinion best left alone until the situation is clarified.

Admittedly warnings are given in the instructions and the range claimed for these experiments is only a few feet; notwithstanding there is still the risk that over-enthusiastic experimenters may use aerials and so cause wider interference.

For the absolute beginner the functions of each component capacitors, resistors, coils and transistors are clearly explained and profusely illustrated by little electrons running here and there uttering the appropriate comments. This goes a long way to assure that each experiment is carried out with a knowledge of its electronic performance in addition to the straightforward connection A to B type instruction.

The price is £7 18s. 0d. including tax which seems good value for this full and carefully designed kit. Several alternative transistor radio receivers, electronic relays operated by capacity, photo electric cells or audio reaction together with amplifiers, pulse circuits and wired intercom. are some of the useful experiments. The convenient layout of the breadboard might permit further experiments, probably directed towards radio control while junior is not looking. In fact, if the resistors and capacitors are merely clipped in the springs, substitution of different component values should widen the range in this respect.

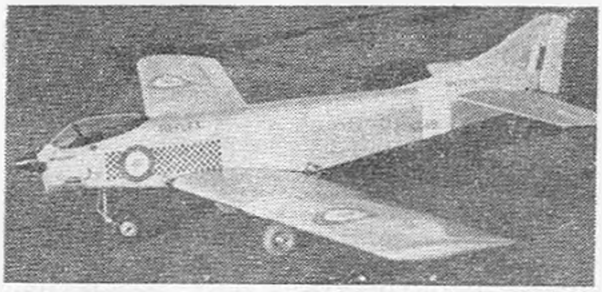
S/A NOSEWHEEL

[Continued from page 289]

in obtaining $\frac{3}{16}$ in. diameter piano wire, in such an event, two pieces of 10g. piano wire could be used. This would give a better binding and soldering area for the bush at the lower end but some filing to elongate the hole in the wheel collet (or even a Meccano bush) would be necessary to suit this new cross section.

The alloy fixing bush may be made to suit the fuselage to which it is to be fixed, remembering that a generous size flange is best for spreading the load onto the air frame. If no lathe is available this component may be fabricated by sawing and drilling and its inner brass bush by sweating a washer and a brass tube of suitable dimensions to the upper end of the leg. A brass control horn is soldered to the top of the leg after fitting the bush.

Two points to watch whilst working out the dimensions for your particular model; the weight of the model will stretch the spring slightly when at rest so the strength of the spring and length



The Swinging Arm nose wheel installed on the author's "reflex". A little careful disguise makes this unit suitable for scale applications.

of the leg should be such that ample prop. clearance is available when taxi-ing. When in flight the wheel hangs down and forward so would probably touch the ground first on landing, do not be mislead into estimating the models approach as being nose down because of this. When she touches the springing is in the best possible direction, i.e. slightly rearward and mainly upward. The trail position of the wheel should not adversely affect the steering power available from the rudder servo.

Readers may like to make their own modifications to suit their workshop facilities and available bits and pieces.

New Equipment

Overseas News

A new simultaneous 4-channel proportional control system, pause for breath, known as "Command Control" is all transistorised except for a 3A5 valve in the P.A. stage, all printed circuit construction and provision is made for flight trim whilst airborne. Price of complete system including 4 servos, wait for it, $399.50. Sampey, 5411 Ira Street, Orlando, Florida, advertise this addition to supplement the growing following of "Multi-simul.-prop." in the States. There are quite a number of Space Control models over here, high priced as this type of system is, we may see more people having to re-learn the piloting technique to suit stick waving as opposed to key twitching.

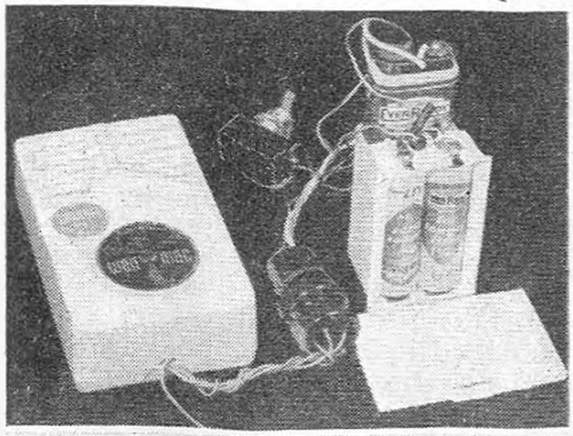
Complete Outfit

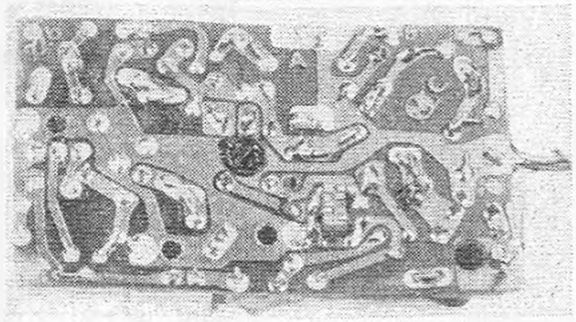
As we go to press we are inspecting the first British complete outfit by R.C.S.; transmitter, pulser, receiver, intergear and model kit, for Simple Simul enthusiasts. The advantage of matching the kit and the equipment should be obvious to anyone who has experimented with pulse systems in different models. Transistorised switching and a lengthy practical flying period during the development time should result in this "by modellers, for modellers", filling a long felt need in the simpler proportional field. The low price at which the equipment is being offered should enable it to be used as an ideal training outfit for budding Space Control followers.

We hope to do some practical testing on the gear in the very near future and it will naturally be the subject of a full test report in a future issue.

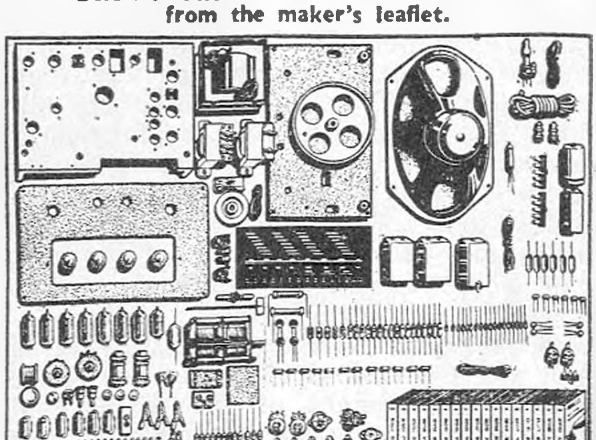
Radiostructor Kits

There must be quite a number of R/C modellers who may wish to produce domestic equipment and learn a little more about electronics for use in the model field: furthermore having satisfied the family with a broadcast receiver one should receive fewer adverse comments when tinkering with R/C gear.





Above, Top: The Wen-Mac receiver and battery box with batteries partly removed from their plastic container. Centre: The superhet receiver removed from its case, crystal in the top left corner may be changed without any further tuning to suit other Wen-Mac transmitters. There are five channels from 26.540 to 27.740 (receiver), 26.995 to 27.195 for the transmitters. We hope to make a test report later. Below: One of the Radiostructor Kits from the maker's leaflet.



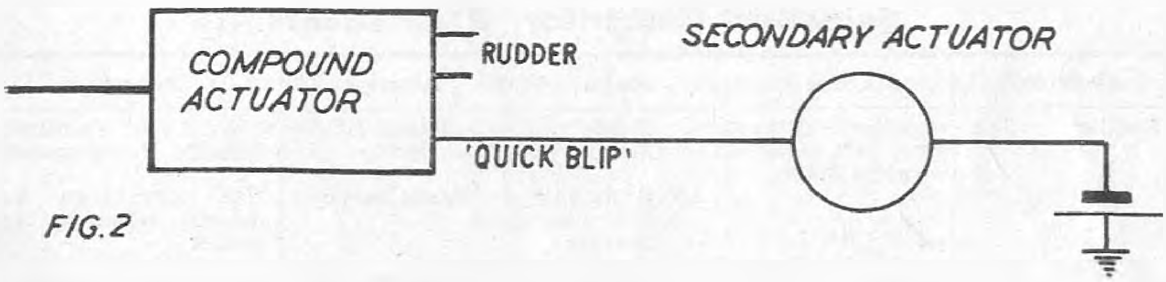


FIG. 2

Boat R/C

PART 2

SECONDARY CONTROL

By R. H. WARRING

The most important and most useful of the secondary controls is motor speed. The sequence switcher may therefore be replaced by a simple actuator to give throttle control on a diesel or glow motor, Fig. 2. If required, a compound actuator with 'third position' can be used to provide separate sequence signalling for selection of auxiliary services via a sequence switcher again, Fig. 3. In the case of electric motor drives for power boats a sequence switcher is preferred to a secondary actuator for speed control since the various step positions can be wired for 'ahead', 'stop' and 'astern'—and intermediate speeds as well, if required, by tapping into the battery at different voltage levels. Some compound actuators produced for boat work incorporate two or three additional switching positions which may be wired directly to control electric motor switching for 'ahead', 'stop' and 'astern'.

Sequence Switchers

Sequence switchers normally have to be made. A standard four-position non-neutralising actuator, used as a secondary actuator, can be used to operate four separate pairs of contacts by its mechanical movement and thus form a four-position sequence switcher, Fig. 4.

It should be noted that the *relayless receiver* cannot be used to operate a secondary actuator via 'quick blip' even if connected to a (main) compound actuator unless there is a back contact on the armature of the latter to wire the secondary actuator through. To utilise a secondary actuator so, it may be necessary to connect the output of the relayless receiver to a slave relay. The main (compound) and secondary actuators are then wired to and switched by this relay.

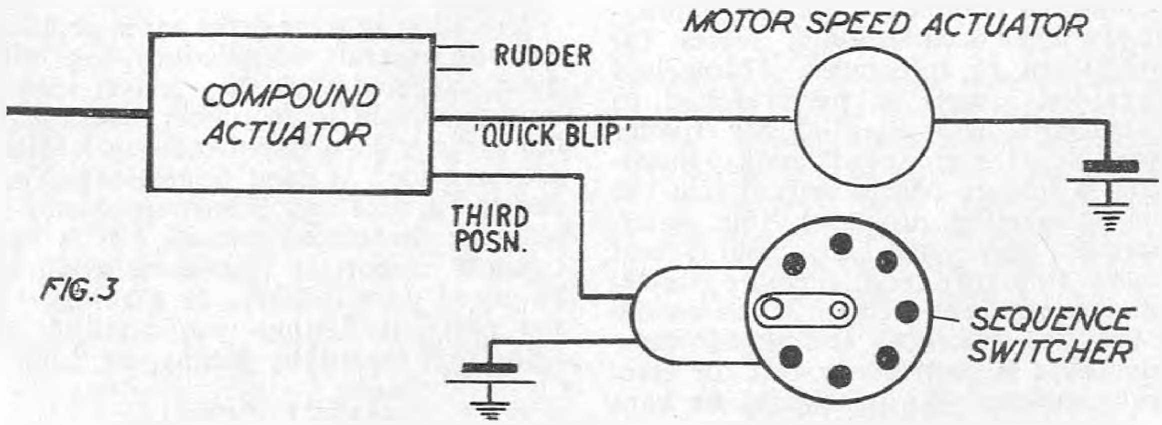


FIG. 3

TABLE 3
Selection Chart for R/C Yachts

Control(s)	Action	Radio	Actuator	Remarks
Rudder	Rudder Right or Left, Self-neutralising	Single Channel	Motorised Servo	Rudder Positions Selected in Sequence
		Multi Channel (using two channels	Multi Servo	Has advantage or direct selection of rudder
	Proportional Rudder Movement	Single Channel Proportional	Proportional Servo	Shows no real advantage over 'Bang-Bang' controls and has technical disadvantages
	Progressive	Multi Channel (using two channels)	Multi Servo	Not a recommended system
Mainsail and Jib Sheet Adjustment (linked common Servo with suitable difference in travel)	"Push-Pull" (In or Out) Not self-neutralising	Single Channel	Compound Servo and	Not a suitable method
		Multi Channel (using one additional channel)	Electric Motor or Simple Progressive Servo	Has distinct limitations
	Progressive	Multi Channel (using two additional channels)	Multi Servo	Recommended System

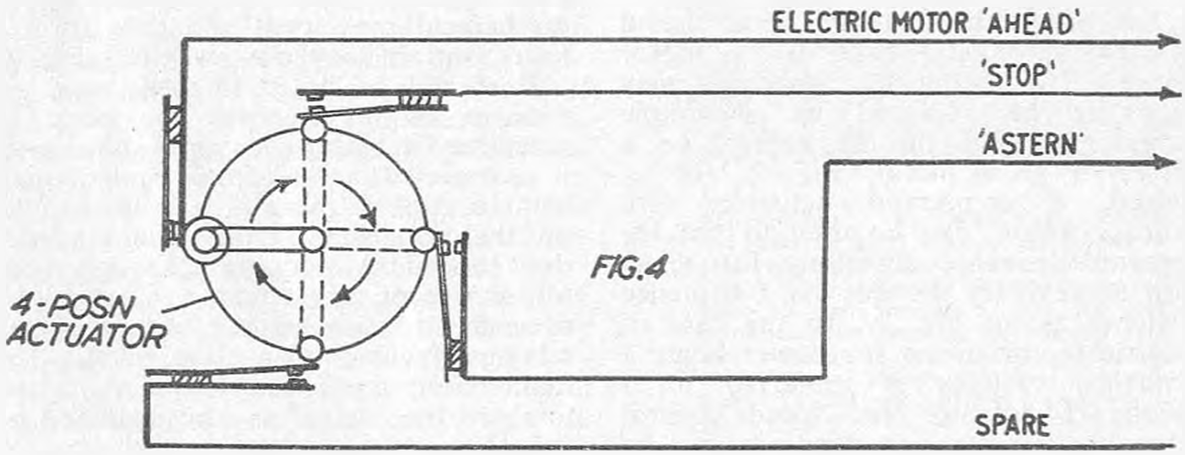


FIG.4

Picking the right gear

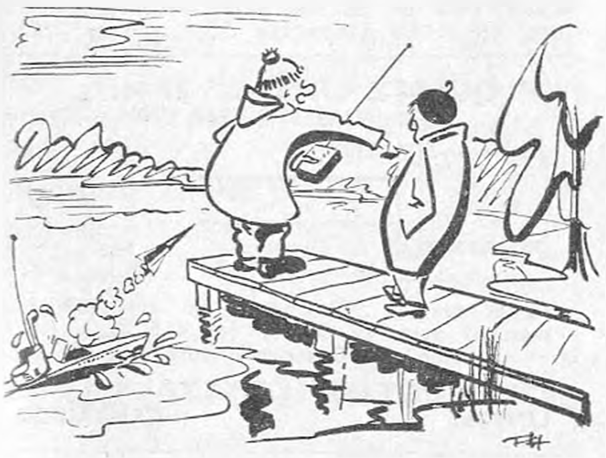
Choice of equipment, etc., is summarised in the accompanying tables for convenience of reference. Motorised servos are always to be preferred to escapements, and essential for rudder operation on high speed boats. Installation is seldom critical, except that the receiver *must* be protected from water, dampness, oily waste, etc., and is best located forward in a separate watertight compartment. Damp is the enemy of anything electrical and a salt-water atmosphere is particularly bad for electrical contacts. Wiring should be kept high so as to be out of the way of bilge water.

Vibration is seldom the same problem as with aircraft installations but with diesel powered craft the receiver should be mounted in foam rubber. Wrapping the receiver in a polythene bag is often recommended as good protection against damp, but this can present problems in reaching the tuning control. It is particularly important that some receivers be tuned *with the boat in the water* as the optimum setting may be different from that found by tuning on land.

[*Table 4 overleaf*]

TABLE 4
Actuator Selection Chart

Type	Action	Suitability	Advantage(s)	Disadvantage(s)	Remarks
Rubber driven escapement	2-position, S-N	Rudder control small, light craft only Secondary actuator	Relatively Inexpensive	Not enough power to operate rudder on larger-craft. Length of rubber motor is awkward to accommodate	Little used
	4-position, non-neutralising	Secondary actuator for motor speed or sequence switching	Gives four separate sequence positions which can be used for switching	as above	Little used
Clockwork escapement	2-position, S-N	Rudder control on small, light craft only secondary actuator	No rubber motor to wind	,, ,,	Suitable as secondary actuators on smaller craft
	4-position, non-neutralising	Secondary actuator	As for rubber type	,, ,,	
Sequence switcher	Sequence stepping non-neutralising	Secondary Actuator	Gives closure of separate servo circuits in sequence	Not readily available and may have to be made	
Proportional servo	Proportional 'R or L' in 'Push-pull'	Rudder control when used with matching transmitter signal	Gives proportional rudder	Suitable equipment may have to be made. Feedback circuit essential on larger models	Additional services may be made available at extreme control positions
Multi servo	"Bang-bang" S-N	Rudder	Direct selection of right or left rudder	Can only be operated by multi-channel equipment	Best for high speed craft
	Progressive	Motor Speed	Full Throttle Control	,, ,,	Can adapt for full speed control with electric motors



ARE YOU LICENCED ?

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

. . . Should surface and fire there.

Query Column

WE WELCOME GENERAL INTEREST PROBLEMS. SETS SHOULD NOT BE SENT TO US UNLESS SPECIFICALLY REQUESTED.

I HAVE a couple of queries about the Terrytone.

I have a 0-5 milliampmeter and also an 0-50 milliampmeter. How can I use these for testing the set when 0-10 and 0-500 are specified—solder in a resistance or something?

The other query—I hope to use my Reptone Tx. for its intended job with the Reptone Rx.—but ALSO *for the Terrytone. Can you say what modifications, if any, I should make to the Tx. (very* SIMPLE *instructions please—I am no "radio-bod").*

Finally—I hope to use the Terrytone Rx. in a fairly small model aircraft with rudder and engine control. Would the F. Rising Compound actuator be suitable and the F.R. Clockwork as the secondary? E. J. C., SOMERSET.

A suitable resistor across the terminals of the meters will extend their range. Use ordinary enamelled copper wire as the resistance as the value is quite small and the result will be more accurate.

Connect the meter in a circuit which will give a full scale deflection on the meter without a shunt. Connect a short piece of say 30G ECW across the terminal (say two feet for the 0-50 meter) and adjust the length until the reading is 1/10th of the original. The full scale reading will then be approx. 10 times the original. A meter of known accuracy in series with the meter on test will help in the calibration. For the 0-5 meter a thinner wire will probably be necessary. Here the original reading must be reduced by half.

For the Terrytone switching of the carrier and tone is essential. To do this with the Reptone short out the keving switch and connect a switch (or button) in the H.T. lead.

I AM making Windy Kreulen's Transmitter described in the February edition of R.C.M. & E. and I have come across some difficulties. Could you please put me right on these points?

1. *The length of the aerial.*
2. *Is 22 mm. the diameter of the coil former, if so, what is the length?*
3. *What S.W.G. is 1 mm. wire?*
4. *What is the range of the Tx.?*

P.H.S., WORCS.

The nearer the aerial can approach the ideal ¼ wavelength the better, if this is too awkward on a hand-held transmitter try the centre loaded type described in the April issue (pages 187-193).

The coil in the Windy Kreulen Transmitter is 22 mm. diameter, space the turns about one wire diameter.

The nearest equivalent to 1 mm. wire is 19 S.W.G. However, either 18 or 20 should be satisfactory.

It is not possible to give any real indication of range as it will vary from different models of the same type, it is also dependent on the receiver with which it is used of course, further, the variations in terrain also have a marked effect.

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