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NOVEMBER . . . 1963

RADIO CONTROL MODELS & ELECTRONICS

PRICE 2s

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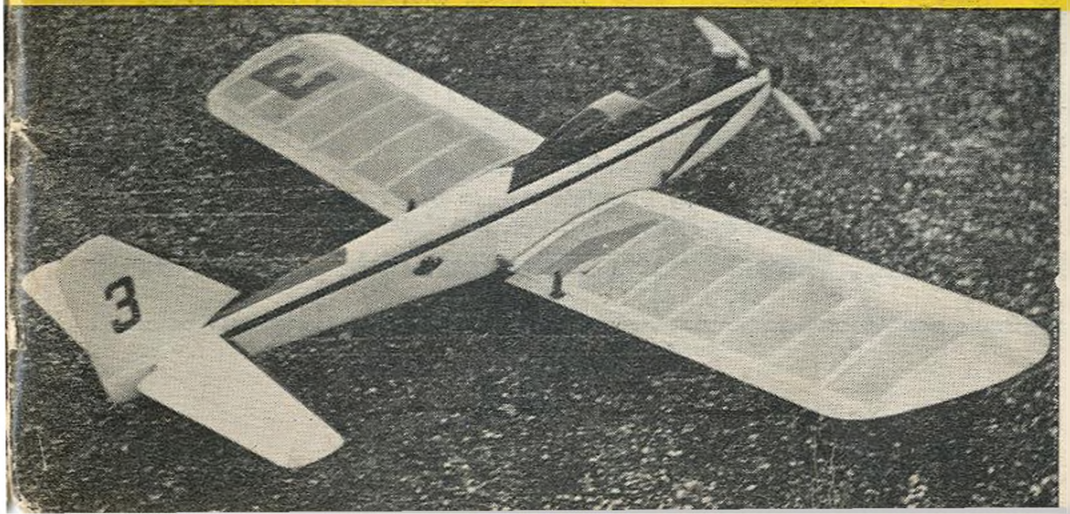
BEGINNERS FEATURE ★ WORLD R/C CHAMPIONSHIPS ★ SUPER PROPORTIONAL



TWO PAGE PLAN FOR PYLON RACER INSIDE ★

RADIO CONTROL MODELS & ELECTRONICS

NOVEMBER 1963

VOLUME 4 NUMBER 11

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MODEL AERONAUTICAL PRESS LTD.

Here, There & Everywhere

Read All About It

Well, here we are with another World Radio Control Championships issue, and what a coincidence, another tie for top place. Shades of Kenley all over again, just goes to show that judging is becoming more and more difficult with the top men putting on exceptionally good performances. All the details are given in this issue together with photographs and the much sought after analysis of the models. May we add a few words of condolence to our less fortunate competitors, who were beset with troubles which, happily, these days are rare. Thanks to our Belgian hosts for providing the venue for a really large scale session of R/C and C/L. A large black mark to the weatherman for providing a degree of wetness and coldness we had hoped to forget. When will modellers learn to put transmitters in polythene bags?

Just Above Ground

Among the many interesting enquiries we receive, came a recent request for radio control equipment for full size hovercraft research, we were able to advise on suitable equipment and control systems for research projects. These days, the reliability of radio control outfits is such that rapid results are usually obtained in such programmes. Cost of a radio control scale model is now greatly reduced by the use of readily available commercial "model" equipment plus a few ancilliary bits and pieces dreamed up by the development boffins.

Latest news from Westland Ltd. is that they are using Telecont 9 channel gear in their research model hovercraft which is powered by two Ohlson and Rice "Compact" industrial engines.

More to Build

Even though we have produced full sized plans before as a special contest season feature, the Christmas issue of *R.C.M. & E.* will carry two free plans; one for a neat single channel aircraft and one for a simple boat. Furthermore, the issue will be packed with constructional features for beginner and expert. In fact, there is so much in our fourth Christmas issue that we are beginning to wish that our printer could print along the edges of the paper and around the margins! With all these extra goodies, we feel sure that you will not object to paying an extra 6d. for the issue.

On the Cover

Following last year's tradition, we give pride of place on our cover to the joint World Champions with the irrepressible Dr. Ralph Brooke on the left partnered by Fritz Bosch.

The models themselves represent an advance in the modelling technique, both Brooke and Bosch use glass fibre fuselages, the wing of Bosch's model is expanded polystyrene and Brooke showed us a spare wing, which has a machined balsa egg crate core. (Read about expanded polystyrene construction techniques in this year's *Aeromodeller Annual.*)

We spread ourselves this issue with a two page plan for the nippy little 4 channel Pylon Racer, shown at the bottom of the cover. Created by Geoff. Franklin it should provide a fast flying session for sport or contest on a limited number of channels.

Latest in Leaflets

The popular multi receiver, the "Multi-Gem" which was published in December 1962, has now been reprinted in leaflet form and costs 2/-; available from our Plans Service, No. RC 834. An additional 4d. should be sent to cover the postage.

Back to Basic

The number of modellers joining the radio control brigade is really amazing. The trade notice a steady increase in sales of bits and pieces for radio, and ready-made commercial equipment. We are happy to say, too, that our sales continue to rise and more and more people inquire from us the best way to start radio control.

We must again devote ourselves to the service of the new boys by going very carefully over the art of radio control so that they start off on the right foot and have no, or very little, difficulty in dropping nicely into the groove. From there we hope to offer a friendly word of guidance, editorially and with the help of some of our already well known regular contributors.

In this way, we would like to think we are doing our bit to make the modeller's path less strewn with tangled wire and battered balsa. Let's start right now, way, way, back to basic principles. At first with no theory, showing what system to use, what it does, how to understand the terminology, then supporting features on design application.

Our earlier issues which make a valuable reference work are now very scarce, so our new series "Basic for Beginners" on page 530 of this issue, starts the ball rolling once again. As we are writing it with the intention of presuming that the reader has no previous radio knowledge, we introduce any new terminology in such a way that the newcomer does not have to search through text books for additional explanation.

Monitors Again

In spite of our plea for a little more care in the use of superegenerative monitors (see our editorial, September 1963, issue), we found more trouble at the World Championships. Several competitors experienced interference trouble which could have been due to monitors that were rediating R.F. output point has also been plugged in a recent newsletter. There is no excuse for the use of a suspect monitor, we published a "clean" diode monitor in our last issue, furthermore, readers who do not understand the complexities of super-regen receivers and wish to know why some circuits super-regen too strongly should read the article on page 552.

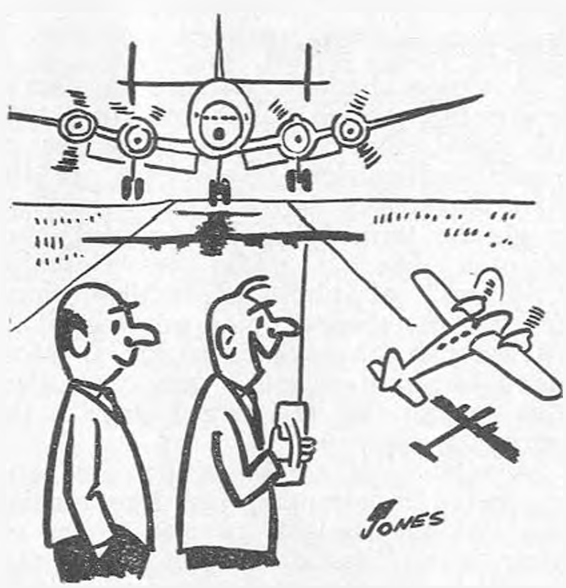
Preparing for Proportional

Readers do not have to be particularly "Hawk-eyed" to notice the trend of modellers towards proportional systems, a fillip in this direction has been given by the success of the Orbit proportional outfits at the World Championships, there may be some significance in the fact that a more than average number of old faithful "Galloping Ghost" outfits were seen at a recent rally, perhaps more modellers are learning to fly the less complex proportional in preparation for greater things to come. We are sure it will not be long before proportional outfits from several manufacturers, are available over here in larger numbers. It should be noted, too, that we have stepped up the amount of proportional in *Radio Control Models & Electronics* and that following on the heels of "Bi-Simpl" (an almost flap proof dual system) we now have the start of a more sophisticated series dealing with a dual feedback system.

Up On The Farm

Pete Waters mentions in a recent letter to us that the Detroit boys have just bought a 140 acre farm to fly on, 30 miles outside Detroit, complete with farmhouse which they are converting so that they can bring their families there for weekends. Two other clubs in the locality have lost their fields through noise. We understand that over here an acre will support three quarters of a cow, half a Galloping Ghost, or ⅛ of a pylon racer. We presume class A amplifiers are used in most of the equipment.

One presumes life will be less hazardous than on an airfield as our cartoonist suggests.



" . . . *Sounds most realistic*".

Basic for Beginners

LET US EXPLAIN THE TECHNICALITIES OF RADIO CONTROL IN NON-TECHNICAL LANGUAGE

Part 1 Simple Single

WHILST the various aspects of radio control have been dealt with in our pages over a period of years, it is felt that with the hobby literally snowballing there must be many new to the game. It is for the benefit of this growing band of beginners, who are now using radio control as a means of operating their otherwise free flight sports models in what are now unfortunately smaller flying areas, that we present this new series.

The present day reliability, simplicity and light weight of commercial single channel equipment has made this possible. We like to think that we have helped in our own way by providing circuits and do it yourself articles to encourage the modeller with a little radio knowledge to save some of the initial outlay necessary for radio control. First, let us go back to the very beginning and explain in simple terms the types of equipment, the most profitable application and the general terminology used in the hobby. In this way, as we progress to more involved systems, the reader should have no difficulty with what may seem to the beginner to be a load of uffs, puffs and apparent jibberish.

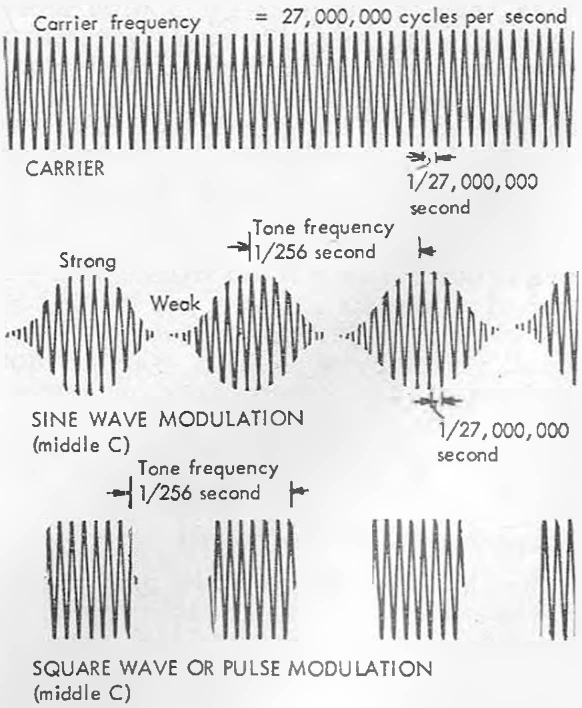
The Simplest "Single"

A single channel system comprises a transmitter which sends just one type of signal. that is to say a carrier or modulated carrier. Now here are the first two tricky terms; *carrier* is what might be termed the basic signal, and, if you like, a radio wave which "vibrates" at about 27,000,000 times (cycles) per second or as we write it 27 Megacycles (abbreviated to Mc/s). Most good transmitters are crystal controlled, this ensures that the carrier stays at the correct frequency.

A *modulated carrier* is increased and decreased in strength, just like turning the volume control up and down on your "steam" radio. If you do this fast enough you get a note; for example middle C (somewhere round about the keyhole on the piano) would require frantic knob twiddling at 256 times per second. All this is done electronically by the transmitter and has been covered in the more technical articles which have been published.

The example given in this simile is a pure note or tone, one can hear this note through an earphone or monitor as a soft singing sound, such as would be produced by a clarinet or oboe. If the note has a harsh sound, it is probably what we call square wave, or pulse modulated, equivalent to switching the radio on and off rapidly. This is an easier way of doing the job although some electronic boffins tend to be horrified by the method. The receiver is less fussy, however, and usually either type of signal produces the desired effect whether it be the first type known as sine wave which looks like a smooth

FIG. 1



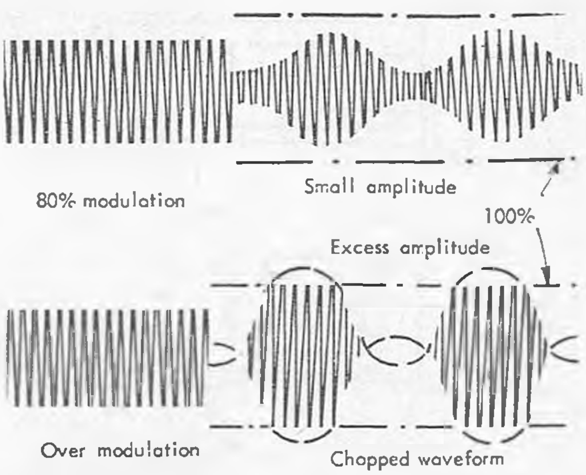


FIG. 2

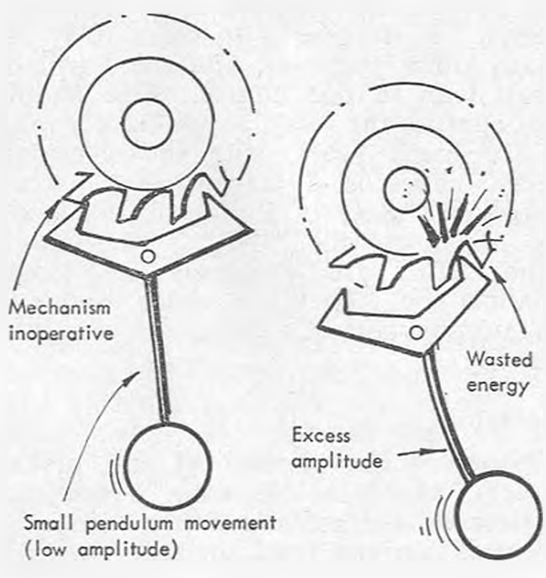
wavy line on an oscilloscope or square wave which as its name implies appears as a series of boxes. Fig. 1 shows the comparison for reference when reading other articles on the subject.

Now you know what is meant by carrier and modulation. It is important to find out from the manufacturer, or our test reports, three further facts about a single channel tone transmitter.

1. The depth of modulation, which for which most receivers these days should be between 80 and 100 %.
2. The frequency of the tone, some receivers like a high note, others a low.
3. The stability of the tone. (This is only important with filter receivers, more about these later.)

What is depth of modulation? you may ask. The best way of explaining this is to look at Fig. 2; a modulation depth which is below 80 per cent does

FIG. 3



not have enough strength or *amplitude* to operate the receiver. Let us draw another simile, imagine a pendulum swinging normally, it has to move a specific amount to keep the clock going. If it only moves a very small amount, compare it with Fig. 2, the various parts of the clockwork mechanism do not move away sufficiently far to clear the teeth, see Fig. 3. There is another term we will come across later; over modulation, this is unimportant to the single channel receiver, but like a clock with the pendulum swinging frantically past its normal limits, leads to inefficiency. The reason why tone stability is unimportant to a single channel receiver, is that they respond to a wide range of tones, and even if you can hear the transmitter note warbling up and down the scale the receiver will function quite happily.

The Pros and Cons

Most modellers use tone systems. These involve very little extra complication, and the receivers are less likely to receive unwanted signals caused by interference produced by electrical discharges, ineffectively suppressed cars and electric motors nearby. One must suspect the model's own electric motors and in some cases what is known as mechanical noise. This is caused by certain mechanical parts in contact with each other in the model such as wheels rattling on their axles, a metal case around the receiver rubbing against metal supporting hooks, or mechanical linkages in the control system.

Valve or Transistor

Whilst a transistor transmitter is more economical and simpler in its demand for batteries, price for price a valve transmitter at the moment is simpler and provides a greater range. Valve receivers are now almost obsolete although it is much easier to build a receiver which has a valve followed by a transistor amplifier. This results in good sensitivity and one is assured of a reasonable amount of success for a minimum of fiddling. In this instance, the valve detects the signal, and the transistor part of the circuit amplifies it to a level where it will operate a relay or in the case of relayless receivers sufficient power to operate an escapement or small electric motor direct. Fully transistorised receivers have a transistor at what we call the "front end", this is the detector stage and serves the same purpose as the valve. The transistor in question is one that operates best around 27 Mc/s whereas the amplifier transistors operate at a much lower frequency and in some cases are just devices to switch those volts through to the relay or escapement.

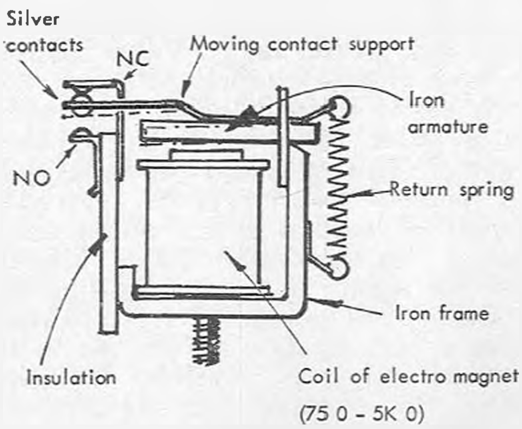
Valves require a high voltage, usually 22½ volts plus a separate 1½ volts for the filmaent. Some receivers make use of the actuator power supply in the model for the transistor stages. An all transistor receiver works on 3 volts although other types are available at various voltages up to 9, most use just the one battery, but latterly an improved system has been devised whereby most of the receiver operates from one battery which can be quite small and the output or driving part of the circuit uses the actuator or motor battery.

Relays

We now have to do some more explaining, but will not worry at this stage about the technical workings of radio components. A relay is used in a number of control systems and requires a little clarification.

The term relay refers in most cases to an electro mechanical switch which is sensitive to a change in current. The most usual type is a single pole change over arrangement, that is to say one contact moves to break in action where it normally rests and then to make contact with a second circuit, as shown in Fig. 4. The moving contact is attached to a balanced piece of iron (armature) which is attracted by an electromagnet

FIG. 4



NC = Normally closed (no current in relay coil)

NO = Normally open (closes when current is present in relay coil)

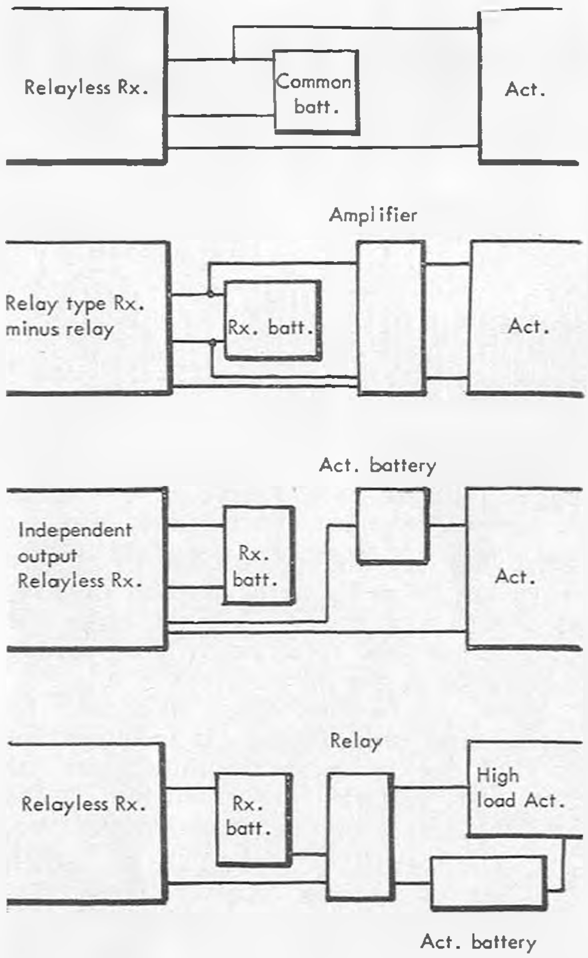


FIG. 5

against the pull of a spring. When the current is increased in the electromagnet the contact carried by the armature changes over, to change back again when the current is lower.

If such a device is fitted to a receiver it will switch an operating mechanism on and off in response to a signal received. It is possible to use a relay for many other purposes, and these will be dealt with in due course. One should not confuse the relay, as we have known it for many years, with the electronic relay. This is a transistorised circuit taking the place of the electro-mechanical relay, and the "Ivistor" or "Transitone TT1" are examples for single channel use. They are really similar to the output stage of a "relayless" receiver, see Fig. 5.

Actuators

Now for the mechanical part of the system, the term "actuator" covers a variety of mechanisms for moving the control surface or surfaces (via a

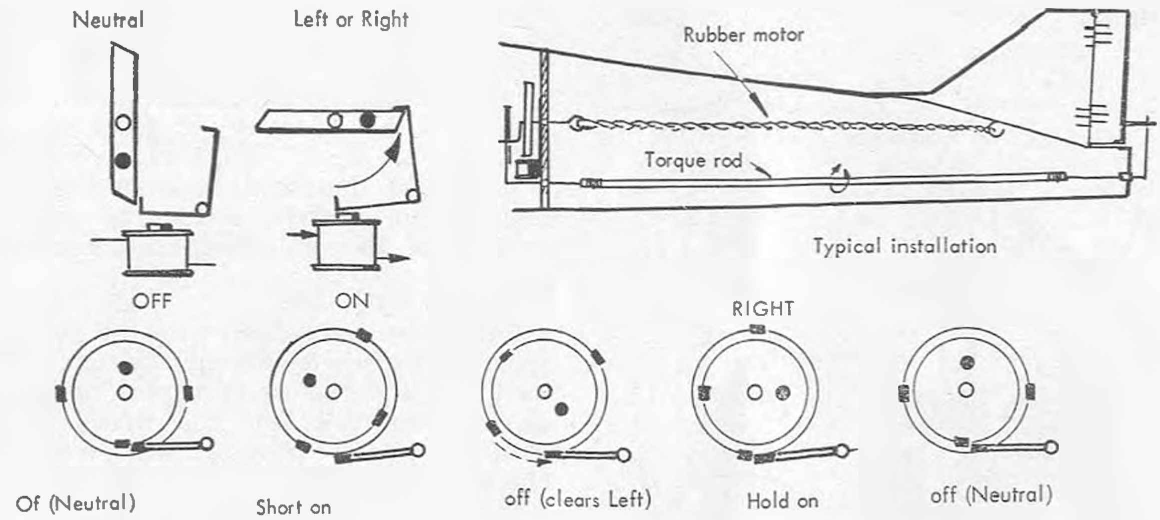


FIG. 6

mechanical link) on a model, i.e., aileron, elevator and rudder. Here again modellers tend to use the incorrect term when they refer to a "servo". An actuator just moves the surface when switched on or off by either one, or one of two relays. A servo in the correct sense is a mechanism combined with a circuit or mechanical switching device which is sensitive to the *difference* between the position of the control surface and the "position" of the command as sent automatically in a proportional system of the more advanced kind.

An actuator may be powered by an electric motor, clockwork mechanism or a rubber band. The latter two usually operate sequentially and are usually referred to as *escapements*. The workings of an escapement are explained more readily by the illustration in Fig. 6. It will be seen that when the current is passed through the electromagnet, the armature, just like a relay, releases the power of the rubber or clockwork to turn a crank so operating the control surface. The crank is arrested in the desired position by a second claw and remains in that position as long as current is present in the coil. By a crafty mechanical arrangement using a "rattler" to slow down the speed of the motor or rubber it is possible to have what we call selective sequential operation.

This method of control is left or right rudder at will, although the rudder will pass through both left and right positions before stopping at the desired point, i.e., for right rudder, say, the escapement moves to right, on release it moves to left and then back to neutral. For left rudder, the escapement moves through right to left, then straight back to neutral. This does not have any adverse effect on the flight, although with model boats the stern twitches over as the rudder passes the unwanted position. The method of control is to give just one signal held on for right, and a short signal followed immediately by the second signal held on for left. In both cases, the rudder returns to neutral when the control button is released.

Sequential motorised actuators work on a slightly different principle, although the method of signalling as explained and the movement of a control surface is similar to that produced by the aforementioned mechanisms. It is necessary in this case, however, to use a relay to switch the electric motor via the actuator's own set of contacts. This will be explained in Fig. 7. Let us follow the two conditions through from the relay.

1. The relay changes from its normally closed or "back contact" to the normally open or "make contact" this passes current through to wiper A rubbing on a printed circuit disc. The motor now being in circuit turns the disc and crank to which the control surface is linked until it reaches the "right" rudder position whereupon a "dead spot" on the disc comes underneath wiper A cutting the current of the motor. We now have right rudder position and no current consumed (this is an advantage over the two previous systems).

2. When the signal ceases, the relay armature contact changes back to the normally closed contact and puts wiper B in circuit. This wiper resting on the live part of the disc, switches the motor on again, the motor then runs until the control surfaces move through left position and back to neutral, whereupon

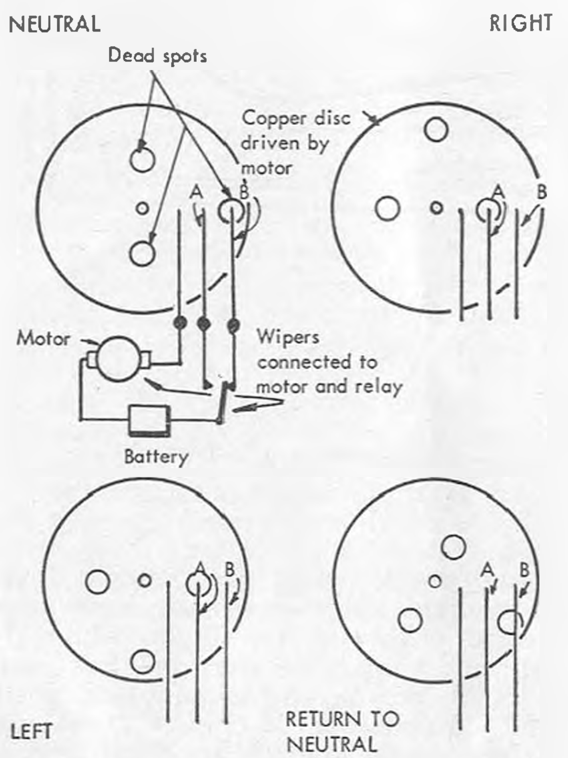


FIG. 7

another dead spot on the disc passes under wiper B, stopping the motor.

Left rudder position is obtained by giving a short signal which starts the motor but before the motor has a chance to stop on right rudder position, the relay contact has changed back to the normally closed position running the motor straight past that position. The next signal, being held on however, feeds the motor via wiper A again until a third dead spot on the disc passes under it. This now corresponds to left rudder position where it switches the motor off until once again the relay changes back when the signal stops, back goes the circuit to wiper B, and the motor runs on to neutral, where it stops.

It will be seen therefore, that the relay is essential for motor driven sequential actuators, when used with a single channel receiver. The writer designed a sequential motorised actuator with its own electronic relay; thus saving weight and improving reliability. It is hoped to publish details later.

There are many cunning mixtures of rubber driven escapements, switching discs, or as they are sometimes known, *selectors,* worked by combinations of coded signals to enable a single channel receiver to operate two or three other escapements or motor driven actuators. Most of these systems, however, demand a certain time lag between signalling and movement of the control surface, to say nothing of the momentary operation of other control surfaces in the process.

It should therefore be seen that for high speed models, sequential control systems of this nature are not suitable.

Summing Up

So far, we have dealt with the average sport flier's single channel system. We have not covered every aspect of single channel control, nor the many other control systems possible with a single channel transmitter and receiver, we must at this stage keep things to the simpler side of the hobby.

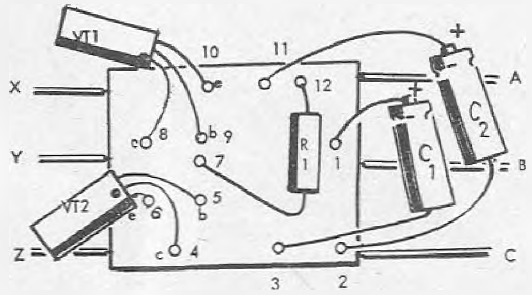
So there we have it, one basic signal, either in the carrier itself (27 Mc/s) or a modulated carrier (tone), as illustrated in our "string of sausages". The receiver, may be a carrier type, or a tone version, the latter to be preferred. Herein lies a subdivision in the receiver which demands a continuous carrier which is then modulated as a control signal, and the receiver which does not require a continuous carrier, operating on a signal of modulated carrier only. The latter is, of course, more economical in terms of transmitter batteries as the transmitter is only working when it is desired to operate the control surface of the model. Usually, this type of receiver will still operate satisfactorily from a transmitter which does radiate a continuous carrier between signals, in fact under these circumstances it is less likely to pick up a signal from somebody else's transmitter some distance away.

Naturally, it is not possible to operate two of these simple single channel models within a mile or so of each other unless they are specially designed outfits. The R.E.P. "Gemini", or superhets (about which more will be said later), will permit at the moment three or four models to be operated reasonably close to each other. The use of superhets does not mean, of course, that one is immune from interference, for any non-crystal controlled transmitter fairly close to the superhet will cause trouble, similarly the super-regen receivers to which we referred earlier will respond to almost any transmitter used in conjunction with a superhet.

In the next instalment we shall deal with some tips on the application of the equipment just described.

A Simple Servo Switcher

By J. H. SKEET



THE first sentence of the article on miniature servo amplifiers on page 351 of the July 1963 issue of *R.C.M. & E.* is, "Just how simple can you get?" Here is a similar piece of equipment which is just *half* the size and weight of the previous version, and far simpler!

The circuit is based on one from Howard Boys' book, and is given below (Fig. 1). It will switch up to 500 mA. for short periods but the transistors do get warm. It will pass 250-300 mA. for about two minutes before overheating starts, and this is ample time for any manoeuvre. Servos used are simple geared "Mighty Midgets", but any spring return or clutch servo can be used providing the motor does not draw more current than the Mighty Midget. 4.5 flat batteries are used on the prototype but a 7.2 volt pack of DEACs would probably be better. Leakage current is of the order of 2 mA. The printed circuit and construction details are shown in Fig. 2.

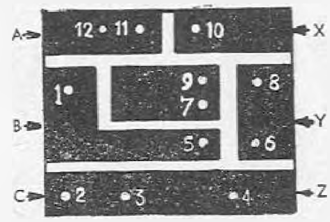
Cut a piece of printed circuit board to size and drill 12 holes in the appropriate places with a No. 50 drill. Bend 470 ohm resistor as shown and insert in holes 12 and 7.

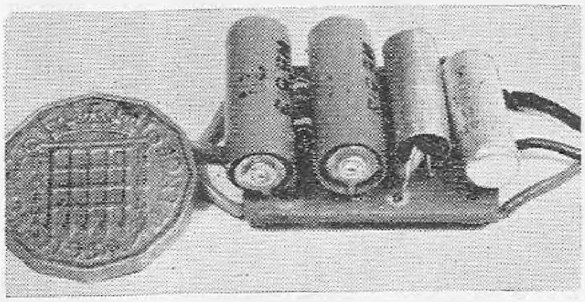
Insert 10 μF electrolytic capacitors,
C1; +ve to hole 1, −ve to hole 2.
C2; +ve to hole 11, −ve to hole 3.

Transistors are OC76, OC83 or OC81. Sleeved leads of T1 and insert collector to hole 8, emitter to hole 10 and base to hole 7. Sleeve leads of T2 and insert collector to hole 4, base to hole 5 and emitter to hole 6. Fold down components as shown in Fig. 3, connections — X, Y, Z, A. B. C. — are made with reference to circuit diagram. The four amplifiers so far made have a total weight of less than an ounce.

The price of four amplifiers is around £3.0.0d., comparing very favourably with the cost of eight relays which is about £5.10.0d.!

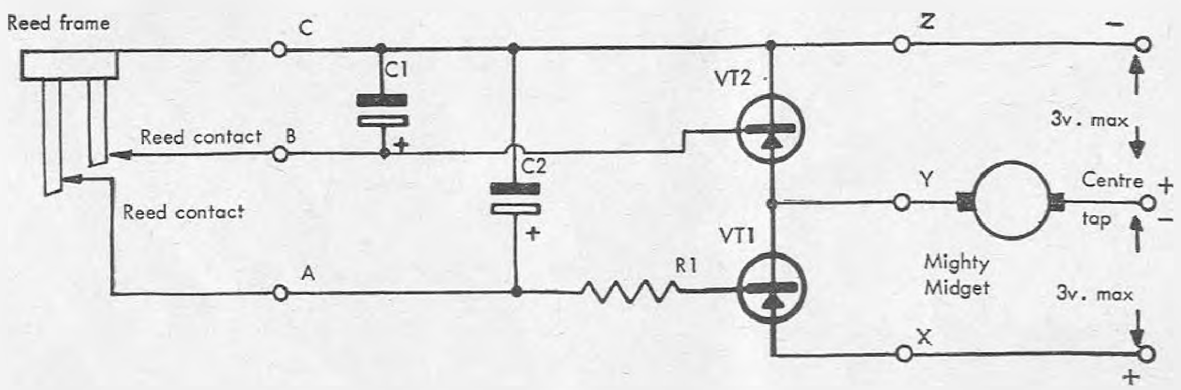
FIG. 2
Full Size

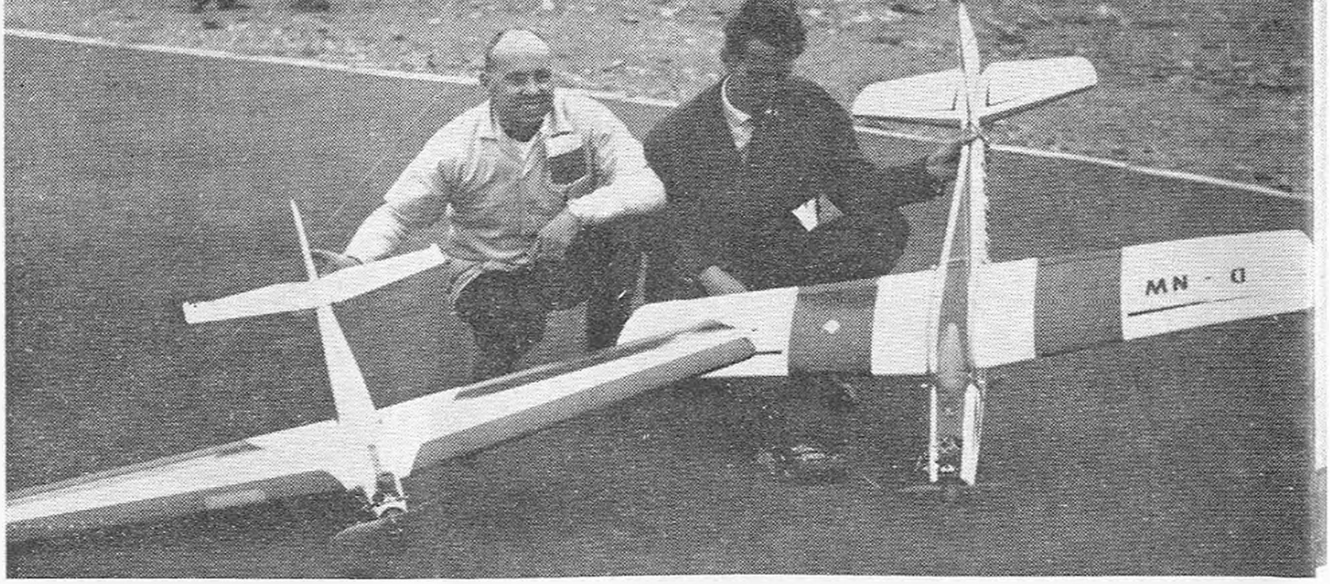




This photo is approximately full size. The components may be protected with Sellotape or potted.

FIG. 1



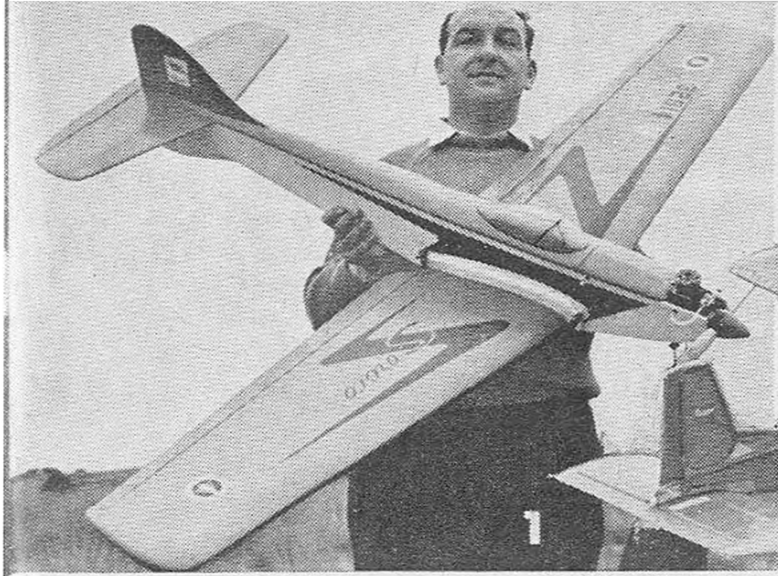


Third World Radio Control Ch

To Genk, Belgium. on August 21st, came thirty-nine competitors and a great many more "followers" for the Third World Radio Control Championships. The aeromodelling centre at Genk consists of four control line circles and a radio control landing area beside a lightplane landing strip, visited by small aircraft throughout the championships.

Practice day did not reveal very much except that if the weather prevailed, the championship would be held in typical British competition weather. The universal interest in the U.S.A. team led to their half hour practice time receiving close scrutiny, and with justifiable reason. Both Ralph Brooke and Jerry Nelson were flying with prototype Orbit Proportional radio equipment and naturally all wanted to see just what improvement this made to flying. Ed. Kazmirski also had the Proportional radio in a model but elected to fly his reed system equipped Taurus instead.

Above : Equal champions with contrasting models. Brooke at left with low wing proportional radio equipped Amanusa and Bosch, right, with shoulder wing machine that used non-proportional Telecont relay gear. Each use a thick wing section though. Right : 1, Harry Brooks with new "stretched" Seraco placed 28th. 2, Sederholm, Finland, was the unlucky "bottom notcher", with his Uproar. 3, Murray Chercover from Canada had a beautiful Taurus and equally fine model box like the other Canadian boys. Placed 13th. 4, Nimbus II by Aebi, Switzerland, was partly proportional controlled. Transmitted two proportional functions on one frequency and two non-proportional functions on another. Model equipped with two receivers on dual frequencies. 5, Unlucky Gast from Germany had crash trouble. 6, Three South Africans. Left to right, Jim Connacher, Monte Malherbe and Cliff Culverwell. Latter starts his engine. Placed 6th. 7, Still with his Skydancer that flies so well, Frank Van den Bergh for Britain, placed 7th. Below, victorious U.S.A., Jerry Nelson, Ralph Brooke and Ed. Kazmirski with team manager Bob Dunham, took home both individual and team trophies.



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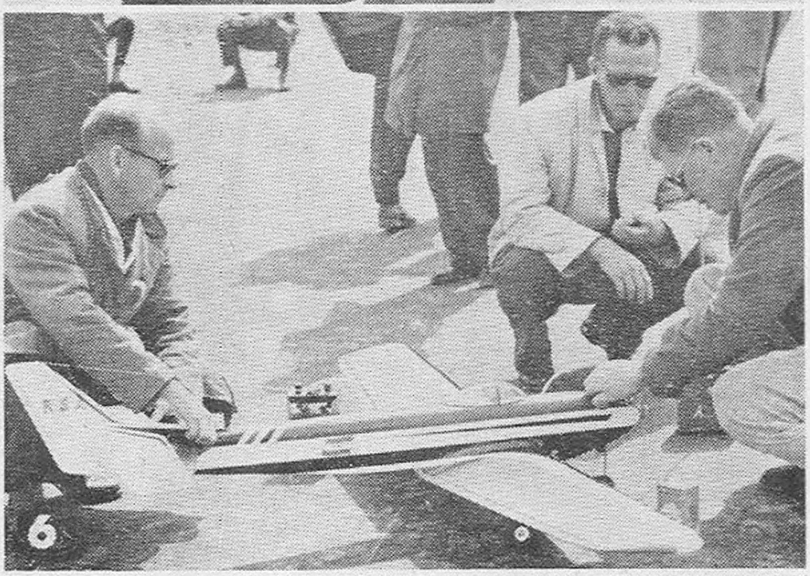

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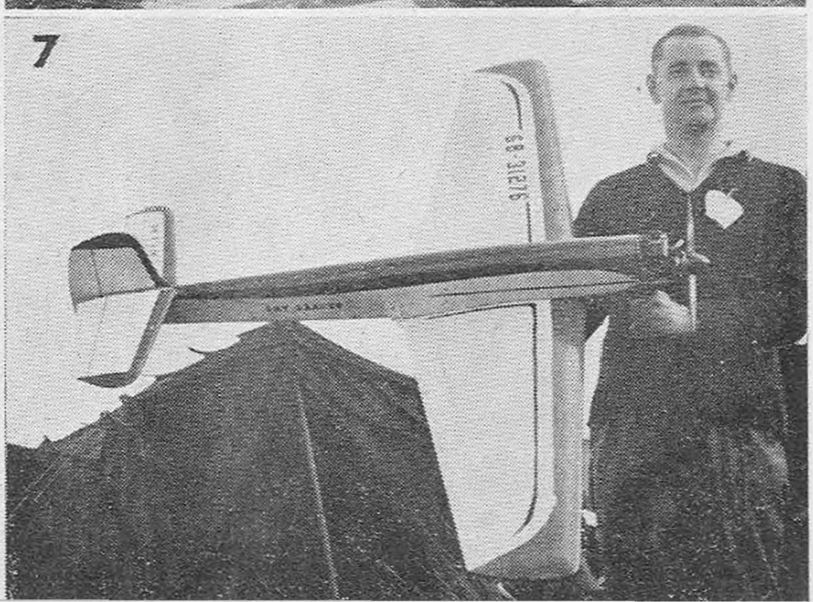

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Competitors came from Austria, Belgium, Canada, Denmark, Finland, France, Germany, Great Britain, Holland, Italy, Norway, Sweden, South Africa, Switzerland, and U.S.A. Nearly half the entry, seventeen in fact, were using the Taurus design and in fact the Belgian, Canadian, Dutch and Danish teams were exclusively Taurus equipped, though, it must be pointed out, Mortensen was the only Dane present. Numerically at least therefore, it was something of a Taurus benefit contest, they were simply everywhere.

During practice, Chris Olsen was unfortunate to smash both his Uproars, one due to a strong downdraught on take off, causing the model to cartwheel. The other model suffered a stuck aileron, caused by rain water in the equipment and was badly damaged in the ensuing crash. Fortunately, Trials fourth placer Peter Waters was on hand complete with models and hastily entered as reserve.

Dull overcast prevailed as the first round commenced early on the Friday morning and among the first called was U.S.A.'s Jerry Nelson, the first of the proportional men to perform. Gusty conditions did not help the big wing, long tail moment Cumulus and his motor cut during the second bunt for only 600 points. Peter Waters, first in for Britain, gave a very pleasing performance for over 1,600 points, which for some time stood second only to Ralph Brooke, the American, whose 1,924 point score indicated the advantage one could obtain with proportional control. Then Fritz Bosch broke through with a beautiful performance to return 1,724.

Second Briton to fly was Harry Brooks, last year's co-champion, but after a poke of "up" to lift the Soraco from the tarmac, all response was lost as the model dropped left into the ground two hundred yards upwind. In complete contrast to Harry's hard luck story, South Africa's Monte Malherbe lost contact with his Sultan while high up, the model touring the surrounding countryside before homing back to the flying area where Monte regained control and completed the schedule.

The Kazmirski reputation prompted everyone to watch his attempt during the afternoon. After a neat take-off the flight was not very inspiring, the light Taurus none the better for a rich engine run in the windy conditions. Perhaps we were expecting too much and as someone remarked, "Everybody was expecting the man to perform miracles". Anyway, it was enough to rake up a score of 1,670 points. Last of the British team was Frank Van den Bergh still with the Skydancer he damaged at Kenley last year, even though it had a new wing. He had a new, smaller model but even so elected to use the Skydancer. Frank can always be relied upon for a smooth performance. Unfortunately his motor cut during the spin, necessitating a deadstick landing which undershot the tarmac landing circle, loosing landing points.

So at the end of round one, U.S.A.'s Ralph Brooke led the field, with Fritz Bosch from Germany exactly 200 points behind. Third so far was Ed. Kazmirski, while Cliff Culverwell from South Africa had climbed quietly into the number four spot. Fifth was Louis of Belgium while our own Frank Van den Bergh held sixth position. Two rounds now remained in which those who had returned low scores could make amends.

Britain's Peter Waters was disqualified since he was an un-nominated entry, so Chris Olsen worked overnight to see what could be contrived from his two wrecks, test flying early next morning with a combination of thick 18% wing and fuselage from his other thin airfoil Uproar.

Strong wind still prevailed when the second round began the following morning. Nelson's early flight improved over his first round score, completing the pattern for 1,556 points reflecting a few ragged manoeuvres. Brooks was first up for Britain, flying his reserve model, which lifted from the runway without mishap this time, completing the procedure turn and repositioned for the stall turn. The nose lifted and then the right wing tip swung over as the model began to point earthwards again. But the engine never recovered from

8, Laugh-a-minute Major Plessier did not bother with a rudder. 9, Beautiful original "Hugin" by Tonneson from Norway. 10, Monte Malherbe from South Africa with the Sultan that free flighted its way round Gank. Used same orange, yellow and black colour scheme as on 1962 entry. 11, Mantelli (right) flew the only Stormer at the Meeting. 12, Jean Pierre Gobeaux of Belgium with Taurus. Jean used an Orion for his first flight. 13, Contradiction of official decisions annulled first round flight by Peter Waters, seen here assisting Chris Olsen. 14, Bignon from France proved that the Graupner Caravelle is a fine competition model. 15, Horman of Austria with his large shoulder wing original which employed aerodynamic balances on elevator.

WORLD CHAMPIONSHIP MODEL ANALYSIS

Name & Country	Model	Span in.	Area sq. in.	Wt. lb.	Wing Section & Thickness	Engine	Prop. (Ins.)	Transmitter	Receiver	Control System	Servos	U/C	Remarks
1 R. Brooke U.S.A.	Low wing original "Amanusa"	72	720	6½	N.A.C.A. 0018 18%	Veco 45	11 x 6	Orbit Proportional	Orbit Proportional	R.E.M.A.	4 Orbit Proportional Servos	Tricycle	Glass fibre fuselage. "Glass Bat" (18 oz.), strip ailerons.
2 F. Bosch Germany	Original shoulder wing	67½	1070	9	Symmetrical 20%	Super Tigre .56BB	12 x 6	Telecont 9	Telecont 9 Relay	R.E.M.A.T.	5 Bonner Duramites	Tricycle Steerable	Glass fibre fuselage, unsheeted exp. Polystyrene wing.
3 E. Kazmirski U.S.A.	"Taurus"	69	720	5¾	N.A.C.A. 2419 19%	Veco 45	11 x 6	Orbit Transistor 10	Orbit Superhet	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	Mechanical kick-up elevator for spin.
4 P. Louis Belgium	"Taurus"	69	720	6½	N.A.C.A. 2419 19%	Veco 45	11 x 6	Orbit Valve 10	Orbit Superhet	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	Override elevator for positive spin.
5 G. Nelson U.S.A.	Original low wing "Cumulus"	70	865	6¼	Symmetrical 17%	Veco 45	11 x 6	Orbit Proportional	Orbit Proportional	R.E.M.A.	4 Orbit Proportional Servos	Tricycle Steerable	Strip ailerons, low set tailplane.
6 C. Culverwell S. Africa	"Taurus"	69	720	5¾	N.A.C.A. 2419 19%	Veco 45	11 x 6	Kraft Transistor 10	Kraft Superhet 10	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	1½ in. longer tail moment.
7 F. Van den Berg G. Britain	Original low wing "Skydancer"	67		6¾	Symmetrical 15-20%	Merco 49 Johnson throttle	11 x 6	Orbit Transistor 10	Orbit 10 Superhet	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	Mechanical kick-up elevator for spin, ½ span ailerons.
8 Ch. Teuwen Belgium	"Taurus"	69	720	6¼	N.A.C.A. 2419 19%	Veco 45	12 x 6	Orbit Transistor 12	Orbit 12 Superhet	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	
9 P. Marot France	"Taurus"	69	720	6½	N.A.C.A. 2419 19%	Veco 45	11 x 6	Radio Pilot (France)	Radio Pilot Superregen (France)	R.E.M.A.T.	Bonner Transmites, own servo amplifiers	Tricycle Steerable	Valve Tx with transistor tone generators. Brakes. Larger fin for improved stability in loops.
10 H Tom Canada	"Taurus"	69	720	5¾	N.A.C.A. 2419 19%	Veco 45	11 x 6	Ace/Kraft kit	Kraft Superhet	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	Kit model. Brakes.
11 J. P. Gobeaux Belgium	"Taurus"	69	720	6¼	N.A.C.A. 2419 19%	Veco 45	12 x 6	Orbit Valve 10	Orbit 10 Superregen	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	Override elevator for spin.
12 P. Stephansen Norway	Original shoulder wing	65	780	7¼	Semi-symmetrical 18%	Merco 49	12 x 6	Quadruplex	Quadruplex	R.E.M.A.T.	Home made & Micromax motors	Tricycle	Mass balanced rudder and elevator.

13	M. Chercover Canada	"Taurus"	69	720	5¾	N.A.C.A. 2419 19%	Veco 45	11 x 6	Orbit Transistor 12	Orbit 12 Superhet	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	Printed circuit servo switcher plate for extra up elevator in spin. Brakes.
14	J. Connacher S. Africa	"Taurus"	69	720	5½	N.A.C.A. 2419 19%	Veco 45	11 x 6	Kraft Transistor 10	Kraft 10 Superhet	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	Mechanical kick-up elevator for spin. Faired in nose with spinner.
15	H. Schumacher Germany	Original shoulder wing "VAT 69"			8¾		Super Tigre 56BB	12 x 6	Bellaphon Transistor Proportional 10	Polyton 10 Superregen	R.E.M.A.	3 Bellamatic 1 Servo- auto-Matic	Tailwheel type	"Pegasus" fuselage. Tapered wing and tail-plane.
16	M. Malherbe S. Africa	"Sultan" low wing	66	810	5½	Symmetrical 14%	Veco 45	11 x 6	Orbit Transistor 10	Orbit 10 Relayless S/R	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	Electrically switched override in elevator for spin.
17	W.Hitchcox Canada	"Taurus"	69	720	6½	N.A.C.A. 2419 19%	Veco 45	11 x 6	Min-X Valve 12	Min-X 12 Superhet	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	Printed circuit switcher board for extra up elevator in spin.
18	P. Bignon	"Caravelle"	70½	660	6	Semi- symmetrical 17%	Veco 45	11 x 6	Orbit Transistor 10	Orbit 10 Superhet	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	Kit model.
19	E. Corghi Italy	Original low wing "X-16"	74	820	6¼	Semi- symmetrical	Super Tigre 56	12 x 6	Controlaire Valve 10	Controlaire Superhet 10	R.E.M.A.T.	5 Bonner Transmites	Tricycle	Moderately swept wing.
20	F. Plessier France	Original shoulder wing "Filocher"	68	690	5½	N.A.C.A. 2415 15%	K & B 45	12 x 6	Modified Grundig 8	Grundig 8	E.M.A.T.	2 Bellamatics 2 Plessier- matics	Tricycle	No rudder.
21	R. Dilot Sweden	"Taurus"	69	720	6½	N.A.C.A. 2419 19%	Merco 49	11 x 6	Bramco 10	Bramco Regent 10	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	Brakes. Override on elevator connected to slow engine for spin.
22	P. Eliasson Sweden	Original low wing "Mustfire"	68	700	10¾	Semi- symmetrical 15%	Merco 49	12 x 5	Kraft Transistor 10	Kraft 10 Superhet	R.E.M.A.T.	Bonner Transmites	Tailwheel type	
23	V. Tonneson Norway	Original low wing "Hugin"	66	720	6	Semi- symmetrical 16%	Merco 49	12 x 5	Orbit Valve 10	Home made Superregen with Relays	R.E.M.A.T.	Home made Servos	Tricycle	
24	T. Van Vliet Holland	"Taurus"	69	720	5½	N.A.C.A. 2419 19%	Veco 45	11 x 6	Orbit Transistor 10	Orbit 10 Superhet	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	Electrical kick-up elevator for spin.
25	N. Kramer Holland	"Taurus"	69	720	6	N.A.C.A. 2419 19%	O.S. Max. 49	11 x 6	Kraft Transistor 10	Kraft 10 Superhet	R.E.M.A.T.	5 Bonner Transmites	Tricycle	Electrical kick-up for spin. Restrictor in O.S. Max 49 carburettor.
26	O. Mantelli Italy	Flat Top Stormer	64	720	9½	Semi- symmetrical 15%	Super Tigre 56	12 x 5	Ecktronics Valve 10	Ektronics 10 Relayless S/R	R.E.M.A.T.	5 Bonner Transmites	Tricycle	

WORLD CHAMPIONSHIP MODEL ANALYSIS *(Continued)*

Name & Country	Model	Span in.	Area sq. in.	Wt. lb.	Wing Section & Thickness	Engine	Prop. (ins.)	Transmitter	Receiver	Control System	Servos	U/C	Remarks
27 H. Gast Germany	Original shoulder wing	68	690	7¾	N.A.C.A. 2415 15%	Super Tigre 56	11 x 6	Telecont Transistor 9	Telecont 9	R.E.M.A.T.	4 Annco Servos	Tricycle	9th channel switches engine control to trim.
28 H. Brooks G. Britain	Original "Soraco" low wing	68	700	6¼	Symmetrical 16%	Veco 45	12 x 6	F & M Matador 10	F & M Midas 10 Superhet	R.E.M.A.T.	5 Bonner Duramites & Brooks amp.	Tricycle Steerable	
29 C. Southier Switzerland	Original low wing				N.A.C.A. 2411 11%	K & B 45	11 x 6	F & M Hercules Valve 10	F & M Midas 10 Superhet	R.E.M.A.T.	5 Bonner Transmites	Tricycle	
30 C. Olsen G. Britain	"Uproar"	66	780	6	Symmetrical 18%	Merco 49	11 x 6	R.E.P. Dekatone Valve 10	R.E.P. 10 Relayless S/R	R.E.M.A.T.	5 Climax Musclemites	Tricycle	
31 G. Horman Austria	Original shoulder wing	74	810	6½	Semi-symmetrical 18%	Super Tigre 40	11 x 4	OMU 10	OMU 10 Relayless Superregen	R.E.M.A.T.	5 OMU Servos	Tailwheel type	Aerodynamic balance on elevator.
32 R. Aebi Switzerland	"Nimbus 2"	60	640	7¼	Semi-symmetrical 15%	Super Tigre 56	12 x 6	Home made Proportional	2 Rxs O/D Proportional	R.E.M.A.	2 O/D, 1 Bellamatic 1 Unimatic	Tricycle	Two proportional chls. on 40.8 Rx, two non-prop. on 27 Mc/s Rx.
33 J. Levenstam Sweden	Livewire "Viscount"	64	720	6½	Symmetrical	Merco 49	12 x 5	Kraft Valve 10	Kraft Superhet Receiver	R.E.M.A.T.	5 Bonner Duramites, O/D amps.	Tricycle Steerable	Brakes. 4 in. extra span.
34 W. de Mulder Holland	"Taurus"	69	720	6¼	N.A.C.A. 2419 19%	Veco 45	11 x 6	Controlaire Transistor 10	Controlaire 10 Superhet	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	Electrically switched kick-up elevator for spin.
35 P. Reinas Finland	"Uproar"	66	740	7¾	N.A.C.A. 0018 18%	K & B 45	11 x 6	Orbit 12	Orbit 12 Superhet	R.E.M.A.T.	Bonner Transmites	Tricycle	
36 F. Mortensen Denmark	"Taurus"	69	720	6	N.A.C.A. 2419 19%	O.S. Max. 49	11 x 6	Kraft Transistor 12	Kraft 12 Superhet	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	
37 A. Matthey Switzerland	"Taurus"	69	720	6½	N.A.C.A. 2419 19%	Merco 49	12 x 6	F & M Hecules Valve 10	F & M Midas Superhet	R.E.M.A.T.	5 Bonner Transmites	Tricycle Steerable	Brakes.
38 V. Miliani Italy	"Taurus"	69	720	6	N.A.C.A. 2419 19%	K & B 45	11 x 6	Orbit Transistor 10	Orbit 10 Superhet	R.E.M.A.T.	Bonner Transmites	Tricycle	Enlarged rudder area for positive spin.
39 J. Sederholm Finland	"Uproar"	66	740	8	N.A.C.A. 0018 18%	Merco 49	12 x 6	F & M Hercules Valve 10	F & M Midas 10 Superhet	R.E.M.A.T.	Bonner Transmites	Tricycle	Stormer fin.

low speed, ruining Harry's chance of a high final placing and the prospect of a British hat trick with the team award. Olsen, now re-entered the fray, with a mid-day flight that brought him a creditable 1,559 points. Again Van den Bergh was the last Briton to fly, and this time his motor did not cut. Despite fierce winds he improved on his first round score with 1,625 points.

Americans Brooke and Kazmirski both returned lower scores this time, Brooke dropping to 1,806 (although still better than all but Bosch) and Kazmirski to 1,503 for a flight without a recognisable tailslide or spin. Fritz Bosch however, improved with 1,812 to the amazement of some onlookers. Culverwell was doing very well and fellow team member Jim Connacher had improved, although Malherbe had fallen back. Chercover of Canada maintained his score, but the other two Canadians, Tom and Hitchcox had fallen down on their first round scores, the latter returning only 825 this time.

As the round closed, Brooke, U.S.A., was still in the lead over Bosch, though Bosch had improved his score. Cliff Culverwell now occupied number three position while Louis, Belgium, also moved up one place leaving fifth position for Ed. Kakmirski who had slipped back. Van den Bergh remained number six in front of Chercover, while Teuwen of Belgium leapt six places to number eight. Jim Connacher, South Africa, was now number nine followed by Marot of France moving down from seventh position he held at the end of round one.

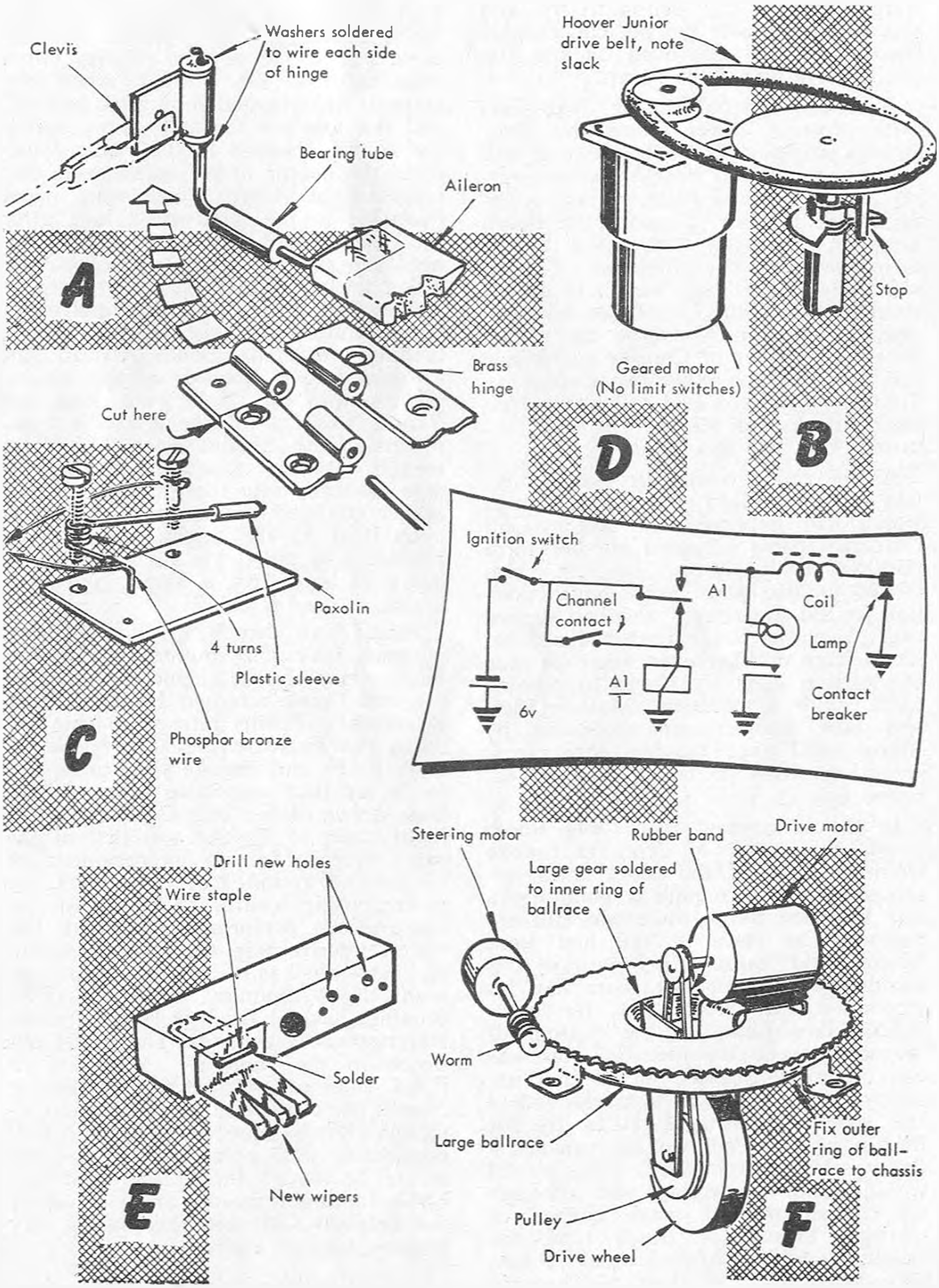
In the last round then, only Bosch stood any chance of deposing Brooke from the top of the score sheet, although it would require a good flight. For Van den Bergh there was still opportunity to place in the first four. Olsen could improve his position tremendously with another score like his second round effort, but for poor Brooks languishing at the bottom of the score sheet, the question now was one of lifting himself out of that unhappy position, which he could with a full schedule flight. First to fly for Britain, as in round two, he managed a shaky schedule for 1,502. This round would decide everything, and although no competitor had much chance of catching Brooke or Bosch now, the Belgium, South African and U.S.A. teams each had all their members in the top half of the running score sheet, standing them in good stead for the team prize. Nelson, U.S.A., now more on his mettle used his proportional radio to good effect for an 1,800 point score.

Belgium's Louis managed a surprisingly high 1.783 and Culverwell made his best flight, returning 1,667. Hopes for another good score by Chris Olsen smashed like his Uproar when the elevator link sheared soon after take-off, and this was not the only prang during the round. Sederholm of Finland suffered the horror of seeing the wing collapse on his Uproar, one wing panel fluttering in the wind gusts long after the fuselage had raised a cloud of dust near the landing circle. Eliasson too, flying the same Mustfire he brought to Kenley last year, broke the fuselage in two by hitting officials' tents during his landing approach. South African Jim Connacher also picked up the pieces. His motor cut while the beautiful Taurus was low overhead at the completion of the inverted eight. An effort to roll out only caused the machine to dive vertically into the ground. Jim had earlier confided the secret of its amazingly light 5½ lb. weight. Every piece selected like pulp, was his explanation, likely to burst like a bomb in a hard knock . . . and it did.

Frank Van den Bergh had a nasty moment when his motor spat during bunts. Happily the engine continued to run and Frank returned 1,653, his best. Kazmirski's Taurus refused to spin yet again but he scored 1,760 nevertheless. Both Bosch and Brooke were to be last to fly for their respective teams. U.S.A. were drawn earlier than Germany in the flight order so Brooke was first of the two. Hoping for an improvement on his second round score to clinch the championship award, he fell down on his previous performances, though not without performing the most beautiful of "near miss" tailslides seen during the event, his "Amanusa" (AMA N-USA) dropping several fuselage lengths before flipping over backwards. This really put Bosch in the running. According to F.A.I. rules an outright win requires a clear 2 per cent point advantage and although Bosch thus required a highly improbable 1993 points to win he could secure an equal first place with just 1,843, forcing a fly-off for the King of the Belgians Cup and this was a very possible turn of events.

(*Continued on page* 565)

Gadgets and Gimmickry



Strip Aileron Connection (Sketch **A**)

D. E. Parmenter uses a slice from a small brass hinge as a universal joint between strip ailerons horns and their push rods. The sketch shows various stages in the production of the connector. it is possible to unsolder the retaining washers on the aileron horn and slide the piece of hinge up or down to vary the amount of throw. Be sure to use the same gauge wire for the aileron horn as that which was removed from the hinge.

Boat modellers will welcome the next idea from A. P. Dowsey.

Simple Over-ride (Sketch **B**)

Why bother to fit limit switches for slipping clutches when the connection between the rudder stock and the servo can be made to provide slip at extreme rudder positions?

A pair of pulleys are used with suitably large grooves to take a Hoover vacuum cleaner drive belt (Junior size). It will be found that if the distance "A" is carefully adjusted. the belt which will be quite slack transmits adequate power from the servo gear box, but slips readily when the rudder reaches its limits.

Simple Limit Switch (Sketch **C**)

If you do go in for limit switches, another trouble saving device from the Dowsey workshop should fill the bill. These little units are the work of a few minutes, we understand they are quite reliable in action. The advantage of making separate switches such as these is that they may be positioned experimentally without affecting their function as a switch. Simply take a scrap of Paxolin or similar material, add an 8 B.A. bolt on which has been wound a 4 turn, 22 s.w.g. phospher bronze brass wire spring. This makes contact on a second bolt which should, needless to say, be filed nice and clean at the point of contact. Purists could use a short peg cut from silver wire. In some cases it is necessary to insulate the end of the spring where it is struck by the moving part of the mechanism. This is easily accomplished by using a scrap of plastic sleeving secured with clear Bostik.

Panic Stop (Sketch **D**)

D. Diamond cuts the ignition of his "Gannet" powered boat by the use of the circuit shown here. It will be seen that the ignition will be switched by the relay contacts on the appropriate channel. The relay will stay operated via its own contact until it is reset by switching the ignition off. If a lamp and a push button switch is placed on the coil side of the contacts, the ignition can be checked.

An additional advantage of the system is that the ignition battery drain is saved by switching off, should the motor stop halfway across the pond.

Servo Contacts (Sketch **E**)

A number of readers who possess the earlier type of Climax "Servomite" may like to bring the wiper contacts up to date by fitting flat "fingers" to replace the wire versions thereon. The idea which comes from D. M. Wright was tried out on a worn Mk. I "Servomite". The modification is best made before excessive arching occurs, for once the tracks have been burnt, centring can be difficult unless the new wipers are carefully aligned so that they bear on an undamaged section of the copper.

The modification is quite simple, simply drill two small holes each side of the centre yoke between the holes used to secure the old fingers. New phosphor bronze wiper fingers are made for 32-36 s.w.g. material and drilled to suit the aforementioned holes. Two U shaped pieces of 20 s.w.g. tinned copper wire are used to secure the phosphor bronze, locking with a dab of solder.

Be quite sure that the wiper on the extreme left hand side (from the gear end) cannot touch the narrow p.c. strip on the edge of the board. Rubbing the contact surfaces with an H.B. pencil improves the contact (blow away all surplus graphite).

Steerable Drive Wheel (Sketch **F**)

M. Gernat uses the system illustrated on unorthodox vehicles. The simplicity of the layout does much to recommend it.

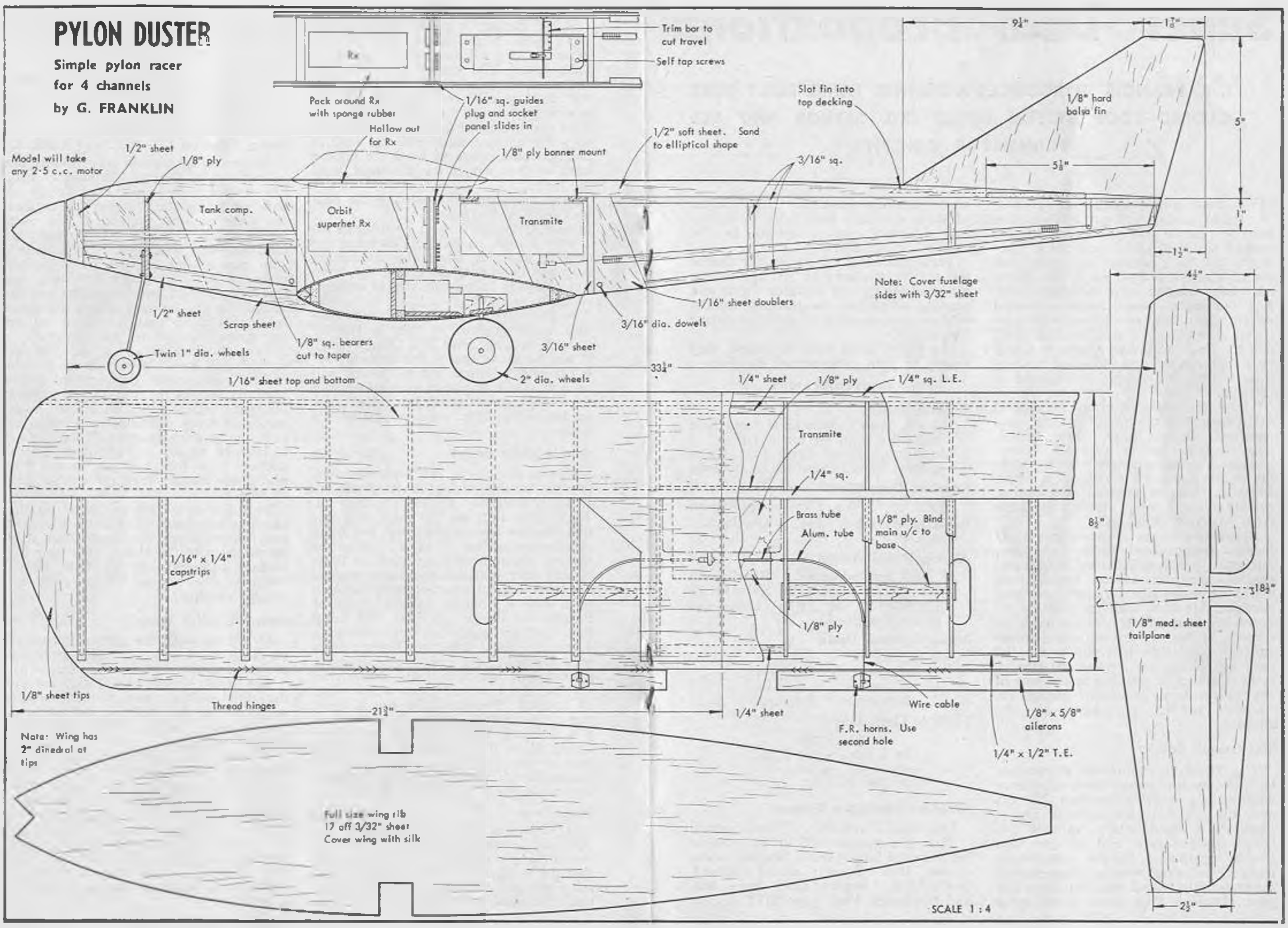
The sketch should be self explanatory, the only difficult part to find would probably be the ballrace, no doubt a local garage would oblige with one from the junk box.

A variety of control systems may be employed; it is an advantage to stop or reverse the motor and a two position actuator would be suitable for this when using proportional steering. Alternatively on slow moving vehicles, the unit may be rotated 360° via a one or two channel system, sequentially in the former case, wherein it would be necessary to provide slip rings for the drive motor connection.

PYLON DUSTER

Simple pylon racer for 4 channels

by G. FRANKLIN



PYLON DUSTER

Simple pylon racer for 4 channels

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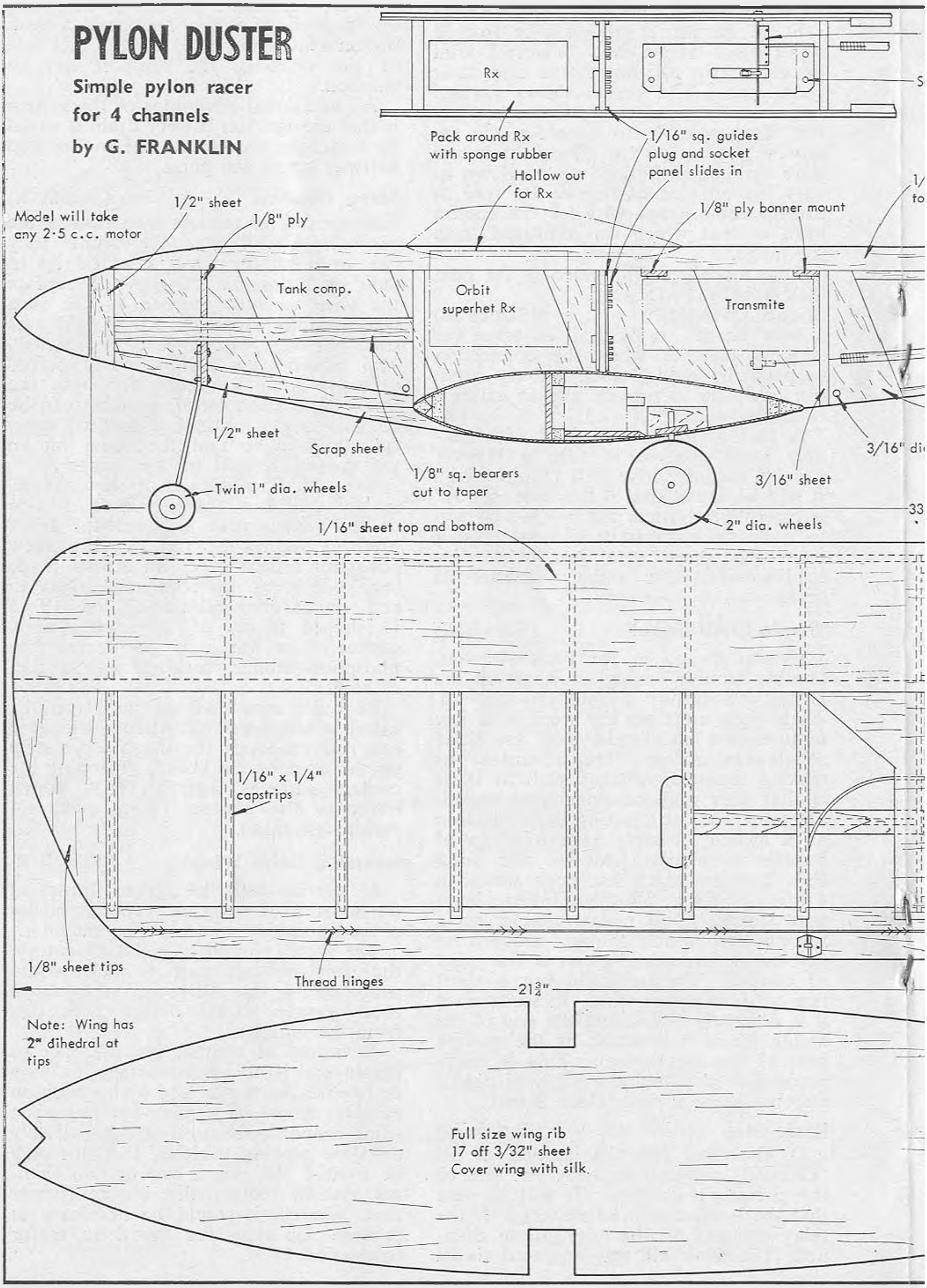
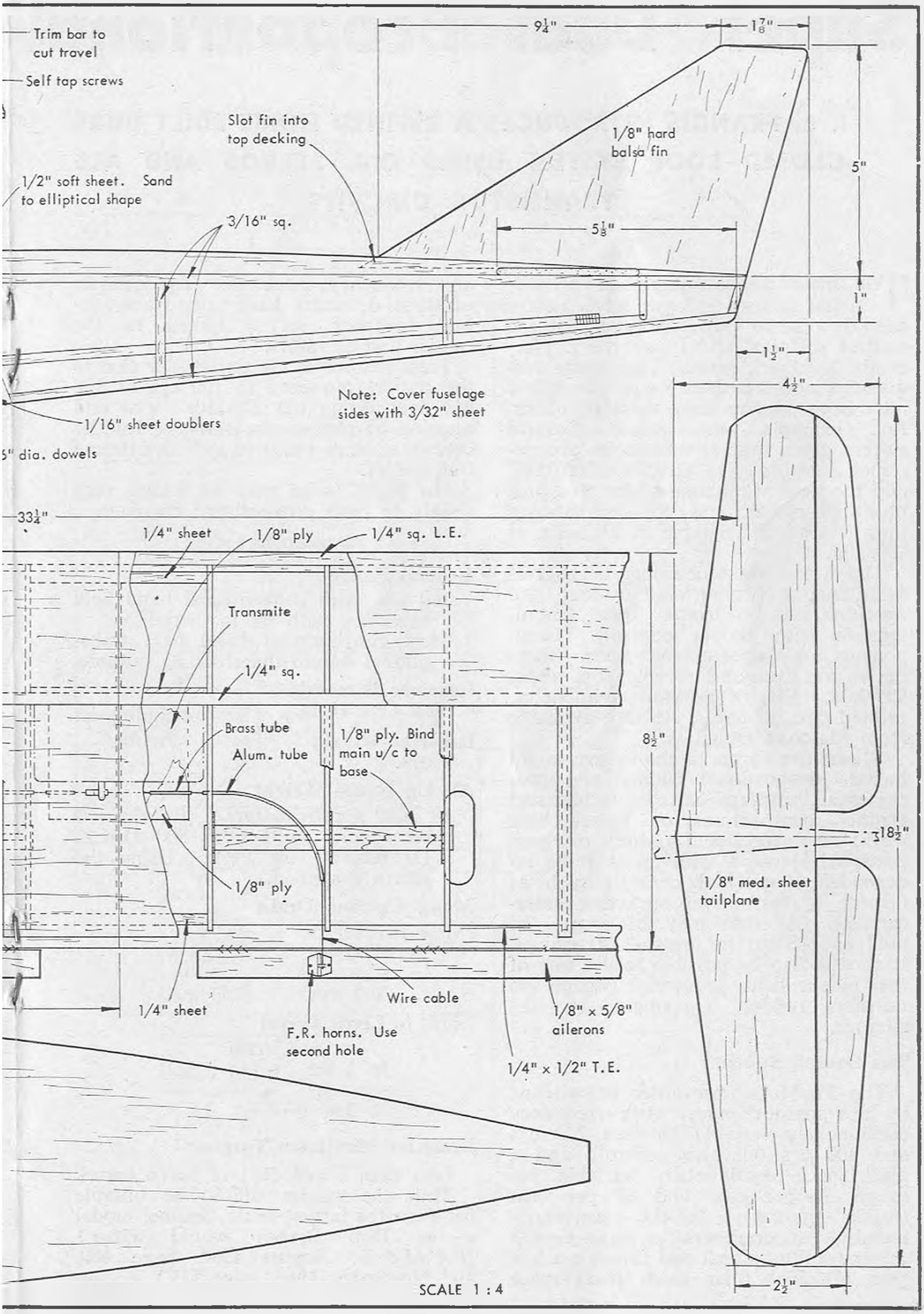




Trim bar to cut travel
Self tap screws
Slot fin into top decking
1/8" hard balsa fin
1/2" soft sheet. Sand to elliptical shape
3/16" sq.
9¼"
1⅞"
5"
5⅛"
1"
1½"
4½"
Note: Cover fuselage sides with 3/32" sheet
1/16" sheet doublers
dia. dowels
33¼"
1/4" sheet
1/8" ply
1/4" sq. L.E.
Transmite
1/4" sq.
Brass tube
Alum. tube
1/8" ply. Bind main u/c to base
1/8" ply
8½"
18½"
1/8" med. sheet tailplane
Wire cable
1/4" sheet
F.R. horns. Use second hole
1/8" x 5/8" ailerons
1/4" x 1/2" T.E.
2½"
SCALE 1 : 4

Super Dual Proportional

I. R. FRANCIS INTRODUCES A REFINED HOME BUILT DUAL CLOSED LOOP SYSTEM USING O.D. SERVOS AND ALL TRANSISTOR CIRCUITS

THE main disadavantages of proportional control systems have always been low servo power, flapping of the control surfaces, and unreliability. Recently, feedback servos, high pulse frequencies and transistor servo amplifiers, have been used to solve these problems. For example, the Space Control system gives four simultaneous proportional controls at a cost of £300.0.0d., and the new Marcytone system for proportional rudder and non-simultaneous throttle trim is available in kit form at £50.0.0d.

The system to be described here, gives simultaneous proportional rudder and elevators, and throttle trim (simultaneous with rudder control). Components for the complete system (transmitter, receiver and servos) cost about £35.0.0d. Kits of selected components, printed circuit boards, etc., are available from Malcolm Douglass.

Alternative forms of the system might include proportional rudder and proportional throttle (ideal for "rudder and engine" competitions or power boat work) or proportional rudder and proportional elevator, with up to three independent sequential controls such as throttle, brakes or even retracting undercarriage. Ailerons may, of course, be used coupled to (or instead of) rudder. It should also be possible to use one of the independent sequential signals to transfer rudder movement to the ailerons.

The Overall System

The 27 Mc/s transmitter is switched by a transistor pulser at a frequency continuously variable between 200 c/s and 400 c/s (elevator control), and a mark/space continuously variable between 33 per cent and 67 per cent (rudder control). In the receiver, a transistor superegenerative stage detects the transmitter signal and through a low pass (quench) filter feeds mark/space and frequency detectors. The outputs of these detectors feed fully transistorised feedback servos linked to the rudder and elevators.

Press buttons at the transmitter change the pulser frequency to 100 c/s or 900 c/s neutralising the elevator servo and opening or closing the throttle. Rudder control remains effective at both extreme frequencies.

"In flight" trim may be added very simply to both proportional channels.

PERFORMANCE

Ground Range

700 yds. with conventional hand held valve Tx with 64 in. aerial.

Most conventional hand held transmitters should therefore be suitable.

Receiver Dimensions

3½ x 1¾ x 1¼ in.

Receiver Weight

4 ozs.

Both including all servo amplifiers.

All Up Radio Weight

18 ozs. approximately. (Receiver, 3 servos, 7.2 volts C.T. 500 D.K.Z. DEACs, 9 volt PP4). Using the servos described.

Mean Current Drain

For two servos

± 2.4 v.	± 3.6 v.
200 mA.	250 mA

Limit to Limit Travel

(no load)

In ½ sec.	In ⅓ sec.
± 2.4 v.	± 3.6 v.

Error for Maximum Torque

Less than 5 per cent of servo travel.

Thus the system should be suitable for even the largest multi channel model — as Don Brown would agree ! (*R.C.M & E.*, August 1962, page 400, and November 1962, page 539.)

with 2 Feedback Servos

PART 1

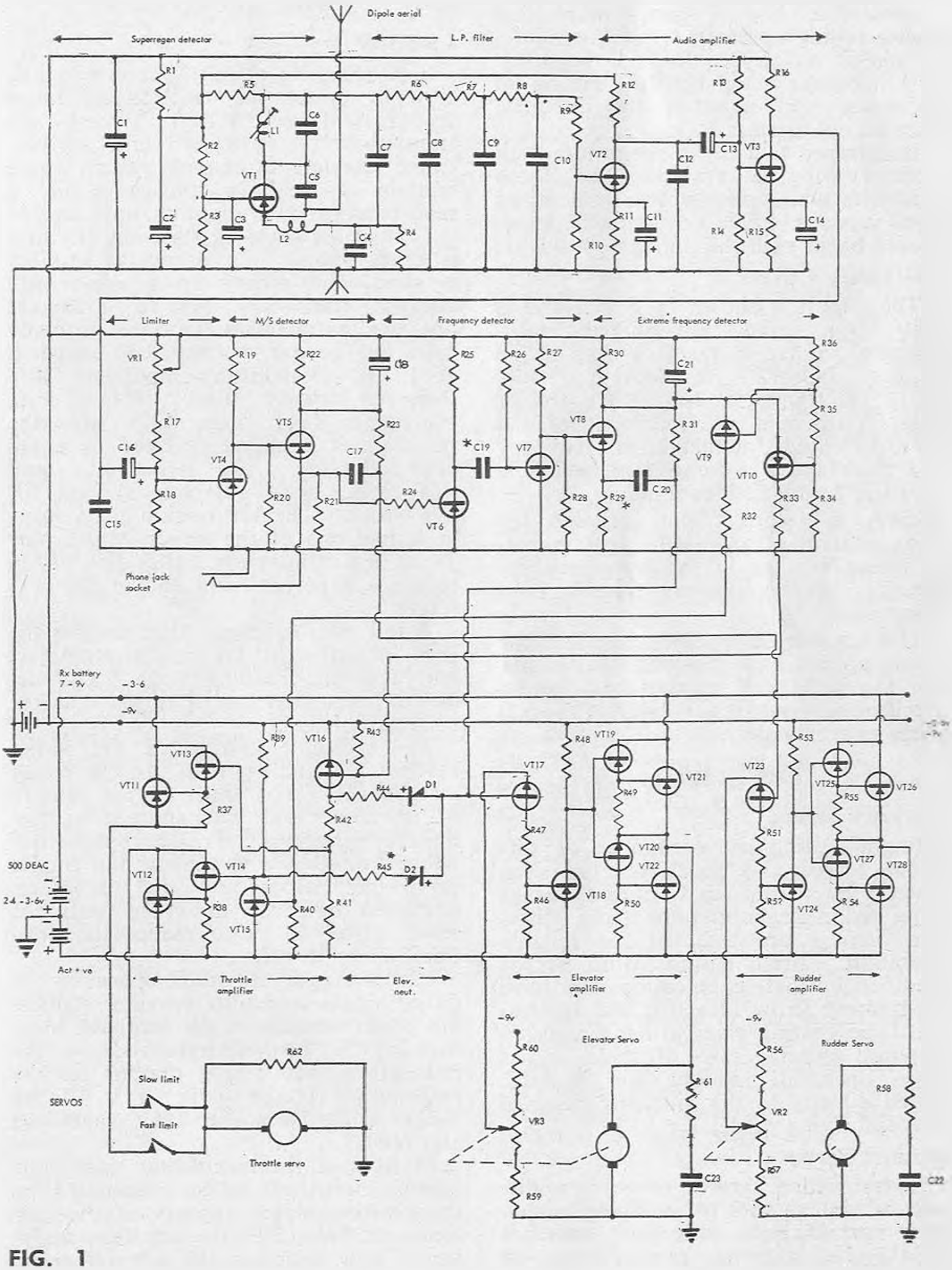


FIG. 1

Construction and Setting Up

Construction is simple for anyone with previous experience of printed circuit soldering and an understanding of most of the technical articles published in *R.C.M. & E.*, particularly those on transistors and feedback servos. A crystal earphone or high impedance headphone is essential, and a good multimeter makes setting up easier.

This is *not* a set for the beginner. If you cannot understand the setting up procedure and most of the circuitry, then do not attempt it.

It is hoped that complete custom-built systems will be available for those modellers who prefer not to build their own versions. "Do it yourself" types should begin with the pulser.

The Pulser Circuit

The circuit is shown in Fig. 2 and is that of a quite conventional multivibrator, similar in form to that of the "Super Pulser" (*R.C.M. & E.*, July 1961). If transistors having β's greater than 50 are used, no trouble at all will be experienced. Interaction of frequency and mark/space is completely negligible over the 2:1 variations used.

VRA is a preset pot included for compensation of any slight drift in pulser frequency, or in the frequency detector. It should very rarely need adjustment.

The 6.5 volt Zener diode stabilises the circuit against battery voltage variations. For any voltage V greater than the 9v. specified, choose RA = 40X (V −6.5) ohms approximately.

THE SERVOS

Feedback Servos

Flight testing of a number of different servos and gearboxes has convinced the writer that rugged servos using nylon gears immune from vibration damage are essential for reliable operation. Fred Rising Multi servos modified by adding potentiometers have been found to be ideal for the application. The gearing gives just the required response speed. Two of these servos have operated reliably for months, bolted directly to the vibrating fuselage of a fast flying model.

Throttle Servo

A fast acting throttle servo is a distinct advantage with a fast flying model. Any normal type with limit switches should be suitable, remembering to check that the maximum servo amplifier current is 500 mA. or less.

The response of the servo circuitry is almost as rapid as that of reeds, so no difficulty should be experienced in blipping the servo to find a particular engine setting.

THE RECEIVER

Circuitry

The complete circuit is shown in Fig. 1. No doubt the reaction of many readers will be: "What! Twenty-eight transistors?" However, any conventional relayless six channel system would contain at least 20 transistors *and* a reed bank, and an eight channel set 26!

Considered stage by stage the circuitry is fairly simple. In particular stability is good, and setting up is non-critical because transistors Tr4 to Tr28 are operated as switches, i.e., are normally fully on or off. The R.F. stage is P. E. K. Donaldson's modified "305" Receiver Front End (*R.C.M. & E.*, November 1961, page 547) with the transformer coupling replaced by capacitor coupling. The writer has used this circuit with complete success for two years. The kit version may, however, use one of the newer Mullard or Texas R.F. transistors. It is also hoped to use a superhet front end in the near future.

A low pass (quench) filter couples the R.F. detector to the audio amplifiers and Tr4, the limiting stage. The detected transmitter signal appears at the collector of Tr4.

The collector voltage of Tr5 varies between −3 and −6 volts, as the pulser mark/space varies from 33 per cent to 67 per cent, and is unaffected by frequency variations. Tr23 compares this voltage directly with that of the rudder servo pot wiper and the difference, amplified by Tr24 to Tr28, feeds the servo motor so as to reduce the positional error to zero.

C18 averages the mark/space of the pulser signal, and also provides stabilising phase advance in the feedback loop. Stability is further improved by the pulse frequency ripple present on the collector voltage of Tr5. (See *R.C.M. & E.*, December 1961, pages 603 and 606).

On loss of the transmitter signal, the quench noise, no longer eliminated by the limiting stage, appears at the collector of Tr4. Tr5, the mark/space detector now averages the quench noise.

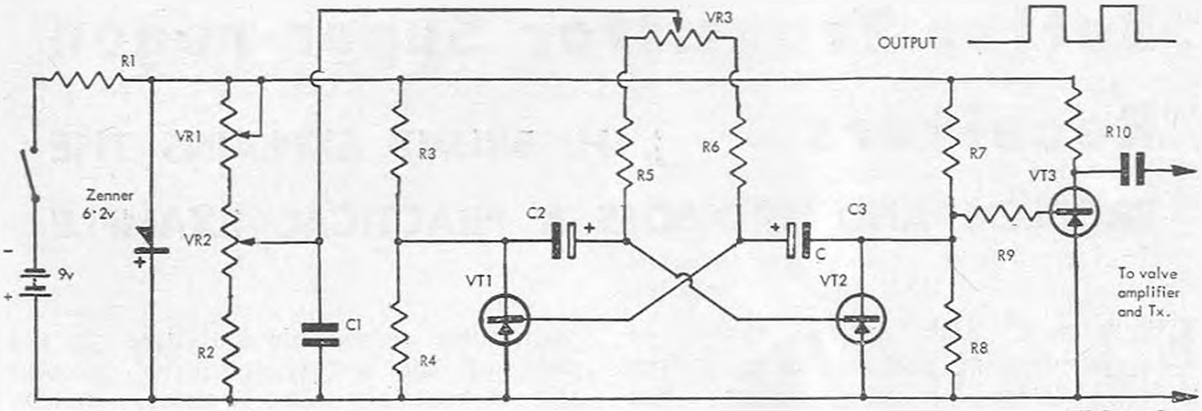
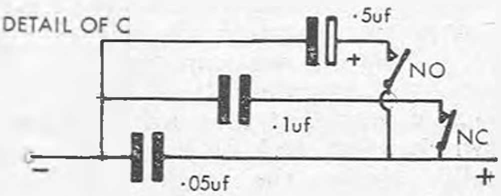


FIG. 2

DETAIL OF C



Note: Both switches double
pole press buttons:
NO for "fast"
NC for "slow

Vr1 effectively adjusts the mark/space of the quench noise to 50 per cent, thus giving neutral rudder on no signal (but has no effect when a transmitter signal is received).

C17 provides a stabilising ripple on the rudder reference voltage on no signal. Tr6, 7 and 8 form a frequency detector which is unaffected by temperature variations and a moderate amount of noise. The collector voltage of Tr8 swings from −3 to −6 volts as the pulser frequency varies from 400 c/s to 200 c/s. The remainder of the elevator circuit is identical to that of the rudder, except for the "failsafe" neutralising.

Tr9 and Tr10 are extreme frequency detectors which are normally biased off. On extreme high frequency signal, the voltage at Tr8 collector decreases below −2.7 v. switching on Tr10, Tr16, Tr13 and Tr11, thus driving the throttle to the "slow" position, and, via the diode D1 and R44, neutralising the elevator servo.

On extreme low frequency signal, the voltage at Tr8 collector rises above −6.3 v. and turns on Tr9, 15, 14 and 12. The throttle servo is driven to the "open" position, and D2 and R45 neutralise the elevator servo.

On loss of transmitter signal the frequency detector "sees" the high frequency quench noise as a high frequency signal, and thus closes the throttle and neutralises the elevator.

The high and low frequency channels could alternatively be used to "step" sequential servos.

A further (extreme mark/space) channel may be added by duplicating in full the low frequency channel circuitry (Tr8, 9, 15, 14, 12, D2, R45, etc.), for the rudder reference voltage. A single pole change over push button at the transmitter may be arranged to give 80:20 or 20:80 mark/space as required.

2. Power Supplies

The receiver will operate on any small 9 v. battery, e.g., PP4, or a 7.2 v. DEAC pack. Current drain is 20 mA. Temperature and battery voltage variations have little effect on the receiver. A 7.2 volt version should be set-up on this supply voltage, reducing all test voltages quoted in proportion, e.g., for 4.5 v. read 3.6 v.

Servo batteries may be ± 2.4 v. (C.T.) or ± 3.6 v. (C.T.) DEACs, preferably 500 D.K.Z. Small models have been successfully flown on four Magnatex cells—two in parallel, either side, for ± 2.0 v.

It is important that the receiver batteries should not be allowed to drop to less than 6 volts, or the reduced drive to the servo amplifiers may cause overheating of the output transistors. The receiver battery should not be removed or switched off, while the +ve servo battery is conected. Either use a double pole receiver switch (one pole for receiver battery, one pole in series with the servo battery) or one of the small sealed rotary switches of American origin (use three poles, three positions — OFF, RX ON, RX AND SERVO BATTERIES

All the construction details with the P.C. and placement diagrams and component values follow next month.

Better Transistor Super-regen Receivers

J. H. BRUNT EXPLAINS THE PROBLEM AND PROVIDES A PRACTICAL EXAMPLE

EXPERIENCE, both in the course of experimenting and also in answering many queries on the subject, has prompted the writing of this article. (These having been made as the results of trouble giving low sensitivity, which appears to be the major fault experienced by R/C constructors building transistor super-regen detector circuits.) An article —Valve version—on similar lines, was published in *R.C.M. & E.* in August 1961, on pages 375-378.

The basic principles of operation of the circuit are, of course, the same whether valves or transistors are employed. However, there are some differences as well as similarities and it is hoped this article will help all who encounter trouble with the super-regen detector.

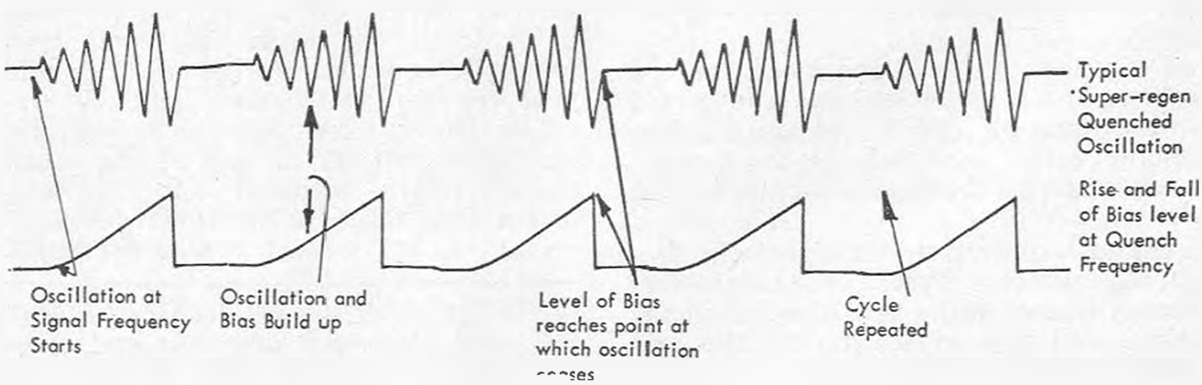
First I will recap on part of the original article, namely what the super-regen detector is and briefly how it works. When a circuit is just on the verge of oscillation it is in its most sensitive condition, therefore, if we make a detector behave in this way, not only will it detect but it will also be a very efficient amplifier.

There is, however, a snag, because apart from such a circuit being very sensitive when just on the verge of oscillation, it will also tend to be rather unstable. The object therefore is to try and achieve, with as simple a circuit as possible, both high sensitivity and at the same time reasonable stability. In the case of the superegenerative detector this is precisely what is done. Briefly, the detector is made to oscillate at the frequency of operation, in our case 27 Mc/s. Now if we can modulate or rather over modulate these oscillations in such a way that they are "chopped" or switched on and off at a high rate (usually above the audio frequency range) then this will have the effect of maintaining the circuit just on the verge of oscillation. Such a circuit, running under these conditions, will not only be very sensitive but will also be reasonably stable. Figs. 1A and B give a step by step illustration of what happens in a super-regen detector circuit, and how the quench action affects the bias and hence the sensitivity by holding the circuit, at its average level, at a point just on the verge of oscillation. It will be noticed that the quenched oscillation waveform is not unlike an overmodulated carrier wave.

An examination of circuits that have been published in *R.C.M. & E.* of super-regen detectors, will give some idea of component values employed, so for the sake of clarity no values are given in Fig. 2

First it is very important that the transistor employed for a super-regen circuit, should be capable of oscillating readily at the operating or signal frequency, in our case 27 Mc/s. Suitable types to use are: Mullard AF115,

FIG. 1a



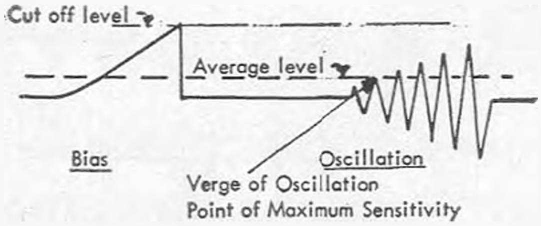


FIG. 1b

AF125, OC171 and OC170, Texas 2G415 and 2G415X or their equivalents. The tuned circuits for 27 Mc/s consists of L1 and C2, L1 being dust core tuned. The resistor network R1 and R2 along with the emitter resistor R3 govern the basis or operating point of the circuit with respect to the collector current, they also have some control with respect to temperature stability. R3 in conjunction with C4 also forms a controlling factor with respect to quench frequency. This latter effect which ties in with bias, which during operation varies at the quench frequency rate, may be likened in the case of the transistor super-regen to the action of the grid leak resistor and capacitor of the valve super-regen. C3 provides the necessary feedback from collector to emitter to maintain oscillation at the signal frequency. The value of this capacitor C3 is very important, it must be large enough to make the circuit oscillate, such that the quench action just passes the point of starting —onset of the well known super-regen "hiss".

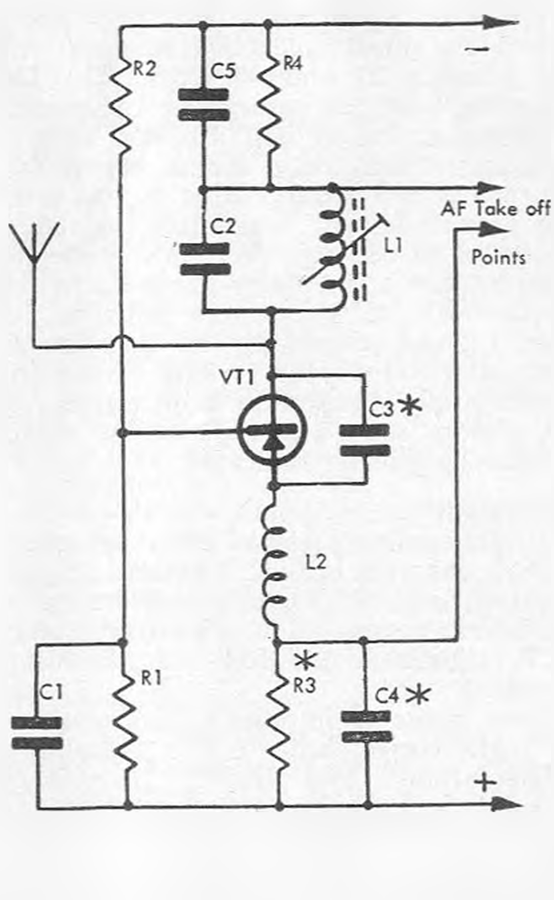
If the capacitor is too small, the circuit may well oscillate at the signal frequency without the quench action starting, but if it is too large in value then the quench or squegging may well be too heavy or fierce; both of these latter conditions will result in low sensitvity. The ideal method to get the correct value of C3 for a given circuit in the first instance, is to use a small variable capacitor, e.g., 2-8 pf Philips Trimmer adjusting this capacitor for maximum sensitivity. (WARNING: A setting giving maximum "hiss" is not the point of maximum sensitvity.) It is far better to start with the trimmer at minimum capacity and then increase the capacity till the hiss just starts, this is usually the point at which maximum sensitvity is also achieved. Once the value required for C3 is determined a fixed value may be used. L2, the R.F. choke, is a very important component, without it the circuit will not oscillate, as it holds the emitter at a point above earth (C4 decouples R3 to earth at the signal frequency 27 Mc/s) so that C3 can give the required R.F. feedback from the collector to the emitter enabling oscillation to occur. C1 decouples the transistor base to earth in respect to R.F. (The circuit operates with the transistor in earthed base mode R.F. wise.) Some circuits may also require A.F. decoupling at the base and in such cases a larger valued C (8-10 mfd) is often paralleled with C1. C5 decouples the R.F. present across R4, R.F. not being desired in the following A.F. circuits. Note: Both C1 and C5 should have a low impedance to R.F. (27 Mc/s) but a high impedance to A.F. (150-10000 c.p.s.).

In some circuits it will be found that R4 is replaced by the primary of an A.F. coupling transformer. In such cases apart from bypassing R.F. C5 may also be chosen to broadly tune the A.F. transformer to a particular part of the A.F. range of frequencies.

Experiments carried out have shown that a correctly adjusted super-regen detector, whether valve or transistor, can have a sensitivity in the order of five microvolts (i.e., a 5 microvolt C.W. signal is sufficient to completely suppress the super-regen hiss), this order of sen-

FIG. 2

* Components affecting sensitivity.



sitivity is in line with the general level of sensitivity achieved by a superhet receiver.

Further, once the detector has been made to function correctly, it will be found that quite large variations in supply voltage can be made without greatly affecting the performance of the circuit, e.g., a super-regen detector designed to operate on a 6 volts supply will still function quite well in the range 4.5 volts to 7.5 volts.

In Fig. 2 the aerial is shown connected to the collector of the transistor. It may alternatively be connected to the emitter (emitter connection will sometimes show an improvement in performance). A further means of connecting the aerial is by means of an additional coil coupled to L1, this coupling coil will require between approximately two and five turns of wire. A.F. output may be taken from two points in the case of capacity coupling. It is debatable which will give the best results, there appears to be two schools of thought in this respect. I would say try both and use which is found to be best.

In addition to the facts so far given, it is important to mention that the sensitivity of any super-regen detector — whether it employs a valve or a transistor—is greatly affected by two factors both concerning the quench action; these are: (a) The frequency of the quench or squegging, for the 27 Mc/s band the ideal quench frequency will lie between 25 and 40 Kc/s. (b) The amplitude of the squegging or quench oscillation, this is best adjusted to give maximum sensitivity at the signal frequency employed, too large or too small an amplitude will both result in reductions of sensitivity. A typical collector current for a transistor super-regen detector will be somewhere between 0.2 and 1.5 mA. depending on the type of transistor employed. The following notes apply equally to both valve and transistors super-regen detectors, except where specifically indicated.

Advantages

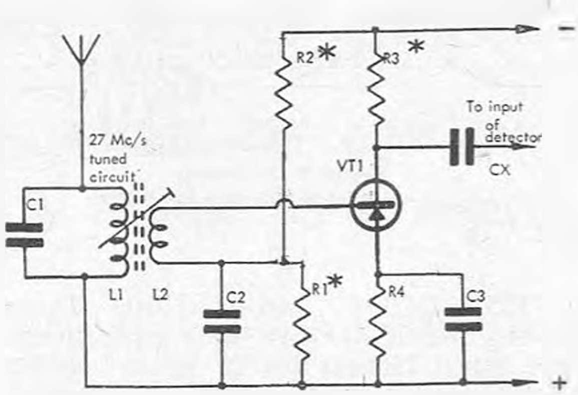
High sensitvity (equal to a superhet).

Has inherent A.G.C. (Automatic gain control) action. Care should be taken however, not to allow excessively large R.F. signals to be fed into transistor circuits.

Not prone to impulse interference.

Will receive both A.M. (Amplitude Modulation) and F.M. (Frequency Modulation) signals.

FIG. 3



Super-regen front -end

Components

Fig. 3

R1: 4.7K
R2: 33K
R3: 2.2K
R4: 1K
C1: 10 pf.
C2: .01 μf.
C3: .01 μf.
CX: Coupling Capacitor (see text)
L1: 15 turns
L2: 3 turns
$\frac{1}{4}$ in. diam. dust cored former.

Disadvantages

Poor selectivity*, giving trouble when two or more sets are operated in close proximity to each other.

**This can also be claimed as an advantage in that it makes tuning easy.*

Aerial length can sometimes be critical (too long an aerial will cause the quench action to cease particularly if length equals $\frac{1}{4}$ physically and/or electrically—e.g., loaded whip).

Radiates at the signal frequency and can cause interference to adjacent receivers (even a transistor super-regen detector gives quite an appreciable amount of radiation).

Aerial Length

The aerial length can have a marked effect on any super-regen detector in terms of performance, unless an R.F. buffer stage is employed to separate the detector from the aerial (see later paragraph and circuit given in Fig. 3). It is advisable to trim the aerial length to suit any super-regen circuit with the equipment in the model, to give optimum performance.

(*Continued on page* 565)

Precision Steering

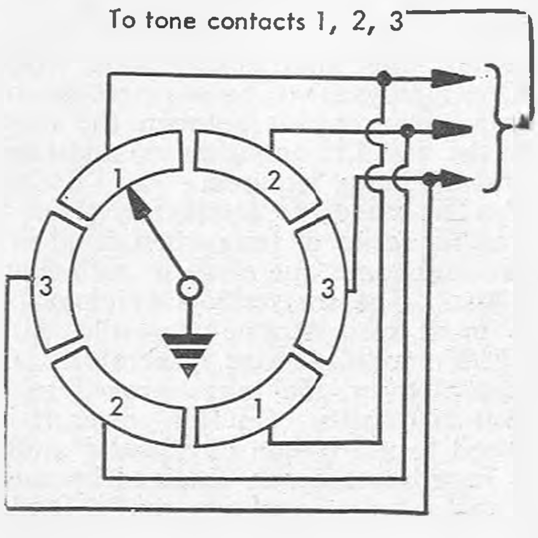
F. W. BETTON USES 3 CHANNELS AND THIS CRAFTY POSITIONAL SWITCH TO GIVE PROPORTIONAL EFFECT TO AN OTHERWISE ORTHODOX REED OUTFIT

THIS system evolved from the urge to make use of normally idle channels, plus the desire to have "real" control over the steering of a boat. With the method I am describing here, gone is the need to press a button—wait until you see how far the boat is going to turn—press the other button, and so complete a snake-like course up the pond.

The requirements are small, the construction simple—let us take the transmitting end first. I am using a model steering wheel revolving on a quarter inch spindle, mounted on which is a wiper arm travelling over contacts etched on printed circuit board, Fig. 2.

The total number of contacts is not critical, so long as it is a multiple of three. What must be remembered is that the more sets of contacts, the less the steering wheel has to be turned for a given amount of rudder movement. One of each of the sets of three contacts is connected to a tone circuit of the transmitter, and if the wheel is turned in a clockwise direction tones will be transmitted in the order 1.2.3. If the wheel is turned in the opposite direction, the order will be reversed 3.2.1. etc.

FIG. 1



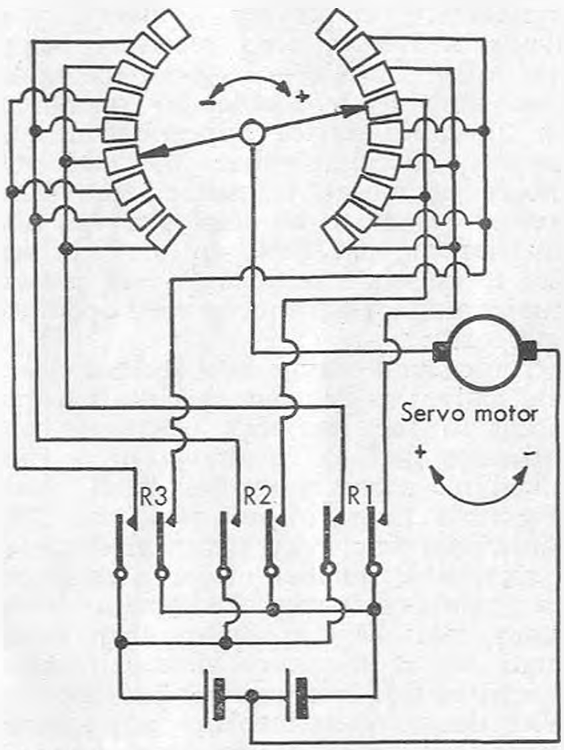


FIG. 2

Now for the receiving end of the business. Again, etched printed circuit board is used to form the two banks of contacts (Fig. 2), and is mounted on the servo motor.

Three double make relays operated by the reed unit of the receiver, are all that is required, except of course a centre tapped battery. Note that one contact on each side has no connection to it. These act as limit switches.

Method of Operation

It will be seen from Fig. 2 that if a positive potential is applied to the wiper arm, the servo will move in a clock-

(*Continued on page* 566)

GO SUPERHET FOR THAT NEW BOAT

The Podlaski Superhet

J. PODLASKI, Grad.Brit.I.R.E. describes his circuit for use with filters

THE decision that a superhet receiver is the only answer for the members of an active club sailing regularly together, was taken before such a receiver had been thoroughly proved. At the time, pulse operated single channel equipment employing valves was almost universal, reed receivers being still rather unreliable. About the same time transistors suitable for operation on 27 Mc/s started appearing in this country, deciding that the receiver should be an all transistor one. The control system to be employed was not finalised at that time, so the receiver had to be made suitable to feed pulsed carrier, audio frequency or reed operated intergear.

The general outline now became clear, and only the detailed specification relating to the receiver's electrical performance had to be drawn up. This called for a sensitivity that would give a ground range of not less than 200 yards, and selectivity that would allow a reasonable number of receivers to be used simultaneously. Although it is rarely that there are more than three boats on at the same time, all these should be free from mutual interference. With the numbers involved, any system giving less than 12 operating channels would be inadequate, and this determined the channel spacing at 25 Kc/s, allowing 13 channels between 26.96-27.28 Mc/s with carrier frequencies on 26.975 Mc/s with 25 Kc/s increments up to 27.275 Mc/s. The specification ready, the development work could now begin.

Development

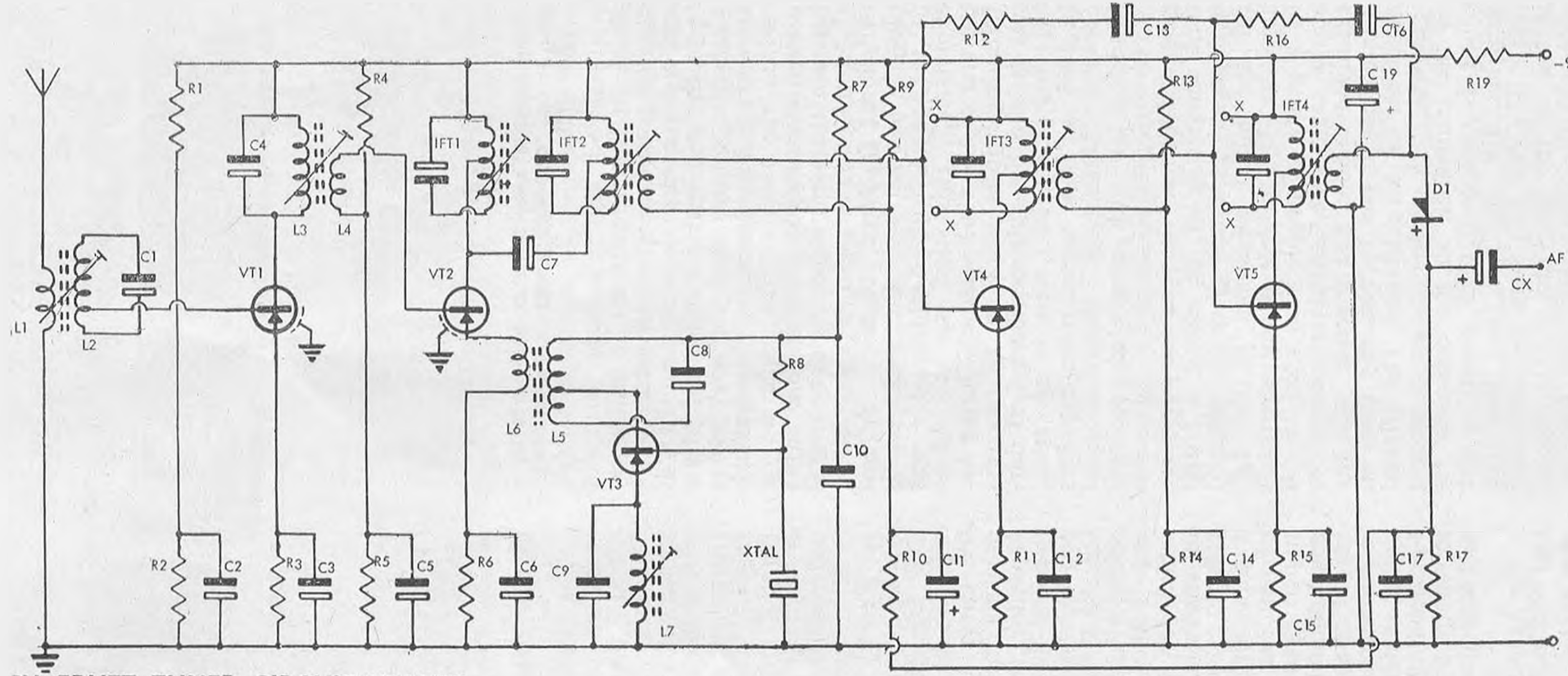
The selectivity requirements did not appear very exacting, and thus a conventional I.F. amplifier was built employing standard receiver practice, i.e., two transistors with single-tuned transformer coupling. The receiver front end consisted of a single stage R.F. amplifier coupled to a transistor mixer. The crystal controlled local oscillator was separate from the mixer and was inductively coupled to it.

At this time the Selectatone (described in a previous issue of this magazine) interrupted work on the superhet, but at the same time contributed something, because it was decided to use tuned filters in the superhet after their success in the multi version of the Selectatone. Thus equipped with a two stage resistance-capacitance coupled amplifier feeding a 4 channel filter unit the superhet receiver was ready for its first test.

Initially these appeared satisfactory. Range and selectivity seemed good. But then it was realised that circumstances arise when a boat under control is nearer to a transmitter on an adjacent channel than to its own. In such a case, the adjacent channel selectivity of the receiver was found to be inadequate.

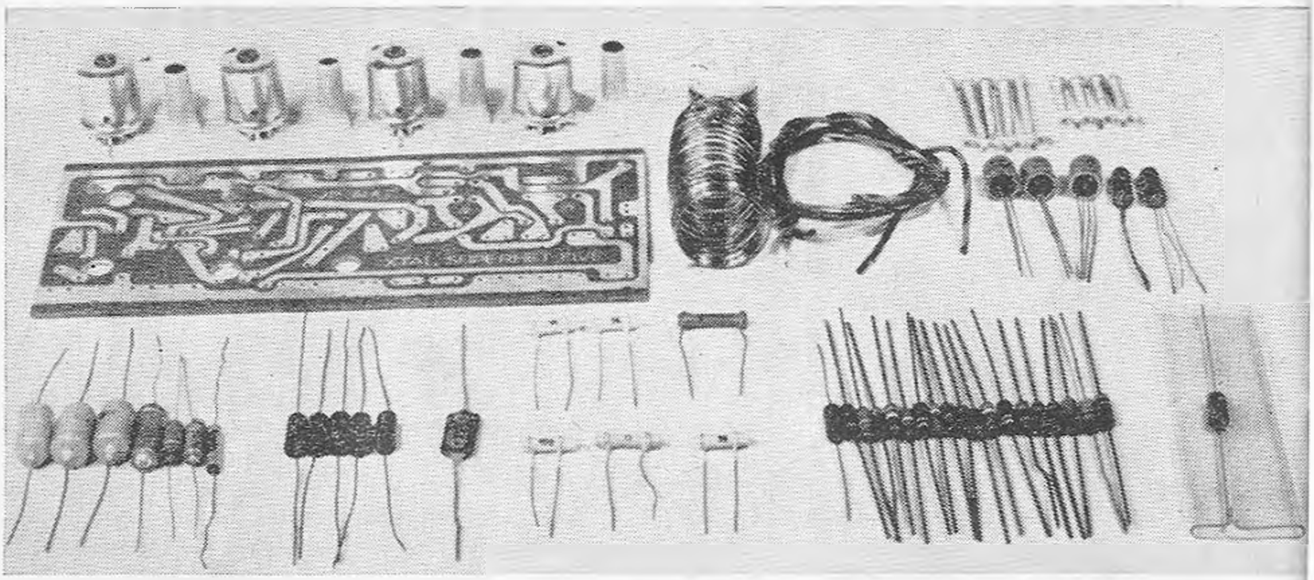
Back on the bench, the problem to be overcome had a special snag, as improvement in adjacent channel selectivity reduces the bandwidth of the receiver's response to control signals, markedly reducing the range of the higher frequency tuned filters. This problem is less important with reeds, as their lower operating frequency requires only a narrow bandwidth, and thus an extra single tuned I.F. amplifier stage effects a complete cure. To allow, however, to operate with tuned filters some means of band-pass coupling between stages appeared necessary. Normally, this is obtained in I.F. amplifiers by double tuned transformers. At that time none were available for transistors, and other methods had to be tried. After considerable amount of experimenting, the final circuit took shape. This employs two tuned circuits, top capacitance coupled between the mixer and the first I.F. amplifier, no additional transistor being required.

At this stage the receiver was put to a further series of tests when fitted in a boat, and came out of them with flying colours. The transmitters employed in the tests were McQue Versatile, fitted with a modified tone generator. On quarter power, the range proved to be about 200 yards. On full power it increased to more than any boat requires. An improvement was obtained by using on the receiver a short, centre loaded



SUPERHET TUNER CIRCUIT VALUES

R1: 12K
R2: 2.2K
R3: 1K
R4: 56K
R5: 10K
R6: 3.9K
R7: 1K
R8: 120K
R9: 68K
R10: 8.2K
R11: 680Ω
R12: 1.2K
R13: 22K
R14: 4.7K
R15: 1K
R16: 3.9K
R17: 4.7K
R18 180K
R19: 500Ω-2.2K
C1: 47 pf
C2: .01 μf
C3: .01 μf
C4: 47 pf
C5: .01 μf
C6: .01 μf
C7: 10 pf
C8: 15 pf
C9: .0047 μf
C10: 100 pf
C11: 10 μf,
6v. electrolytic
C12: .01 μf
C13: 56 pf
C14: .033 μf
C15: .1 μf
C16: 18 pf
C17: .01 μf
C18: 10 μf,
6v. electrolytic
C19: 20 μf,
6v. electrolytic
VT1: OC171 or AF114
VT2: OC171 or AF114
VT3: OC44 or AF117 (see text)
VT4: OC45 or AF117
VT5: OC45 or AF117
D1: OA81
XTAL: 9 Mc/s (see text)
IFT's: Weyrad P50
IFT 1: 2cc or 3cc
IFT 2: 2 & 3 2cc
IFT 4: 3cc
L1: 4t, 22 s.w.g. enam. interwound at bottom of L2.
L2: 9t, 22 s.w.g. enam. tapped 3t from bottom.
L3: 8t, 22 s.w.g. enam.
L4: 2t, 22 s.w.g. enam. interwound at bottom of L3.
L5: 17t, 22 s.w.g. enam. tapped 7t from bottom.
L6: 5t, 30 s.w.g. enam. interwound at bottom of L5.
L7: 20t, 30 s.w.g. enam.
R19 may be adjusted to obtain best compromise between sensitivity and stability.



The complete tuner kit, P.C. board is 6 in. x 2½ in., providing plenty of space for components.

aerial. This increased the range on quarter power to give adequate coverage of all competition courses. In this form the receiver was sailed for about 12 months, during which the weak points showed up. These were only mechanical, and as the receiver was made up on printed circuit panels, the flexible wiring between them provided the only source of trouble at the point of entry where occasional fractures occurred. By employing heavier wire and anchoring it to the panel with Araldite, this was eliminated. This stage was reached at the end of the 1961 season. During the following winter work on 12 receivers was started by club members, and during 1962 season four were in operation. In 1963 we hope to see more members of the Manchester Radio Control Models Club with completed receivers.

The superhet is definitely not a beginners receiver. Besides the comparatime complexity of the circuit, a friend with signal generator may be required for the initial alignment of the I.F. amplifier. This project is best attempted by a group of people who want to sail at the same time. All components are readily available, and together with the printed panels can be obtained from an advertiser in this magazine. The original idea was to leave the choice of system to the individual, so the complete receiver is composed of 3 panels — the superhet, the amplifier, and the filter unit. The last two were not combined in one, as the filter unit is interchangeable with the Selectatone multi receiver.

Circuit Description

The superhet circuit is fully d.c. stabilised, and employs V.H.F. transistors in the R.F. amplifier and mixer. The local oscillator was originally designed for a 9 Mc/s crystal, and worked on the third harmonic using an ordinary frequency changer transistor such as OC44. The circuit operates at the parallel resonant frequency of the crystal, and this should be stated when ordering the crystal. When employing third overtone crystals (such as those supplied by Messrs Cathodeon), a V.H.F. transistor will be required in most cases. The I.F. amplifier is conventional except for the band-pass coupling between the mixer and the first I.F. stage. Increasing the value of the top coupling capacitor, will increase sensitivity at the expense of selectivity. The detector provides simple AGC, and feeds a two stage A.F. amplifier whose second stage operates as a limiter. The limiter output is then applied to the filter unit which can operate almost any number of channels. Each channel consists of a high Q parallel tuned circuit feeding a super-alpha pair of transistors. The current rise in the transistors when the tuned circuit is energised, operates a conventional relay. The normal number of channels thought to cover most requirements is 6, and the printed panel will accommodate up to this number. For reed operation the receiver is followed by a panel consisting of a driver and a reed amplifier.

We have started to build a sample kit and will publish the construction details next month.

"Xtal Gazing" SOME SUGGESTED NEW SUPERHET SPOT FREQUENCIES

Although space presses — we must show the two main proposals so far: A by Dave McQue, B by John Bleakley. We will publish more information for and against next month.

Proposal A

Channel No. and Frequency

0 — 26.970	1 — 26.995	2 — 27.020
3 — 27.045	4 — 27.070	5 — 27.095
6 — 27.120	7 — 27.120	8 — 27.170
9 — 27.195	10 — 27.220	11 — 27.245
12 — 27.270		

It is clear to any thoughtful individual that our presently accepted R.C. contest organisation is unduly restrictive if not discouraging. To accept, as we have done for years, that only one model may be flown at a time on a particular airfield is a restriction peculiar to traditional R.C. flying.

But, you may say, we can only judge one model at a time—true but does everybody go to a rally or other meeting to enter the same or even any contest ? At present mono, intermediate, multi and pylon have to be run consecutively how about if they were run concurrently together with organised sport flying !

We have available a band of frequencies from 26960 Kc/s to 27280 Kc/s which we share with other users e.g. diathering, R.F. welding and latterly I hear, hospital paging systems. There are of course other services including short-wave broadcasting stations operating on adjacent frequencies which can lie within the reception bandwidth of a superegen Rx. tuned to a Tx. within the band.

If all contestants were required to use Superhet Rx and employed current commercial models having 3 or 4 I.F. tuned sets operating with carrier on a channel spacing of 50 Kc/s is more than adequate for operation from a common site. When two groups are separated by say ½ mile, so long as any frequency in Group A is separated from all frequencies in Group B by more than 20 Kc/s, no interference should occur. If, for example we divided the band into 13 channels at 25 Kc/s intervals vis

Multi could use the odd channels
1, 3, 5, 7, 9.

Mono could use the even channels
0, 2, 4, and odd 11.

Pylon could use the channels
6, 8, 10, 12.

Note as the multi frequency correspond to the present American frequencies with the exception of 27.255 most multi flyers using superhets are already on these frequencies.

Now it is an interesting fact that most superegen tone Rx. are unaffected by Tx. having a modulation depth less than around 60 per cent and have little range with less than 80 per cent. Superegen tone Rx. could be used with tone Tx. having Xtals on other than multi and pylon frequencies so long as they were physically separated from the multi and pylon Tx, by ½ mile or so and they kept their carrier on and keyed tone only. As tone superegen Rxs respond to the strongest signal only and the nearer and hence stronger local carrier prevents interference from more distant Txs.

Proposal B (allowing even more channels)

Chan.	Freq. Tx	Marked	Freq. Rx	Marked
A	26.965	A/Tx	26.500	A/Rx
B	—		—	
C	26.985	C/Tx	26.520	C/Rx
D	27.005	D/Tx	26.540	D/Tx
E	—		—	
F	27.025	F/Tx	26.560	F/Rx
G	—		—	
H	27.055	H/Tx	26.590	H/Rx
I	—		—	
J	27.075	J/Tx	26.610	J/Rx
K	—		—	
L	27.105	L/Tx	26.640	L/Rx
M	—		—	
N	27.125	N/Tx	26.660	N/Rx
O	—		—	
P	27.155	P/Tx	26.690	P/Rx
Q	—		—	
R	27.175	R/Tx	26.710	R/Rx
S	—		—	
T	27.205	T/Tx	26.740	T/Rx
U	—		—	
V	27.225	V/Tx	26.760	V/Rx

It should be remembered that whatever frequencies are adopted all must stick to them. Several different sets means utter chaos!.—ED.

Test Report: The ORBIT 10

Superhet Receiver and Transistor Transmitter

EDITORIAL REVIEW

Test figures by J. H. Brunt

For many years the little black box embellished with the name Orbit has been looked upon by contest modellers as a symbol of reliability. Indeed, one sees many such outfits in the transmitter pound and at the club field these days.

In keeping with the march of progress, Orbit have now produced an all transistor transmitter of remarkable stability and very sensitive reed superhet.

Straight from the box, the outfit which came complete with Medco power packs sprang into life, every reed responding with no pot twiddling and each reed gap already set for best drive. One rarely sees adjustments being made to this equipment, proof that the modulator stability of the transmitter is high.

TRANSMITTER

A simple centre loaded aerial which has no provision for (nor needs) tuning, balances the case nicely with Nicad power pack installed. The Switchcraft keys have smooth comfortable action and are conveniently and traditionally positioned. An edge mounted meter is incorporated in the case, giving an indication of R.F. output. We are pleased to note from field strength tests, a brief check on the oscilloscope and, what counts in terms of range, actual field tests; that modulation is *upward*. A rare achievement indeed these days. At this point, it should be stressed that whilst a strong R.F. signal in its unmodulated state serves to block interference, upward modulation gives a *stronger tone signal* than would otherwise be available.

Removing the back of the transmitter reveals a very neatly laid out glass epoxy printed circuit board with the components facing outwards. The lands, which are of rectangular pattern and generous width, face inwards and are, by this configuration, protected against accidental short circuits which might otherwise be caused by metal objects being inadvertently rested on the board. There is a retaining plate securing a specially made five cell power unit produced for Orbit by Gould-National Batteries Inc. with a rating of 1.2 amp/h. This is rechargeable via a socket in the front of the transmitter.

Sealed pots are used with one set of capacitors on the land side of the board, additional capacitors for matching the tones to the reed bank are soldered to riveted posts on the opposite, outer side, making it a simple matter to rematch the transmitter to other makes of receiver. The carrier frequency was changed by return of post by the U.K. Service Agent, to avoid frequency clashing on the local field.

Physical Data

$7\frac{3}{4}$ in. high, $6\frac{1}{2}$ in. wide, 3 in. deep, plus 1 in. projection of keys.

Chrome plated, telescopic, centre loaded aerial, retracted $18\frac{1}{4}$ in., extended 47 in.

Weight 3 lb. 7 oz. with 6 v. (nominal) power pack.

Case 18 s.w.g. folded aluminium, anodised black, chrome plated escutcheon.

TEST FIGURES

Current

Aerial collapsed 32 mA., aerial extended 44 mA.

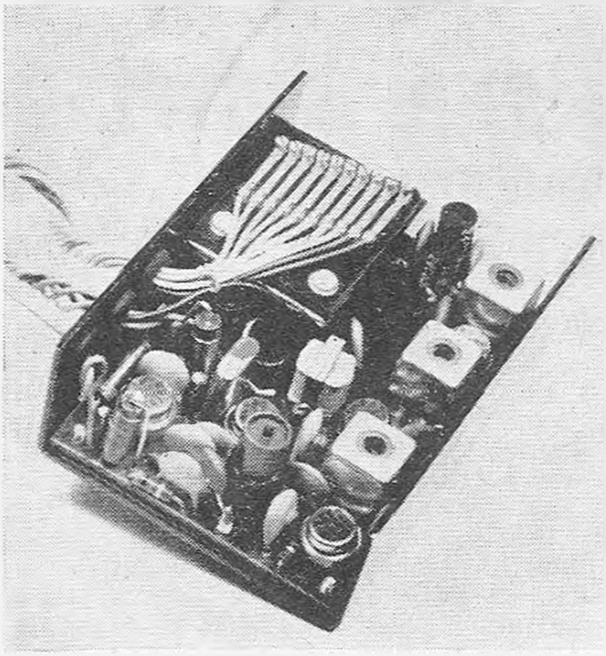
No change in current consumption between carrier and the operation of any tone or simultaneous operation, indicating an efficient circuit with upward modulation on all channels.

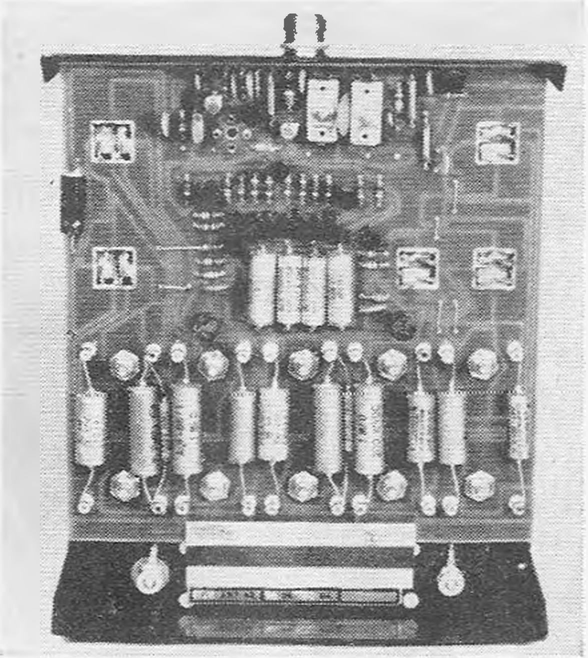
Transmitter Tones

Tones correspond almost exactly to those on the reed bank. We could detect no difference between readings obtained from the transmitter and those produced by our tone generators when we checked the reed bank for maximum drive. (Incidentally, the equipment we used for this part of the test, is the same as that used by Orbit.)

Field Strength

Very high for R.F. power available, indicating approximately 100 mW. of useable output.





Left : Orbit superhet receiver with ten channel Medco reed block and three I.F. cans. Above : Component board of Orbit 10 channel transistor transmitter displaying neat workmanship. Printed circuit lands show up through epoxy circuit board, displaying rectangular land pattern not used on earlier examples. Power pack may be seen in bottom of case.

RECEIVER

The seven transistor circuit employs two I.F. stages, has high sensitivity, and is temperature compensated. The A.G.C. action is very good and it is only possible to swamp the receiver when the transmitter aerial is brought into contact with the receiver aerial. The components are neatly laid out on a glass epoxy circuit board which is bolted to an 18 s.w.g. aluminium chassis. This not only affords protection from crashes, but improves the reed bank characteristics, by virtue of its mass. The reed bank itself is produced by Medco and represents an excellent piece of workmanship.

The reed drive is really hearty and the design of the audio amplifier keeps the drive constant.

Physical Data

$2\frac{7}{8}$ in. long, $2\frac{1}{8}$ in wide, 1 in. deep.
Black anodised aluminium case.
Weight 5 oz.

Reed connections in pairs of coloured wire, i.e., one colour for each servo, it is necessary to check which lead is used for "push" and which for "pull". The reed comb connection is led by a separate black lead and a further lead coloured green is used for monitoring the receiver. The 35 in. aerial is coloured to suit the frequency colour code.

TEST FIGURES

Figures from test with signal generator:
No Signal 4.5 mA., Carrier 4 mA., Tone (650 c.p.s.) 38 mA.
Low Tone (340 c.p.s.) 50 mA., 100 per cent sine wave modulation used.

Currents using transmitter to operate receiver:
No Signal 4.5 mA., Carrier 4 mA., Tone (650 c.p.s.) 50 mA.
Low Tone (340 c.p.s.) 58 mA.
Sensitivity approximately 2 μ volts.

Tone Frequency of Reeds:

Low 340 c.p.s.	=	Rudder	Left
370 ,,	=	,,	Right
400 ,,	=	Aileron	Left
430 ,,	=	,,	Right
460 ,,	=	Motor	Low
490 ,,	=	,,	High
530 ,,	=	Elevator	Up
570 ,,	=	,,	Down
610 ,,	=	Trim	Up
650 ,,	=	,,	Down

The reeds have obviously been very carefully and individually ground to attain such accurate spacing.

Selectivity

Bandwidth approximately 8 Kc/s.
Measured at I.F. frequency (455 Kc/s).

Complete Equipment Test

The equipment has been flown in a "Tauri" after a preliminary ground range

(*Continued on page* 564)

Commercial Developments

By TONY DOWDESWELL

CONSUMER STAFF MEMBER SAMPLES NEW PRODUCTS AT HOME & ABROAD

WE kick off this month with a very interesting item from Roland Scott Ltd., a new multi channel superhet from **C & S Electronics.** Previously, C & S have been concerned purely with the production of single channel equipment and the **"Cardinal"** is their first venture into the multi field.

It is unusual in its use of transfilter I.F. stages, an up-to-the-minute development dealt with in *R.C.M. & E.* last month. The circuit is all transistor and works off 6 volts. Physical size is small, only 3 in. x 1¾ in. x 1 in., components packed neatly on the glass epoxy printed circuit baseboard, mounting a Medco 10 reed bank at one end for an all up weight of 3½ ozs. There is only one tuning control, the main feature of this type of receiver, which then tunes like an ordinary superegenerative set and worked with the first multi transmitter on the same frequency we could find. The set is neatly constructed and the only fault we could find with it on examination was that the green anodised case might not stand up to really hard prangs and a slightly thicker gauge might be beneficial.

The Cardinal can also be supplied with a 12 channel reed bank, or a relay, the latter version weighing 3 ozs. A slightly different version is also produced, called the **Oriole.** The circuit is virtually the same but supplied with a sub-miniature New Haven Electronics 10 reed bank or relay for a slightly smaller case size of 2½ in. x 1¾ in. x 1 in. Weight, too, has been cut down, the single channel version at 2½ ozs. and the multi version 2¾ ozs. Instructions for the Cardinal are commendable, including single and ten channel wiring diagrams.

C & S are also working on a matching all transistor multi transmitter, one of which we examined during our trip to the World Radio Control Championships, but this is not yet available, although Roland Scott indicates a very competitive price. Meanwhile, the multi channel Cardinal is the only one of mentioned items in stock at £27.0.0d., a very reasonable price we think.

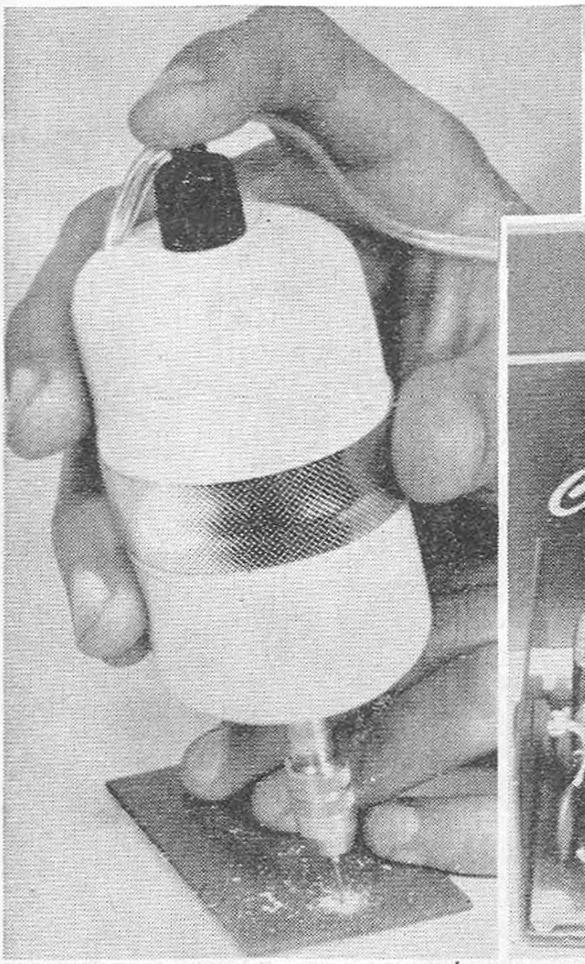
A visiting Skol-Kits representative revealed the fact that this company is now distributing **Minidrills** on an exclusive basis and left a sample No. 8 version. The Minidrill is a miniature, electric motor powered drill working off three 4½ volt bell batteries (13½ volts), a car battery, or transformer unit. The brass chuck accommodates any of five different tools provided with it, including a drill, burr, buffs and brush. For modellers in general this little unit has many uses and for R/C enthusiasts, it drills holes in printed circuit Paxolin as though it were butter. Extra tools are available to fit the chuck, including extra burrs of various shapes, buffs and a tiny circular saw which manages $\frac{1}{16}$ in. ply fairly easily. Extra tools cost 2/6d., all except the circular saw which is 4/-. The electric motor has adequate power, although impatient people may easily stall it.

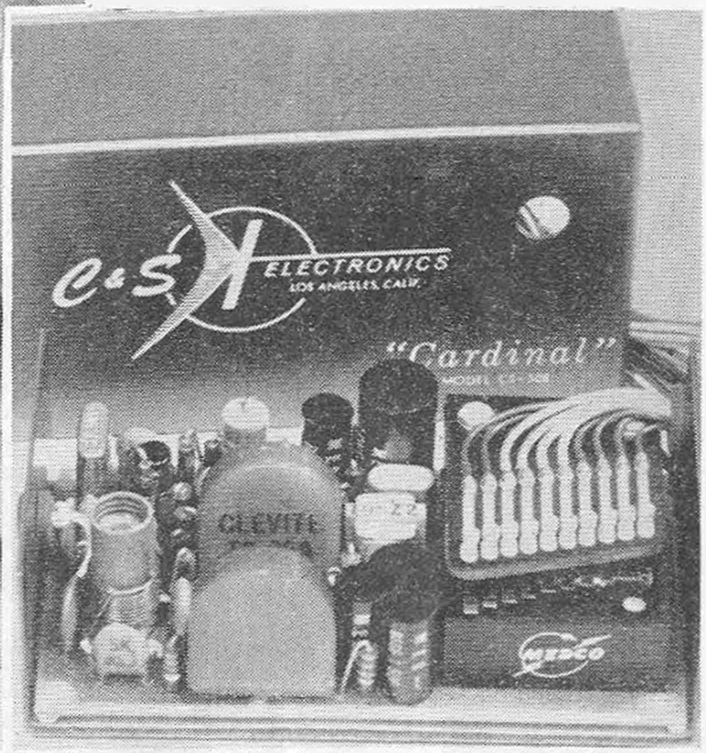
Four different Minidrill models are available, No. 1 rather like an electric torch, accommodating dry batteries inside the handle. Price is £1.7.6d. No. 2 is lighter with extension cable so that it can be operated on a 4½-6 v. battery. This costs £1.17.6d. No. 6, price £3.7.6d., is a smaller version of the No. 8 pictured here, price £4.7.6d.

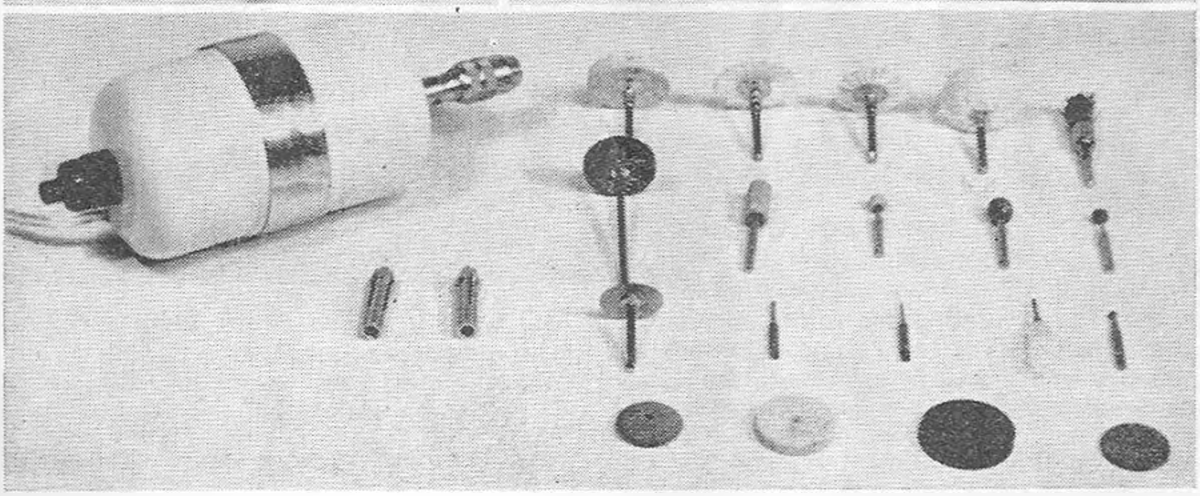
A Minidrill is definitely a useful accessory and not merely a gimmick. The most effective use we have found for it so far is for drilling printed circuits.

Useful workshop appliances received are a set of 12 **Erecto Workshop Boxes** moulded in coloured polythene. These may be used as containers for many of the workshop bits and pieces. Size is $4\frac{11}{16}$ in. x 3¼ in. x 2⅝ in. and the curved fronts prevent small items lodging in inaccessible corners. Provision is made to hang the boxes on rails or for fixing

Below, C & S Cardinal multi superhet receiver. Features transfilters and Medco reed block. Left, Minidrill No. 8 in action, holing a piece of printed circuit Paxolin. Bottom, Minidrill and various attachments.

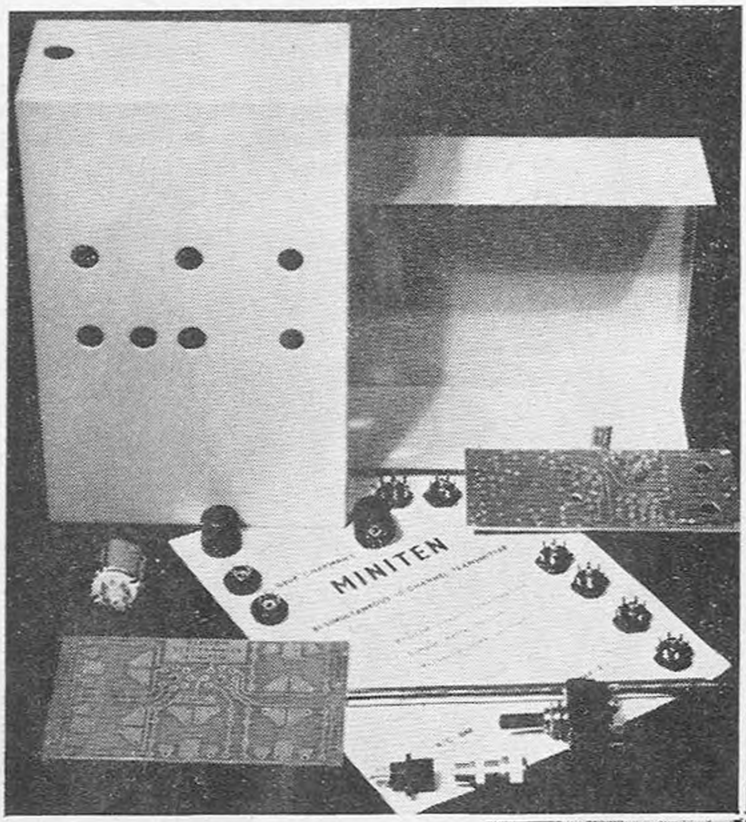




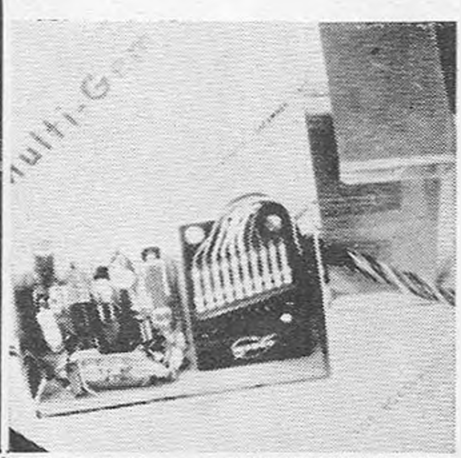


permanently with screws. Ironmongers and Do-It-Yourself shops will carry these at 18/- per dozen.

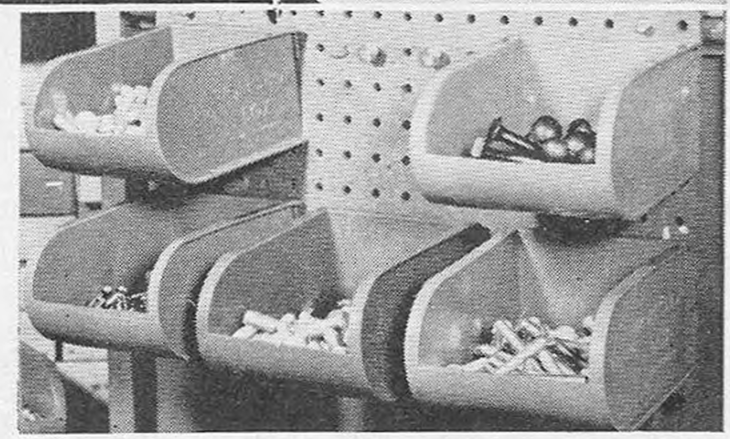
A representative from Remcon Electronics paid us a visit, bringing along Remcon kits for the **Miniten Transmitter** published in *R. C. M. & E.* for July, and **Multi Gem Receiver** published last December. Remcon are supplying grey anodised aluminium cases ready drilled at 35/-. Transmitter section printed circuit board, drilled, with valve bases mounted costs 15/6d. and the tone circuit board is 12/6d. A matched pair of 1.5 H. pot cores, ready wound are 50/- and 27 Mc/s overtone crystal costs 30/-. Other necessary items are biased off lever switches at 9/9d., on-off switches at 9/- and telescopic aerial with coaxial plug and socket, price £1.7.0d. Other components are supplied by H. L. Smith & Co. Ltd., 287 Edgware Road, London, W.2, and intending constructors should study advertisements for prices.



Remcon Electronics components for Miniten Transmitter and below, Remcon Multi Gem receiver assembled with case.



Right, some Erecto Workshop boxes, mounted and used as containers.



For the limited purse multi enthusiast the **Miniten** is a stable and inexpensive ten channel transmitter, bi-simultaneous at that, and costs no more than £15.0.0d. Matching it is the **Multi Gem** receiver, with new case size 3 in. x 2 in. x 1 in. obtainable from Remcon for only £4.17.0d. per kit.

ORBIT TEST REPORT

(*Continued from page* 561)

check. A maximum ground range check was then carried out but unfortunately we were unable to carry the check any further than the 1.320 yards (¾ mile) where we ran out of airfield.

Whilst no extensive claims are made by the manufacturer, it may be said that this is a craftsman's item. Manufacturer: Orbit Electronics Inc., 11612 Anabel Avenue, Garden Grove, California, U.S.A. Official British Servicing carried out by: M. Franklin, 98 Grasmere Street, Leicester. Price $118.50 for Transmitter, $29.95 for Power Pack and Charger, $89.95 for Receiver or $114.90 for Receiver plus Power Pack and Charger complete (same power pack also supplies servos). British prices: Tx, £56.0.0d.; Rx, £44.0.0d.; Tx plus power pack and Rx, £104.0.0d.

Chargers are normally supplied for 110 volts A.C., we understand that 230 volts A.C. versions are obtainable on request.

World R/C Championships

(*Continued from page* 543)

So a few flights later, out came Bosch with his Telecont equipped shoulder wing model weighing nine pounds. From start to finish it was a beautiful flight and quite the best we have witnessed personally. When the score was posted, there were loud cheers from the German spectators for Bosch during his flight, and again when his score was announced; 1,968 points, the highest of the meeting. He had very nearly won the championship outright, an extra 25 points would have sealed it.

A fly-off would therefore decide the holder of the cup. The flip of a coin sent Ralph Brooke out first once more, to perform beautifully for 1,928 points.

Bosch failed to tailslide, dumb-belled his horizontal eights and did not intersect the overhead eight accurately. The spin was good and the landing approach beautifully square, but was enough for only 1,856.

Brooke and Bosch were equal world champions then, while to Ralph went the honour of holding the King of the Belgians Cup. Behind Bosch in the individual placings came Ed. Kazmirski in third position. Louis of Belgium was fourth and Jerry Nelson was now up to fifth place. Culverwell had now dropped to sixth place, pushing Frank Van den Bergh down a peg to number seven. Teuwen and Marot were eighth and ninth respectively and Harold Tom from Canada had climbed to tenth place.

The team award went to U.S.A. with all three fliers in the first five, followed by Belgium. The South Africans were third and the Canadians fourth, while Great Britain, twice winners of the award were down in seventh place.

So ended the Third World Radio Control Championships contested by fifteen teams with temperaments ranging from the quiet purposefulness of the Canadians and the dignity of the Italians, to the boisterous French, notably the crazy Major Plessier, who provided many of the laughs.

Better Super-regen Rxs

(*Continued from page* 554)

Impulse Interference

This should not be a great problem with any super-regen circuit, but where excessive sparking of contacts occurs it is advisable to take precautions, particularly when tone modulation is employed.

Radiation Interference

Radiation of interference by the super-regen detector, even though lower with a transistor than a valve, can still cause trouble when two receivers are operated in close proximity to each other (this applies even more to boats than aircraft). However, the answer is quite simple and the extra drain on the battery—approx. 1 mA. is sufficient to supply an R.F. Amplifier/Buffer stage—is well worthwhile. Of course, it is necessary to screen the detector stage, and the coupling to the detector from the R.F. stage should be kept to a minimum, a 1-3 pf capacitor being sufficient, this coupling is best varied to achieve optimum results. A suitable coupling capacitor may be made by twisting two short lengths of P.V.C. covered wire together.

Apart from practically eliminating any radiation, the addition of an R.F. stage gives an appreciable increase in sensitivity and range, further it also helps improve detector stability, as any variation affecting the aerial and hence the detector is now isolated. The circuit given in Fig. 3 is quite conventional and no trouble should be experienced in employing it. The only item requiring care is the adjustment of the coupling.

The addition of an R.F. stage to a monitor can also help make the monitor safe to use while flying is in progress.

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FOR SALE : Home built Tx and Rx to Mini-Rep. circuit in perfect working order, both neatly case. £8.0.0d. Ground based tone (moulator) Tx with 3 channel control box telescopic aerial. £3.10.0d. Wanted : October 1960, R.C.M. & E., 3/-. R. Stewart, 3 Edson Road, Hr. Grumpsall, Manchester 8.

12 CHANNEL R.C.S. superhet Rx and Tx Xtal 26.995, as new, £30. Phone daytime Erdington 6646, Birmingham.

ADMIRALS BARGE (33 in.) almost complete with engine and steering mechanism, also enthusiast's entire component box consisting relays, valves, switches, gears, condensers and resistors, etc. Bargain £10.12.6d. to clear. WILKS, TWEMLOW, LLANASA, FLINTSHIRE.

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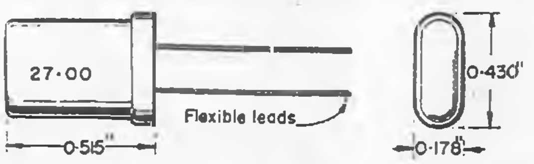

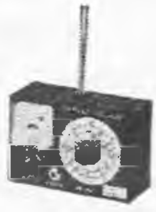

PRECISION STEERING

(*Continued from page 555*)

wise direction. A negative potential will move it the other way. So, if the wiper is resting on the contacts as shown in Fig. 1, and the steering wheel on the transmitter is turned in a clockwise direction, tones 1.2.3. will be sent, relays will operate in the same order and positive potentials will be connected to the left hand bank of contacts in a clockwise direction one after the other. The servo motor, wiper arm and, of course, the rudder, following in step. The negative potential applied by each relay to the right hand bank of contacts, can be ignored at this stage, as it will only be applied to contacts other than the one on which the wiper arm is resting.

If the steering wheel is now turned in the other direction, relays will operate in the order 3.2.1.3.2.1. etc. This time, negative potentials applied to the right hand contacts will drive the servo, etc., in an anti-clockwise direction.

It can be seen from the foregoing, that the rudder follows every movement of the steering wheel just as if there existed a physical link between them. A great advantage of this system is that, if by any chance the steering wheel is operated so fast that the relays cannot follow, the receiver servo automatically synchronises with the wheel next time round.

For those of you who have already noticed that a tone is continuously being transmitted, it is used in my case in a "failsafe" circuit. If not required, it could be cut out by a press button released between steering operations.

F. A. & F. ALLEN LTD.

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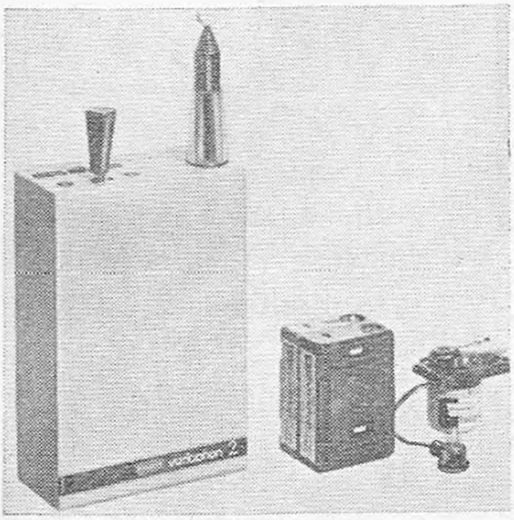

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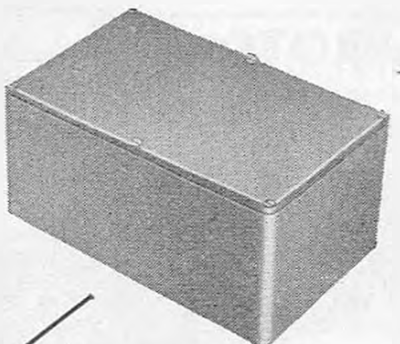

EDDYSTONE

DIECAST INSTRUMENT BOXES

An addition to the three existing Diecast Boxes is the Cat. No. 903, illustrated above. This has dimensions of approximately $7\frac{1}{2}$ in. x $4\frac{1}{2}$ in. x 3 in. deep—the increased depth is a notable feature. The box is cast in aluminium, thus saving considerable weight and, as with the others, is complete with a close-fitting flanged lid. Natural finish. **16/8.** Data sheet on request.

No. 896. $4\frac{1}{4}$ x $2\frac{1}{4}$ x 1 in.	6/8
No. 650. $4\frac{9}{16}$ x $3\frac{1}{2}$ x 2 in.	9/6
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No. 1	5/1	No. 5	31/4
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225, 3.6 volt ...	15/6	450, 7.2 volt ...	50/–

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