E.D. RADIO CONTROL UNITS

INSTRUCTION MANUAL

Introduction

This new development by the technical staff of Electronic Developments (Surrey) Ltd., of 18, Villiers Road, Kingston-on-Thames, Surrey, surpasses any known apparatus on the market to date for reliability, efficiency, design and price. The actual design has been perfected by our Mr. G. Honnest-Redlich, the well-known electrical technician and leading authority on electronics.

The application of the E.D. Radio Control Unit to models of all types answers the ever-growing demand for reliable control and as our unit is designed along the most simple lines possible, its uses can be readily applied by anyone without technical knowledge.

This equipment adheres strictly to the conditions as laid down by the P.M.G. and no licence is required for operation for the above purpose.

The unit comprises the following :

TRANSMITTER 27·12 Mc/S.
RECEIVER
SERVO
AERIAL

The E.D. Radio Control Unit.

Single tuning control on receiver. One pair of phones only required to tune in. No expensive meters or technical knowledge necessary. No shorting plugs required.

Range.—Fully reliable up to 1,000 yards even under adverse conditions, but actual range well exceeds this.

The unit comprises the following :

Transmitter.—Two valve battery operated and pre-tuned to G.P.O. allocated frequency of 27·12 Mc.'s.

Controls.—On-off switch and connection for external remote control.

Batteries.—HT 120 volt Radio battery.
LT 2 volt accumulator.

Aerial.—8 ft. in 4 detachable sections. Attached to transmitter case.

Dimensions. Height 8", width 7", depth 9½".

Technical description. Two valve modulator, oscillator circuit. Frequency stability ensured by careful construction and high Q tuning circuit.

Entire HF stage of low loss components, construction and insulation.

HF carrier permanently radiated on switching on. Keying modulates the carrier with an 800 cycle note.

Receiver. Specially developed three valve circuit.

Controls.—Single tuning control. On-off switch and phone sockets, external.

Batteries. LT 1½ volt dry cell (or 2 volt accumulator connected to the appropriate tag on receiver).
HT 67½ volt battery max.
GB 6 volt.

Aerial.—12 inches up to 3½ feet according to model and range.

Dimensions. 5" × 3$\frac{7}{16}$" × 2$\frac{1}{2}$" deep.

Weight.—Receiver 8 ozs.
Batteries 12 ozs.

Servo.—Sequence escapement. Clockwork motor.

Battery.—4½ volt.

Dimensions. 3" × 1$\frac{3}{4}$" × 1$\frac{1}{4}$".

Weight.—Servo 2½ ozs.
Battery 4 ozs.

Technical description. Highly sensitive superregenerative detector stage feeds screened grid LF amplifier, followed by a pentode valve which includes a positive reactive feed back circuit producing a heavy current change to actuate relay. Escapement changes current pulse into mechanical energy for control surfaces, etc.

General.—Due to this special circuit the relay current does not fall with a weakening signal as range is increased, in fact, the relay is actuated just as strongly at 50 yards as at 1,000 yards. The relay operates a mechanical sequence escapement for rudder control. Additional controls can easily be fitted, which, for model boats, etc., give steering in reverse as well as ahead, also stop, start, etc. The fact that the transmitter radiates a permanent carrier ensures that the receiver is working on a "silent" spot and is thus far less receptive to interference from ignition or exterior sources. The reactive circuit of the receiver is tuned to acceptance of the 800 cycle keying note and this also helps to reject extraneous noise, interference, static mush, etc.

Extensive decoupling is used throughout.

All British components of standard types. Compact design reduced to minimum weight consistent with

mechanical and electrical reliability. Absolutely unaffected by vibration or sources of electrical interference. In all, this equipment is a design based on a thorough study of the requirements of Radio Control for all kinds of models irrespective of type of motive power.

Recommended size of aircraft.

Wing area 900 sq. inches. Span 6 to 7 ft.

Engine size 2·5 c.c. to 5 c.c.

Overall weight of plane including receiving equipment and batteries 4 lbs. 10 ozs. to 5 lbs. 10 ozs.

Excels in E.D. " Radio Queen " 7 ft. aircraft.

External controls on plane.—Socket for phones and on-off switch.

Recommended size of boats.— 18 inches up to 6 feet.

Recommended Power Unit. E.D. Mk. IV. 3·46 c.c. Diesel engine.

Price. Complete unit, less batteries, £14 10s. 0d., plus 5/- for strong wooden box (returnable).

The E.D. Radio Control is designed for use in model boats, cars, aircraft, and numerous other purposes where remote control is necessary or desirable.

The failure of control from any cause in boats and cars is usually no more than an inconvenience, but failure when operating model aircraft may mean disaster or total loss. This booklet, therefore, will deal with Radio Control of aircraft alone, and our endeavour will be to give enough information from practical experience to enable the amateur to achieve success without the mishaps which our pioneering experts have had to accept.

The remote control of a model aircraft is one of the most fascinating hobbies which can be imagined, but to do this successfully, the utmost care must be exercised,

flying of the machine. Whilst heavily loaded, high-powered machines can and are regularly being flown by experts, our advice to all beginners in model aircraft radio control, is to start with a lightly loaded, low-powered machine which, although it may be comparatively slow in flight is easily handled, and will stand the maximum of mis-adjustment in trimming without the fear of serious crashes. Such a machine should have from 800 to 1,000 square inches wing area, and, fully loaded, weigh approximately 4½ lbs., being powered with a 2½ to 3½ c.c. diesel. The faster the machine, the more sensitive it will be to all adjustments and the more likely it is to get out of control.

The E.D. "Radio Queen" which, amongst its other successes, took 3rd, 4th and 5th places in the 1949 British Internationals, was specially designed by Colonel H. J. Taplin for Electronic Developments for this purpose, and we cannot too strongly recommend the use of such a machine to the beginner and, providing that these instructions are carefully carried out, we can guarantee success from the word "Go." Every E.D. Radio Receiver is very carefully adjusted and tested before leaving the Factory, and may be accepted as being in perfect order when purchased by you from a reputable dealer. Whilst they are, naturally, a delicate instrument, they will, and have survived very severe crashes without any damage, when properly installed in the machine.

Do not "tamper" with a set when you get it, neither be advised by your "expert" radio friends. If, after you have installed the unit in your machine you have any doubt about its being in good order, either consult our Technical Department, or return the set for checking.

THE INSTALLATION OF THE RECEIVING UNIT

When mounting an E.D. Receiver in aircraft, the balsa wood case may be dispensed with. The most satisfactory way of mounting the receiver in the aircraft is by means of rubber bands under tension attached to the hooks at each corner of the set, and normally with the set vertical on one edge (Fig. 1). The rubber bands should be under sufficient tension to hold the receiver firmly spring loaded in position. The distance between each hook and the opposite end of each rubber band anchorage being not less than 1¼". This allows the set to take a severe jolt on a bad landing, etc., without causing any damage, at the same time eliminating the transmission of any engine vibration to the set itself. For convenience, in wiring up the set (in accordance with the wiring diagram), it is normally most convenient to have the terminals on the top, whilst the set itself is usually mounted in the fuselage under the wing. The position of the batteries and actuator must be determined by the position of the centre of gravity. A convenient way to do this, is to mount the batteries in suitable casing built into the machine immediately behind the engine bulkhead and forward of the set itself, with sufficient clearance from the forward end of the set to allow the spring anchorage of the set full movement without the set coming into contact with the battery casing or any other part of the machine. This procedure normally brings the centre of gravity of the machine too far forward. Since the position in which the actuator is located in the rear end of the fuselage is immaterial to its operation, it can be placed so as to bring the centre of gravity of the machine to the correct position, namely, approximately one-third behind the leading edge of the wing.

In wiring up the receiver, it is important that all connections are soldered, and that where possible, battery wires should be grouped together and anchored to the fuselage. It must be borne in mind, however, that wires which are actually connected to the receiver should have enough slack in them to allow for the full movement of the spring mounting of the set. The aerial wire itself which, if the machine is mounted in the manner above described, is at the bottom of the fuselage should be run clear of any other wires as far as possible, being led out through the top of the fuselage behind the wing, and attached to the top of the rudder, preferably by a light rubber band. A very important point in the wiring of the actuator is to be sure that the earth wire from the set is connected to the earth terminal on the actuator, namely, the bottom terminal on the relay connected to the terminal marked "X" (Fig. 2) on the actuator. The effect of reversing these lines is to cause the set to be unduly sensitive in tuning, and possibly somewhat erratic in action.

BATTERIES

A convenient battery to use for the 1½ volt LT for the set is a Deaf-aid or D.L.14 or D18 Ever Ready plug-in type. This is the battery which will require most frequent renewal and the two LT lines from the set are conveniently fitted with a two-pin plug; the type of connection, one pin of which is larger than the other in order that no mistake may be made in the correct connections when replacing the battery. The smallest type of HT battery available is the 22½ volt, 3 of which should be used, coupled in series (67½ volts). These batteries have slide-on brass plates for connection, and the replacement of them is merely a matter of sliding off these small brass plates, and replacing them on the new batteries. When these batteries are coupled up, they should be

taped together either with insulated tape or sellotape. Whilst four pen cells, coupled in series, may be used for the grid bias a considerably weight may be saved by using four sections of a small Deaf-aid high tension battery, details of the connections of which are shown in Fig. 3 and 3A.

A 4½ volt flat battery (1289 Ever Ready) can be used for operating the actuator.

TUNING AND TRIMMING THE MACHINE IN FLIGHT

Whilst the set is provided with a tuning lever it is convenient for general purposes on model aircraft to provide a long lever made of thin celluloid or some other insulating material, one end of which is provided with a hole to couple on to the existing tuning lever. This lever is then arranged to project through a slot in the inside of the fuselage, and is locked up in a position so that when central in the slot the set is in tune. This enables final adjustment of tuning to be done when the machine is ready for flight. This method allows of very accurate tuning.

THE ACTUATOR

It will be noticed that the actuator, as supplied for general purposes is provided with a 4-arm star, so that each impulse moves it one arm at a time. For aircraft work it is very important that, in the case of failure of radio contact due either to batteries or from any other cause, that the rudder should automatically return to neutral ; otherwise if the failure occurs when the machine is in a turn it will cause the machine to spin in. For this purpose the actuator should be put in the central position and the ends of two arms running transverse across the actuator be bent up so that they do not engage. If this is done correctly, it will be found that the rudder auto-

matically returns to neutral directly the signal is off, and that it only remains in a turn so long as it is held there by a continuous keying from the transmitter. Under no circumstances should a machine be flown without this modification being carried out. Control lines from the actuator to the rudder should not be too tight, otherwise the pull on the arms may prevent the actuator working freely.

TUNING

Having now completed our machine and the installation as above described, and assuming that gliding tests have been satisfactorily carried out, it is now a matter of testing the machine under power. The phones are plugged in and the set tuned to the best possible note which should be quite steady and clear, and when this is correct the rudder will remain on one or other of the turns permanently. The phones should then be removed and test signals (with the receiver at least 50 yards away) transmitted to make sure that the radio operation is regular. *All final tuning must be done with everything on board including the wings.* Having now finally tuned the set, the engine should be started up and a further check test of the operation of the rudder with the engine running. *Do not launch the machine unless this final test is satisfactory.*

Having reached this stage with a new machine, somewhat naturally, the tendency might be to try a first short flight without the radio in action : under no circumstances should this be done, however, since if the trim of the machine is not correct and it has too much turn one way or another, no correction can be made without your radio. Therefore, always make your first trial flight with the radio in operation, since a machine with a bad

left or right hand turn can be flown and brought safely down again by suitable corrections from the transmitter, and the necessary correction made to trim after the first flight. Train yourself to a "drill" before each flight. Never leave your receiver switched on longer than is necessary, except when actually flying. (1) Switch on your receiver and check the tuning. Switch off the set and wind the actuator. (2) Start engine up, switch on set and check your tuning again before actually launching the machine. (3) Check that the transmitter is switched on before machine is released.

Be sure to repeat this drill before each flight.

FLYING THE MACHINE

Since our advice is largely to the beginner, first of all do not be tempted by your enthusiasm or the urging of your "have a go" pals to fly a slow machine in a high wind. You must recognise that whilst you may have perfect radio control, if your machine cannot make headway into the wind, your first turn is going to sweep the machine away down wind, and you will not be able to fly it back, and every turn you make carries it further away until you are finally, possibly, out of radio range. Do not release your machine unless you are satisfied that everything is under control. If you are not quite happy with your tests before flight, do not take a chance, because it nearly always leads to trouble.

You should always endeavour to fly your machine well up wind from your control position before executing any manoeuvres. The very natural tendency, particularly in your early days of control, will be to want to see the machine turn, etc., but even in a reasonable breeze these turns will inevitably carry the machine down wind and you will find it difficult to bring it back again, and

the farther a machine is away from you, the more difficult it is to see what it is actually doing, and whilst you may think at a long range that the machine is flying towards you, in fact, it may be flying away ; the view is practically the same both ways round. Therefore, in your early stages of control, try to keep the machine either up wind or at any rate over your head, so long as the engine is running. It is quite surprising the amount of advice the little group of spectators will give you whilst you are flying the machine. Our advice is to keep your ears closed to this advice and remember you are the only one who can bring the machine safely to earth. It is possibly, needless to say, that you should always endeavour to land the machine into wind.

MANOEUVRES

The E.D. actuator is only intended, in its present form, for rudder control, but it will be found that with practice almost any manoeuvre, other than inverted flying can be carried out with rudder alone. It should be borne in mind, however, that many manoeuvres which can be executed put excessive strain on the wings of the machine. We, therefore, do not advise attempting drastic manoeuvres unless your wings are well braced and capable of taking the strain. To attempt to loop a machine whose wings are not properly braced is just asking for trouble.

TURNS

Right and left handed turns are, of course, the simplest of operations. It must, however, be borne in mind that when a normally trimmed model is turned either to the right or left, the nose of the machine automatically drops and the speed increases, and if a turn is held on long

enough, the machine will eventually develop into a spin. It naturally follows, therefore, that after doing a turn the machine will have gained speed and when the turn is taken off, the machine will rise steeply before levelling off, and the steeper the turn, the more steeply the machine will rise afterwards, due to the excess speed. It is this very fact, therefore, that enables the various manoeuvres to be carried out by means of the rudder alone.

HAMMER HEAD STALL

This is executed by putting the machine into a right (or left) hand turn and holding it there sufficiently long for the machine to gain speed in its spiral turn. The rudder is then neutralised, if sufficient speed has been gained, the machine will rise steeply until it is in a vertical position, finally stalling and dropping its nose before levelling out.

LOOPING

To do a complete loop, it is necessary to gain even more speed than the Hammer Head Stall. The machine must, therefore, be held considerably longer in the turn until it is really spinning (probably two or three turns) and has its nose well down. Sufficient opposite rudder is then immediately given to stop the spin ; the machine will then be diving straight at a high speed, and will immediately pull up and go completely over if sufficient speed has been given, and no further keying should be given until the machine has again levelled out.

THE IMMELMANN

To execute an Immelmann, the same procedure is carried out as for a loop, with the exception that immediately the machine is on its back at the top of the loop, right (or left) rudder is given and held on when the machine will do a half roll.

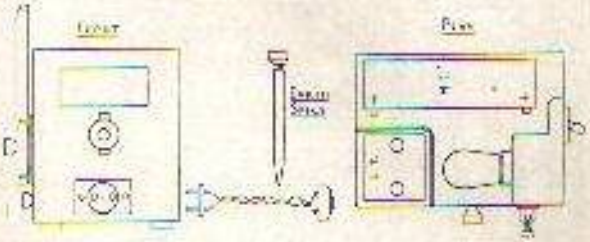
THE WINGOVER

To execute a Wingover : again the same procedure as a Loop and Immerman is carried out, except that when the machine has gained a vertical position in the upward part of the Loop, rudder is again given, when the machine will cartwheel over, the rudder being released *immediately it has finished* the half vertical turn. With a neutralising rudder, always bear in mind that if in your manoeuvres the machine is getting out of hand, neutralise and let it settle down again. In other words, if the machine is pitching badly owing to the various turns that you have been giving it, do not try to correct by further keying from the transmitter. Finally, do not attempt to do turns too near the ground.

THE TRANSMITTER

There is very little to be said in the way of precautions with the transmitter, except that possibly when operating with the transmitter sitting on a grass field, be sure that none of the blades of grass or stalks can possibly touch the bottom of the aerial. Be sure that your batteries are always well up, including the transmitter, before flying the machine. It is false economy to try and use the batteries up to their last.

TRANSMITTER

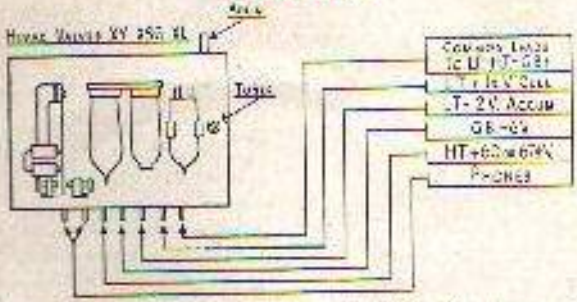


Batteries. 2 Volt Accumulator ; 120 Volt HT Battery.
Connect Red Spade to LT +
Connect Black Spade to LT –
Connect Red Plug to HT + 120 Volts.
Connect Black Plug to HT –

Join the aerial sections tightly together and fasten to aerial anchor bracket on aerial panel. If on soft ground, push in earth spike supplied and connect to earth terminal on transmitter case with a short lead. If transmitter is stood on a car, the earth terminal should be connected to the car body. Insert operating key plug in socket.

To check note of transmitter plug phones in Keying Sockets, when the Sound Note is heard switch on and then press the operating key. With ear held close to transmitter case a buzzing tone will be heard. Transmitter is now ready for use.

RECEIVER



Batteries.—For aircraft the following batteries are recommended :

LT D18 1·5 volt battery or Venner Accumulator Type D.

HT Three B122 22·5 volt in Series 67·5 volt.

GB Two pen cells broken in half and joined in series to give 6 volts.

The average life of fresh U2 LT cell is approximately 12 minutes, that of the 60 volt HT, 20 hours, and the 6 volt GB, from which no current is drawn, indefinite. These times are continuous rating. For intermittent use they can be doubled.

However, the shelf-life of dry batteries is not of great duration for these small sizes. Three months is a fair average.

For boats or larger planes the following batteries give a longer life and maintain their voltage over a longer period :—

LT Several D18 cells in parallel (or a 2 volt accumulator connected to the appropriate tag on receiver).

HT Three 22½ volt deaf aid batteries in series, 67½ volt. Ever Ready type B115.

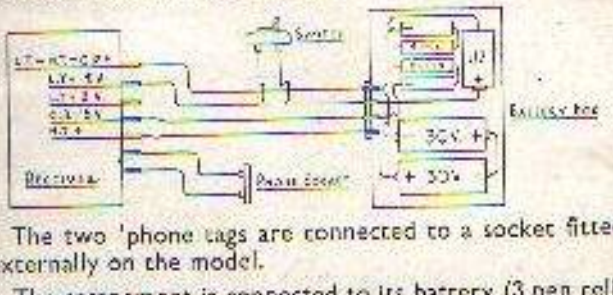
GB Two pen cells broken in half and joined in series to give 6 volts.

CONNECTIONS

It is advisable to construct a battery box of balsa to hold all three batteries snugly. The batteries are then connected to a four-way socket let into the box. Leads of length required are soldered to the tags on the receiver, terminating in a four-pin plug to fit socket. A four-pin wafer valve holder and an old valve base as plug are suitable.

The on-off switch is connected in the LT + lead.

It will be noticed that no provision is made in the battery box for the escapement battery. This can be left on a longer lead and moved to adjust the CG of aircraft and finally held by rubber bands.



The two 'phone tags are connected to a socket fitted externally on the model.

The escapement is connected to its battery (3 pen cells in series) and the relay.

The earthed tag is connected to terminal 1 of the relay, the other tag through the battery to terminal 2.

Phones.—Any pair of phones can be used, either high resistance types or ex-forces low resistance types. They

do not affect performance, and are only used to hear the tuning note.

INSTALLATION

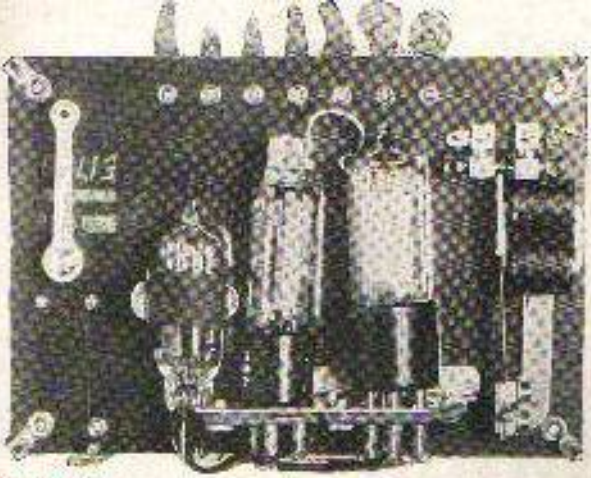
The receiver can be slung by rubber bands from its four corners or bedded on to sponge rubber with rubber bands. In both cases the tuner must be accessible from outside the model, either by hand or by means of a screwdriver.

All components, receiver, battery box and Servo should be kept at least 6 inches away from ignition wiring, either LT or HT, of petrol engined models.

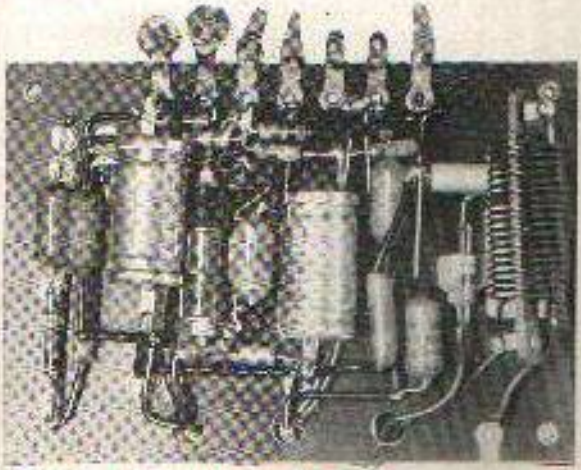
All wiring should be twisted or cotton bound so as to lie in one neat cable. *This is essential.* Loose individual wires can give rise to fluctuating signals.

When RC is fitted to a boat a wire from the LT – tag should be taken to earth.

Aerial. Can be anything from 18 inches to 3 feet. The aerial and its lead to the aerial tag should be kept clear of all wiring, metal parts, etc., in the model. In planes it should run through a tube directly above receiver and thence to top of fin. Other alternatives can be tried, if the precautions listed are adhered to.



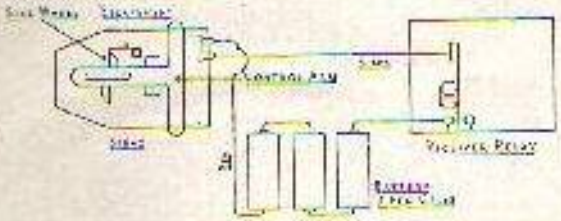
Front View



Back View

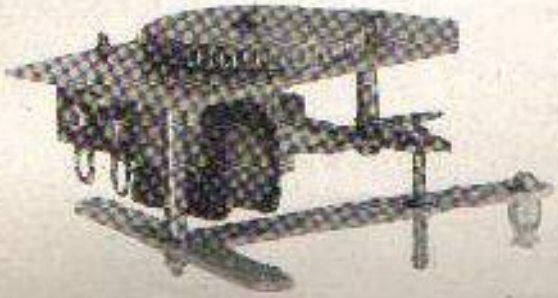
RECEIVER PANEL

SERVO



The Servo can be fitted, where most convenient in the model, preferably as near as possible to the point of control. The control arm permits several methods of drive, either by fine piano wire, cords direct, or cords over pulleys. Any convenient position, either vertical or horizontal, is permissible. In boats the control arm can be fitted direct to the rudder operating bar.

The Servo can be wound up either by the extension which projects through the slot in the control arm, or by the spring housing underneath, both in a clockwise direction. If wound up fully, release by hand one full turn on star wheel to ease spring tension. Servo provides for about 200 movements, 50 complete revolutions of star wheel.



OPERATION

With all batteries connected and phones plugged in, switch on. A rushing or hissing noise will be heard. If not, shorten the aerial until the characteristic rushing noise is heard which indicates the correct operation of a super-regenerative circuit.

Switch the transmitter on. Tune the receiver until a silent spot is found. The disappearance of the rushing noise with reception of carrier indicates correct operating conditions.

Now key the transmitter ; a buzzing tuning note will be heard. Tune the receiver to the loudest note. Intermittent keying of the transmitter will now make the escapement click over. Disconnect the phones and check again by keying transmitter.

Final tuning should be made with all aerials fixed and with the transmitter at least 150 feet away.

Recheck with engine or motors running.

GENERAL NOTES

All wires should be soldered. Wires running together should be bound into a cable.

A packet of solder is supplied with each unit.

Wiring from one unit to another should *not* be tightly stretched, but have just enough slack to prevent breakage.

All wiring and metal parts should be kept at least 2½ inches away from aerial-coil and condenser portion of receiver panel.

No wires should be run parallel to the aerial (receiver) within 8 inches. For example, mechanical connection from escapement to control surface, if parallel to aerial, should be of cord *not* of wire.

Transmitter should be installed well away from large metal objects, cars, railings, etc., and cyclists should be told not to wheel their cycles close to transmitter aerial. Metal objects under the transmitter do not interfere (cars, etc.) if earthed to the transmitter case.

A general space of 6 feet around the aerial should be kept clear of spectators.

Keying pulses should be firm and definite. The receiver and escapement will follow impulses up to four a second, but large control surfaces and stiff mechanical connections will slow it down. Therefore, key positively for at least a quarter of a second and leave a quarter of a second gap before keying again.

If single D18 cells are used as LT, make general adjustments and tuning tests and then change for a fresh cell before flying.

Connections to HT and GB batteries in battery box should be soldered.

The LT cell which has to be changed should fit tightly and snugly between clean brass contact strips. Also clean tip and base of cell before inserting.

Ninety per cent. of all troubles are bad connections.

Use only flexible stranded wire for connections.

Check battery voltages periodically. If a meter is not available, a rough check can be made in this way :

LT cell. A torch bulb can be used as a check.

GB 6 volt. If, with receiver switched on and tuned to transmitter also switched on, but not keyed, the escapement armature is pulled on to electromagnet and will not return. Then the GB is low.

If escapement armature barely pulls in on signal, change escapement battery.

The above are general rough checks. When in doubt, change batteries.

Side by side working of two RC models can be made by removing one aerial section from one transmitter and dading it to the other, also, of course, retuning the models to their individual transmitters.

Before releasing the model, reflect if all has been checked and do not forget to wind up Servo which may have run down during checking.

FINALLY

Familiarize yourself with the equipment making extensive ground tests.

DON'TS

Do not tamper with the transmitter. It is sent out accurately calibrated to the exact centre of the G.P.O. allocated waveband. Valve positions should not be changed. In the eventuality of a valve having to be replaced, the transmitter must be returned to the manufacturers for recalibration. The rated life of the valves, is in view of the intermittent use of Radio Control Gear, at least several years.

Do not attempt to adjust the relay. This is set to fall in and out at the correct current rating for each individual receiver.

Do not take valves out of their sockets. They should fit tightly.

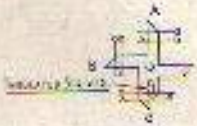
Do NOT connect blue battery wire (LT + 1·5 volts) to a 2 volt accumulator without first transferring it to the 2 volt tag on receiver. This is essential, as permanent damage will be done to the valves.

APPLICATIONS

USE OF STANDARD SERVO TO CONTROL VARIOUS CIRCUITS

Disconnect control arm. On actuating pin which engaged in slot of control arm, fit an insulated striker. At three sides of star wheel arrange switch springs.

Now one has a choice of three circuits which can control various motions driven by small electromotors geared well down. Gearing is necessary in this circuit due to having momentarily to pass over unwanted switch positions.



A.B.C. Circuit Switches for additional controls, rudder, motor reverse, stop switch, etc.

This is just a basic circuit, switches being indicated only.

The "Stop" switch would be opened by the striker. The "Reverse" (for models electrically propelled) would be either a single or double change-over type.

The rudder motor would drive the rudder from one extreme to the other.

The "rest" position is the fourth one. Combined with a delay relay unit (see simple reverse circuit) the fourth position can be used for another operation, the procedure being short pulses to go from one position to another and a long pulse on the selected position.

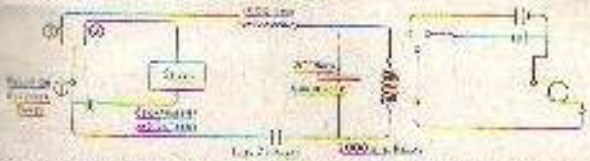
SIMPLE REVERSE CIRCUIT FOR ELECTRIC MOTORS

The back contact 3 of relay is led through an electrical delay circuit consisting of a sensitive relay, a condenser, a resistance and a battery. Values are given for a particular relay. Relays of different types, sensitivity, coil

resistance, etc., require different values of resistance condenser and battery. Roughly, the lower the relay coil resistance the lower the resistance and battery voltage, but the higher the condenser value. As condensers of high capacity are not readily obtainable in small sizes, it is best to obtain a relay of high coil resistance.

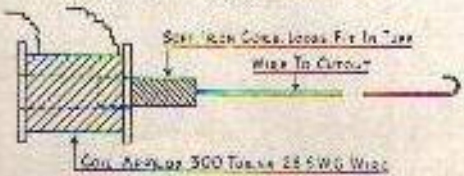
OPERATION

Off signal, the receiver relay reed is up against the back stop completing the delay circuit. The delay relay is held in and drives the motor in forward. On keying for rudder positions (quarter second pulses) the delay relay is not affected. If, however, the key is depressed permanently, the delay relay clicks back after approximately ¾ second, putting the motor in reverse. For steering in reverse the key is released for a fraction of a second. When released permanently, the delay relay goes into forward after ¾ second.



This delay system is applicable to various circuits, for example, see method of stopping Diesel Engines.

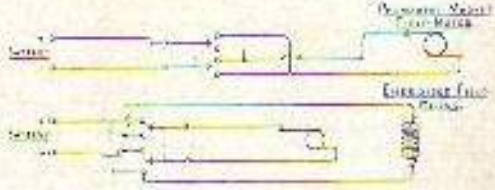
Solenoid for stopping Diesel Motors.



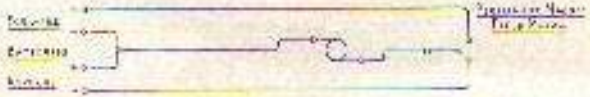
Coil connected in series with 4½ volt battery to delay relay contacts. Soft iron core will pull smartly into core, when coil is energized.

METHODS OF REVERSING ELECTRIC MOTORS

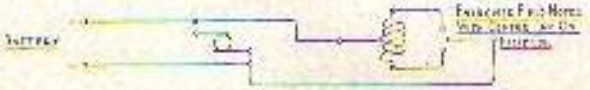
1. Double pole change-over switch.



2. Single pole change-over switch.



Requires separate batteries for forward and reverse. As reverse is only used for a relatively short time, it can be a smaller battery.



E.D. Mk. I

PRICE - £2-5-0

One c.c.

E.D. Mk. II

PRICE - £3-10-0

2 c.c.

E.D. COMP. SPECIAL

PRICE - £3-17-6

2 c.c.

E.D. Mk. IV

PRICE - £4-12-6

3.45 c.c.

ELECTRONIC DEVELOPMENTS
(SURREY) LTD.

18 VILLIERS ROAD, KINGSTON - on - THAMES
SURREY ENGLAND
Telephone KINGSTON-on-THAMES 1223

THE E.D. RADIO QUEEN