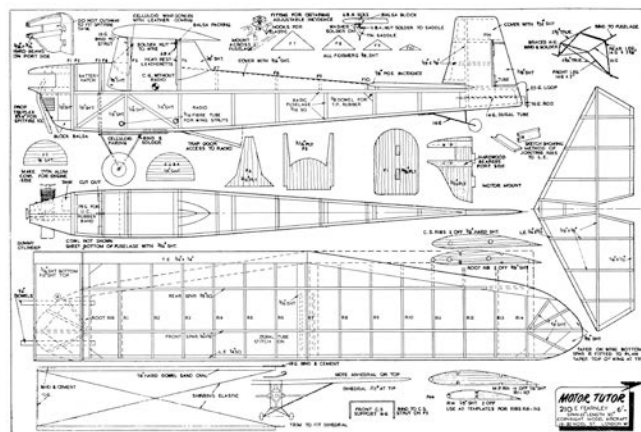


Kirby Motor Tutor



An Interesting Flying Scale Model that can be adapted for R/C by Eric Fearnley.

The first contact we had with the Motor Tutor was on a summer's dusk while flying «it our aerodrome site, when club members were startled to find a plane that looked half B.A Drone, half Luton Minor, circle us and make a smart landing at about 30 m.p.h. Out of the (very) open cockpit jumped a young man in a sports coat, who said he had come from Yorkshire. By the time we had pushed the aircraft into a hangar, it was dark.

A year later at our annual exhibition we made further contact with the aircraft through the second partner, who turned out to be a local, and afterwards he gave our club an excellent talk on gliding, with films loaned by the Yorkshire Gliding Club members, and I then realised the possibilities of this aircraft as a model.

The instruction book, three view drawings, and some photographs were kindly loaned to me, from which the model was designed and built. The finished model has been examined by the pilot-owner, and he says that it is true in every way as far as he can see, except for the dihedral which is increased. After careful trimming it is possible to reduce this to almost scale proportions. The makers, Slingsby Sailplanes Ltd., kindly supplied information to assist in ensuring the accuracy of the model, and have shown a keen interest in photographs.

The aircraft was developed from the Kirby Tutor glider (so well known to A.T.C. members) and was intended to be a low priced power machine which was easy to

fly. The first engine used was the Scott Squirrel, but this was replaced later by the Jap 36 h.p. twin. Two aircraft, G-AKEY and G-AKJD, were completed. These machines have been flown by glider pilots who have never been in a power plane before, and the maker's specification states, and I quote, "It's impossible to stall or spin with the c.g. in the normal position."

Although the span is greater than a Hurricane, the 36 h.p. engine allows a maximum speed of 71 m.p.h., a cruising speed of 67 m.p.h., and a landing speed of 38 m.p.h. The Motor Tutor uses only 2.2 gallons of fuel per hour. The wing loading is 4.83 lb. per sq. ft.

As a model, the plan view is rather shaking. The span is more than twice the length, the tail looks inadequate, and altogether it looks "different" from the usual run of models. I was reassured by the pilot that the Motor Tutor "wouldn't" stall or spin, that it was easy on the controls, and would in fact fly itself. I shook off the "thirds" complex and pressed on with the model. It has proved, as a flier, everything the makers state of the real aircraft.

The power required is nominal, my Allbon Spitfire diesel was fitted as the model was designed from the first for ultimate R/C. Without radio the model weighs about 1lb., and is so efficient that it positively hurtles skywards with full revs. in fact it is well overpowered, and must be throttled down. The radio is a lightweight unit weighing about 10 oz. all in, and this is enough to steady the plane down nicely but still leave a very light wing loading— probably the lightest, loaded flying scale radio job possible.

Full details of conversion to radio are scheduled for a future issue of MODEL AIRCRAFT.

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Those who do not intend to fit radio gear could get a smaller engine to fly the model. If radio is to be fitted, the Spitfire would be a minimum choice of power.

A certain amount of hardwood ply is used at strategic points, and the result is a very high factor of safety. On its first day out it flew into a car at full revs., and the damage was only on the wing tips, which have now been strengthened. When the power stops, it has a glide that would do justice to some A2's—it is, of course, basically a glider, and on suitable days it might even pay to fit a d/t!

Fuselage: Mark out and cut the ply parts first. The basic frame is the usual box, with sheet strengtheners in the nose. Choose the four longerons carefully to match—cut them from the same sheet if you use a stripper. The ply and other formers are added, and the top sheeting. The front cowl top is removable for access to the u/c shock bands, and this also forms the battery box in the radio version. For this reason the first former is ply to take the shocks of the high thrust line, and this must not be weakened by cutting away for any purpose.

The two front pylons support the wings, with a wire frame bound on before the front fairings are added. Cement this part thoroughly. The back pylon carries a 6 B.A. nut soldered to a wire clip passing through the ply. The wings are bolted on at the rear, with suitable packing to give the incidence shown on the plan, and they are stitched on to the wire at the front.

The fin is built separately on the plan, cemented on the fuselage, dead true on the center line, and the sheet covering added, fairing into the fuselage. A tube for rudder control is now fitted if wanted. This must be 14 g. to take a 16 g. shaft, which must run dead true.

The undercarriage is 14 g. wire, torsion bar style, securely bound to the longerons. Pay attention to the soldering and bind well with 10 amp. fuse wire. A dummy cylinder should be fitted on the starboard side to match the real one. I used an old Frog 100 casting filed down. This was fitted with a 6 B.A. bolt to a wire clip fastened to the motor bolts. The front of the cowl can now be faired in with scrap blocks and sheet.



Photo shows engine installation.

Plastic wood is useful for plugging bad joints round the dummy engine. The dummy exhaust is plastic tubing. Fit the tailskid, and give all the wood-covered parts a coat of sanding sealer.

The tail is very straightforward, and no trouble should arise here. It is advisable to mark the top, so that it is always the same way up, or trim may change. An optional detail modification, to give sensitive adjustment on the tailplane, is shown on the plan. The tin saddle fits over the fuselage and is held in position by rubber bands. The angle of incidence is controlled by turning the 6 B.A. screw.

Wings: The wings are of normal construction, but great care is advisable to keep them true, as the high aspect ratio (2 : 1) will not allow for great warps. The tapered part of the structure ribs are cut by making a largest and smallest rib out of 1 mm. ply and sandwiching a suitable number of blank 1/16in. ribs between with long pins, when they are cut and sanded to exact shape.

The strut fixing is dural tube, bound in place. The struts are 1/4 in. dowels sanded to oval section—bind the wire parts to the top and fit to wings. The bottom of the struts is then trimmed to fit against the

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fuselage tubes giving proper dihedral, and the bottom wire hooks added.

Flying: The short couple on the tail oilers no difficulties in trimming because the final fine trim is possible by giving a turn on the screw adjustment on the wing fitting. If medium balsa packing is used it will compress quite a bit to allow adjustment.

Balance exactly where indicated. Fit two washers of the normal thin type under the front motor lugs, and if the wings and tail are true, it will fly almost dead straight first time. Without the side thrust shown, it will nearly catch its own tail going round, but due to the remarkable design, it takes a lot to spiral it in, a characteristic that makes it ideal for radio work.

Don't spoil the scale effect with an incorrect finish—the G-AKJD modelled here should be silver with dark blue trim on nose and lettering as shown in the photographs.



Below: The model before it was covered.

Article part 1 from:

Model Aircraft Magazine May 1955

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To conclude the present short series of flying scale topics, Eric Fearnley illustrates this article or the conversion of a scale model to radio control by describing the radio gear he fitted in his Motor Tutor, the plan of which was published in the May issue.

I want to write what may very well turn out to be the first article on R/C which does not tell the reader (a) how easy it is to make his own receiver and/or transmitter, (b) what such things as Ohm's law, modulated carrier waves, resistors, condensers, anodes, triodes, grids, oscillators are, and expect the average aeromodeller to absorb all this and still remember how to get the model to fly as well.

I will not deal with these matters because I know next to nothing about radio, nor do I want to, beyond the simple knowledge necessary to operate the gear satisfactorily. We must make up our mind right away whether we intend to let radio be the slave or the master of the situation.

If R/C is to be the master, then we will probably be content to do without a model at all for a year or two while we build: (1) a receiver (2) a better receiver (3) a poorer receiver (4) a transmitter (5) get it to work (6) build a test meter (7) find out we have nothing to test (8) when we come to the stage where we are running out of excuses for not doing any more aeromodelling, and we build a so called "test rig" which proves exactly nothing.

Finally, when we are something of a standing joke at the club, it is time to build a model to save our faces.

And what do we build? A soapbox with wings added. Must be strong we say, must be simple. Engine mounted on top, or at the back. Functional stuff; and we hide behind a smokescreen of it being a highly experimental prototype if any rude remarks are passed.

The manufacturers of radio gear went over this ground many years ago, at some cost, to produce a better job, and there seems to be no point in our wasting time repeating the process. It certainly can't be the cost, for it is actually cheaper in the long run to use reliable commercial gear, by the time we have counted the many hours of toil, spoiled batteries, frayed tempers, blown valves, and when we are done we still buy the relay and actuator and the dearest items of the lot.

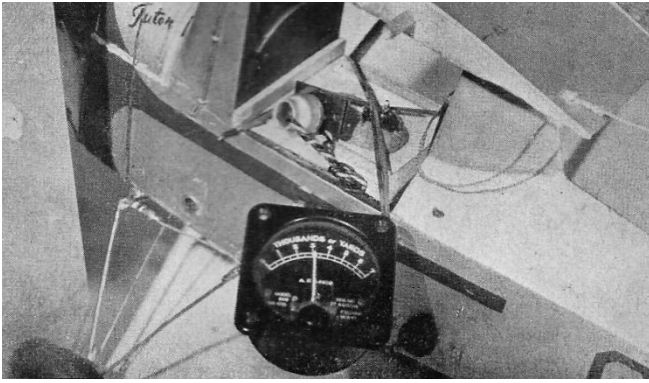
If we are to construct our own radio, why shouldn't we also build our own engine, prop, wheels, or even chop our own balsa tree and saw it up? Surely the radio, like the engine, should be bought as a ready-to-use unit, to fit and forget. The sooner we get to this line of thought, the sooner will we get model airplanes flying with radio, and stop building eyesores.

If we are to build flying scale R/C models—the most exacting and patience-testing branch of this or perhaps all hobbies, then the radio must quite definitely take second place. I have found that the trim of the model is far more difficult to accomplish than the radio link. The result of seeing an exact replica of an airplane, operating under our own control, is so stimulating that we can overlook our "off" days when we piled up the lot! For no radio flier I know has got off without a crack up or two. But it's all in the game.

If we get a model flying well, it is beginner's luck; if it doesn't fly, it's a case of "told you so, messing about with radio." But whatever the critics say, we get a kick that no other can share, and when the model altered course after the first signal I gave, I was on top of the world.

What is entailed in converting a flying scale model for R/C? It is actually a matter of simple arithmetic to decide whether or not we can do a conversion. The

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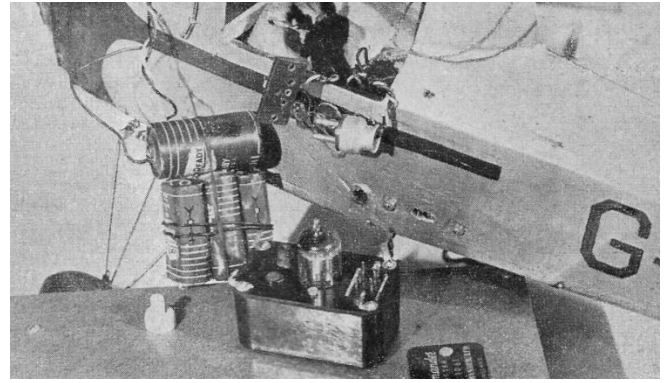
Although the scale on the meter reads in yards it has a 5 mA deflection.

weight of commercial gear is about 10 oz. all up, on the average. Weight can be pruned off this with smaller batteries, but it is asking for trouble to sacrifice efficiency to save a couple of ounces.

Based on 10 oz., then, take two hypothetical models. Model A weighs 45 oz. and is about 5 ft. span; flies quite slowly, and the 2.46 engine offers ample reserve power. This is a comparatively easy conversion, because it will only weigh about 25 per cent, more with radio gear in, and will need only a little strengthening to stand the added stresses. It is big and roomy, and fitting the parts is a simple matter. Model B is 4 ft. span, and weighs 20 oz., with a 1.5 engine. The loading on this model with a 10 oz. radio will jump up 50 per cent., and considerable re-stressing and maybe more power is needed. Obviously then, conversion of an existing model is easier with the bigger model.

My first conversion was with an old faithful stand-by, a 64 in. span Vultee Vigilant, and the weight of the radio made very little difference to the flight path of the model. Except for strengthening up the undercart, and minor trim changes, there was very little required in the way of alterations, and I had the advantage of gaining valuable flying time with a sturdy, but rather sluggish old bird that gave me time to think when operating the controls.

The next model I had in mind for conversion was the Motor Tutor described in last month's MODEL AIRCRAFT. Although it is rather a small model for radio, I felt that it could be converted, as the loading was light. I planned to get the job airborne, with radio,



The E.C.C. 951B receiver and the H.T. and L.T. batteries beside the Tutor.

without fitting a more powerful engine than the Allbon Spitfire used for free flight.

We were messing around with condenser discharge actuators at the time, which obviated the use of quite heavy actuator batteries, and I thought I could, with this gear and a home made Sills receiver (made by club member Sam Dowie, not me!), get the lot down to the 8 oz. mark. In practice, as so often happens, this discharge type, while light, will stick on whatever signal was last given if the radio link is lost, and of all the jams I have witnessed, in every case it has been the right rudder that has stuck. I did this on the Tutor after "buzzing" across the tail of another model (justice?) and it came down one mighty wallop—on the runway, of course!

While it proved that the receiver, as mounted, was shock proof, as no radio damage was done, and that the model could take it (damage being limited to what a few blobs of cement could repair). I retired to lick my wounds and have some long thoughts about pulse-type receivers. Eventually I sent for an E.C.C. 951B receiver to go with my hand transmitter that had served me so well. Although this gear needed a heavier actuator and batteries to feed it, and raised the all-up weight a little, I decided that the model would lift the extra weight, as it had gained a fair height with the Sills gear fitted. This receiver works on the more common "drop" type of current change, which means that if the transmitted signal is lost, the controls neutralise themselves. This means a fly away, of course, but surely that is better than a spiral dive from four or five hundred feet?

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As anticipated, the Allbon Spitfire engine flies the lot quite well. The original Tutor, as presented last month, comes out at little over a pound, and like its big brother, comes in the ultra-lightweight class. That it is strong enough to stand another 10 oz. of radio without any serious alterations gives some indication of the strength/weight ratio of the ordinary free-flight model.

The radio parts have to be fitted so that the center of gravity is not altered (adding ballast to an already heavy model is bad). The weighty parts are disposed so as not to upset the inertia factors and the stabilising effect of the tail. In addition, it is necessary as far as possible to put the heaviest components at the nose, as in a crash a heavy object will surge forward, and if the radio is at the front, well . . . !

I have already explained how all-up weight can upset the tail action of the scale job. In this case we are increasing the wing loading considerably. Although the total loading of my Tutor with radio is only 11 oz. per square foot, a reasonable enough figure for even a non-scale radio job, we have to remember that this is a model of an ultra-light prototype, and as long as the model is ultralight, we can expect a similar stability. With the addition of radio, the loading comes into the normal class, thus altering the basic characteristics. However, I can assure any builder that the Tutor is quite stable at this loading. The tailplane, thanks to the screw adjustment, gives a fine trim, and I have not had any trouble with longitudinal stability. Lateral stability is first class. The enormous wing span actually levels out the model on a tight turn near the ground, due to the ground effect.

Directionally, I experienced some teething troubles, as the model would give an immaculate power flight, only to spin alarmingly on the glide. I added about 3/4 in. of soft 1/4 in. sheet to the leading and top edges of the fin to correct this, only to find that the trouble had been a natural built-in left turn on the fin, which I had tried to cure with excessive right thrust. A little right rudder, and one of the packing shims out of the motor front bolts, and it flew straight and true on both power and glide the goal of all R/C fliers for successful results. (Maybe I should read my own articles !)

The added fin area actually reduces spiral stability—which may be a good thing for radio work—but improves the general flight, so whether it is added or not, I leave to you. It will fly either way, but is probably easier to trim with the increased area.

I do not like altering existing scale form normally, nor with good design is it necessary, but I suppose in the case of a radio model I will be forgiven in this small increase in the fin. Actually, going off the subject a moment, I was surprised to hear from a friend of mine who learned to fly in a Maurice Farman Shorthorn 40 years ago (and has had a go in Tiggies, Ox-boxes, Suitcases and Stirlings in the last war) that in real flight the turn is always more a matter of aileron rather than rudder. When he saw my Tutor on the sideboard for the first time he immediately said: "You don't control it with the rudder, surely?" When I assured him it was the thing, he said it was time we tried something more akin to full-size flying technique.

He was most emphatic that to fly a real kite straight and true, and bang on full rudder as we do in a radio job, is the quickest way there is to spin the aircraft. The plane skids, and drops tire inner wing, as most of the tip lift will be killed instantly. I think he has got something, and hope to try out this theory. This explains why the increase in fin area helps the turn on the Tutor.

Getting back to the practical installation, the main batteries are carried in the front compartment as shown in the diagram. In the case of the E.C.C. 951A or B, this will be three 22 1/2 volt dead aid batteries in series and a U11 for the low tension current. The makers recommend the D18 l.t., but this will be a little large. It is best to solder a miniature two-pin socket (taken from an old D18) to the l.t. Lop, so that a spare battery can be fitted on the field.

The main batteries are soldered up to three wire leads, which are neatly cabled together, passed through the bulkhead into the cockpit, and terminate in a three pole miniature socket, the appropriate plug for this being wired to the receiver; (tag No. 3 being common negative, tag 6 l.t. positive and tag 1 being the h.t. positive, the latter carrying a two pin plug in

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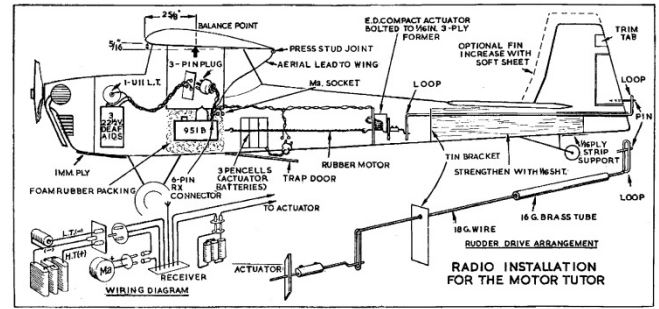
the circuit to take the test meter which reads 0-5 mA—the positive being the thick pole, in the case of the 951B).

The receiver is carried in the cockpit, suitably nestled in foam rubber. A quantity of clippings of this material is usually obtainable at the local rubber shop for a shilling. A piece of rubber, with a hole cut to accommodate the valve is fitted on top, and covered with a sixteenth ply top, cut, with an oval hole to allow the set to surge forward on impact. This is retained in place by diagonal rubber bands across the corners of the cockpit top. Pack the set quite tightly with rubber on all sides, and bottom. This way it will stand a spin-in, in the same way as did mine. This is a far superior method, and much easier than the traditional rubber band fixing from the corners.

The remaining leads from the set are now fitted. Tag 4 on the 951B is the aerial lead, and must be carried away from the high tension wires immediately, or feedback will render the signal weak. Tag 5 is not used in this set up. Tags 2 and 3 are the actuator wires which switch the actuator on and off as the signal is received, and these two leads should be neatly cabled and carried through the rear of the cockpit. Allow a little spare wire for the set's forward movement on landing.

The three pin-plug fitted to the main batteries is used as the main battery switch. A switch can be fitted, but the weight is to be considered. The switch in the actuator circuit is best devised by fitting a two pin-plug in the side of the model opposite to the exhaust in the bay aft of the cockpit. I fit the actuator batteries (three pencells) to a short flex and terminate in a two-pin plug to fit this socket. Thus the actuator batteries can be changed instantly if a spare set is carried.

Remember that the actuator circuit is closed while the set is off, so disconnect the batteries at once after flying. Access to these batteries is through a trapdoor in the bottom of the model. A nylon hinge and rubber bands hold it in place. Due to the small size of the fuselage, and also due to the inertia forces, the actuator is not carried in the tail extremity, but on the last station before the tailplane leading edge. The actuator chosen for the model is an E.D. Compact



type. It has not the battery economy or the high standard of efficiency of the large standard type that I favour, but size dictates using this type on the Tutor. It will operate for a considerable time on the three cells if they are changed regularly.

A rubber band is fitted down the fuselage to drive the actuator, terminating in a hook over the trapdoor. The recommended loop of eighth rubber is too much—one strand gives ample torque, and enables the actuator to release more easily with less magnet pull.

The actuator rudder link is the most troublesome part of any radio set up and I had many flying sessions spoiled by this component before I finally got a rig that is reliable. Discard any hook-ups on the Tutor that require a long rotating crank unless you like fiddling on the field. The set-up now fitted, which I can recommend, is shown on the diagram. You will see that the actuator acts directly on to the torque tube end loop, and it works equally well whether it is exactly lined up or not. The tube through the tail should be 16-g. and the wire 18-g.; the shape of the crank on the actuator governs the amount of rudder movement. In the early stages this should be no more than an eighth of an inch either way. As flying experience is gained it can be increased as long as your nerves hold out!

I don't know whether it is the aluminium dope or the general "smallness" of the model, but the aerial position played me up all ways until I fitted it on the trailing edge of the wing. Numerous types of aerial were tried, but in every case I could not keep up the standing current without signal and at the same time get the proper sensitivity out of the set. Provided this position is used, and the correct length fitted by trial and error, no trouble should be experienced.

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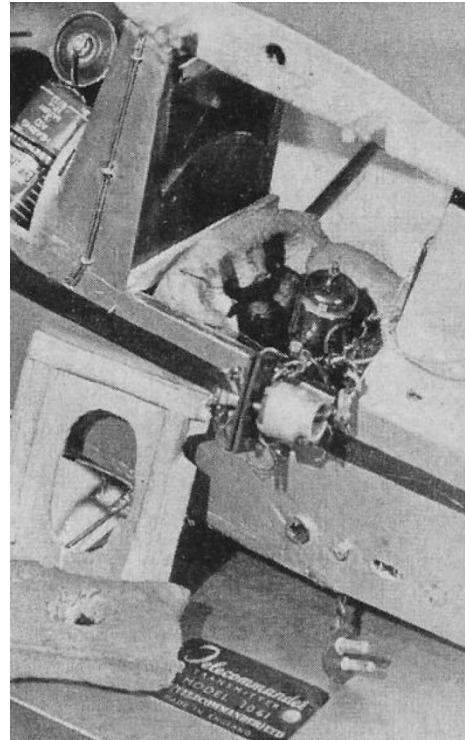
I finished up with enamelled 24-g. copper wire cemented round the T.E. I fitted too much, and clipped it down until I got the maximum range without making it difficult to hold up the standing current, which will happen if the aerial is too short. If it is too long, on the other hand, it will overload the set, and the range will suffer. Quite a critical business on the whole, so don't leave it for the flying field.

If these instructions have been followed, the radio should work O.K. It is now time to modify the trim of the model to cope with the extra weight. If the model has been flown without radio, very little change is necessary.

Take out the 1/8in. wing packing which is fitted, substituting a 1/16 in. piece. This increases the wing incidence so that there is now a 5/16 in. drop from the front to the rear of the center section in relation to the top longeron.

The tailplane now requires a similar increase in incidence, so in. is added to the leading edge by screwing up the adjustment. The result of this is that the glide should be exactly the same as before, but under power the model will head for the horizon, climbing only about 20 ft. in a wide circle. As a power run is considerable on radio, this will keep the model low enough for comfort, and at the same time eliminate all tendencies to stalling, which produces the resultant loss- of-rudder effect, until the model finally turns, and the sudden increase in flying speed whips the tail round, and before you can say "Honest- Redlich," your number is up !

It only remains to straighten up the power run with small shims under the motor lugs, and the glide with trim tab adjustment, so that we get a straight power and glide flight. That about sums up the lot, except to say that a penn'orth of experience is worth a pound's worth of theory.



The receiver positioned in the cockpit.

Article part 2 from:

Model Aircraft Magazine June 1955