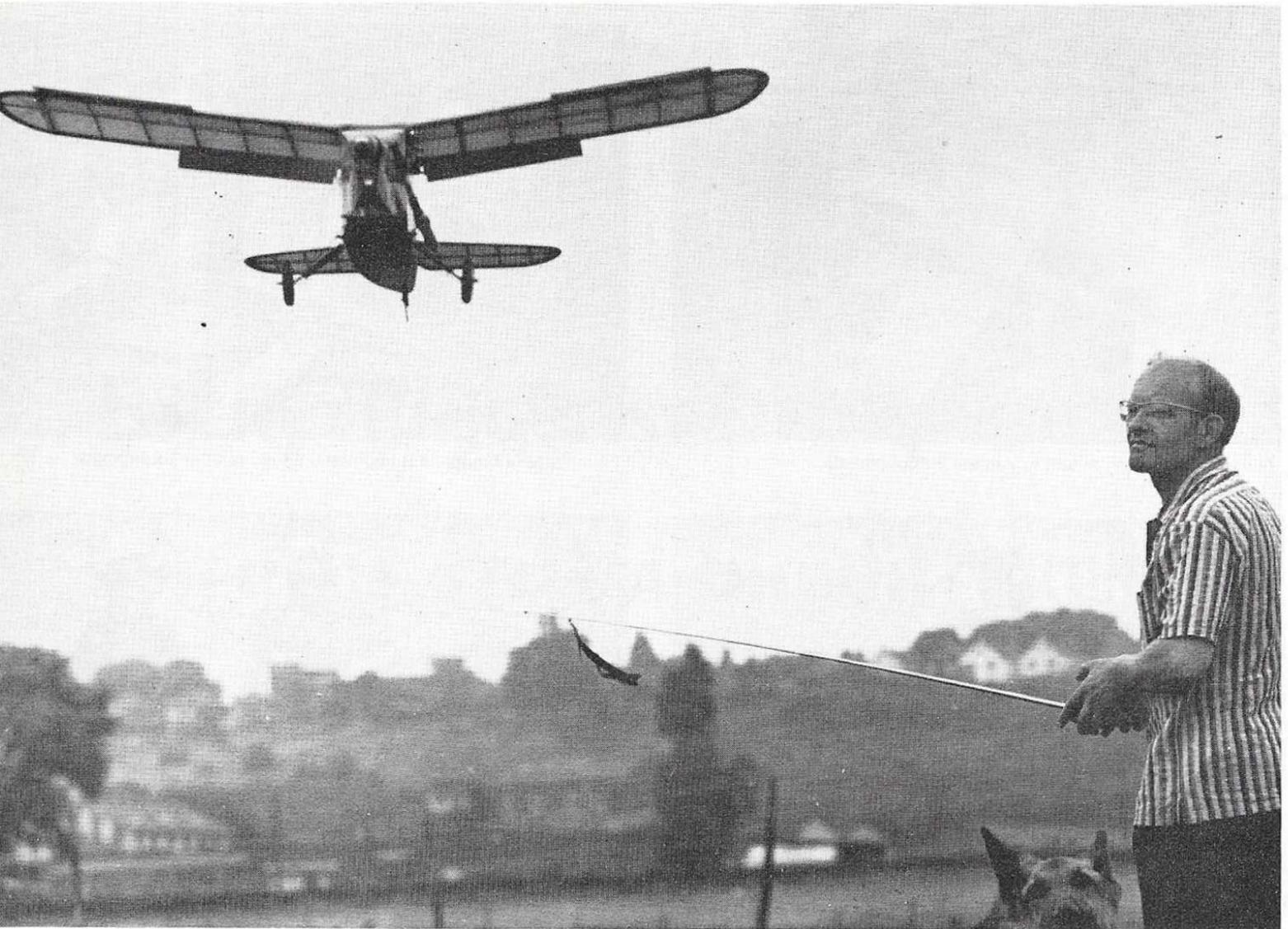


the **STOL** machine

BY PETER RUSSELL . . . may not be the complete answer, but our STOL (short take-off or landing) project can be useful for those with field problems and, of course, makes an interesting project for those who like a different type of aircraft!



Fearless photographer stands his ground as author takes STOL over his head at about one knot above the stall (about 14 miles per hour, as a matter of fact).

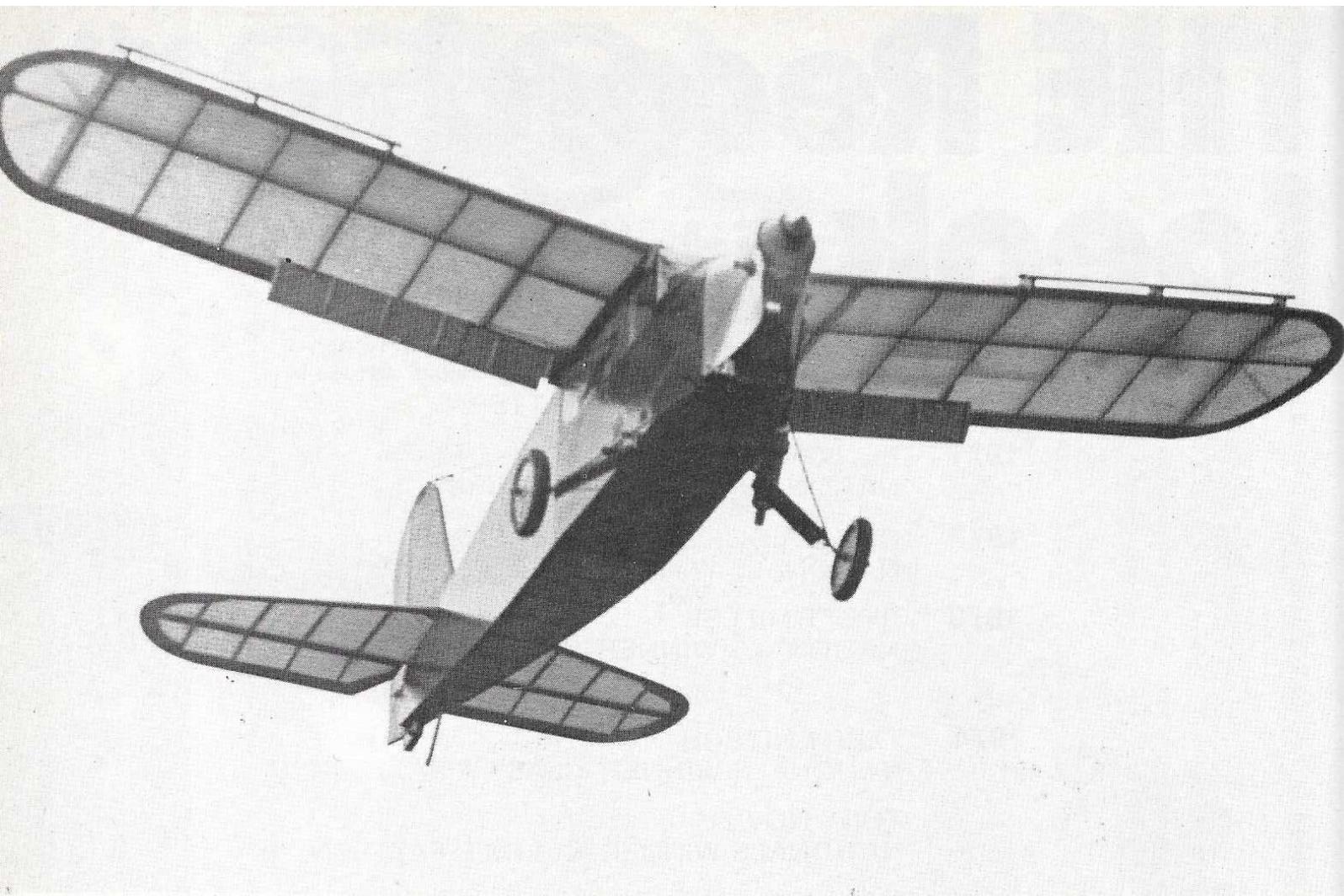
● **ANCIENT AND MODERN.** If you think this design looks as though it escaped from a 1939 *Model Airplane News*, then you would be both right *and* wrong. It was, in fact, designed in 1972 but is a close relation of this writer's very first power design, the "242" of 1943, itself inspired by Malcolm Abzug's "How to Build a Three Foot Gas Model" article that appeared in the January 1939 issue of M.A.N. So much for its history.

But how, you ask, did a 1972 design come to have that spidery, "olde worlde," see-through look about it? Well, it's a long story. Over the past years it seems to have become necessary to drive longer and longer

distances to find flying sites. Since I used to drive about 30,000 miles a year, in connection with my job and gave up driving for pleasure long ago, I wanted a model that could be flown in and out of nearby, small fields. Also, I thought that such a model might be considered a welcome innovation by other modelers who, too, do not want to regard their car as an essential modeling tool. It also occurred to me that it just might be possible to operate in my fairly good size yard, but more of that later. So what seemed to be needed was a small, rugged airplane capable of short take-offs and landings on rough land. At the same time, a mere flying machine would soon lose its novelty, so a

reasonably sprightly performance plus an ability to perform at least some aerobatic maneuvers would have to be considered in the design. Also, because of my own interest in gadgetry, cameras, barographs, glider towing, and so on, it was important to give it enough "stretch potential" to accommodate such extras.

But first things first. The two maneuvers that you must perform on every flight are take-off and landing. Now, there seemed to be two main approaches to insuring good "short field" performance. The first is to build a simple, light airplane with a low wing loading and plenty of power. The second is



Nose up, quite a bit of power on, here you see the STOL in the approach configuration with full flap, nice view through slots. Note glider tow hook at rear.

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to build an "ordinary" aerobatic-type model and equip it with high lift devices like flaps, slots and leading edge droops. I decided to try the simple approach first, so the design criteria began to revolve around a 48" span, 19-powered lightweight with an old-fashioned high lift wing section. In view of the unusually low speed potential, more powerful than usual controls would be needed. As I was "going for broke" on light weight, ailerons were not used, as I felt that a powerful rudder allied to the right amount of dihedral would give enough yaw/roll control without the extra complication and weight of ailerons.

THE NUTS AND BOLTS. I suppose it was inevitable that with my interest in Old Timer engines and models, the structure would have a nostalgic look about it, but there is more to it than that. In spite of the apparently fragile construction, many of the old gas models would take a tremendous amount of punishment without damage. They *had* to, because many of them were marginally stable and many flights ended in sickening, full-power spirals into the ground. Damage, if any, was usually confined to the bits actually involved in the impact, such as nose and wing tips. Furthermore, the paper or silk-covered structures were very easy to repair and the strength/weight ratio was better than most currently flown structures. By comparison, "modern," quick-to-build, strong, light

structural methods have three basic disadvantages. They are not quick to build because of the carving and sanding involved. They are not particularly strong. (Unlike the old timers, crash damage, in the form of splits and cracks, often spreads over much of the airframe.) Finally, they are heavier than necessary for a given strength.

All of this theorizing has been vindicated during the first five hundred flights of the original STOL Mark 1. It has spun into the ground with no damage at all. Following a glider towing mix-up, it crashed with only slight damage to the nose, and innumerable bad landings on rough ground have failed to reveal any weaknesses. The paper covering, English Modelspan, has proved quite satisfactory, too. It now has a few patches, but these are the result of careless handling.

To the inevitable "beef-it-up-a-bit" artists I say, "Don't!" It is unnecessary and it will ruin the performance. If you are a bit ham fisted on the sticks (and who's going to admit *that*!), you could perhaps draw a straight line across the underside of the wing section to eliminate the undercamber. It will lose you some lift but make the model a bit less touchy to the pitch control and enable you to increase the depth of the main spar a bit. This is not to say that the wing is weak. It is simply that the high lift section, itself very sensitive to small changes of angle of attack, plus the unusually powerful controls,

make it easy to apply abnormal loads to the wing if you don't fly smoothly. In this respect it is in line with full size practice, where there is always some limitation on speeds and maneuvering. If you built an airplane to withstand *any* sort of rough handling, there would be an unacceptable weight penalty. I've gone into this in some detail because I don't want the customers to be tempted to "strengthen it up a bit" and then find that it flies like a wet log. As originally flown in the "stage one" configuration, that is without the slots and flaps, it weighed 44 oz., dry, giving a wing loading of 13¾ oz. With the C.G. at 35% this gave a very short take-off—zero run with a small breeze—a very steep climb and lively performance for this type of model. There is no need to dive before loops and rolls, and it will, perhaps surprisingly, do a genuine spin. It has performed at weights of up to 56 oz. and it has flown, with a 25 oz. automatic camera on board, at 4½ lbs.

BUILDING THE STOL To any modeler who has been around a bit (chronologically speaking) the building is very simple, but for the benefit of those who have never built a sticks-and-tissue model, here are a few tips. *Wing.* Make up the main spar first, tip to tip. Pin the spar to the edge of your building board so that the flat rear part of the ribs can go flat on the board and the drooping leading edge part can hang over the edge. You can then assemble everything on the board ex-

cept the leading edge and the tip. When one half is finished, tilt it the other way and complete the other half.

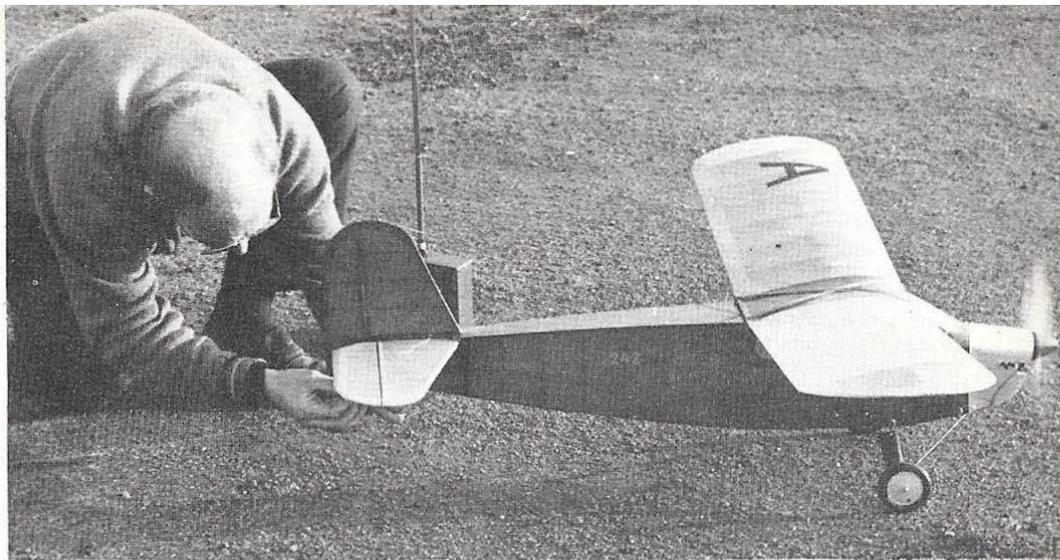
Fuselage. The two sides are built directly on the plan, one on top of the other to make sure they are identical, as in days of old. To assemble the two sides, first fit the two cabin formers in the appropriate places; then draw in the rear part of the sides to fit the former that goes just in front of the tail plane mounting. Give it a chance to set, checking to make sure that it is lined up and square. Then add the rest of the formers and top and bottom struts. To get the sharp bend at the front of the cabin, you will first have to score the bend line; then *carefully* crack it until it bends in at the required angle to fit the engine bulkhead. Make all the gussets a snug fit and use plenty of glue. White glue was used overall on the original, but, particularly around the front end, epoxy would perhaps be better and would speed things up.

The engine mount was originally bent up from .050" alclad sheet and bolted to the engine bulkhead. The sheet metal mounts used to work well on the old free flights and were simple and light, while their "bendability" was an important source of engine protection after those spiral dives that we were talking about. Unfortunately, short engine runs in a free flight are one thing and the sort of runs we have in R/C models (the STOL has an endurance of 30+ minutes on the 6 oz. tank shown) are another, and after about fifty flights the STOL's first mount developed fatigue cracks around the engine lugs. A replacement mount of slightly different design went the same way, so the wooden mount shown on the drawings was fitted. This is another traditional layout that goes back to the dim, distant days of Maxwell Bassett, and this one solved the problem and has been flying ever since. You could use one of the regular cast metal or nylon mounts, but why not make your own, if only to be different?

Some people may not want to bother with the 18 gauge wire-with-nylon-bush elevator horn, but don't be tempted to skip this. It is *so* much neater, tucked out of sight inside the rear end of the fuselage, than the usual, externally bolted-on, nylon horn, with its push rod end exposed. For the rudder, a short horn (to give about 35° each way) is used, but if you are not too sure of yourself, reduce this by using a longer horn.

Again, the undercarriage might look like a time consuming cat's cradle of wire, binding and solder, but it takes only a little time to make, and it has a number of advantages over the dural gear that you might be tempted to fit instead. It works, for instance! It is also light and wide based so that it gives without knocking the bottom of the fuselage about. The fairings are strictly ornamental but are very much "in period" and only take a few minutes to fit.

Covering, even if you've never done it this way before, is simple, but you have to take a bit of care with the undercambered underside of the wing. It is essential that the covering is firmly stuck to the underside of the ribs *all the way*. If it comes unstuck from just one or two ribs, it has the same effect as quite a bad warp. So cover the underside first; then carefully run some dope down the inside of the ribs, repeating if necessary, until you are sure it is firmly stuck all over. It's too late if it comes unstuck after you've covered the top of the wing! Before you apply dope, water shrink (spray it with water



(Above) Engine idling, Pete hooks up glider tow line; will tow 7 ft., 2 lb. thermal soarer to 1,000 ft. in 5 min.

Full STOL climb-out here, hanging on slots with some help from flaps in the take-off position—steep!

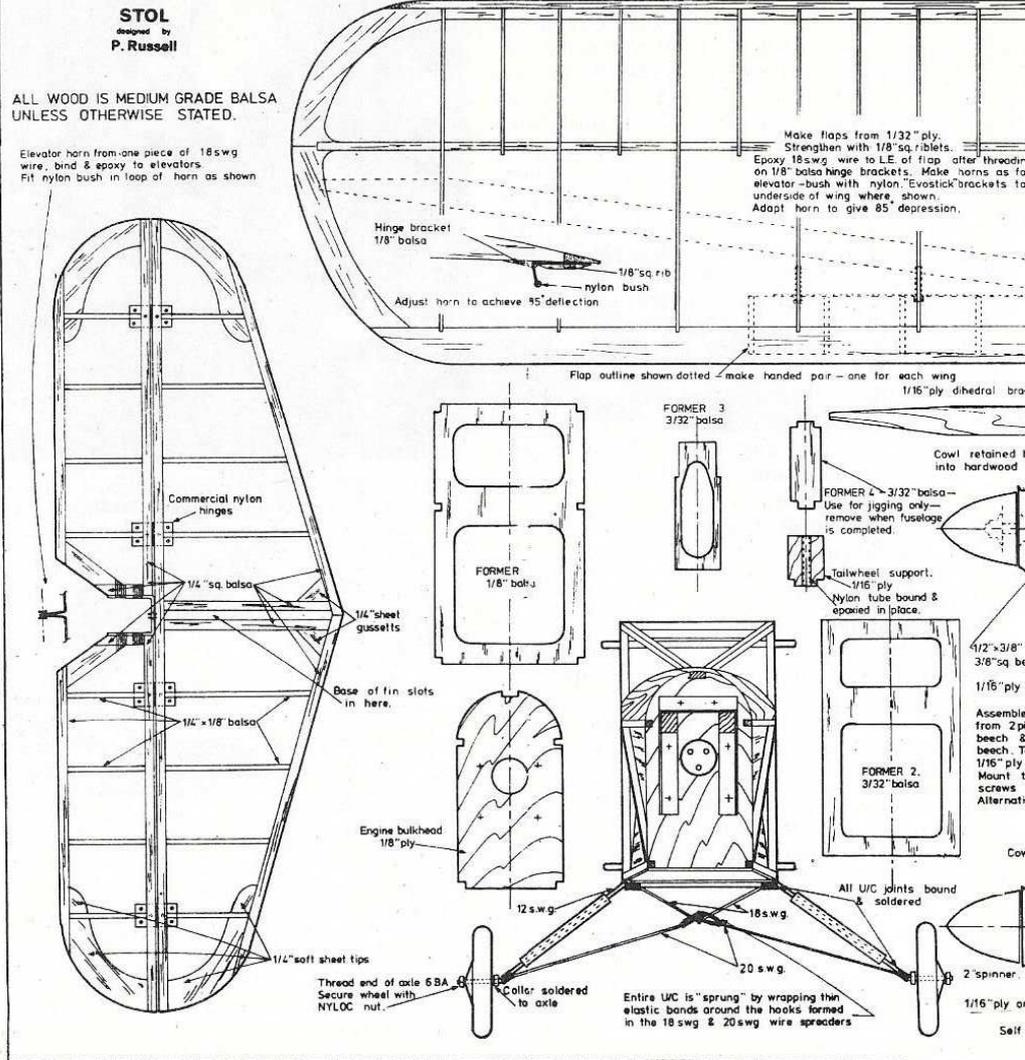


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and allow the covering to dry over a period of hours); then put on about five coats of clear dope. The first should be full-strength, straight out of the tin, but coats two, three and four should be thinned about 50:50. (Use color tissue, to avoid having to use color dope which adds weight and makes the tissue brittle.) You don't really need five coats of dope, but it makes a better looking job. The last coat should be plasticized by adding a little castor oil—about 4 drops per 2 oz. jar of thinned dope. This plasticized coat is important, as it takes the stresses out of the covering and leaves it quite flexible. It then seems to last indefinitely, whereas unplasticized covering becomes brittle after a time. Finally, fuel proof the whole model. The original had several coats around the engine bay and on the underside of the fuselage where the undercart bears. (This latter area has a light fiberglass coating, too.) For the rest of the model, one coat of proofer is sufficient.

THE MOMENT OF TRUTH. Operating from a normal size field, flying the STOL is very simple. If you can fly at all, you can fly the STOL. If you are using the full-throw, high-gear controls though, better take it easy until you get the feel of it. Take-off with the "tail-down" type undercarriage is standard practice. Hold a bit of "up" elevator and right rudder until it gets moving, then ease off both. By that time it will be in the air anyway. The only way you can get into trouble is by over-controlling on the rudder. For short take-offs, full "up" is held on until it comes off in the three-point attitude, then eased off into a reasonable climb. Leave the "steep climb on take-off" until you have had more experience with it. Aerobatics are easy but be careful to fly smoothly, especially on looping plane maneuvers—those elevators really work! For loops, etc. I usually shut the throttle during the nose-down parts, just as in the old days. You will find it "screws" the loops more than a pukka aerobatic model, and your first bit of inverted might be wild until you get used to the amount of "down" needed to keep the nose up when the high lift wing is busily high lifting downwards. Likewise, the generous dihedral is now working in reverse, so you are fairly busy with the rudder during inverted flight. The rudder still works in the normal sense, of course.

A 48" span Short TakeOff & Landing R/C Model for 0.19 cu in. motors
A.P.S. codes G & H

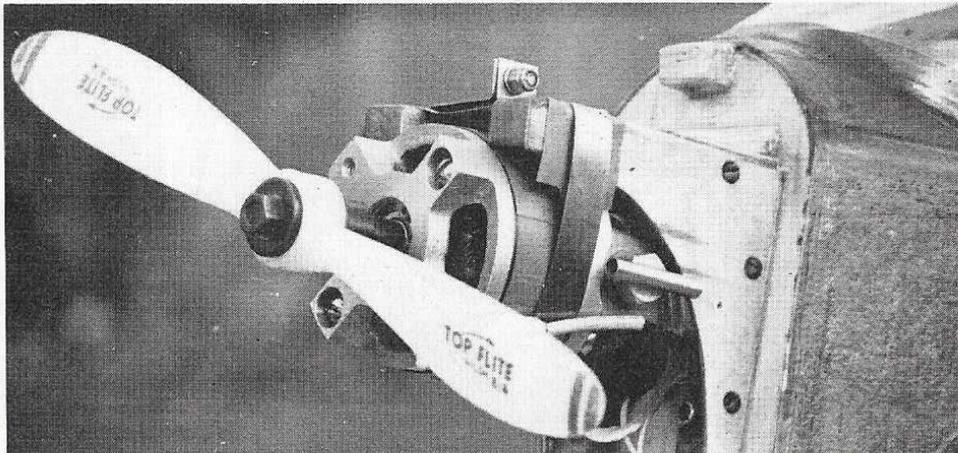


Before you try your first landing, get in some slow flying practice at a safe height, progressively reducing speed until it stalls. Do this with some power on. Then repeat a few times until you are sure you've got the feel of it. You've got to be careless to spin it accidentally, but it can be done, so you want to be fairly sure of yourself before you start hauling it around at "stall plus zero" knots. Normal landings are—well—normal. There is enough elevator to do genuine three-point landings if you want to, but if you want to "wheel it on," flare in the normal way but hold it short of the three-point

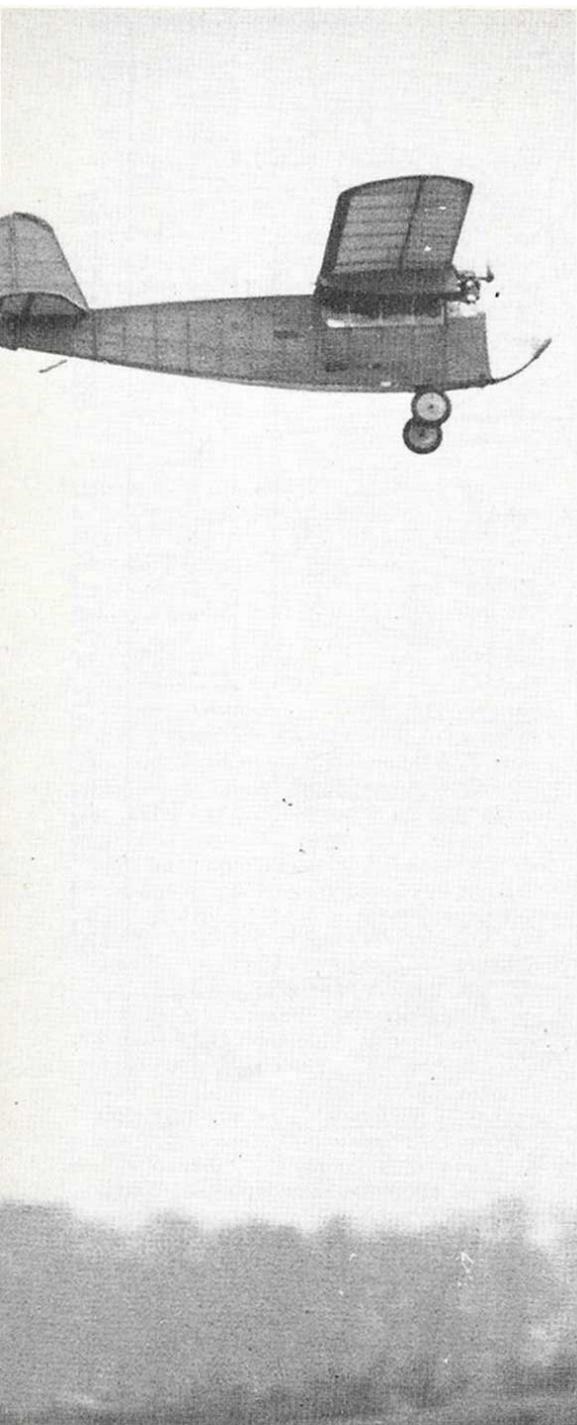
attitude. Then, as soon as the wheels touch, let the stick go back to neutral quickly. With a bit of practice you will be able to grease it on every time.

Short landings are different. The aim here is to bring it in as slowly as is safely possible, reducing speed early in the circuit so that by the time you are on finals, you will have the nose well up and quite a bit of power on. Control the speed with the elevators and the rate of sink with the throttle. If you try to do it the other way around, you will get into an awful mess. If you have got it all right so far, you will be approaching the full "up" elevator position by the time you get down to about 3 ft. and almost in the three-point attitude, then just the merest tweak of extra elevator will sit it down on three points with a minimum of float. If, as is likely, you have come in a bit too fast, chop the throttle a bit earlier. You will then have to "feel it down" and will use more runway, the actual amount depending on how near to "Vmc" (minimum airspeed for acceptable control) you have it. Just a few knots too many and you will float away down the runway. The old full size method of figuring approach speed of "stall speed plus five for luck, plus five for the wind gradient, plus five for the wife and kids" is right out if you want to do short landings!

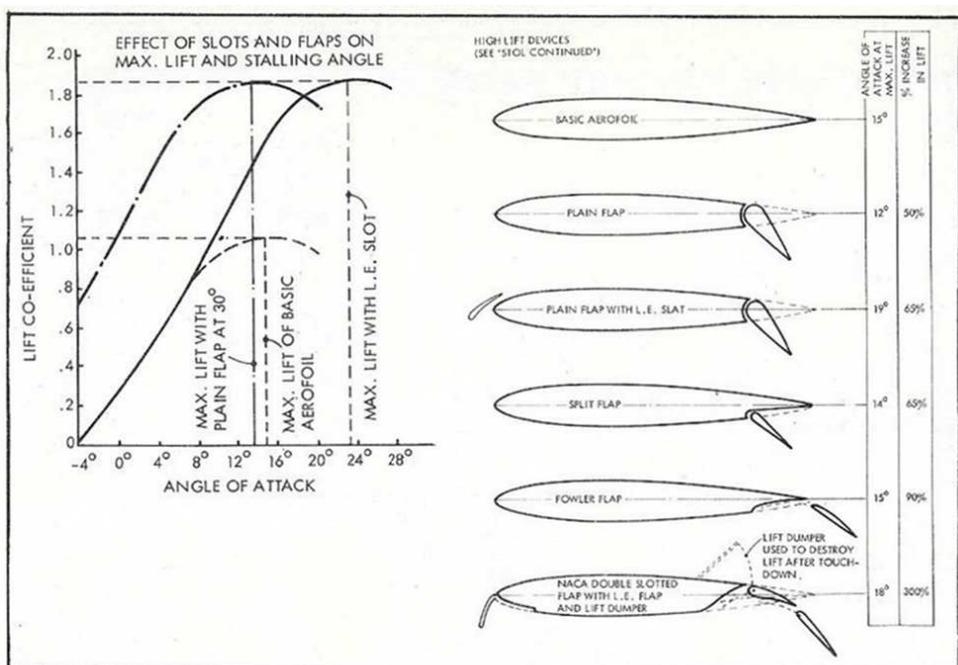
So there you are, your STOL Mk. 1 in its "stage one" configuration is a nice, simple, forgiving sport model able to do mild aeroba-



Here we see the Kroker Sea Pup electric motor in the STOL; good, quiet power.



Twin STOL shows off simple nacelles for O.S. 10's.



Derived from full size sources, graph and diagram show some of the factors influencing the choice of slat/flap layout.



Twin STOL with O.S. 10's on a fly-by. Normal nose mounting still there; could be made into a tri-motor.

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about the slots, as I had tried them back in the dark days before R/C was invented and found them to be no help at all, which explains why I didn't fit them in the first place. But the final proof is: With the slots it won't spin at all. Without them, it spins quite easily. Q.E.D., as mathematicians say!

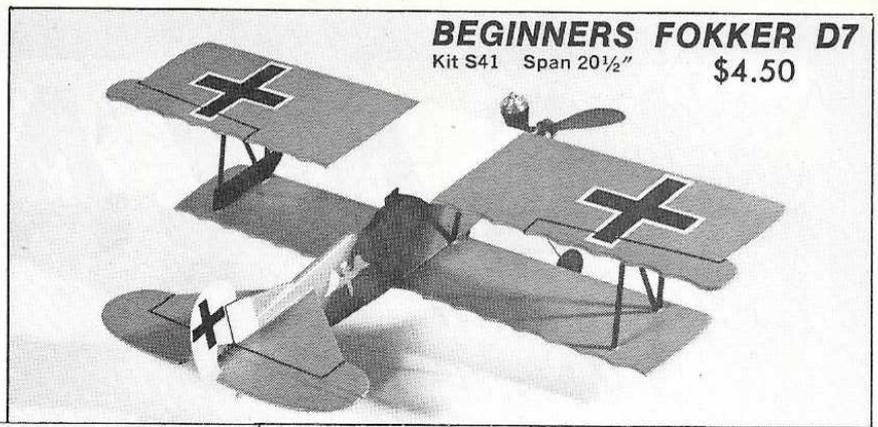
As for handling qualities of the "stage two" model, take-off is slightly improved by using about 15° of flap, but the take-off is so short anyway that it's hardly worth the bother. Looks good, though. For the approach and landing, select full flap at the normal "downwind" position on the circuit. There isn't much point in putting them down in stages, it simply means you have to retrim several times.

Oh yes, Hmmm, the trim. When you put the flaps down, the model pitches nose up. To make sure you can trim it, it is best to arrange the elevator trim so that full "nose up" trim is needed for normal, full power flight. Then when you put the flaps down you've got nearly the full travel of the trim lever to play with. With the engine idling the glide will be pretty steep, so it is easier to bring this back to normal by applying quite a lot, perhaps as much as a third, of power. Try to set up a steady approach angle like full size carrier pilots do, and if you've got the speed right, just the slightest flare as you chop the power will have you on the ground with a very short run, sometimes as little as 20 ft. Like everything else, practice makes perfect.

SEQUEL. All this happened two years ago, and since then, the original STOL has done about 700 flights, nearly 200 in the backyard. It has proved very useful at events where space is limited and it is not possible to operate "normal" R/C aircraft. Apart from that, a slightly modified version has flown with electric power. Another modification, a bit more drastic, was to remove the engine and fair over the nose while fitting two engine nacelles on the wing to make the Twin STOL. This is done without altering the basic airframe, and it can be converted back to the single engine (or for that matter into a Tri-STOL!) quite quickly. Two O.S.

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10's were used for this version, fitted in ultra simple nacelles, held on by the old-fashioned rubber band. About the only complication is to fit a right angle bellcrank to take the throttle push rods back to the servo, located in the center section of the wing in the place normally occupied by the flap servo—the flaps are removed, but the slots are retained.

When I first started flying the Twin-STOL, we in England were going through a fuel crisis in which normal lubricating oils were difficult to get. The result of this was that all 20 of my first landings were on one engine . . . ample proof of its docility in this condition! With an engine out, the only precaution you have to take is to see that the speed is kept reasonably high. It will still climb slightly (on one little O.S. 10!) and you can turn either way as long as you trim the rudder accurately first—there is plenty of rudder trim to do

this. It is so very easy to fly that it would be the ideal way to get in your first few hours of "multi engine" time.

More recently, the original STOL has been flown with a number of different flap configurations. Some of these including a slotted Fowler flap and a Fairey-Youngman flap (this latter has a fancy support linkage which allows the position and angle of the flap to be varied almost *ad infinitum*) have proved very effective, but there are two snags. One, they enable the model to fly so slowly that even in the slightest breeze, control becomes a real problem. Two, any increase in flap effectiveness results in an increase of the trim change, *pro rata* and in the case of the two last mentioned types of flaps the angle usable has been limited by the amount of elevator trim available—I hate having to hold the stick halfway forward to fly level!