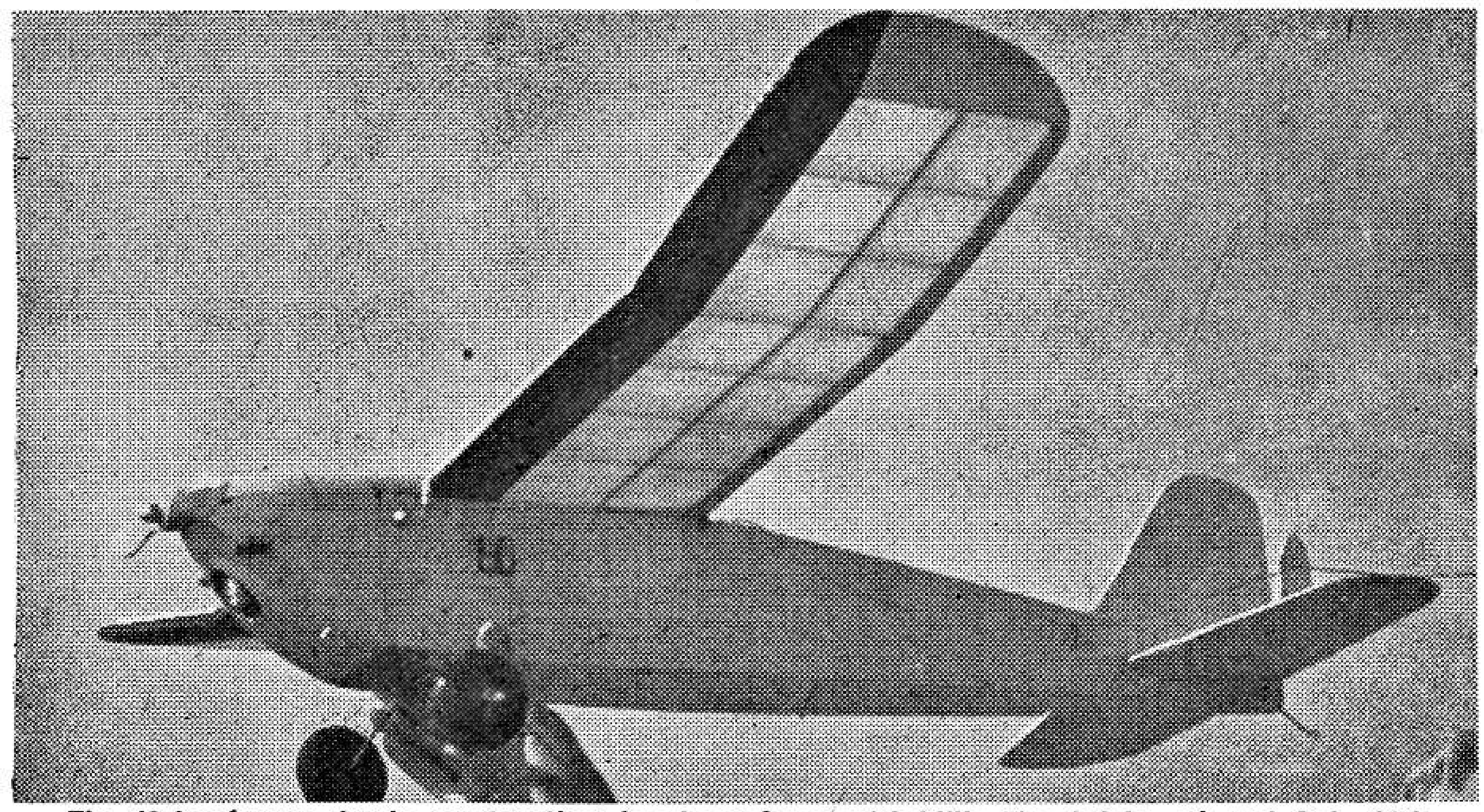
Roy Mayes with the author's "Little Ship"



The *42* is of very simple construction; has been flown with Mills Diesel (shown) and Cub .074

R. C. Models are getting smaller—here are some ideas on what's practical

RADIO CONTROL PLANES

by DICK SCHUMACHER

THIS could start out with "once upon a time a .19-powered ship was the ultimate in small radio control," but today it is no fairy tale that any ship over .09 cu. in. displacement and 4' span is intermediate class radio control, and .19 cu. in. displacement almost borders the giants. This is normal growth made possible primarily by glow-plug and small foreign diesel engines plus the light RK61 tube receivers, and made practical with battery "charging" (see *M. A. N.*, March '49, page 32) and the current savers described in Herb Owbridge's article in the September, 1950, issue of *M. A. N.*

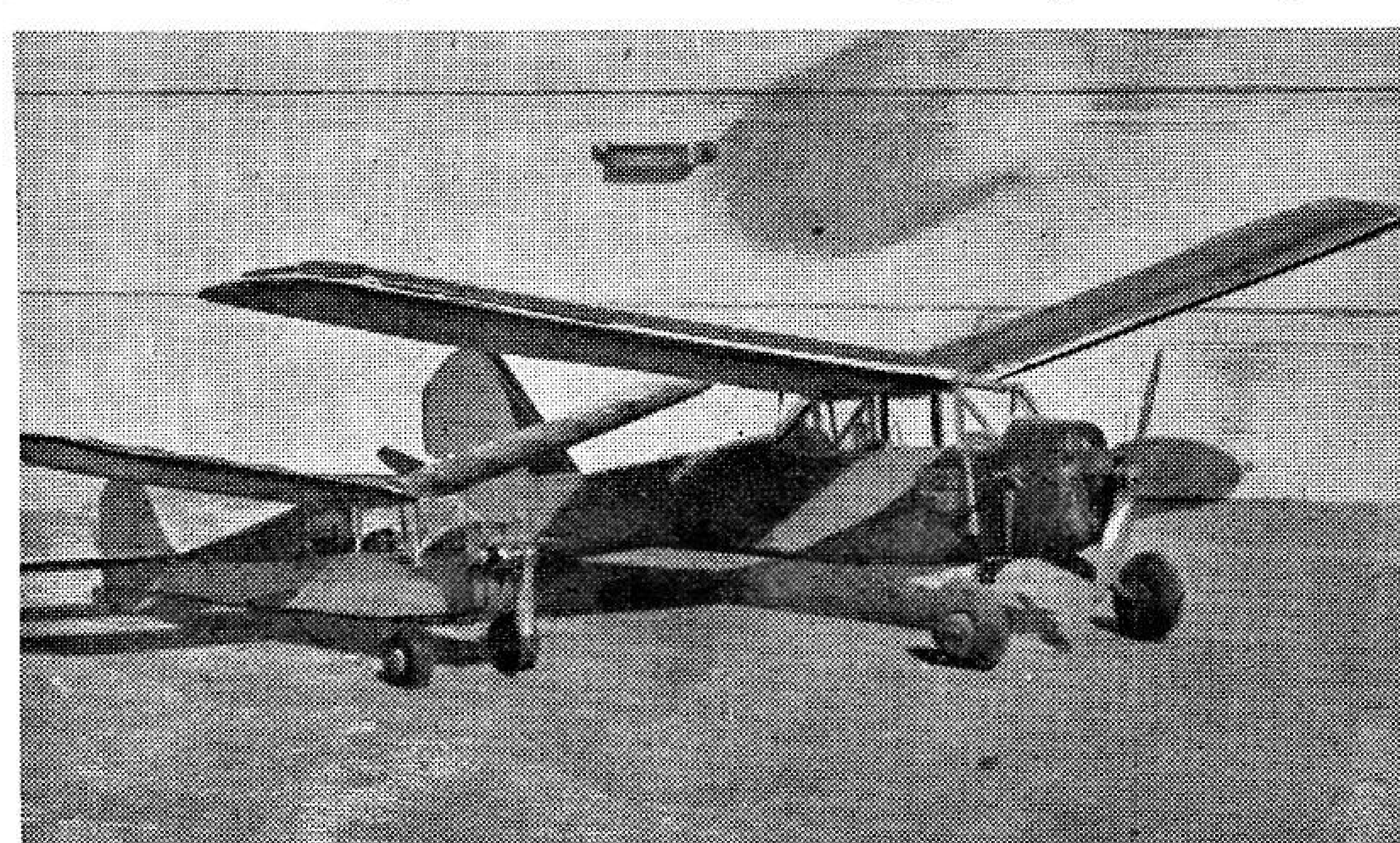
Radio control in the midget class has many real advantages besides the undeniable appeal of any small ship. Perhaps, most important is the amazing increase in the strength-weight ratio as the size of the ship decreases, a major talking point with the beginner in R. C. who is faced with the inevitable piloting and operational mistakes. Second, and also of major importance, is the inherent ability of the small ship to fly in confined areas, which is also a step toward increased radio reliability due to the shorter range required. Third, the simpler structures involved shorten building and repair time. Fourth is low cost. Of course, the family peace and quiet that occurs when no one has to dodge big wings, fuselages, and assorted paraphernalia in the workshop and family car is no small item either!

The old theory that you need a big ship for visibility has been well exploded as experience has proven that the "maneuvering visibility" is almost proportional to the size of the ship. In other words, a small ship is capable of making as many turns within its visibility range as the big clunker. Of course, if you are interested mainly in cross-country flying, the small ship is not so good, but the writer holds to the idea that the cross-country event is just a contest to see who has the most powerful transmitter and owns a set of binoculars. Contestwise, even if the wind is blowing, the small ship will compete with the average big ship on surprisingly even terms. The small-field ability of the small ship is ideal for sport flying as you can pick your weather due to the greater selection of close-in fields.

In approaching the design of the small R. C. ship, the primary point to consider is the control weight or "pay load" the ship will have to pack. This "pay load" consists of receiver, batteries, control, and wiring. The planning and decisions involved in designing a ship to carry this load, which may run over 50% of the total weight, poses one of the problems that helps lift the R. C. field far above the usual modeling endeavor.

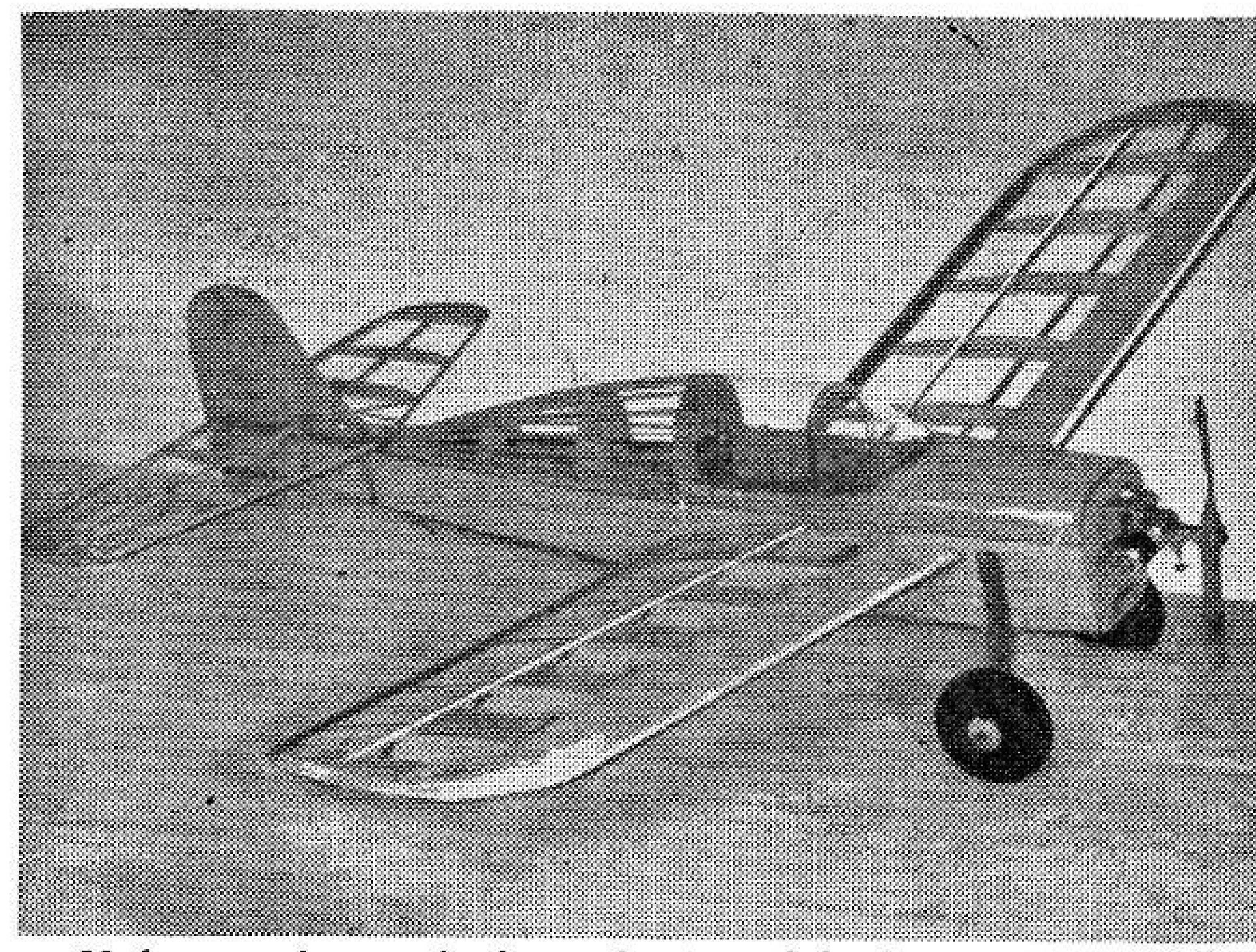
A brief outline of these "pay load" problems is in order, and the first object to consider is the receiver. In the small ship field the only practical receiver available today is the RK61 type (considering the top size limits of this class to be 48" span and .09 cu. in. displacement). Weights of these receivers will run from 2 oz. for the *Control Research* or *Aerotrol*, which use the lighter but more expensive Kurman relay, to 3 1/4 oz. for the sets using the cheaper (if bought surplus!) but more rugged Sigma 4F relay. This

Two midgets! Rebuilt *33* and the author's young hopeful



The *33* posed with a "giant" 5' ship, O & R 23 powered. 13½ oz. vs. 3 lb. 15 oz!

The author with midwing version of *33*, which resembles Goodyear racers.



33 framework was simple—entire top of fuselage was removable

type of receiver, while the lightest on the market, has proven rugged and reliable when properly handled. Its small size, low drain, and simple operation make it a natural for baby R. C. flying. (See the October '49 issue of *M. A. N.* for operating hints.)

Number two design point is the battery supply necessary to keep the airborne equipment in operation. This supply must be chosen with care so that you arrive at an adequate supply for reliable receiver and servo operation and yet are not loading the ship any more than necessary. This means at least enough battery supply to last several flights, if not the entire day's flying. Battery changing can soon get to be a nuisance, and this type of operation is too marginal; you are apt to find the ship up a couple of hundred feet with no control, due to low batteries. Because of the low drain on the "B" supply, from 1.4 to 1.6 ma. idling or .2 to .5 ma. under signal, the smallest "B" batteries available are more than adequate. The "B" supply then consists of two 22 1/2 v. Eveready 412's or two 30 v. Eveready 413's or their equivalent. The 60 v. "B" operation is commonly used when the tube becomes aged. "Charging" will extend the life of these batteries in actual use far beyond the usual shelf life. We have a set about one year old that is still putting out 44 v! These batteries will weigh 2.4 oz. for a set of 412's or 2.9 oz. for a set of 413's.

All low voltage batteries, both A and servo, are the familiar pencell type, or the new silver-zinc Venner Accumulators, which are available from England if you are fortunate enough to have a correspondent to dicker for you. Use of the pencell is made economically practical with the previously-mentioned "charger" practices. Use of the "charger" cannot be overrated. As a conservative estimate it will increase the life of a pencell some 400%.

The "charger" is compulsory when using the Venner Accumulators. These are a new type of storage cell which will not spill; in fact, only five drops of liquid are in it when fully charged. There are no corrosive fumes during charge or discharge unlike the usual lead-acid cell, and it does not hurt to leave a silver-zinc cell fully charged, partially charged, or fully discharged. A cell weighing .6 oz. is rated a .5 amp. hr. when fully charged. At 1 1/2 to 2 v. per cell, it is a real electric powerhouse in miniature. A single pencell or Venner is entirely practical for the 50 ma. drain of the RK61 filament, with an occasional voltage check during the day's flying, and it should last several sessions if touched up by the "charger."

Escapement operation will require from two to four cells. Actually no more than two are required on a common type escapement, if you are willing to put the necessary work into adding an economy switch. This means a total of three to five pencells for filament and servo together; therefore, the low-voltage battery weight is a maximum of 2 1/2 oz. and a minimum of 1 1/2 oz.

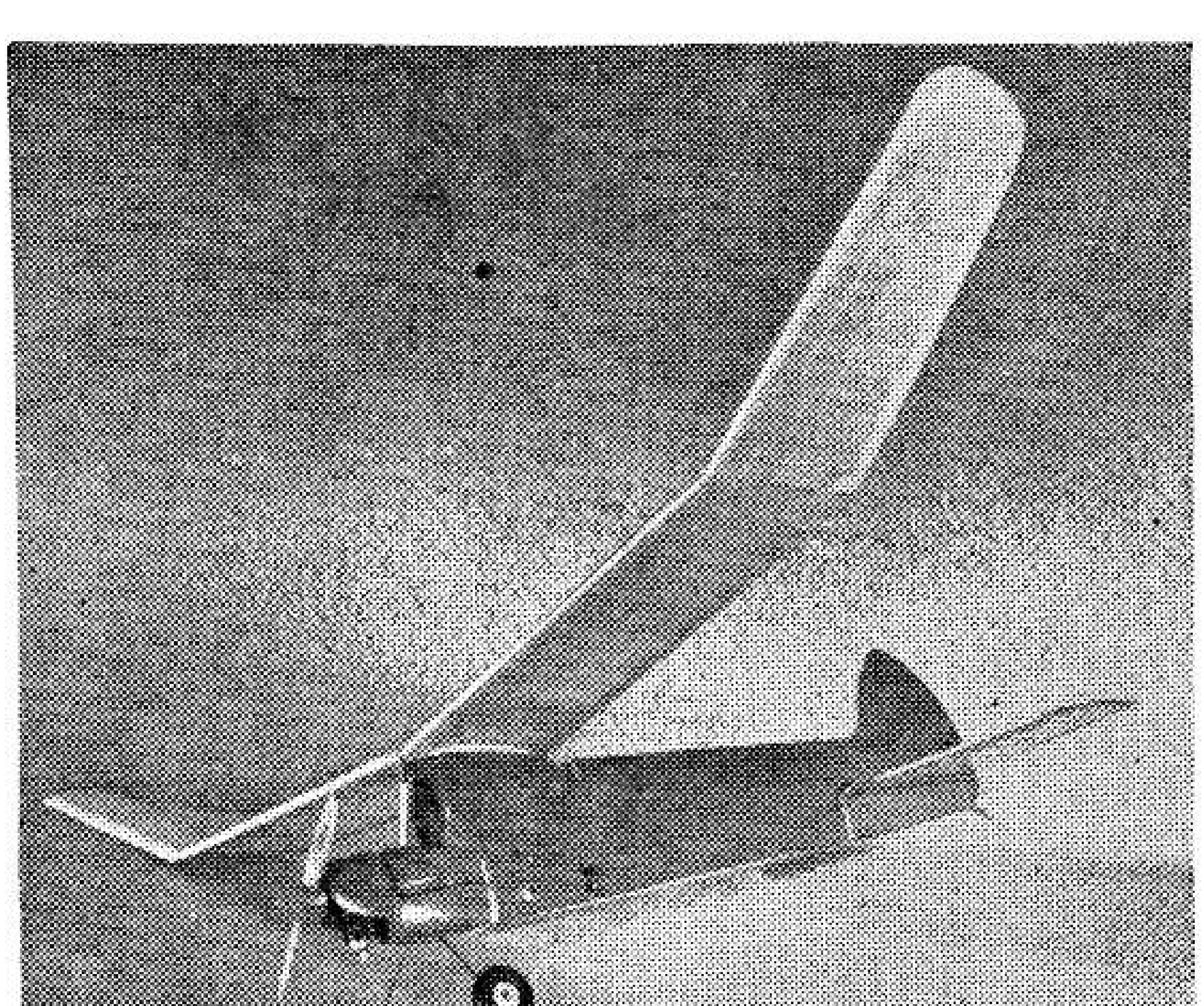
The third item of the control unit is the servo. For our simple and light ships, the escapement or some variation of it is the obvious choice. These simple units have won more Nationals than all other types of control put together; they well deserve their popularity for simple and economical operation.

The various forms of the common types of escapements have been thoroughly discussed in *M. A. N.* from time to time so that everyone is familiar with the mechanics; however, a brief discussion of the merits of each type is worthwhile.

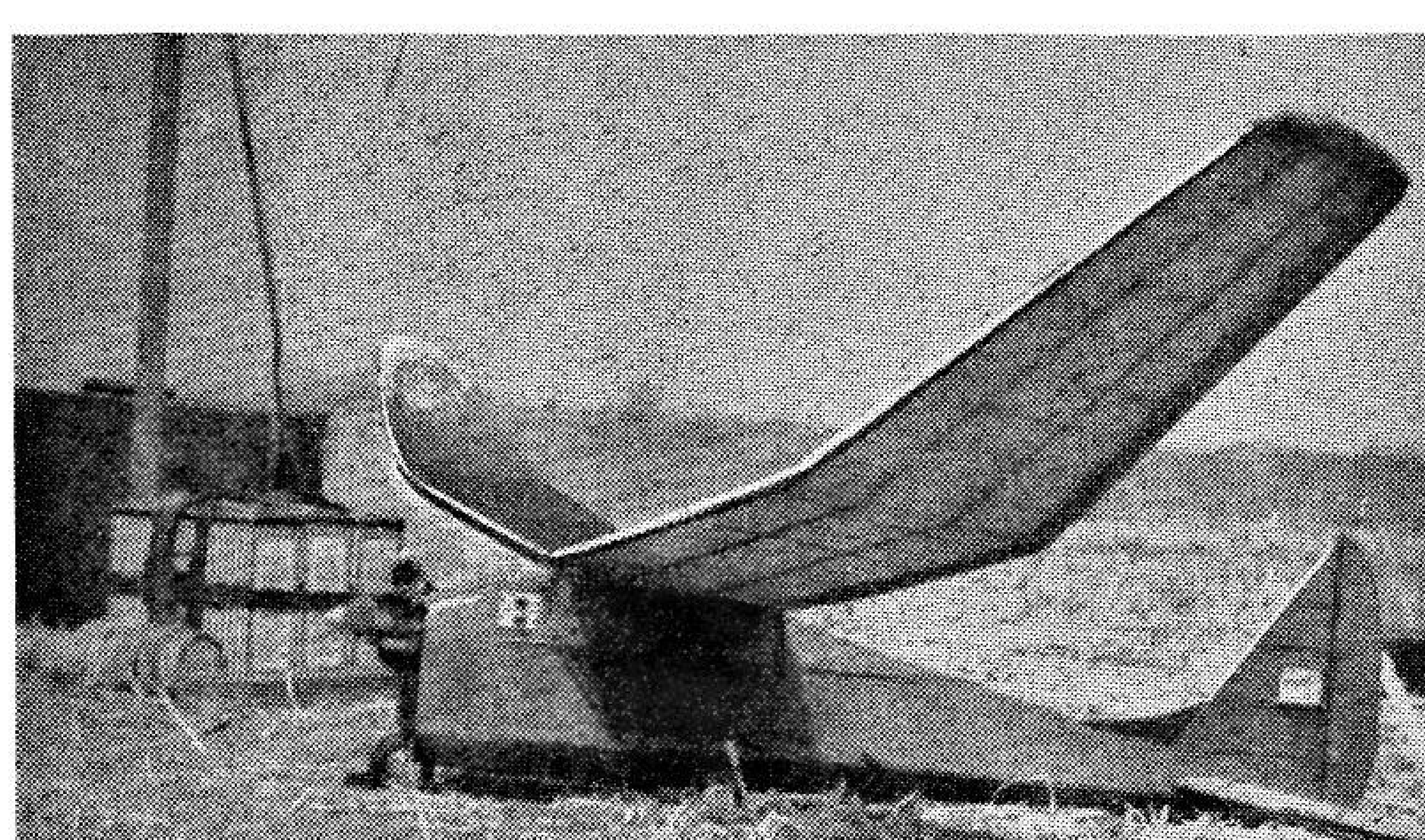
Rudervator and particularly *Superudervator* are undoubtedly tops in giving the most control for the simplest installation. Coordinated elevator-rudder on turns, plus elevator action, plus two-speed engine and shut-off (if you are man enough to try it on one of these small engines!) is a lot of control for 1 oz. of weight. The economy switch used on *Superudervator* and described in the September 1950 issue of *M. A. N.* is applicable to any escapement, and it's well worth the work of installation. This switch gives the two point *Control Research* or *Aerotrol* type of escapement a slight edge over the standard four point *Beacon* type because of the simple automatic neutral and removal of the original objection to the high battery drain when holding a control position. The one penalty is the lack of in between positions for additional control use.

The four point *Beacon* type of escapement, which Walt Good has pioneered and with which he has had so much success, is slightly more complex to fly since you have to signal for neutral positions. It is, however, tops in the low-drain field

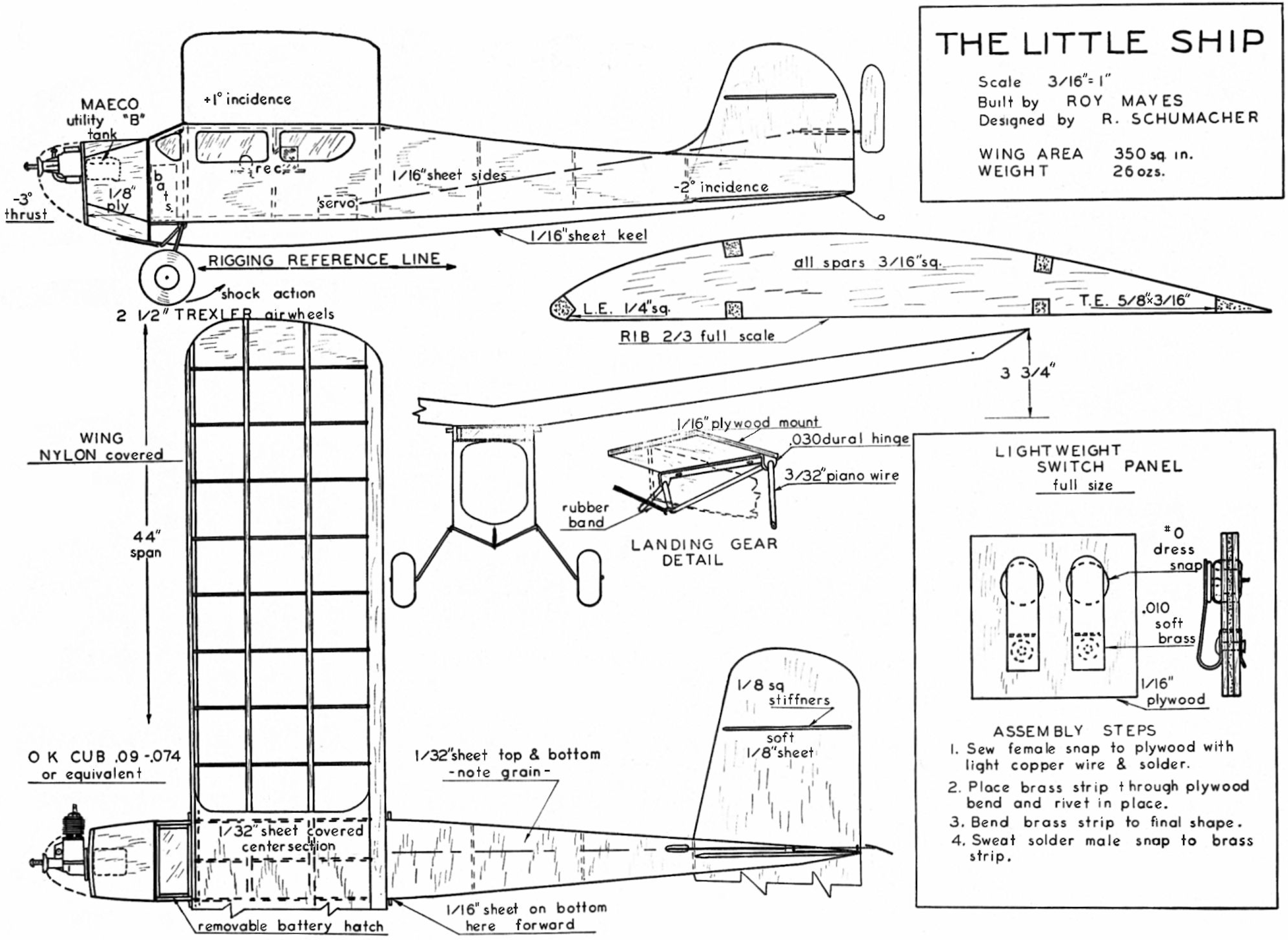
(*Turn to page* 38)



300 sq. in. midget by John Worth weighs 24 oz.



Bill Butler's *Floater Bug* has large span but moderate wing area


THE LITTLE SHIP
Scale 3/16"= 1"
Built by ROY MAYES
Designed by R. SCHUMACHER
WING AREA 350 sq. in.
WEIGHT 26 ozs.
MAECO utility "B" tank
+1° incidence
-3° thrust
1/8" ply
bat s.
rec.
servo
1/16" sheet sides
-2° incidence
1/16" sheet keel
RIGGING REFERENCE LINE
shock action
2 1/2" TREXLER airwheels
all spars 3/16" sq.
L.E. 1/4" sq.
T.E. 5/8"x3/16"
RIB 2/3 full scale
3 3/4"
1/16" plywood mount
.030 dural hinge
3/32" piano wire
rubber band
LANDING GEAR DETAIL
WING NYLON covered
44" span
LIGHTWEIGHT SWITCH PANEL full size
#0 dress snap
.010 soft brass
1/16" plywood
ASSEMBLY STEPS
1. Sew female snap to plywood with light copper wire & solder.
2. Place brass strip through plywood bend and rivet in place.
3. Bend brass strip to final shape.
4. Sweat solder male snap to brass strip.
1/8 sq stiffners
soft 1/8" sheet
1/32" sheet top & bottom -note grain-
O K CUB .09 -.074 or equivalent
1/32" sheet covered centersection
removable battery hatch
1/16" sheet on bottom here forward

Radio Control Planes

(*Continued from page 11*)

since it takes no power to hold a desired control position. Control confusion is a relatively minor point when you utilize Bill Winter's "discovery" that if you are in a turn and become confused, one pulse will always bring you back to neutral regardless of the turn direction. Four-point escapements have the advantage of more positions to utilize for added controls, as *Rudervator* utilizes them for throttle and cut-off.

Since most escapements will run about 1 oz., we can use this figure for servo weight.

Finally the greatest source of unsuspected weight gain in the control system is the wiring job. Switches are the easiest dead weight gatherer of this section. An ordinary toggle switch, double-pole, single throw, will weigh .65 oz. Slide switches will weigh considerably less, but experience has taught us to look with suspicion on this type as they are prone to be unreliable and subject to vibration. This would appear to leave little choice; however, it is possible to make switches that are still lighter and yet have all the reliability of the toggle switch. This type is shown in the drawing and consists of simple dress snaps, a little scrap of brass and some plywood. They will run about .1 oz. per switch, which means a little over 1/2 oz. saved, almost 3% of the total weight of the *33* ship!

The best hook-up wire found to date is Belden No. 8014 indoor antenna wire. It comes in 25' hanks and is easily procured at your local radio store. Wire enough for the average small ship will run about .07 oz. Next, for light weight the 10,000 Ohm potentiometer of *Control Research* is first choice. (If it will not handle the load when using a 60-v. "B", a small ½ w. fixed resistor can be added in series.) Weight for this unit is .08 oz.

A phono jack is the standard component for meter test plug and will weigh .14 oz., although a little weight can be cut off by reducing the size of the base.

To tie all these components to the electric supply, we use the handy dress snaps on the batteries. They are light and positive, and make battery replacement simple. Polarity is easily maintained by using the male snap on all positive terminals.

The only remaining part of the wiring system is a miniature five-prong connector that hooks the receiver to the wiring at a weight of .25 oz. This, of course, can be eliminated by wiring the receiver direct to the batteries, but the convenience of easy receiver removal more than offsets the weight of this part except for special purposes when such weight is a premium.

The total wiring will run between .39 and .94 oz.

We now have all the components and their weights that make up the pay load the ship will have to carry. Simple addition will soon reveal that we have an absolute minimum of 7.29 oz., and a maximum of 10.84 oz. with several possible combinations in between. This is certainly no load for the remarkable small powerplants we have available today. Experience has shown that a 4' ship of more than adequate strength will run about 28 or 30 oz., and anyone knows that an .09 engine will haul that weight with a considerable margin of power to spare. The author feels that this tendency toward overpowering is handy as it allows a comfortable amount of liberty with prop selection and power output. It is a lot easier to cut down the power than try to get power that is not available. Perhaps, Jim Walker's "slow motion" prop would give a simple adjustment for this problem.

As for actual ship design, that is a story that could fill a book; however, I have included a few examples as a cross section of work done in this new class. The ship shown in the drawings and in picture 1 is a fairly good example of what I consider about the upper limits of the "Midget R. C." class. Construction is very simple and flying performance leaves little to be desired for beginner or expert.

Next in line (Picture 2) is the *42* which is the original of the small ship line built by yours truly. It is powered by a *Cub .074* at present, although it has been flown with both a *Mills* diesel and a *Cub .09*. Weight is 24 oz., and as you might have guessed, the span is 42". The .074 is an ideal power plant for this weight; it gives that reserve of power that becomes so useful when everything is not up to snuff, yet does not climb you into trouble too fast. The design itself is victim of too great a rolling moment due to the polyhedral, and consequently has a wicked right turn entry. However, as a workhorse and balsa bulldozer, it has proven many tricks of simple construction useful in the midget field.

At the smallest end of the class (Picture 3) is the little *33*. As a midwing it was an experiment to see if fixed wing construction was practical in this small size and to get away from the usual cabin design. The structure was unable to take the rough and tumble of the relatively poor fields available in our area, so I bowed to convention and converted it to the standard high wing setup in Picture 4. With a span of 33" and a weight of 13½ oz. dripping wet (considerably smaller and yet not much heavier than some Wakefields), it is probably one of the smallest and lightest outdoor R. C. jobs in the country today. It packs the minimum receiver weight, which at 7.29 oz. is almost 54% of the entire weight of the ship—a respectable payload in any airplane. Power is the well-known *Baby Spitfire*. The escapement in this ship is a special four-point design that gives useful one-half rudder positions of less than one-third the full movement instead of three-fourths plus movement, as in the standard type. This means the ship has two definitely different size circles in both directions. This escapement has proven a useful and interesting addition to the rudder-control field.

The other two ships shown in the photos, while above the 48" limit, are interesting because of their small wing area and small powerplants, compared to run of the mill ships.

John Worth designed the ship shown in Picture 5. It has a 300 sq. in. wing area and a total weight of 24 oz. The entire upper half of the fuselage is removable for easy receiver maintenance. The plane also sports a separated receiver-relay mount that is claimed to give better radio protection. The ship suffers as does the *42* from rocking caused by the poly, although it stabilizes out quite well when the turn is developed. An *Arden .09* naturally overpowers the ship at this weight, and John reports that they resort to putting the prop on backwards to kill the climb!

Last but not least we have Bill Butler's *Floater Bug*. This ship utilizes the well-known *Jasco Floater* wing, stabilizer and rudder, with a *Rudderbug*-type fuselage. Powered by an *Arden .09* it weighs 34 oz. and still has that extra performance under power that I like to see. This ship is the exception that proves the rule as far as polyhedral is concerned; it is well known in the Los Angeles area for its consistent performance, and it probably has more flights logged on it than any other R. C. ship on the West Coast.

Well, there you have a cross section of radio control in the Midget class as seen on the Coast. Practical, simple, and inexpensive, the sky's the limit on design, and a new horizon opens up in the model field. The rest is up to you.