be high. Insufficient production demand will never allow the prices of this equipment to compare with the prices of the more common radio merchandise. Since the goal is for ever smaller and lighter equipment for radio control, this fact will become even more noticeable in the future. There is one consolation. The three basic units for radio control (transmitter, receiver and control mechanism) are less subject to wear and damage than the engine and the model itself. Hence the investment in one set of radio equipment can (with reasonable maintenance) suffice for a whole career in radio controlled model aeronautics.

The model size required for popular radio control must be small enough not only for reasons of storage and transportation but also to fit the average budget. This requirement can be more than met with modern available equipment. Radio control can be “jammed” into a model of as little as three feet wing span. This is not advised however, and he who tries it will soon tire of it. Not only is the installation too marginal for reliability, but (and the majority will agree) as wing spans go too much below six feet the model develops strong tendencies toward flight rather than flight. Radio controlled flight can be the most beautiful of outdoor model flying. Let’s keep it that way.

Before radio control can become really popular it must at least show that it is capable of being reliable. This requirement has not been sufficiently met as yet and it at least shows promise. Overall reliability is meant. Not only the radio, but the engine, the aircraft, the control and all details of the installation. A reliable radio controlled model would be one that could be flown six to twelve times on a Sunday and be ready for the same performance a week later without maintenance other than a general inspection and battery check. At present, it takes the most painstaking model builder to operate with this kind of reliability. Present equipment requires several pre-flight performance checks—any one of which if not done properly, can mean control failure in the air. This does not necessarily mean disaster, since, when such a failure occurs, the airplane simply (in most cases) joins the free flight class. But this can be very disconcerting to one who is priding himself on the fact that he has graduated from the free flight class. One logical way to increase reliability is to build a slightly larger model with more than the minimum necessary weight-carrying ability. Then install a little more than the minimum required battery weight and also build in the structure necessary to withstand the consecutive rough landings that are a part of radio-controlled operation. It is surprising how much time it has taken us to learn things as simple as that.

The “sufficient control” requirement means enough control to make the overall personal effort worth while. For several years the simple rubber band powered rudder escapement has been available. The radio requirements to operate it are extremely simple. It seems logical to surmise that at least part of the reason why this simple control has not become popular is because rudder alone has not been considered worth the effort. This point is logical only to a degree. Of all controls to be desired, rudder tops the list. It affords in itself the major part of control necessary to adequately maneuver a model airplane. This fact cannot be appreciated until one has flown a model and compared at first hand the extreme usefulness of rudder as compared to the other conventional controls—elevator and ailerons.

Next in importance comes either power control or elevator. Either one or the other is necessary for altitude control. Since a typical radio controlled flight will be of five to fifteen or more minutes in duration under power, it is obvious that altitude control is very nearly as important as directional control. After ten minutes of flying under power, a model can disappear vertically just as thoroughly as it can in a horizontal direction. For altitude control we favor power control for the following reasons:

1. The model can be spiraled down with rudder but this is a violent maneuver and not always effective. The model attains very high speed and the ground has been known not to stop coming up when it is supposed to. Even if it does, the recovery often puts the model back up to almost the altitude where the spiral was begun.

2. Elevator would be a good altitude control if it were proportional or semi-proportional or in other words trimmable. A well-known U.S. Army target plane uses such a control. But proportional controls tend to run on the heavy side. A step control elevator is not satisfactory as an altitude control. Down elevator will increase the model’s speed and upon release of the control, the model will simply zoom violently or may even loop, depending on how much kinetic energy was gained in the dive which must be absorbed in the recovery.

3. Power control, however, can be nearly automatic as an altitude control. Proportional power control is unnecessary. Step power control (slow and fast engine speed) is sufficient. At reduced engine speed, the model will level out at an absolute ceiling somewhere be-
between 500 and 1,000 feet. We have seen it time and again. It is a law of nature, well understood and requires only the addition of an extra set of ignition timer points on the engine (and a little extra patience in finding the optimum fuel mixture for the two speeds).

So assuming our opinion is faultless (always a questionable assumption) and that power control is the most practical form of altitude control, this leaves elevator as the third most desirable control for use in executing the more violent manoeuvres (loops, rolls off the top, flick rolls, etc.) which require an air speed in excess of normal to begin.

Beyond elevator, we begin to deal with the controls that just don't pay their way. Ailerons are all but unnecessary. Landing flaps, retractable landing gear, fuel brakes, bomb bay doors, etc. If you can load them aboard and still take off, they're all yours! But they'll never contribute to popular radio control and if you go stark raving mad, remember, we warned you.

So much for an attempt to predict the requirements it will take to make radio control popular in the future. Now, what equipment is available or will need to be available to fulfill these requirements? Two good transmitter-receiver combinations are available in the States. These are the "Aero-Trol" and the "Beacon Electronics" sets. Both operate on 52 megacycles. In considering the future of radio control, this equipment must be considered temporary since it is not on a licence-free band. They are interesting however, if only to predict what is desirable in the future. Both receivers are long on simplicity but somewhat short on reliability. Their unreliability comes not from utter failure to operate but rather from the attention required to maintain them in proper adjustment. Without asking for any more sensitive performance in the future, we do ask for a receiver that will stay in adjustment not for hours, but for weeks. One that needs less checking, cross-checking and tinkering with to determine whether it is ready to fly, whether the tube is going out or not. It is just because we are out at the field too early in the morning and not quite awake yet. All respect is due to the boys who designed and produced these clever little receivers. Many of our troubles in the field have in no way been related to them. But if our receiver was under less suspicion, trouble-shooting time could be reduced considerably. The popular receiver of the future may well be a two tube rather than a single tube affair. The two tubes may prove worth while not only for the extra reliability but also they will be in a better form to cope with that ever looming problem on the horizon—separation.

Finally, a word about the controls themselves. And rather than have it whispered to you by your best friend, let it be known that your author happens also to be the developer of Rudlevator—that newcomer to the list of available control mechanisms. Now if this topic of discussion is going to seem biased, let it be so only to a fair degree by stating first off that like all controls, Rudlevator too, is a compromise as we shall see. Four controls appear to be in line for future popularity. These are Jim Walker's "Pos-i-po," George Trammell's pulse length follower, Rudlevator and the Nicholls-Cossor "Mercury" servomotor mechanism. The latter has not yet been seen by the author, so cannot be discussed, but from information received, appears to have enough of the necessary features to get in line with the rest. The old reliable rubber powered escapement is not included in the group since it should be well enough known not to need further discussion here.

Jim Walker's "Pos-i-po" is a rather ingenious cam and linkage mechanism weighing but a few ounces and driven by an electric motor. The mechanism gives rudder and elevator control in three steps of \( \frac{1}{2} \), \( \frac{1}{2} \) and full. Ailerons (although not usually used) can be connected up if desired. Two-speed engine control and engine cut-off are included. The mechanism is mounted on the shaft end of a motor and gear train and responds to the number of circular degrees that the motor shaft turns before it automatically reverses and returns to home. When the shaft returns to home (rotating the mechanism with it) the mechanism picks up the proper control linkage and moves it. For example, a shaft rotation of \( \times \) degrees and return will pick up and move \( \frac{1}{4} \) left rudder. A shaft rotation of \( 2 \times \) degrees will pick up and move (say) \( \frac{1}{4} \) down elevator. A shaft rotation of \( 3 \) degrees will pick up and move (say) \( \frac{1}{4} \)

---

Typical RUDULATOR installation on 5 foot model. Cylindrical object is thermal delay cut-off switch.
off the air. To move a control, the signal is allowed to remain on the air for a longer time than it is held off the air in the given time interval. Hence the bar magnet moves longer and harder in one direction than in the reverse. Full control in one direction would be by steady signal— and in the opposite direction by no signal. On the ground, the control surface actually flutters violently at the signal pulse rate but in the air, the airstream damps out this flutter so that it is invisible. This control also produces some beautiful flying and comes very near to being a true proportional control. The compromises? Well, one carrier channel is needed per control in neutral, the servo batteries are still being used. But it could become popular.

Rudlevator gives rudder and elevator in single-step form plus two-speed engine control and engine cut-off. This should be enough for a one-ounce mechanism. The cylindrical object in the photograph is a thermal time delay ignition circuit breaker used in conjunction with Rudlevator to cut the engine and at the same time save the ignition batteries on the way down should the engine timer points stop in the closed position. The free rotating control surface (a piece of balsa propelled at a lazy rate by the ship stream) is the clever invention of one William Rhodes. When the control surface is rotating, all controls are in neutral since the ship simply cannot respond to such rapid changes. Free rotation takes place whenever the transmitter is off the air—hence neutral is very easy to find. The Rudlevator mechanism is the good old reliable rubber-powered escapement type. But in this case, the rubber band drives nothing but the bearing friction of the escapement wheel shaft. On the escapement wheel shaft there are four stops spaced 90 degrees from each other but each in a different plane. On the control surface shaft are four more stops stacked in planes that mate with the four stops on the escapement shaft. In neutral, all stops miss each other. With a steady signal on the air, the electromagnet will escape the escapement wheel shaft and allow one of the four stops to rest in the path of its mate on the control surface shaft. This will stop the control surface in some position (say up elevator) and produce con-
USE THOSE PLANS
(Continued from page 20)

If the fuselage structure is of the crutch type, you need not bother to connect these top view outlines. You can simply lay your crutch wood along these marks when pinning down for building. If the top-view outline must be completed, simply use the balsa strip to get the needed curve, as was done on the fuselage side view.

Straight tapered portions of the model can be easily drawn by first continuing the tapered line on the plan through a reference line and then measuring both vertically and horizontally to find the line end position.

Enlarging the wing plan follows the same procedure used for developing the fuselage. Lay off a horizontal reference line to correspond to the spanwise dimension of the wing. This can be leading or trailing edge. Mark off rib spacing with the scribed triangle at right angles to this line. Draw spars in proper locations and develop tip curves, if any, by the grid system described previously. Straight taper shapes can be drawn by measuring line end positions from the horizontal reference line.

The best magazine plans present wing rib and fuselage bulkhead patterns full size. If such is the case with the particular model you are working on, very little drawing will be needed to get the patterns on to wood for cutting out. The patterns can be transferred directly to the wood by using carbon paper.

If you do not want to mark the magazine plan, or if the patterns are drawn superimposed over each other, the tracing paper comes into use. Trace individual patterns on to the tracing paper or, if good accuracy in the finished wood piece is desired,
rubber-cement the tracing paper pattern on to the wood and then cut out the pattern and the wood at the same time.

When using the rubber cement to do this job, spread a coat of cement on both the wood and paper and let dry separately. Then place the paper on the wood and press down. The two rubber cemented surfaces will stick very well, and when the piece is cut out the paper can be peeled off easily and the rubber cement remaining on the wood can be rubbed off with your finger.

If wing ribs or bulkheads are not presented full size, they can be enlarged by using the grid method or photostatic enlargement described earlier in the article.

Just a few tips in closing. First, a really straight straightedge for the long reference lines is a must. The right-angle line scribed on your triangle must be accurate. When using the triangle, be careful to line up this fine directly over a drawn line on the paper. When marking off dimensions with the ruler, hold your head directly over the division you are marking, so that you can see your pencil exactly opposite the mark rather than to one side of it. Small errors in a series of dimensions along a fuselage mount up when you get to the tailskid. Keep those pencils sharp, work methodically and you will soon have that favourite model out of the magazine and into the air.

THIS ARTICLE APPEARS BY KIND PERMISSION OF
"FLYING MODELS" 215 FOURTH AVENUE, NEW YORK, 3, U.S.A.

**BULLET**

(Continued from page 35)

Cut the tailplane from 1/8-in. ply and taper the edges as indicated. The 20-gauge elevator horn is attached to the elevator by a linen patch (cemented in place underneath). The 18-gauge control rod is connected to the bellcrank and elevator horn—checking carefully that elevators and bellcrank are both set at neutral.

**FUSELAGE (2)**

In order to reduce frontal area, the engine fins should be filed until they fit the cowling drawn on the plan. The compression lever is replaced with a 1/8-in. diameter milled disc (soldered in place) which projects slightly from either side of the cowl. Attach a 1/8-in. extension to the needle valve.

Check that the upper fuselage shell seals the engine and control components—then cement the two halves together. Join two pieces of 1/8-in. sheet to obtain the required width for the cowl sides (grain vertical). Cut the sides to shape and curve them round the engine. Use pins and Scotch Tape to hold the ends together whilst the
cement is setting. When dry, cut out the air intake and outlet holes—also slots for the compression disc and for fuelling. Dope the inner surfaces of the cowl and cement in place on the fuselage. Cap the top with a piece of 1-in. sheet (see plan).

Fair in the angle between wings and fuselage with plastic wood and go over the entire model carefully with fine glasspaper. Give several coats of grain filler (try talcum powder mixed with dope) and rub down with fine glasspaper. Brush on six coats of clear dope, followed by two of coloured. Finish with a coat of clear glossy varnish.

FLYING
The diesel can be primed with a drop of fuel in the exhaust ports. The original model had an extension fitted from the venturi to the rear of the cowl but this is not essential.

It has been found quite practical to hand-launch the model and a take off dolly is only an unnecessary complication. Hand flights are perfectly safe if the following procedure is adopted. The assistant should hold the model at shoulder height and release after a short run. The operator gives full UP elevator as the model is released and must be ready to step back to keep the lines taut—leveling out as soon as the model is under way.

PHOTO CREDIT
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POWER MODEL STRUCTURES

(Continued from page 29)

bind to the bearers with strong thread spreading glue over the binding. A contribution to the structural strength of the fuselage is made by the wire crosspiece and consequently the use of plywood formers is made unnecessary.

Control line undercarriages present no special problems. In addition to the usual fixed type, the use of dolly and drop off undercarriages are becoming widespread—both on speed and stunt models. In our experience, the drop off type is the best for foolproof take-offs. To prevent the undersides of speed models from slowly rubbing away, due to belly landings, we recommend that a 1/4-in. or 2-in. solid rubber wheel be fitted. The wheel need only project 1-in. from the fuselage, so the increase in drag is negligible.

WING CONSTRUCTION

WINGS
Methods of free flight wing construction are too numerous to completely detail in a short article, so we shall confine ourselves to the most important—from both an aerodynamic and structural point of view.

When we started building models, some fifteen years ago, too little stress was made—in kits and magazines—of the importance of building all parts flat on the plan. Attaching ribs to a tip spar which projected up from the building board was tricky to say the least of it. With polyhedral wings, the most practical and accurate building procedure is as follows. First of all build the main spar flat on the plan. Then build each wing panel flat on the board, propping up the panels as they are completed. Fig. 4.

FIG. 4

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Make trailing edges broad enough to resist warps. A sheeted leading edge has several advantages over the older method of closely spaced ribs. Sheeting gives a rigid structure of good warprotesting qualities. Covering is made easier and a perfect airfoil section achieved.

PIRATE—A simple cabin design featuring several of the methods described in this article.

The model designer has plenty of choice when it comes to choosing the spar layout for his wing. Some modellers swear by built-up box spars, while others follow Dick Korda’s example, by using as many as eight small section spars. Henry Cole, well-known American designer, advocates the use of wide shallow spars. We ourselves favour one deep main spar set at 30% of the chord, plus a small square section upper spar at 30% back from the leading edge. The upper spar is little more than a stiffener for the leading edge sheeting—the two combining to resist any tendency for “elliptical dihedral” to develop in the doping stage.

Good wing construction depends on many small points—such as inserting ribs into the trailing edge; cap-stripping rib undercamber to provide plenty of area for covering attachment; the use of hard balsa or ply dihedral braces at the leading edge and trailing edge breaks. If a wing features a single spar, it should be notched into the upper edge of the rib to prevent warping and tissue sag between ribs. A double thickness wing rib in the centre of each panel is helpful in preventing the trailing edge from warping. Pins and cellulose tape are useful in wing construction—particularly for keeping parts in place on the plan and for attaching sheet covering.

Control line stunt wings are a little difficult to build on account of their symmetrical wing section. But even symmetrical wings can still be built on the plan—by blocking up the leading and trailing edges. The main spar should be positioned at the thickest part of the ribs, so that the spar may be pinned directly to the plan. On simple control line trainers, solid balsa wings are frequently used—being sanded to a thin Clark Y solid glider section. A 1-in.

to 4-in. thick sheet is suitable for a Mills 1-3 c.c. or an E.D. 2 c.c. powered model.

Wing tips are worthy of mention—balsa sheet being mainly used for these components nowadays. The strength of balsa tips depends largely on the location of the joints. An attempt to make a graceful curved tip from a couple of pieces of sheet will result in a weak structure. Use four or even five pieces of sheet, so that the grain follows round the curve. All joints should be at an acute angle to obtain quite a large cementing area. A sharp change in contour between the last rib and the tip may be avoided by gradually thinning the wing section over the last few ribs. A piece of sheet shaped to conform to the front tip profile (and cemented on top on the main spar) makes a neater and more efficient covering job.

Tapered wings with blunt “Mustang” tips are becoming popular with both free flight and control line modelers. These tips are simple to make. Just cement very soft block to the tip ribs, carving and sanding to shape afterwards.

PHANTOM—Well-known C.L. trainer. All sheet construction is popular with this type of model.

TAIL SURFACES

Tailplane construction is basically the same as for wings—being simplified by the lack of dihedral. Unless an upper spar is fitted, the shrinking action of the dope on the covering will almost certainly cause an upward “bow.” If your model is large enough to feature a sheet-covered wing leading edge, the tailplane should be treated in a similar manner. To prevent a sharply curved L.E. from distorting the framework of the tailplane, use two narrow leading edge strips—cementing the second to the first (in position on the plan). Sharply curved wing tip leading edges may also be built up in the same way.

With the exception of ultra lightweight stunt models, control line tail surfaces are usually cut from balsa sheet. The tailplane and elevator should always be carved and sanded to shape in one piece—cutting apart along the hinge line on completion. Incidentally, covering sheet parts with tissue, boosts up the strength by at least 50%. Metal
elevator hinges are best, but too tedious to make and fit for the average modeller. The conventional fabric hinges work well on all controliners—usually outlasting the life of the model.

Flat fins, with the leading and trailing edges streamlined, are satisfactory for all except the largest models. Best way of attaching the fin (and tip fins) is to sandwich it between two of the tailplane ribs. Thicker tailplane ribs should be featured for this purpose. The fin may be a push fit or cemented permanently in position—after covering the tailplane.

To sum up—complete as much building as possible flat on the plan. Make full use of building pins. Always choose your materials carefully especially for highly-stressed components such as spars and longerons.

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the engine bearers to F1 and F2 and squaring up with the control platform which should be cemented under the bearers between the formers. The lower wings should next be cemented into position, care being taken to ensure that the correct dihedral is maintained, also note that the incidence should be zero. A slot should be cut in the lower wings for the undercarriage struts to pass through. The control plate should next be assembled and fitted with the control rods. The elevator end of the rod should be left bent until the canopy is fitted.

If the Amco engine is to be installed the stunt tank should now be fixed to the front face of F1. The side can now be cemented to the front end assembly, care being taken to see that the top edges of the sides are horizontal and square to each other.

Cement the fuselage bottoms to the under side of the lower wings and with the tail block complete with tail skid, bring the bottom and sides together and cement. Place three pieces of 1 in. square balsa across the fuselage at the bottom to strengthen. Cement 2 in. square balsa along the top inside edges of the fuselage and brace across as shown on the drawing.

The tail plane and elevators should now be prepared. The elevators are connected by a piece of 20-gauge piano wire. This unit may be cemented to the fuselage when the correct length of control rod has been found. Do not allow more than 70° total movement of the elevators or this will cause the surfaces to stall, resulting in ineffective control.

The rudder should now be fixed and it will be seen from the plan that this is hinged to the tail block and that the rudder has a control horn or kingpost on its starboard side. This should be connected by 22 SWG wire to a small block cemented inside the fuselage about 2 in. from the rear end. The length of this wire will determine the angle of rudder which may be altered to suit individual requirements. The device also assists in the true scale appearance.

The rear portion of the fuselage can now be completed by cementing the top piece into position and sanding to a gentle curve.

WINGS
The upper wings have no dihedral but have a built-in incidence of 2°. A slot should be cut in the upper wings for the wing brace which also forms the Lewis gun front support. Glue the interplane struts together and also glue the cabane struts to the fuselage. When firmly set, cement the top wing into position. Check the rigging angles carefully as this is very important.

The rigging must pass through the wings and wrap at least once around the top and bottom of each strut. At the bottom front, a rubber band may be used to maintain tension in the rigging but if this is not done the line or wire must pass around the front undercarriage legs.

UNDERCARRIAGE
This is built up from three separate pieces of wire. The front struts are of 16 SWG, the rear struts of 18 SWG and the axle of 16 SWG or 14 SWG piano wire. All three pieces should be bound with thin wire and soldered. The front attachment points should be glued to the fuselage and when firmly set the undercarriage unit fitted into position. Next fix the rubber bands for the shock absorber and it is stressed that no play should be allowed. The rubber should be quite tight and only allow a little movement.

The engine can now be installed. Finally, fit the nose cowl, side and top decking (manilla card) into position.

FLYING
The model should be test flown on 20-ft. to 25-ft. lines and when satisfied with its performance longer lines may be used (depending on the weather) and stunt manoeuvres may be attempted.

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crankshafts are turned from nickel steel, ground and polished before being let into the bearings by hand. The manufacturers have carried out extensive tests on the strength of the 2-4 crankshaft, which will take a bending moment of 500 lbs. in., when the deflection is still under 1/2 degree. The shaft will resist a bending moment of 250 lbs. in. with no distortion whatever. This gives an adequate safety factor with any type of airscrew, ensuring that in a crash landing the airscrew will break long before the shaft will bend.

Under torsional tests, the shaft was loaded up to a torque of 650 lbs. in. without failure. This represents a load of over 3/4-ton on the crankpin, which was not affected or damaged in any respect.

The cylinders of both motors are of chrome-molybdenum steel with a nitrided case and are honed to a tolerance of 0.001 in. The case has a diamond hardness figure of 110 and, after final honing, a surface finish figure of 2.4 in 100 in. The diamond hardness figure of the crankshaft case is 852.

The pistons are lapped to a tolerance of 0.0001 in., and married with the cylinder to give an annular gap of 0.00075 in. wide. This fits ensures excellent compression and excellent oil retention under operating conditions. Material specification of the pistons is not disclosed.

**SPECIFICATIONS**

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**MATERIALS**

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<tr>
<td>Bearing</td>
<td>Phosphor-bronze</td>
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paper, steel pins, hand drill and a pair of half round nose pliers. The building instructions are intended to be used in close conjunction with the plan. Many small sheet gussets are used on the model to prevent warping—and should not be omitted on any account.

FUSELAGE

Lay out the two main "crutch" members on the top view of the fuselage, adding the 1/4-in. x 1/4-in cross braces. Use pins to hold this frame in position on the drawing. When dry, lift up from the plan and insert the fuselage formers (F-F11). Bolt the landing gear bracket in place with the landing gear already attached—or substitute a conventional two-wheel undercarriage if you usually fly from rough ground. If a conventional spark ignition engine is being used, this is the time to install the coil, condenser, timer and battery box. Note the position of the components on the plan. Now add the fuselage stringers.

In the case of a diesel version, omit the fuel tank and install an Elmico timer to operate the fuel cut out. The E.D. Comp. Special is shown on the drawing and the bearers are lowered and spaced wider apart than on the standard (Bantam) version.

Fill in between the bottom stringers with 1/8-in. sheet balsa. Cut the slot for the retracting landing wheel. Add the 1/8-in. x 1/8-in. wing mount and the wing blocks. Go over all joints with several coats of cement.

WING

First cut out the front and rear spars—tapering the tips in accordance with the layout. Slide all the W1 ribs on to the centre panel spars. Then add the ply dihedral keepers and the tapered tip spars. With all the ribs in position, add the leading and trailing edges. The outboard laminated E.E. is added last of all. Sand to the correct sections after the cement has dried.

TAIL SURFACES

Tailplane construction is also started by sliding the ribs on to the spars. The trailing edge and tips are next added, followed by the laminated leading edge. The final sanding of the leading edge should be carried out after the cement has set.

Cut the fin parts from 1/8-in. sheet and install the small movable tab. Cover both the tailplane and fin before joining them together. Slit the covering between the T1 ribs to take the fin.

COVERING

The original models were covered with Silkspan, given one coat of clear dope and several of coloured. High visibility colours were used—such as red, orange and yellow.

Silkspan is not available in this country, so any of the power model coverings available should be used. Go over the model with fine sandpaper to start with. Cover the curved surfaces with small pieces of paper. The rudder, tailplane and wing panels can be covered
with one piece to each side (except the tips). Three coats of clear dope followed by three of coloured are recommended. ConTrin the coloured dope to the fuselage and fin. Be sure to put your name and address on the model.

FLYING
Dick Korda used the Arden 19, Bantam 19 and the Ohlsson 19 in his original models. The largest recommended powerplant is the Ohlsson 23. Note that 4-5 of downthrust is featured. High pitch 8-in. diameter airscrews were used on the record flights—but experiment until you find the best suited to your own model.
Balance point should be on the rear spar. Hold the wing and tailplane in place with heavy rubber bands. Set the air screw so that it will stop horizontally—to avoid breakages on landing. Use the rudder tab to correct any excessive turning tendencies. Spinning tendencies are usually traced to warped flying surfaces.

POWERHOUSE 33—co2 Version
Construction of the CO2 Powerhouse is very similar to that of the larger model—so we shall only detail the differences in powerplant installation. Follow the plan carefully and no difficulties should arise.
The standard model needs no undercarriage, although one may, of course, be fitted for contest work. Mount the CO2 engine on F1 and support the CO2 bulb with a frame of ⅛-in × ⅛-in. hardwood benders immediately underneath the crutch—spaced ⅛-in. apart (all three engines). No fuel cut out is provided in the Bee, but the Amco or Mills should be linked up to a diesel timer (positioned between F2 and F3). A fixed twin leg undercarriage is best for these diesel versions. The C.G., will be further forward than the CO2 model, but this can be counteracted by a little negative incidence on the tailplane.
Here are a few tips for CO2 engine operation. Do not allow the bulb to “pour” the liquid into the cylinder—hold the model in a nose up attitude when starting. Keep the bulbs warm for extra power—but do not actually heat them as this is DANGEROUS. Korda used an 8-in. × 4-in. air screw on his original model. (C.G. 1½-in. forward of T.E.)

LITTLE MIKE
(Continued from page 22)

After a smooth glide has been obtained, wind the airscrew up about 50 turns and launch the model in level flight at shoulder level. Add a small amount of right turn to the rudder so that the model makes a circle of about 30 feet in diameter. Increase the number of turns progressively, making slight adjustments in balance and rudder turn, to eliminate undesirable stalls, dives and spins.

When maximum turns are approached, it may be found that the model tends to stall slightly. If this occurs, add ⅛-in. packing between the top front of the fuselage and the nose block to incline the thrust line downwards. A good quality motor, well lubricated, will take about 300 turns.
Here’s hoping that Little Mike will give you many pleasant hours flying.

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was used on the original. This year I shall be using the same motor with glow plug ignition. Any 3-4 c.c. spark-ignition or 2-3 c.c. diesel motor will provide ample power for this model. Installation details for the E.D and Efin are shown on the plan, together with the Ohlsson mount. Propeller pitch should be standardised at 6 inches, using a diameter best suited to the particular motor used.

KNOCK-OFF MOUNTING
Cut out back plate and plug from 1-in. ply and rivet (or nut and bolt) together. Tailor the dural mounting to suit the engine you use and arrange for approximately ½-in. airscrew clearance from the nylons. Use 20-gauge dural for radial mounting and 18-gauge dural for beam mounting. To bend dural—cut sheet to required shape, rub toilet soap on the surface, heat over gas until soap goes brown-black and immediately dip sheet in cold water. Now bend sheet to desired shape with all corners radiused off. When bent to shape, repeat heat treatment above—this will prevent the dural from cracking when bent. Leave 24 hours to harden.

COVERING
The wing, tailplane and fin are covered with Jap tissue. Water spray all surfaces and then apply clear dope. The wings should have three coats, the tailplane two and the fin one coat.

FLYING
Trim for a flat glide, the model turning in about 100-ft. diameter circles. Test for power flight on 10 sec. motor
runs, gradually increasing revs. as correct trim is obtained. Looping cannot be cured by down thrust, but by careful adjustments of warps, turn and wing and tail incidences, it can be practically eliminated.

The dethermaliser parachute is of 12-in. diameter, and is fitted to the extreme end of the fuselage. It is advisable to set it for all flights made during the daytime.

**WEIGHTS**

- Fuselage and fin: 2.59 lbs
- U/C with wheels: 0.78 lbs
- Knock-off mount: 1.28 lbs
- Engine (Oldson 215): 5.24 lbs
- Propeller: 0.54 lbs
- Ignition hook-up: 2.74 lbs
- Flight batteries: 1.65 lbs (3 of 1/2 pen cells in parallel, i.e., 1½ volts)
- Wing (covered and doped): 2.02 lbs
- Tailplane (covered and doped): 0.47 lbs

Total weight: 17.91 lbs

Weight with glow plug engine or diesel (with timer*) should be 13-14 ozs.

(*Fit timer between F2 and F3.)

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**FREE FLIGHT**

- POWERHOUSE 33: by DICK KORDA
- POWERHOUSE 41: by DICK KORDA
- FIRECRACKER: by NORMAN MARCUS
- JERSEY JAVELIN: by WALTER SCHRODER
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AERIAL ENGINEERING - LIVERPOOL 13

(Caught from page 44)

The extreme simplicity of layouts such as these will undoubtedly appeal. A one-piece elevator can be used, coupled to the control plate in the conventional manner. Provided the elevator area is not excessive, controls are not too sensitive and yet response to control movement is positive and rapid. Stable aerobatic foils are, of course, used—simple symmetrical sections being much favoured.

The American design—Flip Flop by Ray Borden—is again virtually a rectangular flying wing with an extension carrying the elevators. The addition of a definite fuselage and attention to the lines has produced a model which has, really, a semi-scale appearance.

AEROBATIC AERFOILS

As a stunt model, powered by a Drone diesel, it has proved extremely successful. Dave Slagle, on the other hand, in producing a "pterodactyl" stunt model did little more than sweep back the tips of the wings of a conventional stunt job and still retain the orthodox tailplane and elevators. Slagle's design is not a flying wing model in the true sense of the term.

All of these flying wing jobs fly much faster than orthodox machines with the same power unit, although compared with a specialised speed design in the same category their performance is inferior. It is, indeed, this inherent high speed flight which has led to development troubles on many flying wing stunt
models. Departures from the simple functional design, where, for example, split elevators are called for, have complicated mechanical linkage and lead to other control difficulties—so that it is much more difficult to produce a semi-scale flying wing stunt model than a simple "flying saucer," both to have a comparable performance.

Manoeuvres with a flying wing stunter are often carried out so rapidly that observers are at a loss to follow exactly what has happened—a point which may confuse judges in contests!. But on the whole they afford two distinct lines of approach for stunt fans. On the one hand is the simple "flying saucer" which can really stunt well and teach the pilot a lot about stunt flying. On the other hand there is the possibility of producing a scale or scale-appearance flying wing model with a full stunt performance, calling for ingenuity in construction and detail design, for those modellers who prefer such "tricky" problems. *

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CONTEST GLIDER
(Continued from page 42)

possibility of failure is very small indeed. Even if the locking piece sticks, it can be pulled out by a gentle tug on the line. The line joining the locking piece to the towline should be stronger than the towline itself, so that the latter will always fail first.

The original Contest Glider was 3-ft. wing span and of very light overall weight. Still air flight time from 300-f. of line was consistently around the 5 minute mark, but it was a good weather model. In high winds, the wings would flex and twist under tow and hence a stronger wing was built for the F.A.I. version of the design.

Since the original model was so light, wing area was reduced on the F.A.I. version to reduce the amount of ballast to be carried. Span was now 48 inches and the wing further strengthened by sheet covering the leading edge back to the top main spar. All of these wings, incidentally, used a very thin, laminar-flow section, which has since been abandoned. The latest version detailed on the plan has a standard RAF 32 section.

To bring up to F.A.I. loading, ballast was carried under the wings, this being preferable to building a heavier airframe throughout. In fact, it has been found that provided the airframe is reasonably strong, the lighter it can be made the better, additional weight being added in the form of ballast amidships, i.e., immediately under the wings. This minimises inertia forces which may affect stability—particularly under tow.

The other new feature to be incorporated is an adjustable tow hook, which has been thoroughly proven on a large-scale Wraith (6-ft. span), this
particular model being used as a "guinea-pig" for testing various devices. A single adjustable tow hook allows the hook to be adjusted for the best possible position for any condition. It is readily possible, on the large Wraight, for example, to bring the model right overhead and release immediately above utilising the full length of the towline. To achieve this consistently, practice is needed in setting the tow hook position and also the lightest possible line should be employed.

All constructional features are detailed on the plan, the airframe being strictly conventional. The only unconventional feature is the use of \( \frac{1}{8} \) in. sheet bracing inside the nose to strengthen the nose section against stalled landings. Under optimum contest trim, all gliders of this type should have a tendency to stall slightly when approaching the ground.

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\( \frac{1}{32} \) PLY
LINE GUIDE

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MEET THE DESIGNERS

W. A. S. GEDDIE
built solids from 1933-36, then rubber duration until call up in 1940. Served in the Royal Engineers, being invalided out in 1944. Started modelling again with rubber and glider types. Now concentrates mainly on Walkfast, with free flight power as a secondary interest. Belongs to Bromley M.A.C. 1937-46. Member of Zombies club since inception in 1946—now club secretary. Has a brother—Duncan—who is also a modeller and goes in for HAT'S. Is 28 years old and single. Profession: Quantity Surveyor.

DICK KORDA
is 33 years old and one of the best known of American designers. Won Walkfast Trophy in 1939—his winning design still being popular in this country and the U.S.A. Established himself as a free flight expert with his Powerhouse in 1946. Started off with a ready built R.O.G. stick model at the tender age of 5. Built his first flying model at 12 and has had cement on his fingertips ever since. Has been a member of the Cleveland Balsa Butchers for many years. Other interests are fishing and deer hunting. Married, has two children aged 5 and 10.

NORMAN MARCUS
is just 19 years old. Took up serious modelling in 1944—on joining the Croydon club. Engineering student at Kingston (with Roy Yeabsley). Has won contests in nearly all classes. Won the S.M.A.E. Individual Championship in 1946. Favourite type of model is lightweight rubber. Has a definite dislike for Walkfasts. Considers that high-powered free flight models require most trimming skill.

R. D. RANDERSON
has built scale models for the last 12 years—but has yet to try a free flight model. Became interested in power designs when he met P.E. Norman at R.A.F. Halton in 1945. Started building scale controller in 1947 and founded "Modelair Control Liners" in January, 1948. Served in the R.A.F. for eight years (from 1937)—logging over 1,000 hours as a flight engineer. Collects 1914-18 diaries and autobiographies of famous airmen.

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Rover... 10
Sticker 42”... 10
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Sticker 68”... 10
Outlaw... 10
PROG 35”... 10
PROG 42”... 10
PROG C"... 10
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Playboy... 2
Flying Wallaby... 2
Thunderbird... 2
Witch... 2
Pterodactyl... 2
Stuntmaster... 2
Stout... 2
Kangaroo... 2
Vulture... 2
Heron... 2
Goshawk... 2

DIESEL ENGINES
Kahnur, 0.32 c.c. 2
Mk. III, 0.37 c.c. 2
"K" Vulture, 1 c.c. 2
"K" Falcon, 2 c.c. 2
E.D. Bee, 1 c.c. 2
E.D. Mk.II, 2 c.c. 2
E.D. Ciro, 2 c.c. 2
E.D. Mk.III, 2.49 c.c. 2
E.F. 1 R.E.C. 2
Mills, 1 c.c. 2
Mills, 3 c.c. 2
Mot. 100 2
Frog 101 2
"K" "Vulture Mk.II, 5 c.c. 2
"K" "Vulture Mk.III, 10 c.c. 2
Slick Savages, 1.8 c.c. 2

PETROL ENGINES
Torpedo Special, 5 c.c. 3
Kai Kniff, 6 c.c. 3
Nordex, 10 c.c. 3

GLO PLUG ENGINES
Frog 100 2
Flat 29 2
Nordex 10 c.c. 2

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