PRECISION RADIO CONTROLLED

PARACHUTING

RCM introduces true-scale precision parachuting — jumping from a powered aircraft, stable and steerable free-fall, plus radio controlled opening of the chute and steerable landing to a designated target. By Konrad Riggenmann

● If someone is an enthusiastic sports parachutist and a dedicated modeler at the same time, it is very likely that, one day, he will combine the two kinds of sports. I first had this idea in the Autumn of 1973 after completing my military service as an airborne infantryman and, since that time, haven't been able to lose my initial enthusiasm for the project. I wanted to carry out true-scale parachute jumps with a small model parachutist. With "true scale" I mean - - - exit from a motor-powered R/C aircraft; stable and steerable free-fall; plus radio controlled opening of the chute and steerable landing to a designated target.

Fortunately, the state of the art of radio control technology has progressed so far today that it is possible to place a complete radio system in the body of a 15" high "Pinocchio." After a great deal of thought, as well as some sleepless night, I started building the project on Christmas 1973.

The first problem was how to control the chute, itself. With my experience in full size sport parachuting, this was quite easy to solve. I used a circular canopy parachute with a single steering gore at the rear side which produces the forward drag as well. Control lines are mounted on both sides of this gore and connected to the jumper's hand. The arms of the parachutist are moved vertically by two servos. By pulling one of the control lines, the airflow through the left out gore is conversed and the chute will turn to the side where the control line is pulled. The arms are moving around the shoulder joint only while the legs are moving around one axle and are not controlled.

The second question was how to achieve a stable position during a free fall with a closed chute. A falling body obtains stability by a sufficient dihedral and a low Center of Gravity. Jumping yourself, you will have to get your arms and legs high and your body low to be stable, and that's just exactly what I did with the model — the arms are mounted with dihedral and the legs are drawn backwards until the opening of the chute, by elastic. The relatively heavy receiver-battery is put into the reserve dummy chute, thus giving the jumper a low Center of Gravity. By moving one of the arms, the jumper can be turned quickly during free-fall.

The problem which perplexed me the most was to obtain a maximum of safety on chute opening. Two different methods proved too unsafe in ground test before I eventually found the ideal solution. The parachute container is closed, as usual, but only one locking pin. This pin is kept in place by a perlon-line hooked up on another pin which, in turn, is linked with the servo lever arm. The servo pin stands out through the jumpers shoulder. When he is drawn inside by the servo, the perlon-line becomes free and the locking pin is pulled away by two elastics stretched to the shoes of the parachutist, thus the container is forced open. A small cellophane pilot chute deploys and pulls out the main chute.

The completed jumper (named Konrad) looked quite pretty when finished and I was very proud of my sculpture work. He was equipped with a Multiplex 2 channel receiver and had an all up weight of 20 ounces. The first jump tests from the second floor of a building (with opened chute, of course) were successful, and I started at once to build a special powered model for dropping the jumper. This model has a wingspan of 77", a weight of 7 pounds, and is powered by a Webra .40. A strong elastic band keeps the jumper tight in the interior of the especially broad fuselage. When the locking pin of this elastic band is loosened by a radio signal from the transmitter, the jumper will leave the aircraft through a pair of swinging doors in the fuselage bottom.

The long awaited first jump took place in June of 1974. All preparations were completed with almost pedantic accuracy, and you can imagine the excitement until the model was in the air. To our amazement, all worked better than we had expected. From the climb out of the model, to the exit of Konrad, the free-fall-delay, the parachute opening, and the landing on target was all very realistic. Now, with a stable of four parachutists, I have completed 130 jumps, and keep on improving the technique. Perhaps the most effective innovations are the new wing-type chutes. The Para-Plane, sometimes called the "flying mattress" in Germany, is the most up-to-date high-performance sport parachute. The advantages of this type of chute are the lift/drag ratio of 3:1 (makes a top speed of 25 mph) and the airplane-like flying characteristics. Of course, it would be even more interesting to drop two jumpers simultaneously.

Thus, the next project in the evolution of the radio controlled parachutists begin to take shape. I constructed a semi-scale model of the well known Swiss Pilatus Porter utility aircraft. The fuselage of this fast climbing model has enough room to take up to two jumpers, one behind the other. The model has a 90" wingspan, weighs 10 pounds, and is powered by one of the new Profi .61 engines. It is a really magnificent spectacle to see the two parachutists leaving the airplane a short distance apart, approaching one to the other in the air in free-fall, opening the chutes, and landing together on the designated target. To avoid interferences of the three transmitters during starting preparation, I constructed simple automatic switches which don't switch on until the jumpers exit the aircraft. The delays can easily be watched without binoculars in altitudes from 300 to 1500 feet. It's true, of course, that I used binoculars when I set my 40 second free-fall record delay. And, of course, because I had to test a lot of innovations, a few malfunctions did occur during initial testing. But, during all of the test, none of the R/C equipment was ever damaged and the wooden jumpers were easily repaired.

My models have always been a sensation at flying meetings and model exhibitions. Model parachuting is nearly as fascinating as sports parachuting and full of additional possibilities. At the present time, we are preparing for small precision competitions, and I am hoping that many modelers will become interested in R/C parachuting.

CONSTRUCTION NOTES

The Jumper:

The construction of the parachutists figure starts with part #1 on the plans which must be cut out of 3/32" plywood and provided with the holes for the arm-axles and for setting in the snap fasteners for the chute container. Glue on the 3/32" plywood shoulder and hip parts as well as the 1/8" balsa side parts provided with the appropriate holes. Cement together parts #6 and #7 after drilling the axle holes in the plywood. Drill the hole through after drying and cement into it a piece of 3/16" inside diameter aluminum tubing. Finally, connect the whole assembly below the hip part together with balsa fillets #9 and #10. Cement together the balsa parts of both arms with 1/32" plywood reinforcement after hollowing out the balsa parts to save weight.

Two balsa parts are cemented together for the thighs and lower legs after they have been hollowed out. Cement together by the knees. For mounting the hooks later on, the ankles are reinforced by plywood parts.

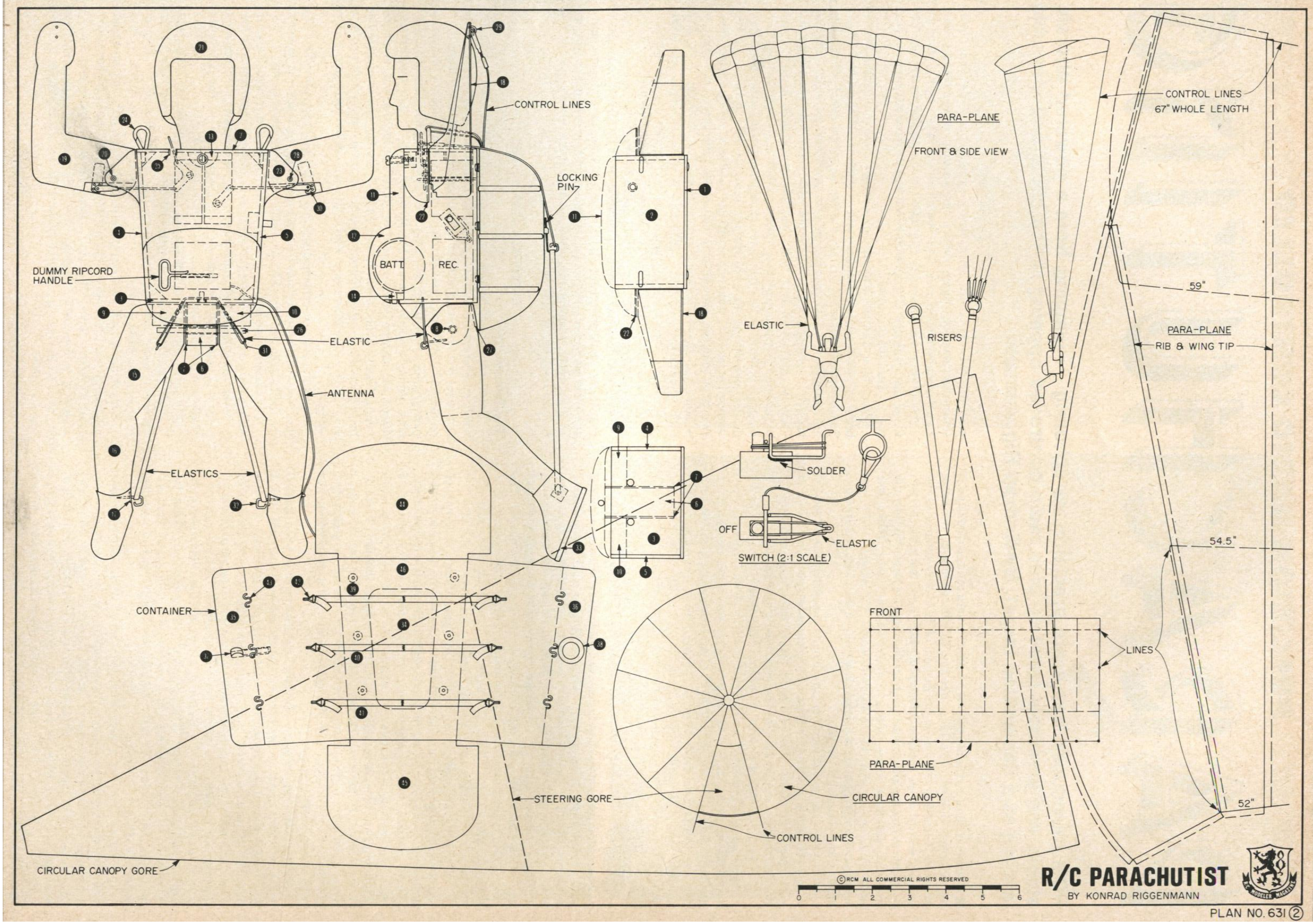
The cover for the body is made from 3/8" balsa and cemented together with a piece of 3/4" balsa for the reserve dummy chute which is later hollowed out to the size of your battery pack. For mounting the cover, apply parts #13 and #14. In part #13 (hardwood) a 4-40 nut is inserted. Hardwood dowel #14 fits into the hole in part #3.

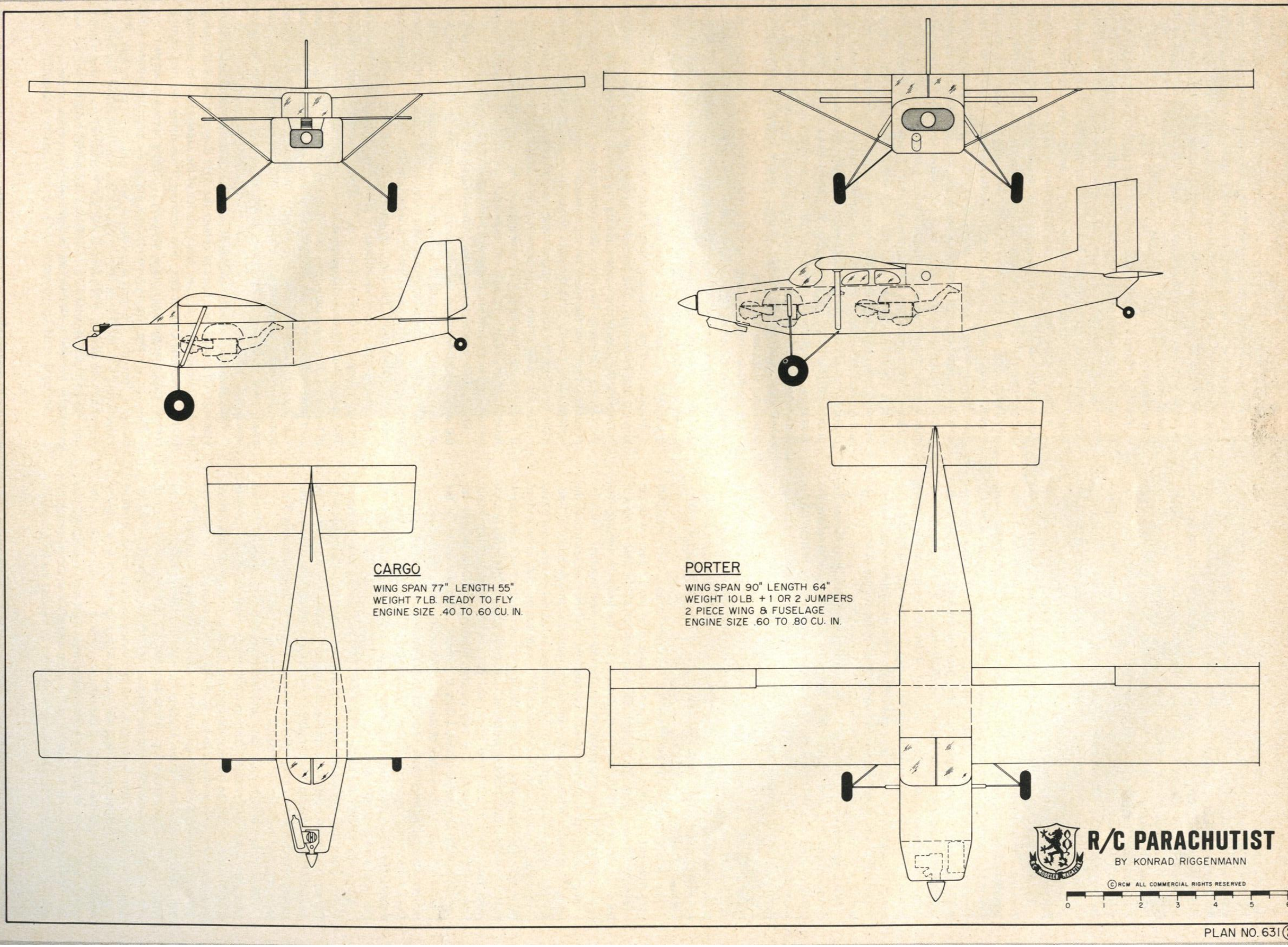
The 1/32" plywood reinforcing part, #22, is cemented to balsa pieces #23 and the two assemblies are joined afterwards to the body sides. Cement the spring hooks carefully with epoxy. The inside edges of the body are reinforced by balsa fillets.

For the head, tack glue two parts of 1½" balsa and sand roughly to contour. Before finishing, the two halves are to be taken apart once more in order to hollow them out. Finally, sand the whole figure and finish it according to your own preference. For a more original appearance, you might cover the reserve chute container with fabric and provide it with a ripcord handle.

After finishing, elastic cord loops are secured on the backside of the hands

FULL SIZE PLANS AVAILABLE — SEE PAGE 173




CARGO
WING SPAN 77" LENGTH 55"
WEIGHT 7 LB. READY TO FLY
ENGINE SIZE .40 TO .60 CU. IN.
PORTER
WING SPAN 90" LENGTH 64"
WEIGHT 10 LB. + 1 OR 2 JUMPERS
2 PIECE WING & FUSELAGE
ENGINE SIZE .60 TO .80 CU. IN.
R/C PARACHUTIST
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0 1 2 3 4 5 6
PLAN NO. 631 (2)

for mounting of the control lines.

For smooth operation, a piece of 1/8" plastic tubing is inserted in the pin hole in the shoulder part. The legs are to be assembled with a 3/16" diameter hardwood dowel as an axle cemented into holes in the legs. On the backside they are connected with a piece of 3/32" plywood which is both screwed and cemented. Mount the arms with 1/16" diameter steel piano wire axles, fitting through the plastic tubing inserted in the arms.

Use 1/16" diameter piano wire for bending hooks #29, and 1/8" diameter piano wire for the hooks in the shoes. The aluminum control horns #30 are to be mounted tightly and accurately. The soles of the shoes are cut out of a 1/4" thick self-adhesive rubber material. They are not absolutely necessary but add to the overall appearance. The lower legs and forearms are dressed with trouser-like material to increase resistance.

The Parachute Container:

The first step is to cut the main part out of strong fabric as shown in the drawing. The stiffeners, #36 and #37, are made of 1/16" plywood, the hole was drilled, and the parts glued to the inside of the container. For the eye, part #38, I used the cover parts of a camera film container, cut to size, and cemented from both sides over the hole with the epoxy. The locking loop, #37, is made of strong textile rubber, pressed through the slots in the stiffener #35 and sewn to the inside. The elastic bands, #39-41, must be cut to the different sizes shown in the drawing. When the hooks are ready sewn to these parachute pack opening rubber bands (let the ends stay over), the bands are sewn to the container's exterior. Sew the six eyelets on the outside of parts #35 and #36. Parts #44 and #45 are to be cut out of thin fabric, hemmed in, and sewn to part #34.

What remains now is the 3/32" plywood frame necessary to mount the container on the jumper's back. For cementing the snap fasteners, put the frame on part #1. When dried, press six holes through the bottom of the container through which to pass the snaps. The snaps will keep the container in place and cementing is not necessary.

The Parachute:

For the chute, use ripstop nylon, or parachute taffeta, with a weight of 1.1 to 2.2 ounces per square yard and a low porosity. For the lines, I recommend a thin twisted non-fraying nylon line. If you're not overly proficient with the sewing machine, you'll surely find someone to sew the chute for you.

Circular Canopy:

The circular canopy with the 12 gores is the simplest design for a steerable parachute but yet shows excellent performance. Cut the 12 gores with the two-piece steering gore according to the shape shown on the plan. You will need 6 pieces of nylon line with a length of 14 feet (the lines are running over the canopy). First, put two gores on one another and sew together. Then the seam is to be folded, the line inserted to the fold, and the fold sewn onto the seam once more. When all gores are sewn together in this fashion, all lines must be cut to a free length of 50". For the risers, I used two pieces of broad shoestring. The four steel wire connector rings are sewn tightly to the ends of the risers. Pass the ends of the lines through the connector rings and fasten each one with a small piece of textile self-adhesive tape. (Three lines to each front riser, two to each rear riser, and the control lines running freely between the rear risers). The two control lines (53" entire length) are provided with adjustable Kwik Links to connect with the loops on the jumper's hands. In the vortex of the chute, where the lines meet, a loop is mounted to link the pilot chute. You may use a cellophane parachute, such as from a rocket toy, as a pilot chute. This pilot chute must have a minimum diameter of 10" and deploy itself without fouling. Mount the pilot chute on the loop with adhesive tape.

To be able to pack the chute, a locking pin is required, which is bent of 1/16" steel wire for a bicycle spoke. The line to connect the locking pin with the servo pin must be stiff and strong. It's length depends upon the size of the packed chute. The loop is kept tight by cementing it into a piece of aluminum tubing. The two elastic rings should have a diameter of approximately 3½" (sew together with textile elastic).

Packing the chute is quite easy and accomplished very quickly. It's an extremely simplified method compared with the original chutes like the Para Commander, due to the fact that the opening shock is not considered. Before beginning you have to check to see if all lines are running freely. Then the parachute is to be laid on the ground for its entire length and stretched. Now lay out the gores on both sides, keeping the lines together with the hand and the open gore laying on the top. When the gores are in order, the tension of the lines may be loosened to put the lines along over the gores. Now fold the gores over the lines from both sides, thus producing a sleeve just as broad as the container. Continue folding the sleeve along its length in a zig-zag fashion, fitting to the length of the container. Now put this pack on the container frame, with the risers below. Keeping it tight with your knee, you can fold the pilot chute and place it on the main chute. Close the container by pulling the sides over the pack and locking them by passing the loop through the eye and the pin through the loop. Use a small flat wooden stick with a rounded top for pushing the upper and lower container covers below the side parts. Fasten the hooks of the pack-opening bands on the opposite eyelets and link the loop of the locking line on the shoulder pin. Finally, stretch the two elastics to the feet and the chute is ready for jumping. Check once again to make sure that both arms are moving freely and are not hindered by the control lines.

Para-Plane:

The Para-Plane wing-type parachute is a little more complicated to make. It consists of an upper and a lower side and the ribs in-between. Overall, the Para-Plane has the form and the profile of an airplane wing. Individual cells, shaped much like jet air intake scoops, are connected to form the leading edge. Thus, incoming air blows the wing in an upwards direction.

A shape for the cutting of the ribs and the wing tips is shown in the plans. Upper and lower sides are made individually from one piece of nylon fabric. The size of these parts is to be measured on the rib shapes. The position of the ribs and the line, where the upper and the lower parts are connected, must be drawn on these parts. For the latter, cut twelve pieces to a length of 13 feet. First, sew the wings and rib tips to the lower side. Continue sewing the lines on to the same seams as it is shown in the shape, making a pair of lines by one piece (mark the middle of each piece of line before sewing). Finally, the top side is sewn on and connected with the lower part at the end of the ribs. All edges should be hemmed in. Put small drops of glue on the lines to avoid slipping through the seams. On the rear edge, two additional lines are mounted on both sides (the knot to the seam in the middle between two lines) and connected with one of the outer control lines on the half length. The control lines of each side are connected 5" above the hands. Between this point and the Kwik Links, a piece of elastic band is set in to prevent damaging the control mechanism by the opening shock. Tighten the connection with the lines by cementing and wrapping with thin thread. The other lines must be cut exactly to their proper length and taped to the connector links on the risers.

On the Para-Plane it is better to use a pilot chute of 12" diameter with a sewed-in elastic spring. The spring must be bent from 1/16" steel wire in a conical spiral of about 4" in length and a diameter of 2" at the top. Instead of this chute, you can use a pair of cellophane chutes, equally well. They are mounted on a loop in the middle of the top side with self-adhesive tape with a distance of 5" between the main chute and the pilot chutes.

To pack the Para-Plane, the canopy is laid flat on the ground with the ribs aligned one on another. The ends of the canopy are folded to the middle. Now place the lines on the canopy in a zig zag pattern. Then continue folding the canopy, covering the lines, and producing a pack which fits in the container. First, put the risers on the container frame, then cover with the canopy, and, finally, fold the pilot chutes (pilot chute with elastic spring must be set on the canopy and compressed) and close the container.

The automatic switch that is shown on the plan is not absolutely necessary if you have only one jumper in your aircraft. He is locked by a pin which is fastened with a snap hook on a 10" long line in the fuselage. On exit, the pin remains in the airplane and the switch is switched on by a small elastic band.

Steering the jumper is very easy. After exiting the aircraft he will turn to the same direction where the arm is moved. To open the chute, take both arms completely backwards. The jumper should not turn while the chute is opening. The circular canopy will turn to the left, if you are pulling the left control line, and vice-versa. He will slow down his drag if both lines are pulled simultaneously. For landing, turn the chute into the wind.

The wing-type parachute differs in its flying characteristics from the circular canopy. With no brakes, it has a highly increased forward speed. The jumper with the circular canopy is steered by pulling down the rear edge of the chute. If you are pulling by one arm only, this will effect more lift, but also more resistance on this side as well — thus, the chute will turn to that side. By pulling both sides simultaneously, the forward speed may be varied from about 6' per second to 0' per second. With full brakes, the Para-Plane might even stall, but will regain stability as soon as the arms are taken upwards again.

With increased experience you'll learn to make very soft dead-center landings. Of course, you have to choose the right dropping point according to wind direction and velocity. Inaccuracies of the canopy may be corrected by the adjustable control link. For steering, I am using the two vertical control sticks on the transmitter with the centering springs removed.

You can see that this is a completely out of the ordinary project for a modeler, but the fun and excitement you will experience with R/C Parachuting will more than reward you for the time and effort you took in preparing your jumper. It is our hope that R/C Precision Parachuting will not only be an added dimension for air shows and public exhibitions, but will eventually become a precise and demanding competition event. □





TOP, LEFT: A jumper with the cover removed to show R/C equipment. TOP, RIGHT: Jumper in free-fall position. CENTER, RIGHT: Jumper next to cargo aircraft gives indication of size. ABOVE: The single jumper aircraft with chutist mounted in position. RIGHT: Two jumpers mounted in the interior of the 'Porter.'