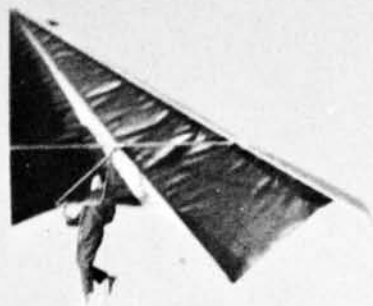
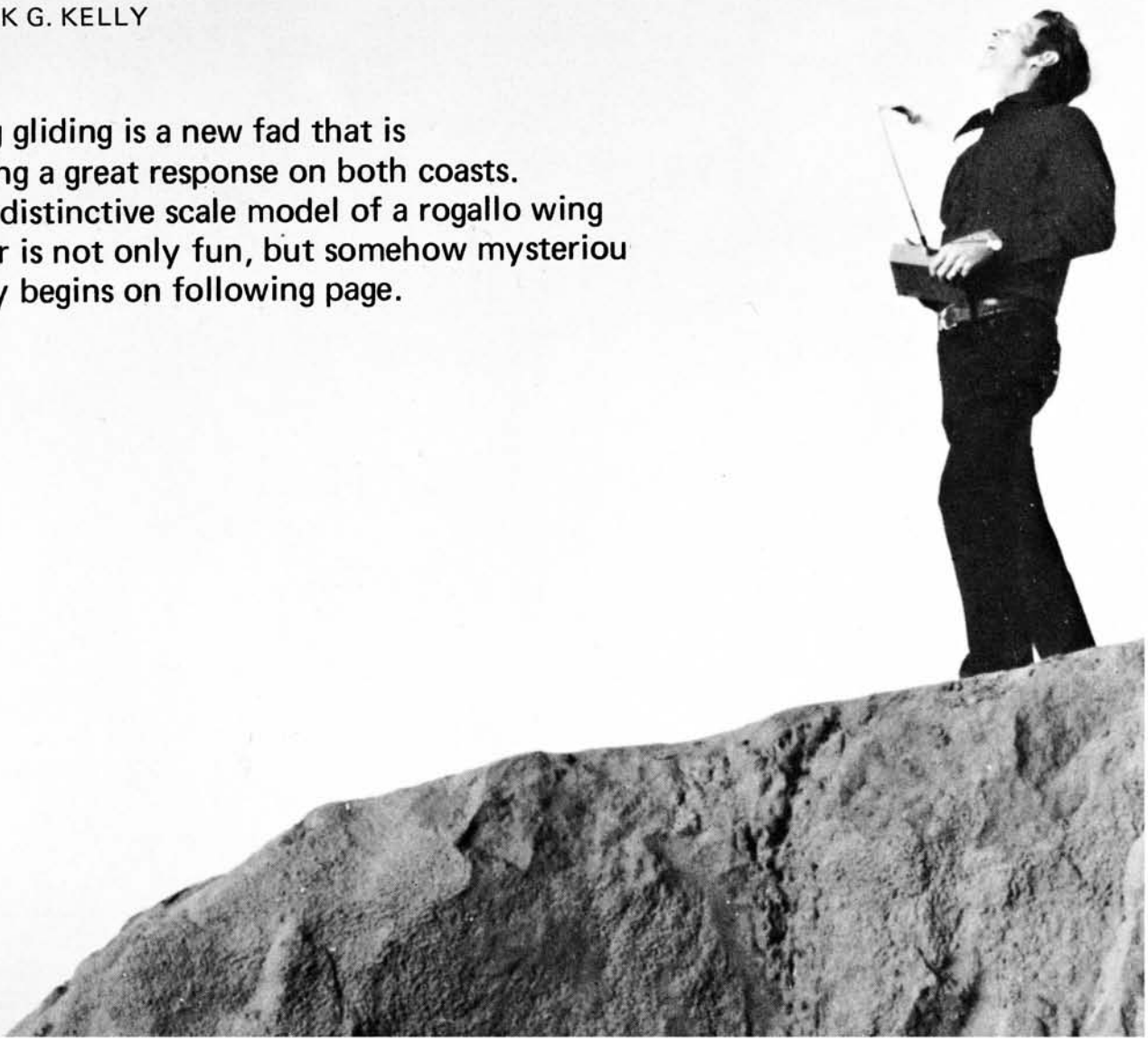
FLEXI-FLIER

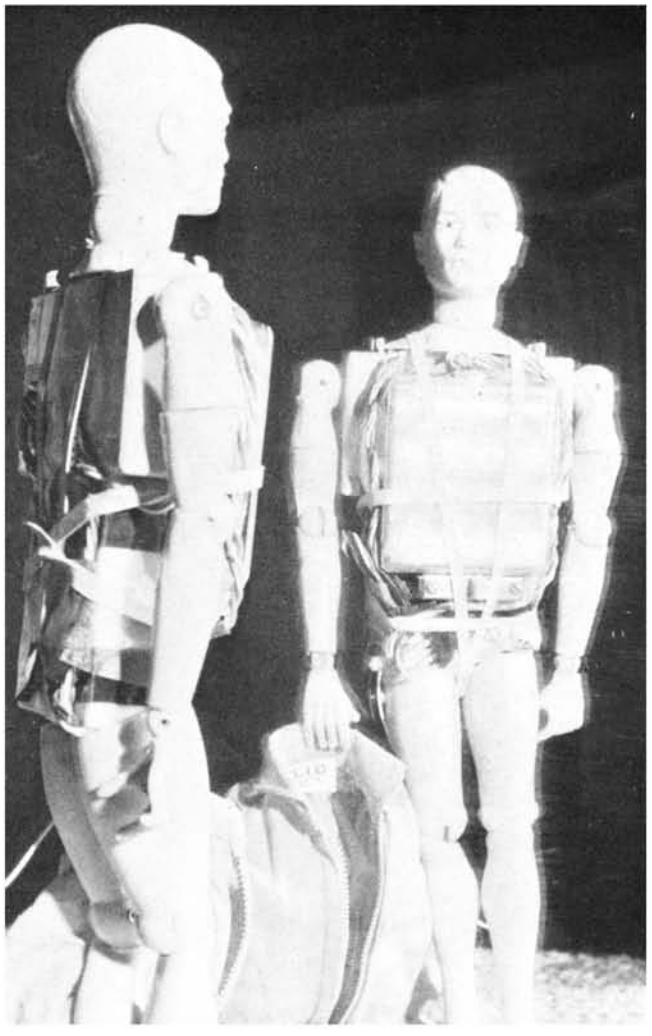


FRANK G. KELLY

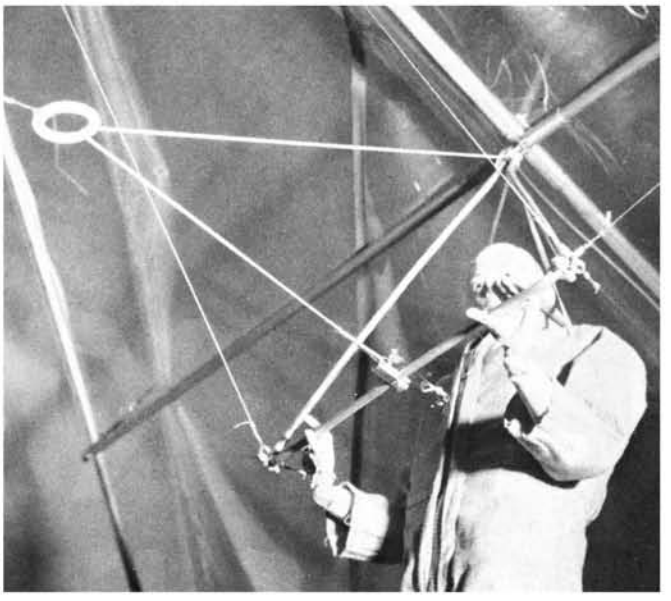
Hang gliding is a new fad that is
getting a great response on both coasts.
This distinctive scale model of a rogallo wing
glider is not only fun, but somehow mysteriou
Story begins on following page.



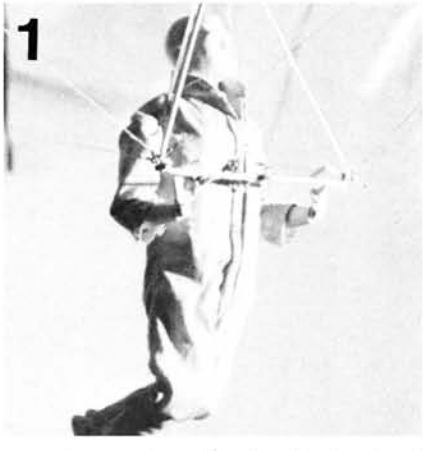
Flexi-Flier



The mannequin doll looks like a robot from science fiction as he admires his electronic innards in a mirror. Even with KPS-10 size servos, there is adequate room inside the chest for a complete flight package.



ABOVE: The doll in position on his hang bar, amid a maze of rigging. Tow hook release bridle is shown here. GI Joe is also available with a beard. BELOW: GI Joe takes a hop aboard his Flexi-Flier. Note that the author holds the transmitter at a 45° angle, a clever way to get elevon control. Watch that you don't detune the signal by accidentally grounding the antenna with your hand. (Photo by Jerry Trager)



The mini-man does his thing. Control inputs should find the doll in each of the positions shown: photo No. 1, neutral; 2, left turn; 3, right turn; 4, up elevator; 5, down elevator. It's a real marvel just to watch the mechanical man do tricks.

I first became aware of hang gliders in their present form when I met Bill Moyes. While experimenting with a rogallo wing as a potential sidelight to his Australian water ski exhibitions, Bill discovered that he had broken the altitude records for such things. Perhaps more significant, he found that the rogallo wing ski-kite was a stable aircraft with the line slack or disconnected. The conventional water ski-kite is in no way stable with a slack line. When Bill showed the movie of himself jumping off the south rim of the Grand Canyon for a nine-min. flight to the river, I knew I was hooked! On another occasion, he was towed to 10,000 ft. by an airplane, then he released himself to glide back.

During the past year or so, hundreds of young people in the Los Angeles area have assembled hang gliders, mostly the products of available hardware. Some are frightening creations of bamboo, clothesline and garbage bags; others are very professional, made of the proper kind of aluminum tubing, stainless steel cable, and rip-stop dacron.

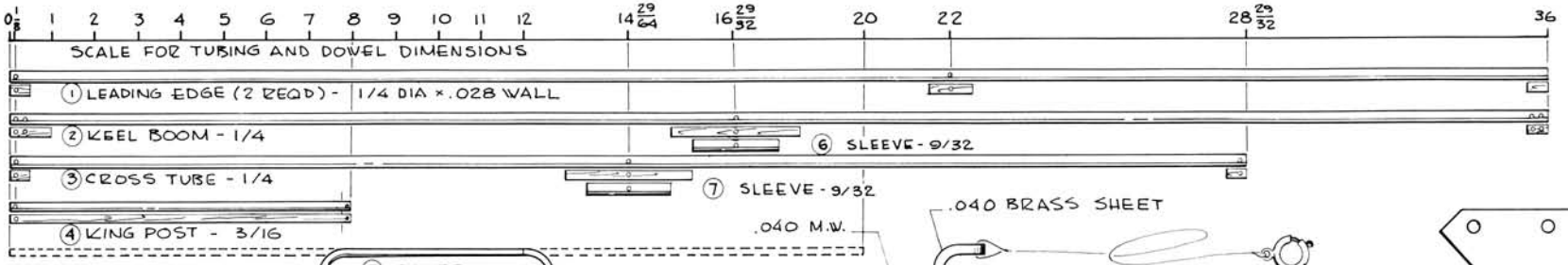
The one modeled here is a nearly exact 1/6 scale "Flexi-Flier," a popular contemporary design by Dick Eipper. (If you want to build a full-size glider, get a set of plans from him. DO NOT scale the model plans up. Parts and materials must be carefully selected to avoid disaster!) Dave Cosgrove recently flew one (full-size) continuously for over *two hours* in unusually favorable conditions near Palmdale!

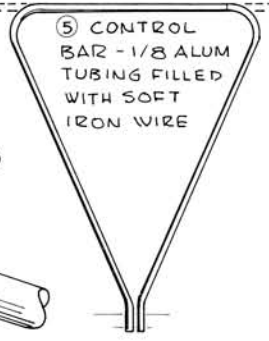
The model, like the prototype, has a primitive but interesting and effective control system. Pitching and turning is done by shifting the center of gravity by means of body english. The pilot is suspended from a harness or swing seat, and the control bar provides something to push against. The model is equipped with only two muscles, so the body is suspended from a string leading under the arms and around the back. This worked out much better than any of the more scale versions, and does not detract from the appearance. It is interesting to note, if only for academic interest, that this control system is effective at zero velocity. Ponder that during your next hammerhead stall.

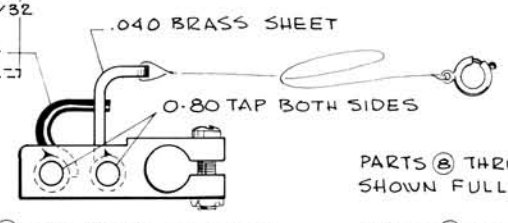
Now ponder this: Two rotary servos operate the two arms. BOTH must move for each direction. To pitch up, move BOTH arms forward to cause the body to move back. To pitch down, move BOTH arms the other way. To turn right, move RIGHT arm back and LEFT arm forward (try this while holding onto an imaginary towel bar).

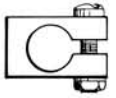
To effect this complex set of motions, simply rotate the transmitter 45°. This way the aileron/elevator stick operates in a normal manner: "forward" moves both servos in such a way that the model responds appropriately. Right stick turns right, etc., and after just a few min., the controls feel quite natural. The same system could be used for a V-tail airplane with NO extra linkage! The completed glider weighs just eight oz.; after his extensive transplant, GI Joe weighs one lb.

(Continued on page 78)







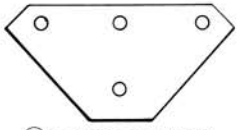


(12) CONTROL BAR CORNER FITTING 2 REQD - 5/32 SQ. BRASS TUBING (2X SIZE)

(13) TOW HOOK RELEASE (OPTIONAL) - 5/32 SQ. BR. TUBING - 2X SIZE • FIT BOTH PARTS TO MOVE FREELY

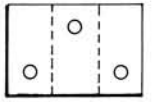
PARTS (8) THRU (11) SHOWN FULL SIZE.

PARTS (9) THRU (11) .020 STAINLESS SHT.

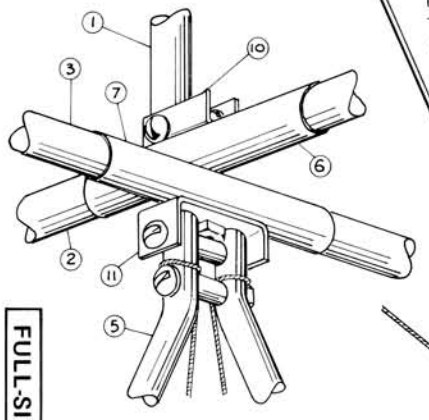


(9) HINGE PLATES 2 REQD

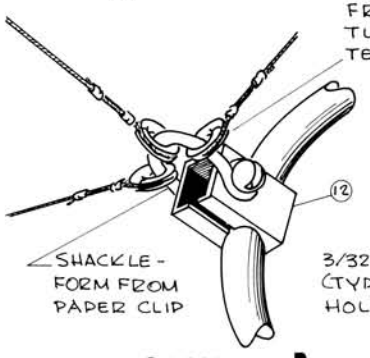
(10) KING POST FITTING



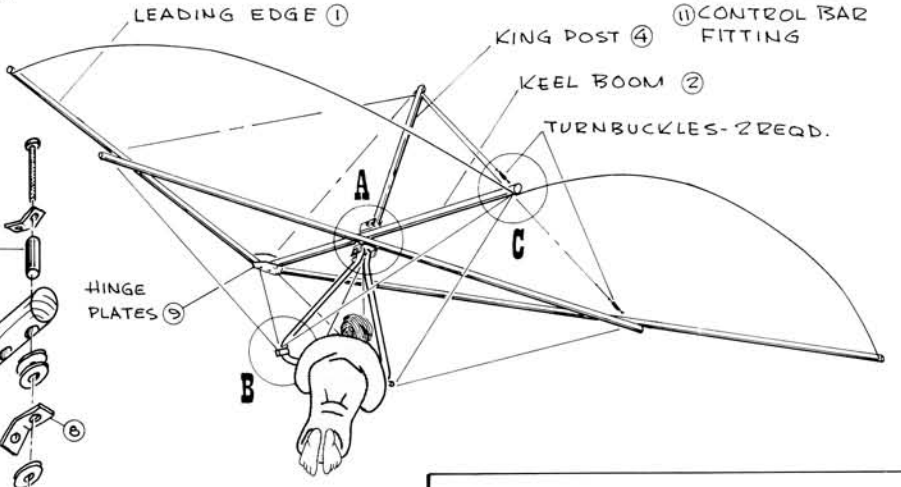
(11) CONTROL BAR FITTING

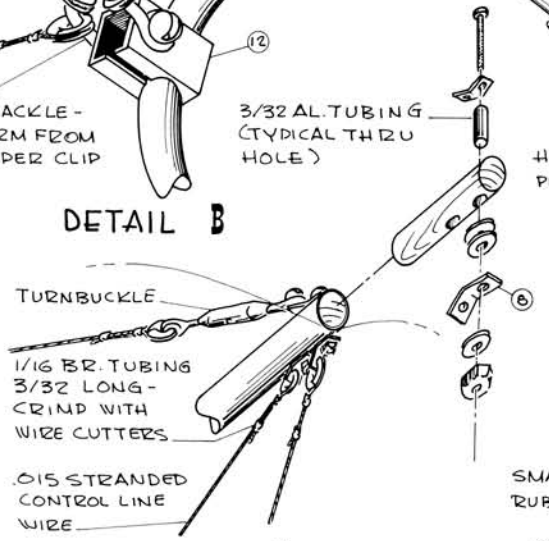


DETAIL A

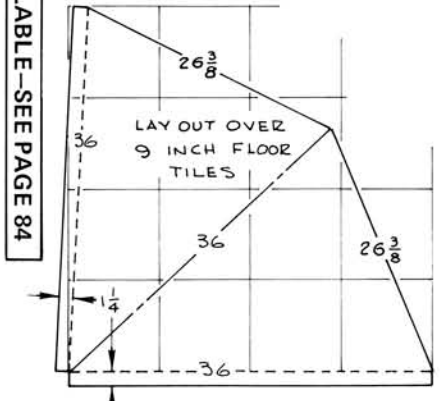


DETAIL B



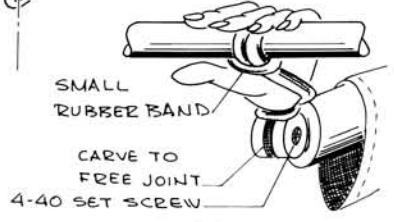


DETAIL C



SAIL PLAN

MOUNT WITH DOUBLE BACK TAPE:



HAND DETAIL

DICK EIPPER'S

FLEXI FLIER

R/C SCALE ROGALLO HANG GLIDER

DESIGNED AND DRAWN BY

Frank Kelly 26 DECEMBER 1972

FULL-SIZE PLANS AVAILABLE—SEE PAGE 84

The model didn't take long to assemble, but working with 0-80 screws involves some fumbling, at best. I bought a 12-ft. length of 1/4" 2024-T3 aluminum tubing from a nearby industrial supply house and settled for .028 wall thickness, rather than the more scale .008. This was a good thing because it has to take some lumps. All the rest of the materials are available at hobby shops or hardware stores, although finding long steel 0-80 screws is something of a challenge. I made a drill jig out of a block of wood to help get the little holes lined up properly.

The rest of the assembly is pretty much straightforward, with just a few exceptions. The thimbles for the cable loops were made by threading bare copper wire through a piece of 1/16 aluminum tubing. This was wrapped tightly around a long 4-40 screw and chucked up in a drill motor. After filing half way through, the copper wire was removed and the aluminum tubing sawed lengthwise with a modeling saw. This provided a handful of split rings which resembled thimbles. The crimped ferrules were made of short bits of brass tubing and crimped carefully with wire cutters. They're too small to crimp any other way.

The control bar was made of 1/8" soft aluminum hobby tubing but, since strength was necessary here, I selected a coat hanger which fit inside snugly. Music wire won't do because it has to be drilled. Bending is easy with the wire inside.

Now that the hang glider is finished, you'll need a pilot. You've survived the jibes about playing with little toy airplanes, so don't worry about playing with dolls again. GI Joe is really a remarkable doll, beautifully articulated to move in all the proper places. Pull an arm and a leg out of their sockets and snip the elastic holding them on. Now saw through the torso at shoulder height. I did this on my table saw and found it to be a curiously satisfying experience! My radio is a six-channel Kraft with KPS-10 servos and I found it necessary to discard GI Joe's hip sockets to make room for the radio. With a two- or four-channel rig and KPS-12 servos, you might be able to retain them, but it's not terribly important.

The two servos are taped together back-to-back with the rotary shafts available for attaching to the arms at the shoulders. The receiver can now be slipped between the bottom mounting ears of the servos. This will locate the "brains" appropriately in the seat of his pants. The flat battery pack will fit in the chest area. There's even room for a switch under the battery in the general vicinity of the belly button. An S-shaped wire hook can attach the head to the neck, and a 4-40 screw holds the legs together in the upper thigh. A big rubber band holds the head and legs on like suspenders.

Drill out the wrist and elbow rivets and tap to accept 4-40 headless set screws. Carve these joints until they move freely. Remove the rivet from the shoulder area of the upper arm, and with a small soldering iron, fill in the area where the hook had been. The plastic melts and fuses easily. When cool, cut a square hole to accept the servo output shaft and screw on the arms. The flight suit can now be slipped over the pilot and when zipped, he can't be distinguished from the original GI Joe. At this point, he is capable of doing pushups to get in training. With the doll suspended from his armpits, and his hands attached to the control bar with little rubber bands, the effect is absolutely captivating! He swings around in a very realistic way.

Flight characteristics of the completed model were very realistic. It has about a five-to-one glide path (remember, this is a glider, not a sailplane), and will flare out very nicely for landing. Upon landing, the legs swing back gently and everything is protected by the hang bar and rigging. Control capability is about the same as the prototype, but I found that control could be overpowered by a strong updraft. A half-oz. fishing sinker in the nose corrected this.

For the first few test flights, follow the technique used by the big ones. Find a gentle slope which the prevailing wind blows toward and which has a loose sand surface. Start at the BOTTOM and, holding the model loosely at the top of the control bar, get the feel of wind filling the sail and lifting the craft. Avoid touching the transmitter antenna while holding it sideways because it will detune somewhat. Now make sure that the sail is filled. Ease it gently straight into the wind and slightly downward. The shove will cause the body to swing aft, giving it a tendency to pitch up a little.

After a few preliminary flights like this, you can start working your way up the hill. Notice that you haven't gotten into a dangerous situation yet. If nothing works, the worst thing that can happen is a mild jolt. The jump suit helps to keep sand out of everything but doesn't prevent it. Finally, standing on the edge of the cliff, point the hang glider directly into the wind and launch. It will gain altitude as it moves through the updraft, and the model can compete with a full-size manned hang glider on absolutely equal terms. Sink rate, glide path, and directional control are all quite comparable. The only problem is that everyone stops flying and crowds around to watch when the model is there!

If you become inured to the thrills of jumping off cliffs in relative safety, you can add the tow hook release mechanism. Full "up" control pulls the body back, and a string from the chest releases the catch. Full-size ones use a motorcycle clutch cable. Towing is much more dangerous than cliff jumping, because the rigging can be overstressed at high angles of attack. Higher speeds are attained, and it is possible to get into a condition which cannot be corrected before impacting. Longer flights can be sustained with the model though, and it makes for another interesting novelty. With the tow hook, the model can be flown like a kite, towed aloft like a tow line glider, launched with a long rubber band, towed from another RC craft (I'd like to try water skis behind an RC boat, but GI Joe hasn't learned to swim yet), or dropped from a weather balloon. My longest flight so far was from a manned hot air balloon at 5000 ft.

Braided fishing line is hollow like polypropylene water ski tow rope, and a loop can be formed by threading an end back into the core. This bridle can be attached to the control bar with a clove hitch. The towline has a drapery ring on the end, through which the bridle is threaded. The ring can ride up and down the bridle freely and the pitching moment induced by towing can be overcome. (If the towline is attached directly to the control bar, the pitching moment will cause an immediate problem.) Upon release, the bridle pulls through the ring and comes free. For the balloon launch, I melted a small hole in the sail with a soldering iron and allowed the bridle loop to pull through at release.

Under tow, the model has much more lateral control than in a free glide, due to the way the different forces act and the moments associated with them. For this reason, the kite technique is suggested for training purposes before attempting a tow. The ground speed is initially zero. It is still possible for undampened oscillations to build up, with hard dirt at both ends; so be prepared to release the instant a dangerous situation develops. If you can find another RC modeler willing to tow you up with his airplane, the following precautions are important: attach the airplane tow hook just behind the cockpit, not at the tail. Also, arrange for either end of the line to be released in an emergency. The tow plane can use a spare channel or release with full left rudder. The glider can get airborne in the first few ft., then after a brief period of uncertainty, both can fly together. Use a 50-ft. towline of four-lb. test nylon monofilament fishing line. It will stretch a little, maintaining tension under load, and will break if overstressed. Teamwork is required to pull this off. Gentle turns and a steady pull are important. The tow pilot should throttle back a bit at release to avoid overstressing the glider rigging, but also the release will pitch the glider up, slowing down the tow plane. If the tow plane turns down and left at release while the glider turns right and down, there will be less of a tendency to interfere with one another.

If you like something different, try a hang glider. It is in no way an improvement over more conventional aircraft, but it's fun and very easy to fly.

American Aircraft Modeler

April 1974