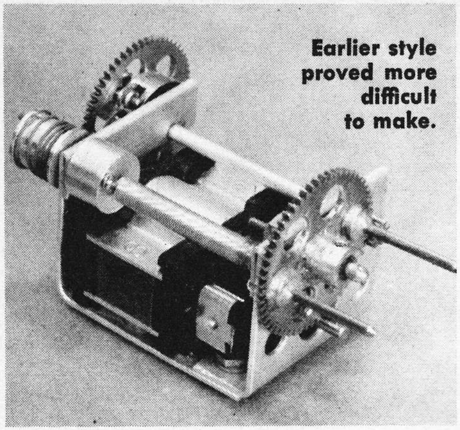
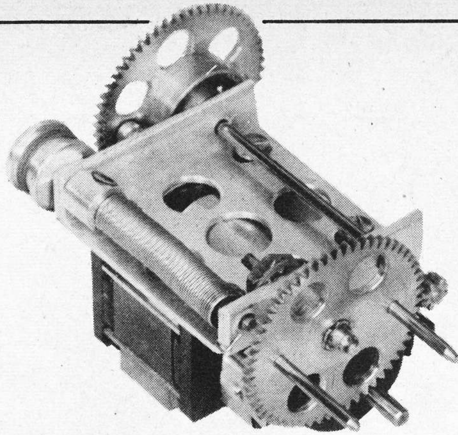
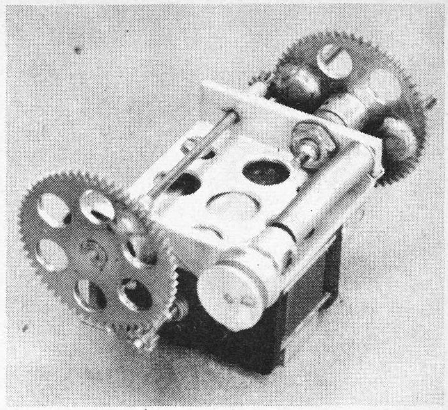
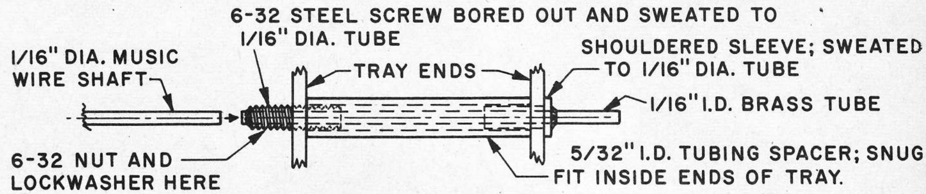


Earlier style proved more difficult to make.







LITEWEIGHT

PROPORTIONAL SERVO

■ This servo has built-in centering. Users of motor driven proportional servos know the centering system sometimes can be a nuisance. Whether it be rubber bands, springs, cord and pulley with spring, it is usually external to the servo and attached to the fuselage. Whenever the servo is moved, the centering arrangement must be removed. Often it hinders access to the R/C installation. A centering setup usually requires considerable space—not always easy to arrange.

Here is a compact lightweight that can be tucked in a cramped fuselage with no worry about where to run rubber bands or springs. It has lots of power, yet takes less battery current than you would expect. Bonner's compact and well-constructed motor supplies power, parts mount on a "tray" attached by self-tapping screws into the motor's mounting holes. Two pairs of standard Mighty Midget gears give an overall reduction ratio of 50-1.

Centering is by a coil spring "wound up" in the same direction, no matter which side of center the servo turns. First used by Jim Martin of the DC/RC, this system is highly versatile; you can vary the centering force through a wide range, by changing the amount of pretension in the spring. Shaft and fittings ("B" in the drawing) provide the centering.

"C" is the countershaft, "D" the output gear. Latter is rigged with a pair of pins to engage matching holes in a fitting on forward end of a torque rod. This handy coupling method allows for a little misalignment, takes fore and aft loads off servo gear, makes it easy to remove servo or torque rod. Note that the two pins are unequal in length to aid in getting them into torque rod holes.

To make this servo you should use a lathe and drill press. While a careful, resourceful builder with only hand tools can do a first class job it will take him considerably longer. We turned the shaft of the motor down to 1/16″-dia at the end opposite the commutator to take the standard 8-tooth M-M pinion; this was a quick and accurate job in a lathe.

First servo along these lines used a 10-tooth pinion from a Victory Industries (makers of the Mighty Midget) type CCD motor (obtained from Polks) and which fits a 3/32″ shaft; this pinion thus will go on the Bonner motor shaft with no alterations and you have an overall ratio of about 40-1. This still gives a lot of output power, we feel the higher ratio is desirable.

When dissembling motor, keep the two polepieces and the two magnets together in a single unit, place them on a steel surface while the motor is apart, We have been told that the commutators on some of these motors have tiny sharp edges where the cutter was run through to produce the five segments. We have not found such ridges on the motors used here, but if yours has them, remove them carefully with a sharp knife point. If not removed they will wear the brushes out very rapidly.

For good centering, brush pressure on this motor should be reduced considerably. Clip off a turn of the original brushes. This works all right but does not allow much leeway for brush wear. We found a bronze spring of .115 to .120″ diameter OD and cut lengths for brush springs; it has finer wire than the Bonner spring with turns more closely spaced. We feel the brush tension should be cut in half or less for good centering action.

Our tray is half-hard .040″ thick aluminum; it cracks where the fold-over was made on each end, but not enough to come loose. Soft aluminum for house roofing repairs (much of this is .032″ stock) will do and should be amply rigid. Some have used 1/16″ aluminum with no need to make fold-overs—which provide a greater bearing surface. We have seen trays of brass, which makes

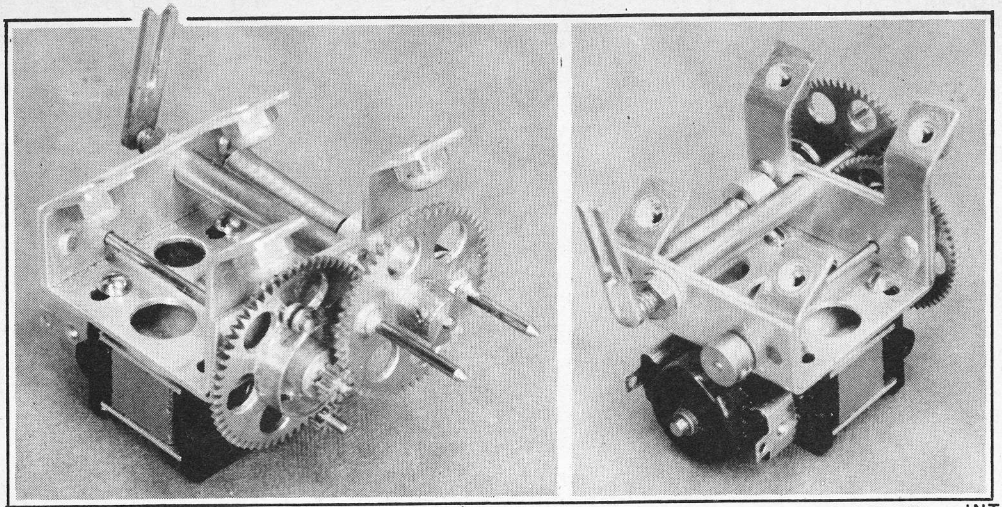
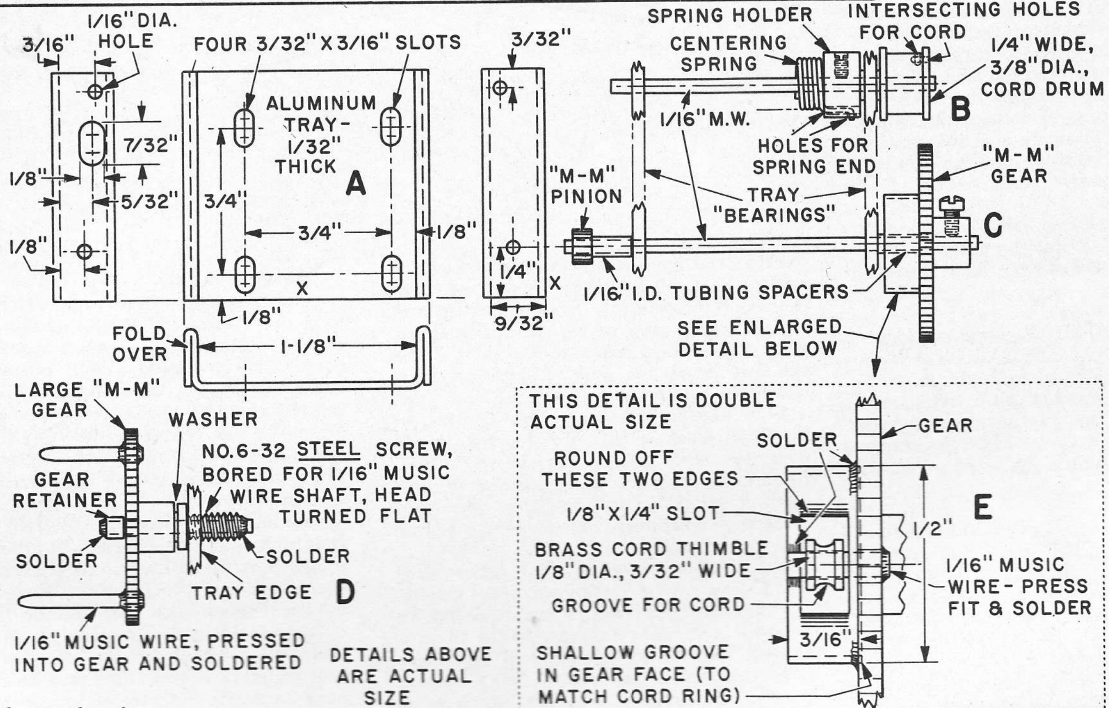


Diagram on page 22 is "Fig. 3" in text, the countershaft bearing assembly, shown twice actual size with some parts out of scale. Photos above it, Fig. 1 in text, are basic elevator servo by author Howard McEntee. To the immediate left are two photos (Fig. 2) of the "CAR" version; fork engages wing crank to drive ailerons.



an even better bearing.

Four slots allow the tray to slide sideways on the motor to provide desired gear mesh. Before drilling countershaft hole (detail C) check your motor to be sure slots allow desired mesh. Dimensions given are for the 8-tooth pinion. For proper mesh regular M-M gears should be spaced on .550" centers. We rubbed the assembled motor over a fine-tooth file, to remove slight irregularities in the nylon case ends. This took a slight "cut" from the steel polepiece, but made a flat surface for the tray.

Large holes in the flat portion of the tray were to reduce weight. For the same reason the gears have holes cut in their faces.

Output gear turns on 1/16" music wire shaft soldered into a bored-out steel 6/32 screw. If the two pieces are sweated together with care, the results seems amply solid. This gear is also adjusted for proper mesh by sliding entire gear and shaft-screw assembly in slot provided.

The gear which meshes with the armature shaft pinion has a cord ring soldered to it; the ring was cut from thin wall brass tubing. To assure concentric attachment a shallow groove was turned

(*Continued on page* 50)

Servo

(*Continued from page 23*)

in the gear face 1/2" OD. The groove holds the ring in the position desired while you solder it.

Into the ring face is cut a 1/8 x 1/4" slot (do this after ring is soldered to gear). Detail E shows how 1/16" music wire shaft and cord "thimble" are assembled in this slot. Gear hole for wire is drilled so wire is flush with outer face of ring. Thimble, turned on the lathe, doesn't have to be a snug fit on wire. In fact we have used a similar thimble found on the end of most metal musical strings. Attach cord to thimble so cord does not take the rubbing wear of constantly turning back and forth as gear revolves.

Centering assembly requires a small drum and a spring holder fitted with a setscrew. Drum was dural, drilled through center with #53 drill, then halfway through (from left side, as seen in drawing) with #52 drill. Shaft is then pressed into place. Two small intersecting holes at the edge allow cord to be pushed through and knotted outside.

Spring holder has #60 drill hole through outer edge, plus same size intersecting hole. With end properly bent, spring will hold reliably in this hole.

Centering spring from the fuel feed tube of a Homelite gas engine is about right. This spring prevents fuel tubing from kinking when bent sharply, obtain tubing assembly at Homelite dealers. Spring is 3/16" OD, wire is .014"; any spring used here should not have its turns wound tightly . . . if they are pull ends till spring becomes "floppy" with a slight space between each turn. Other spring end is bent to hook over tray edge.

Servo mounting. Unit in Fig. 1 has aluminum angle attached to one side of motor, using 3/16" long #2 self tapping screws (the same hold tray to motor) turned into holes made with #47 drill; motor end pieces have bosses for this purpose only on the one side. For servo in Fig. 1, a brass block was drilled and tapped for a mounting screw, then soldered to the core.

This makes a neat mounting point but it is necessary to remove pole-piece from the two magnets to do the soldering—heat can reduce magnetic potency—taking the core assembly apart does too! Epoxy cement might do a good job (make the metal piece a little larger to allow more cementing area); we find Evercoat Epoxy Mender satisfactory. Be sure surfaces are clean, roughen them before assembly—but take care that you don't "collapse" that polepiece assembly while so doing. Mark the magnets before you disassemble the motor, so you can get them back together properly if things do come apart.

Many of these servos have been made with a pair of legs a half inch or so wide as part of the tray and bent downward on each side of the motor. These utilized 1/16" aluminum for the tray. If this mounting is desired, the tray will have to be made wider on the lower edge than shown.

Run-in the gears before centering system is rigged up. One modeler uses buffing compound on the gear teeth to polish them smooth. A mixture of thin oil and toothpaste such as Colgate's. Run the motor both directions—you want the teeth polished on both sides.

Gears should be set up so they mesh snugly without binding no matter how they are turned. We have 10-lb test braided nylon fish line between the cord thimble and cord drum. It needs only three turns around latter; in use cord ring will turn no more than one full turn each side of neutral on 2.5 volts; if heavy centering tension is used it won't turn this much.

When pulsing on 2.8 volts (two nickel-cads just off charge) servos draw 200 to 225 ma from each pair of cells, measured on a milliameter in series with one contact of the relay. At about 20-80 pulsing, current was 50 ma, and 450 on the other side of neutral. Fig. 1 unit weighs 1.95 oz.

A similar servo for limited-space position where there was no room at one end for the large gear is shown in Fig 2. All gearing is on the end opposite the commutator. It drives a rudder through a torque rod, link to wing ailerons is via forked lever on opposite end of same shaft. This servo is suspended from above, hence the four angular "feet" projecting upward. Parts are quite like the servo described, except both large gear and pinion are on the same end of the countershaft. To allow adjustability for proper gear mesh, entire output shaft assembly can be moved in slots at each tray end; it is made as sketched in Fig. 3. This servo weighs 2.2 oz.

There are several tricks to insure better fits of music wire shafts in their tray bearings. If you "mike" various batches of "1/16" music wire, you will find it varies from perhaps .059 to .064" diameter; former will give a sloppy fit, latter will be too snug. Try to get some about .063". When drilling the holes for this wire, run through with #53 drill first, then (unless you have a 1/16" reamer) put #52 drill through hole to bring it to size.

Next issue:

SCALE DRAWINGS BY JIM TRIGGS OF CURTISS F11C-2