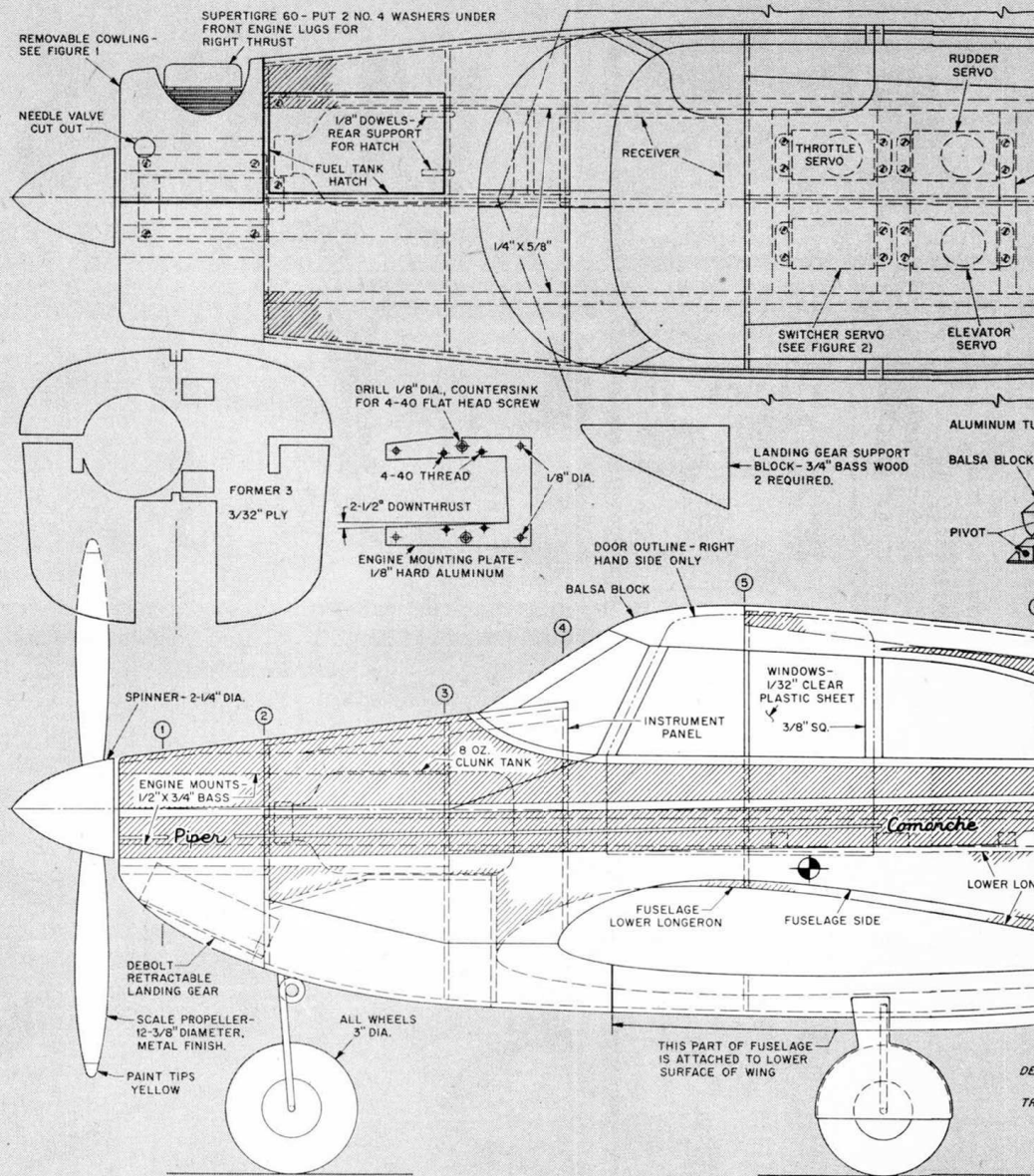


**Designer Jackson was kept so busy by IBM working on the guidance computer for Saturn 5 rocket, he just had to employ every latest time-saving building procedure possible to quickly complete this . . .**

# Radio Controlled Pulchritudinous PIPER COMANCHE



When I was considering which airplane to use as the prototype for an R/C scale copy, the principal characteristics required of the aircraft when built as a model were: (1) attractive appearance; (2) good flight characteristics; (3) easy to build; and (4) able to utilize the full performance capabilities of a six channel proportional control system

The Piper Comanche has more than met my requirements. The miniature was a pleasure to build and fly and its performance and appearance were sufficient to bring it second place in R/C scale competition at the 1965 National Championships in spite of some errors and omissions by the builder. The model plans were scaled from Piper Aircraft Corporation drawings. The only deliberate deviation from true scale was a ten percent increase in the size of the horizontal tail surface. The color trim and lettering were obtained from Piper sources.

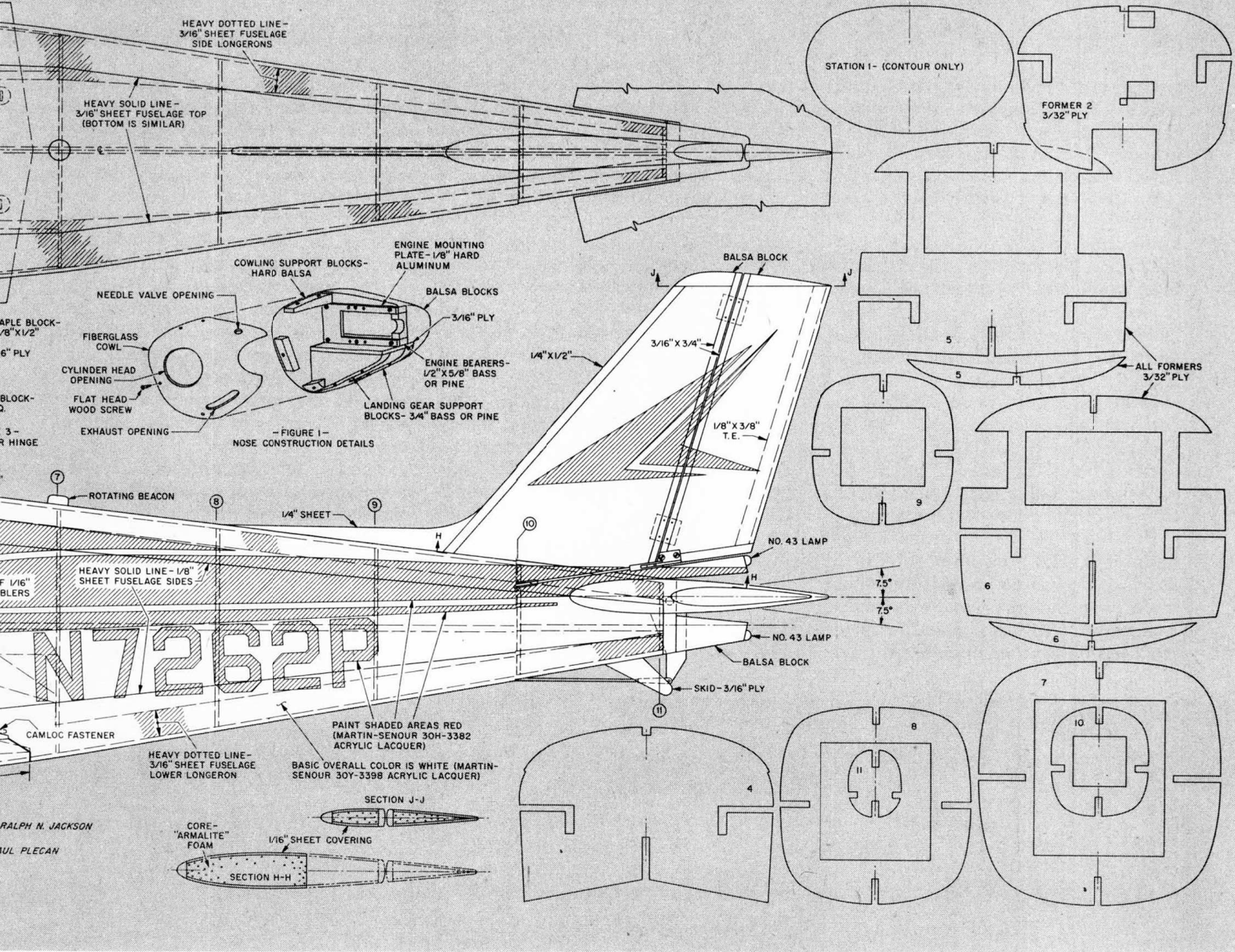
Happily, the full size aircraft offers several interesting features which have been incorporated as functional

elements of the model design. These include wing flaps, navigation lights, retractable landing gear and the single piece horizontal tail surface called a stabilator. The model has demonstrated that the extra control channels now available on proportional systems can be used to advantage in adding those touches of performance realism which makes R/C scale work so appealing.

*Flight Characteristics.* As the Comanche neared completion, it became apparent that weight was going to exceed my original estimate. This was confirmed when the finished model totaled 10 pounds, giving a wing loading of 31 ounces per square foot. Because of such a high wing loading I was somewhat dubious about flying performance. However, my pessimism disappeared completely during its first flight. After a short take off run along a grass field, the Comanche proceeded to perform beautifully with only slight trim correction required on the stabilator. On its initial landing approach speed seemed high so a second approach

was made with flaps fully extended. The result was a successful first landing, certainly the most important part of a scale craft's first flight. Since then, many landings have been made with the flaps both up and down. Although the Comanche performs well without flaps, its slow speed ability with flaps makes their installation well worth while. At high throttle settings a slight pitch up tendency develops when the flaps are lowered. At low throttle the plane can be flown with good control at surprisingly low speed when the flaps are down.

What are the main factors that contribute to the excellent flight characteristics of this highly loaded model? The general arrangement of the full-scale Comanche with its long tail moment and adequate vertical tail surface makes for a stable configuration. And, of course, don't forget that the horizontal tail surface was increased to promote stability. The airfoil, previously used on another heavily loaded model, is a modified Pittz design. It has a three



percent curvature of the mean chord line which produces a high maximum lift coefficient and results in the low stalling speed so welcome when making a slow speed landing. The ability to perform outside loops is probably impaired some, but this is generally not too important for scale planes.

Although no violent maneuvers have been attempted, the more graceful exhibition maneuvers such as Cuban Eights, Immelmans, loops and rolls are easily and well done by the Comanche. A low pass with landing gear retracted always pleases the spectators . . . and the operator!

**Construction.** A major objective of this project was to minimize building time, a commodity which becomes increasingly scarce. All of the construction methods used were selected for their contribution along this line. For example, the principal time saver is the use of balsa covered Styrofoam for the wing and both tail surfaces. The foam wing technique offers a significant reduction in building time over conventional con-



Ralph N. ("Gen'l") Jackson is a mechanical engineer at IBM's Owego, N.Y., facility.

## PIPER COMANCHE

struction methods and is particularly effective here because of the Comanche's double-tapered wing with its numerous cutouts for wheel wells, flaps, ailerons and servos.

Birch plywood formers were used in the fuselage to save time over laminating balsa sheets for that purpose. Top, bottom and sides of fuselage were made of sheet balsa since it would conform to the gradual curves of the formers in those areas. Only the sharply curved corners required planking.

In general, only those construction features which are peculiar to the Comanche will be detailed. Many articles have appeared which describe both foam core and conventional construction techniques.

**Fuselage.** To permit quick former alignment and assembly, build the fuselage up from a foundation of four main longerons pre-cut to the shape. Longerons outlines are indicated on the plans. Location lines for formers

should be marked lightly on the longerons before assembly. Top, bottom, and side sheet coverings are cut to shape before use. The 1/16 plywood doublers attach to the sides with epoxy adhesive before assembling to fuselage. The corners, plus top and bottom front sections of the fuselage are covered with planking strips. Fuel tank hatch cover, made of balsa block, is held with two 1/8" dowels at the rear and two machine screws at the front. The dowels, glued to the block, engage holes in fuselage former when installed. Blind nuts in the fuselage retain the screws.

The side mounted engine has proven itself a fine compromise between performance and appearance. While fairly well enclosed, there has been no evidence of its overheating. Glow plug, exhaust port, intake and needle valve are all accessible. The cowling may be fabricated by any fiberglass molding technique. A half-cowling configuration minimizes the size of the molded part and promotes easy fitting to fuselage. Figure 1

shows details of cowling and nose construction.

**Wing.** Cut the cores from blocks of expanded bead foam (Armalite) by the hot wire technique. The double taper surface requires four cut pieces of foam. Three 1/16" plywood rib patterns for the hot wire guides were made the same size as the outer surface of the sheeted wing to compensate for the shrinkage and sanding of the foam. Rib sections B-B and C-C were used for generating the outer panels, sections A-A and B-B for the inner panels. All panel ends are cut at 90 degrees except the inner ends of the inner panels which are cut at 5 degrees to form the dihedral angle.

The two foam sections of each wing are joined with epoxy adhesive. Then the leading and trailing edges are added. At this point the bellcranks, wing light wiring and main pushrods for flaps and ailerons are installed. A small soldering iron such as the Ungar pencil unit is a good tool for cutting grooves and holes in the foam.

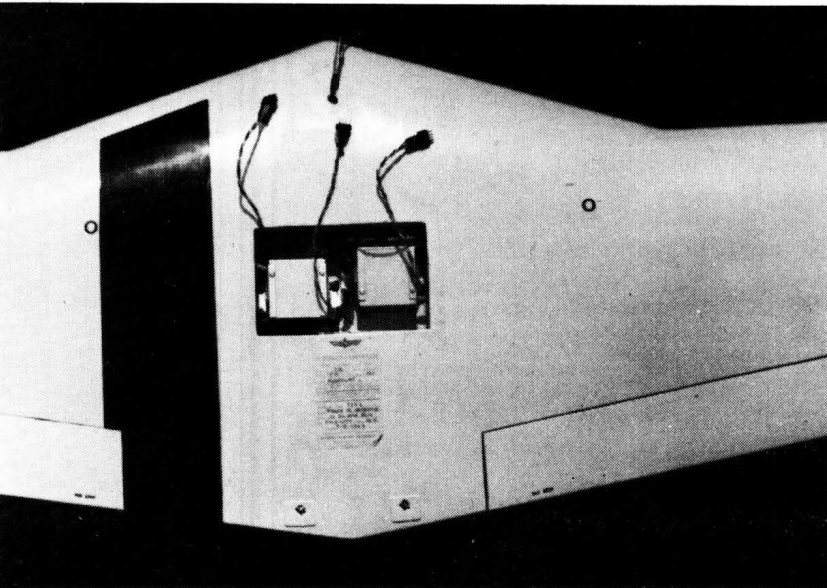
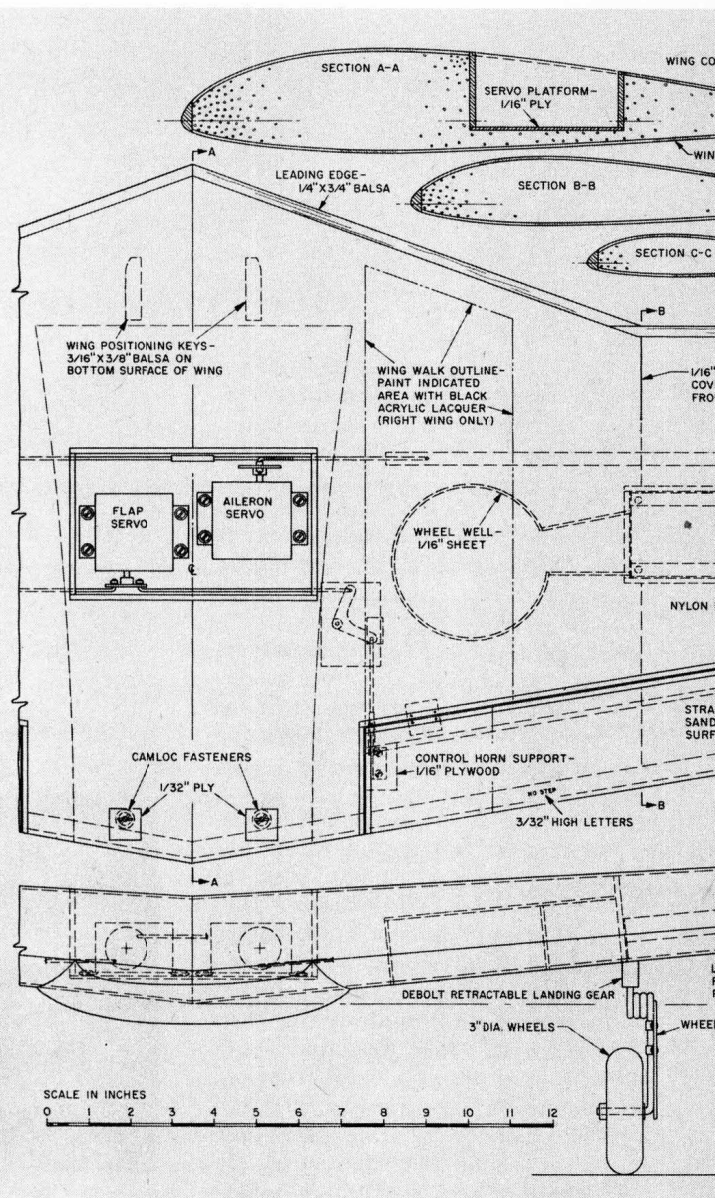
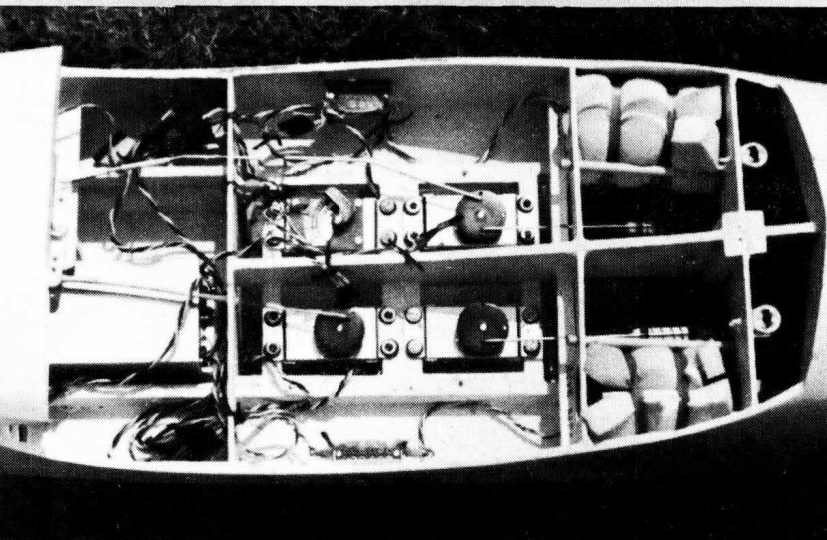


Fig. 2 (above): Aileron and flap servo. Fig. 4 (below): Control system. Hobby Helpers has full-size working drawings for model.



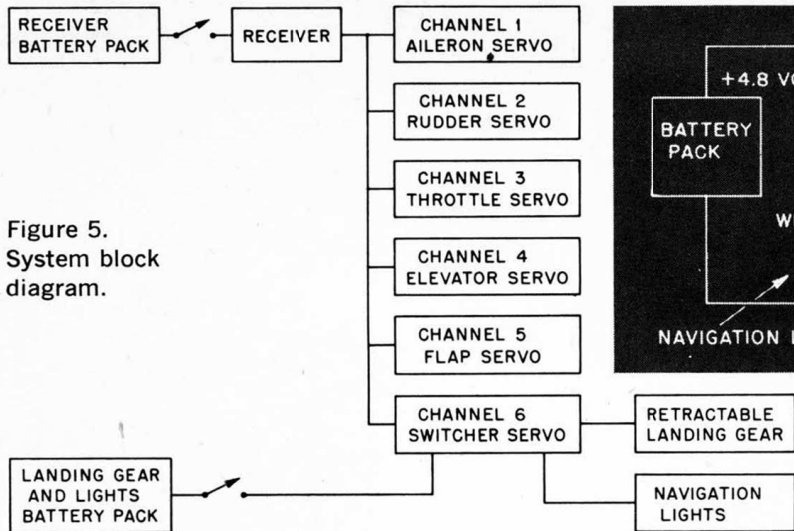


Figure 5. System block diagram.

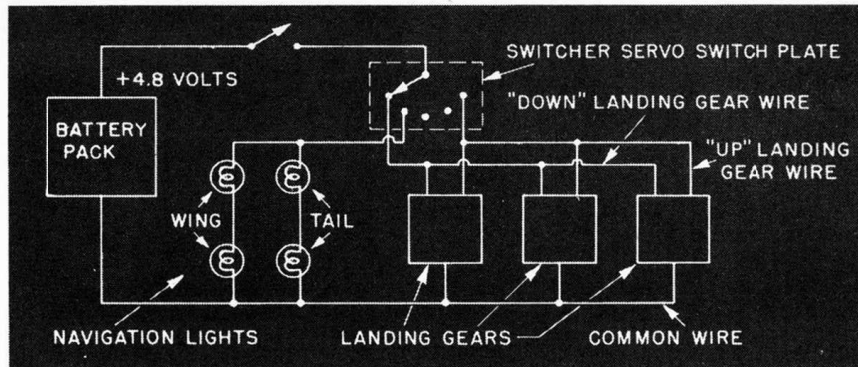


Figure 6. Electrical schematic, landing gear & lights.

The bellcrank platforms should be installed at an angle so that rods to aileron and flap control horns can be installed later parallel to the plane of the bellcranks.

The sheet covering is fastened with contact-type cement to the two wing halves. All joints between the sheets and leading edge, trailing edge and

other sheets should be made with epoxy adhesive. (Any other type of adhesive may produce separation of the sheet from the foam when the wing is doped.)

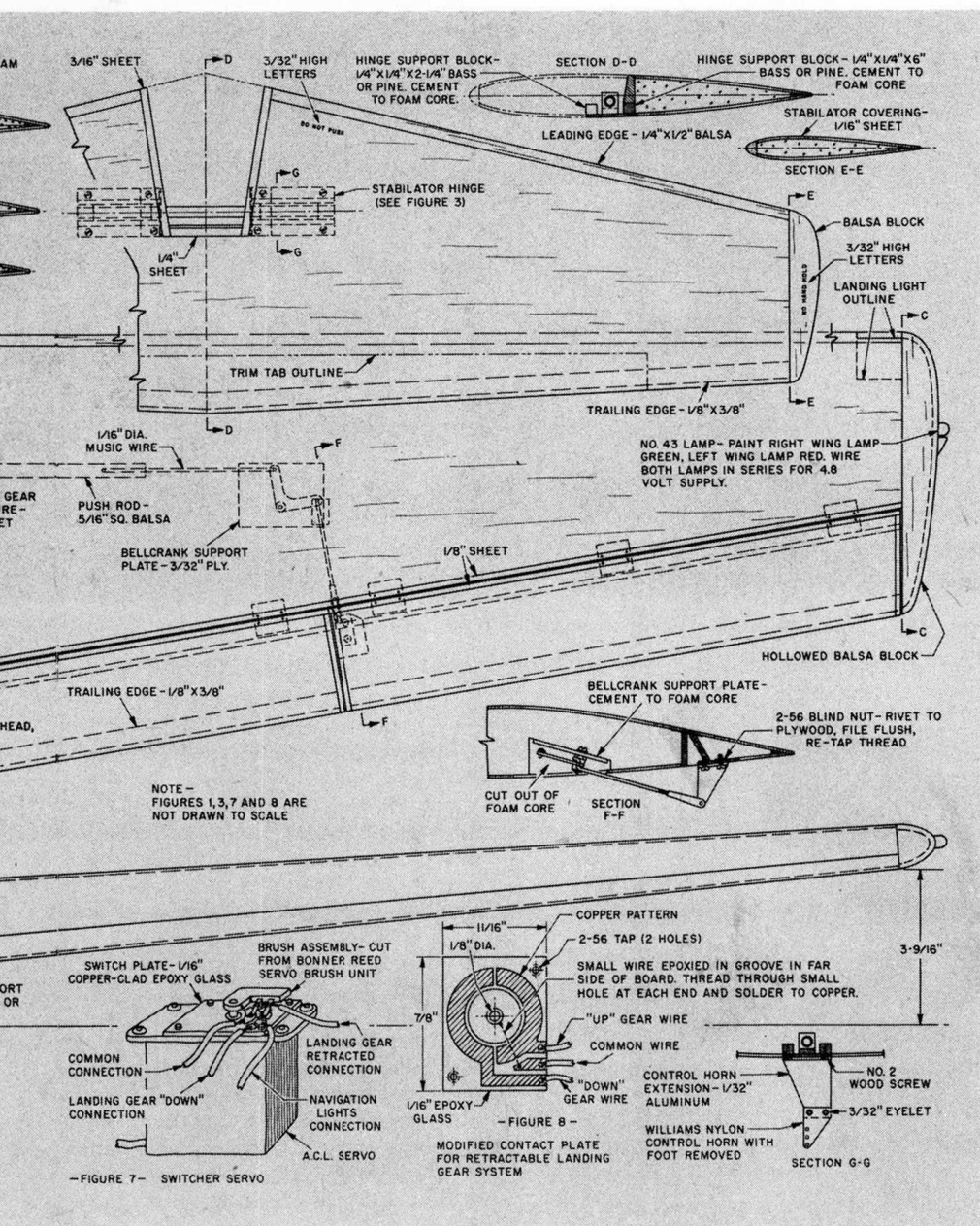
Then join the two wing halves with epoxy adhesive. No spars or splices required. After center joint has set, a two inch wide strip of fiber glass is

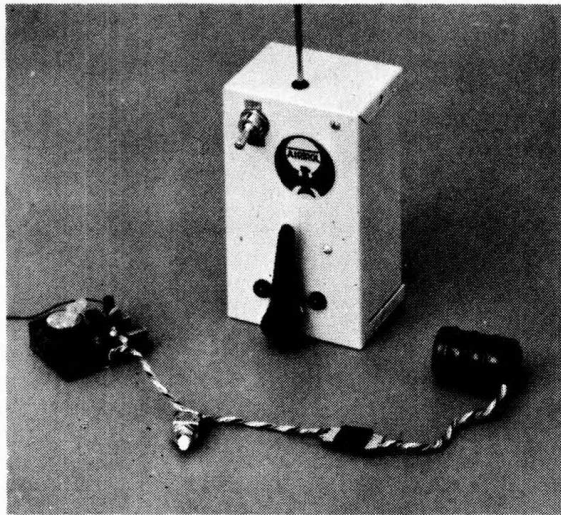
applied to the top and bottom surfaces with epoxy. Cutouts for ailerons, flaps, wheel wells, landing gear support wells and servo platform are marked gently on the wing with a ball point pen. The various cutouts are made with an X-acto knife and soldering iron. After ailerons and flaps are cut from the wing they are completed as on the plans, then re-installed with nylon sheet hinges. Care must be exercised to avoid nicks or scratches in this type of hinge. Figure 2 shows servo installation in wing center section.

**Tail Surfaces.** Both tail surfaces are quickly made via foam core and sheet covering, each built up and covered before modifying with cutouts. Stabilator hinge, on plans and in figure 3, was designed as a removable part so that it could be repaired without major surgery. It proved easy to build and has performed perfectly. Making the stabilator removable from the fuselage has eased the transportation chore.

**Covering, Painting, Trim.** Entire model was covered with silk applied with clear dope directly to the wood without use of water. Before use the silk should be pressed with a steam iron to remove creases. After it was on several coats of talcum powder in clear dope were applied and sanded.

For color and trim, acrylic lacquer was selected for ease and speed of application and availability of proper colors. This material is found at auto finish stores. Acrylic lacquer must be specified because of its excellent fuel proof qualities. Ordinary automotive lacquer, plus glow fuel, adds up to complete disaster. While the white acrylic was applied with an air brush a conventional spray gun would have been adequate. The red and black trim details were brushed on. For spraying, the manufacturer's instructions for thinning were followed. A small quantity of almond oil, obtainable from drug stores, was added as a plasticizer. Do not





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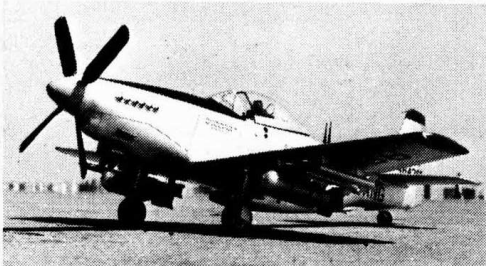
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use almond extract, a flavoring material. Although the acrylic lacquer can be applied over the clear dope, do not put clear or colored dope over the lacquer . . . they are incompatible in that sequence. The colors indicated on the plans are similar to colors in Piper's brochure. As we said, an advantage with acrylic is that any shade of automobile finish may be obtained.

All lettering was done with "press-on" type letters available in stationery and artist supply stores. The small 3/32" characters are Letraset No. 195 (black). The "Piper Comanche" script letters are Cello-Tak 3160-C (white capitals) and Cello-Tak 3160-L (white lower case). The large N7262P characters were formed of 1 1/2" Letraset No. 100 (red letters) and Letraset No. 114 (red numbers). Scale size letters would be 2"; these were not available to me. Since I could find no fuel proof overcoat which did not damage the letters, they were left uncoated. Only the lettering exposed to raw fuel or heavy exhaust accumulation near the engine has evidenced any deterioration. Trim tab, door, windows and landing lights were outlined in 1/16" wide black plastic tape.

Since the model was built, about 4000 people have kindly informed me that the wing walk and door were on the wrong side. My excuse: I put them on at midnight on the eve of my departure for the 1965 Nationals. By the time I discovered the error I was too bleary eyed to attempt to cover up all that black paint with white.

**Installation.** The miniature Comanche was designed to use all six channels of the ACL Digilog proportional control system. A view of the fuselage installation is shown in figure 4. The aileron and flap servos are in the wing. Six servos plus lights and retractable landing gear not only occupy a fair amount of space, they generate a complicated tangle of wiring. In order to achieve success with a system of this complexity the installation must be planned and executed with care.

The system block diagram is seen in figure 5. A separate battery pack for the landing gear is necessary to pre-

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vent a control system failure if the landing gear jams. To facilitate check-out and repair, each landing gear and light is connected to the system through a pluggable connector. Figure 6 shows a detailed schematic of the landing gear and light wiring. These lights and landing gear are controlled by the channel 6 servo which has been modified (figure 7) to provide five switch contacts. Contacts on opposite ends of the contact plate were selected for "up" and "down" landing gear positions so we could use two extreme positions of the transmitter control lever for such important functions. A third contact on the switch plate turns on the navigation lights. Although time did not permit addition of wheel brakes, the fourth contact on the switcher was reserved for controlling an electric brake on the nose wheel. The fifth contact was intended for actuating a blinker light which was to have been in-

stalled in the rotating beacon. This also was undone when time ran out.

To eliminate synchronization problems inherent in sequentially operated landing gears, they were modified to operate simultaneously in response to an "up" or "down" command. We replaced the epoxy glass contact plate with a new one having the different circuit pattern illustrated in figure 8. In addition, two adjacent contact wiper arms were bent back so they no longer touched the contact plate.

Radio frequency noise suppression components were also added to each gear. A small .01-mfd capacitor was connected across the motor terminals and a small, low-resistance R.F. choke was put in each motor lead. These components, attached directly to the motor terminals, all fit within the landing gear case. The frame was also connected to one of the motor terminals. These measures were very effective in eliminating R.F. noise generated by the landing gear.

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