Metal Parts and Fittings in Light Aircraft Construction

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Reprinted in part from the magazine Canadian Aviation

An "all wood" construction aircraft is assembled by means of metal fittings, and unless the amateur is already used to working with metal, he will find them more difficult than the wooden components. Many amateurs have found this part of the construction a stumbling block in building an aircraft. For some aircraft like the Jodels industrially manufactured parts can be purchased.

Metal fittings and parts come in a great variety, since they are designed specifically for each aircraft. They can be classified broadly into four categories:

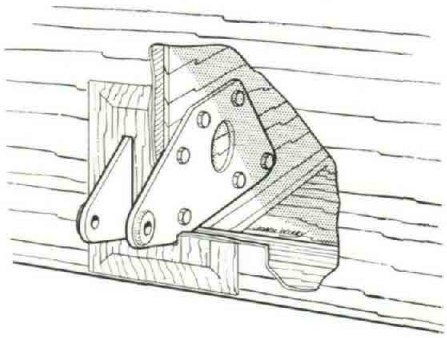

Fig. 1—Wing strut fitting on a lower longeron of a wooden fuselage.

1. **Flat fittings**
2. **Bent sheet metal fittings**
3. **Welded fittings**
4. **Machined parts**

Flat fittings are typical of wing spar fittings, strut attachments, fuselage fittings and control parts such as bell cranks, control horns, etc. They are cut from flat sheets and of steel or thick aluminum alloy. Steel parts are more commonly used for assembly fittings, while aluminum alloy is often used for control parts. Two examples of flat fittings are shown in Figs. 1 and 2. Fig. 1 shows a typical strut fitting such as will be found on the fuselage of a high wing aircraft. These are made of chrome molybdenum steel. Similar fittings are used on wing spars.

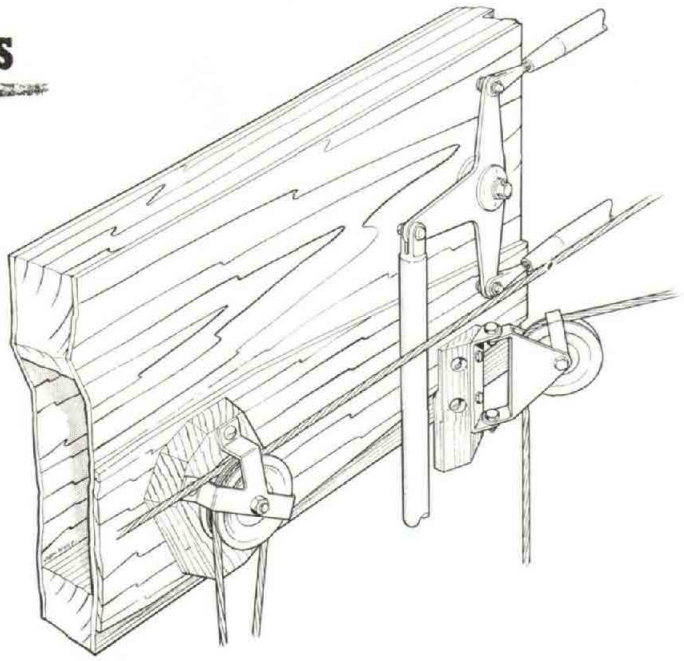

Fig. 2—Aileron, rudder and air brake controls in the Fauvel AV-36 sailplane, mounted on the back of the main spar.

Fig. 2 shows an aileron control bell crank as used on the Fauvel AV-36 sailplane. A system of push-pull rods is used on sailplanes in order to provide a differential motion to the ailerons; i. e., one aileron rises twice as much as the other drops. This is done to reduce adverse yaw. The complete system is shown in Figs. 2 and 3. Here the bell cranks and control levers are cut from ¼ in. aluminum alloy plates and riveted onto specially machined parts. Although this type of metal part is easy to make, it cannot fulfill all the needs of the design and other types of fittings are necessary.

Bent sheet metal fittings are a little more complicated. Various types are shown in Figs. 2, 3, 4, 5 and 6. The parts must be cut from flat sheets and bent over pieces of hardwood especially prepared for each case. The radius of each bend must be adjusted according to the thickness of the sheet. This radius is usually specified on the drawings. Another point which must be kept in mind is the layout of the developed shape accounting for the metal required for the bend. In some cases the designer has thoughtfully drawn this pattern showing the measurements before bending, but this is the exception rather than the rule.

Aluminum alloy must be heated to 1000° F. before bending. After a few hours it becomes hard again and any attempt at bending produces cracks. Aluminum alloy is not too well suited for amateur construction, therefore, and is generally used only for secondary parts not requiring bending. Furthermore, aluminum lugs made of sheet metal do not stand up very well under the vibrations

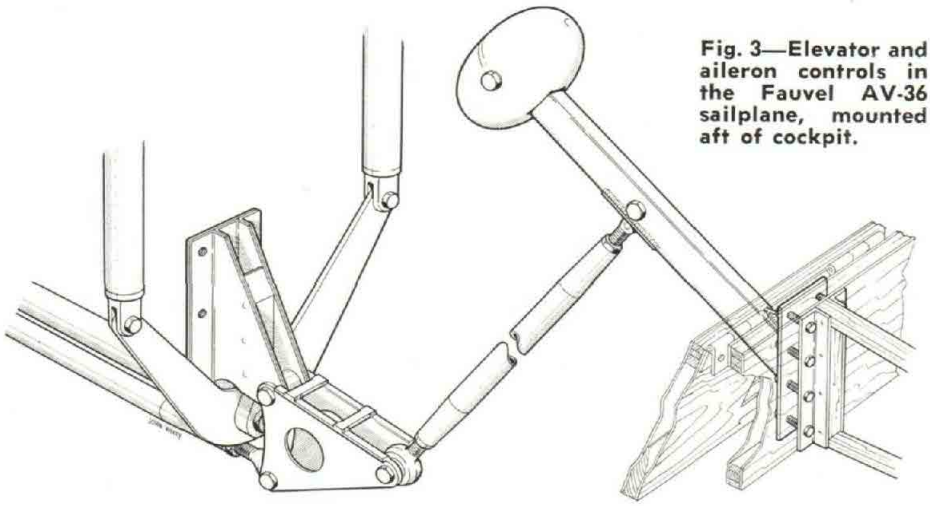

Fig. 3—Elevator and aileron controls in the Fauvel AV-36 sailplane, mounted aft of cockpit.

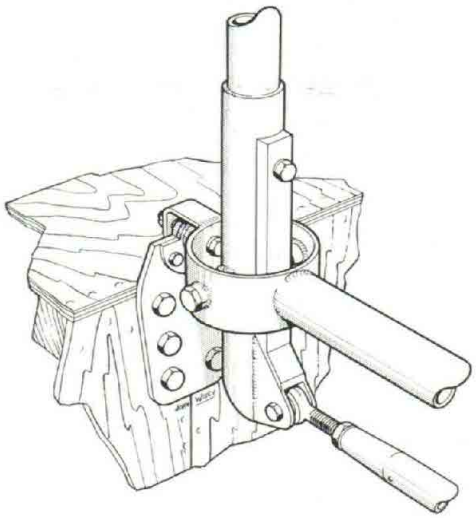

Fig. 4—Control stick mounting in the Fauvel AV-36 sailplane.

existing in light aircraft. For these reasons sheet metal fittings made of aluminum alloy are rarely used.

Gas welding is used in making the welded fittings commonly used in light aircraft construction. Several examples are shown in Figs. 3, 4 and 7. These fittings are always made of steel, in general chrome molybdenum (SAE 4130) because of its high strength and good welding properties. The fittings are usually the bent sheet metal type in combination with steel tubes. Fig. 3 shows the elevator control used in the Fauvel AV-36 sailplane which has a variety of parts combining tubes and sheet metal. Fig. 4 shows the arrangement of the control column in the AV-36 and Fig. 7 shows a compression strut typical of the two spar wing construction in aircraft such as the Baby Ace. This type of construction is generally used in making up landing gears and engine mounts, which will be discussed later. Construction of these welded fittings is the same as the bent sheet metal type, with the addition of welding. The welding must be perfect so the help of a good welder is necessary.

Machined parts are usually those requiring work on a lathe or other metal working machine. They include various types of bushings, connecting rod ends and adjustable strut ends made of steel or aluminum alloy. Some bearings are made of bronze or oilite type material. Some of these parts, like the connecting rod ends shown in Figs. 2 and 3, may require a milling operation which can be done by hand when only a few parts are required. Standard parts covered by AN and other specifications may be purchased. The amateur should become familiar with the various specifications as he can often simplify his work by adapting existing standard parts to his needs. When standard parts are to be adapted to a design, the amateur should consult the designer of the aircraft to make sure the change can be made safely.

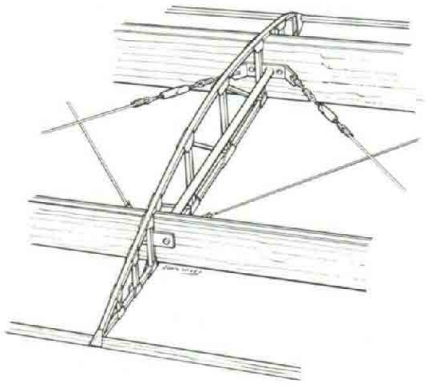

Fig. 7—Typical wing compression strut.

Two typical methods of attaching the stabilizer on light aircraft are shown in Figs. 5 and 6. In Fig. 5 the stabilizer is hinged on its rear fitting and adjustment is provided at the leading edge. The strut is usually of fixed length, but the upper end has a ball joint fitting to accommodate adjustment. The stabilizer in this case is in one piece. The strut and fittings at the leading edge are of the welded type, while all the others are either flat or bent sheet metal. An aluminum fairing closes the gap in the fin.

The folding stabilizer shown in Fig. 6 does not provide adjustment. It folds against the fin after removal of the fillet. The strut is identical to that in Fig. 5 except without the ball joint. This strut is removed and stored in the cockpit when the stabilizer is folded. Excepting the strut all metal fittings in this case are flat sheet type. The fuselage fittings are attached on both sides of the bulkheads. Pieces of extruded aluminum angles are used to stiffen the attachment of the root rib.

Brazing is not used in the manufacture of structural parts. However, it is acceptable where hole reinforcements must be provided by adding washers such as shown on the lugs in Fig. 1, and for a few other secondary applications where it does not have to take loads.

The construction of metal fittings and parts presents more difficulties for the average hobbyist than the wooden parts. How these can be overcome will be the subject of another article.

Next month we will discuss landing gear construction ●

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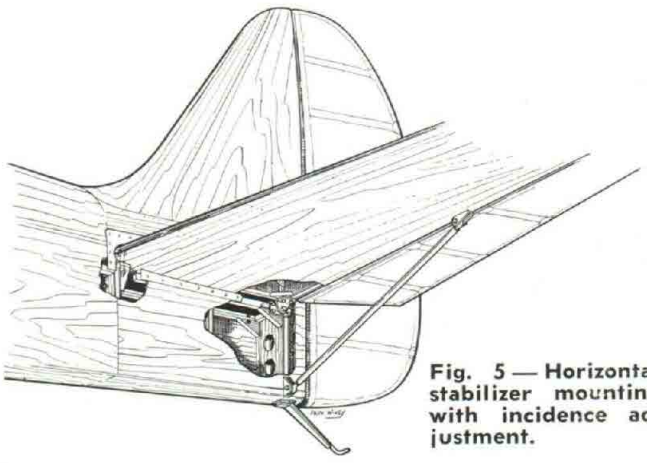

Fig. 5 — Horizontal stabilizer mounting with incidence adjustment.

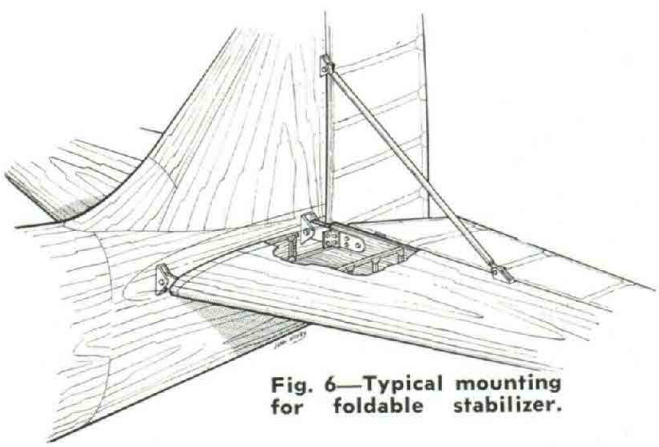

Fig. 6—Typical mounting for foldable stabilizer.