This invention relates to an improvement in airplane control surfaces and, more particularly, to movable control surfaces, such as rudders, elevators, ailerons, flaps, and the like.

More specifically, this invention relates to an improvement in structural features which will enable the formation of control surfaces having requisite strength and rigidity under the applied load coupled with desired lightness in weight.

Heretofore movable control surfaces have variously comprised a frame, usually of metal, as dural, covered with either a thin metal, as dural, or fabric skin. The thin metal skin has not proved satisfactory due to the requirement for extra balance weight and to the fact that wrinkles form in the skin. The fabric covering is also unsatisfactory since rigidity cannot be obtained due to the fact that a fabric covering has a tendency to deflect in and out when the load is applied, with consequent variation in the contour of the surface and impairment of the efficiency of the surface. Further, the fabric cannot take any high pressure differential which may arise on the inside and outside of the covering, thus frequently resulting in tearing the fabric away from the frame.

While a good many different constructions were made in wood more or less improving the characteristics as against the metal ones mentioned above, the main objection to use of these was the fact that due to their construction, under different atmospheric conditions, a deformation and twisting would result at the aft ribs or their trailing edges which the construction according to this invention would remedy.

Now in accordance with this invention generally, a structure is provided which comprises a frame of novel construction and a covering or skin composed of plywood applied to and secured to the frame, all as will appear from the following description with reference to the accompanying drawings, which illustrate an embodiment of the invention and in which:

Figure 1 is a plan view of the uncovered frame structure of a control surface, as a rudder.

Figure 2 is a sectional view on line 2—2, Figure 1.

Figure 3 is a sectional view taken at right angles to that of Figure 2.

Figure 4 is a sectional view on line 4—4, Figure 3, showing a detail of construction.

Figure 5 is a sectional view showing a detail of construction.

In the several figures, 1, 1 indicate spars extending spanwise of the structure and to which are attached nose ribs 2, 2 and trailing edge ribs 3, 3. The spars are spaced by means of spacer members 9, 9 and the nose and trailing edge ribs are spaced by spacer members 4, 4. The trailing edge ribs 3, 3 are spaced and stiffened also by spacer members 4, which extend from the spars to adjacent the trailing edge. The spars are secured together by means of angles 5, 5 overlying the spacers 4, 4 and secured to the ribs 2, 2 and 3, and spars 1.

Extending lengthwise of the spars and recessed into the spars and ribs 2, 2 and 3, 3 are apron strips 6, 6, scalloped between the rib stations.

The nose skin 7 is composed of plywood material and extends over the apron strip 5 to abut with the main skin sections 8, 8, also composed of plywood, just above the spars. The apron strips 6, 6 are formed from plywood of approximately the same type and thickness as that of the nose skin and are molded to the nose skin.

At the trailing edge of the structure a trailing edge strip 10, composed of plywood and scalloped between rib stations is secured in slots formed by recessing the trailing end portions of the ribs 3, 3, respectively. The grain direction of the face plies of the trailing edge strip runs in a chordwise direction.

Secured on opposite sides of the trailing edge strip and extending spanwise are strips of wood 11, 11 having their grain direction running spanwise and machined to triangular or wedge shape, as shown in Figures 2 and 4.

The skin sections 8, 8 of plywood are applied over the ribs 3, 3, abutted with the nose skin 7 in the plane of the spars 1, 1 and secured by gluing to the apron strip 5, the ribs 3, 3 and to the wedge shaped strip 11, 11 carried by the trailing edge strip 10, which in turn is glued to the ribs 3, 3.

It will now be appreciated that in the construction according to this invention the ribs and spars, which may be formed of wood, are secured together by the usual angles and, in addition thereto, by the plywood apron strips 6, 6, to which the plywood nose skin 7 is molded, and which are recessed into the spars and ribs, to which they are secured by gluing. The main skin sections 8, 8 are butted into the nose skin 7 just over the spars and are secured to the apron strip by gluing.

Finally, the trailing edge is formed by the trailing edge strip 10, composed of plywood the grain direction of the face plies of which runs chordwise, which extends into slots in the ribs, to which
3 it is glued, and which carries the spanwise exten-
ing wedge shaped strips of wood 11, the grain of which extends spanwise, to which, as well as to the ribs, the main skin sections 8, 8 are glued.

The structure according to this invention is easily produced and has been found to be of great strength and rigidity, and the facenner metal and fabric covered structures and particularly adaptable for the control surfaces of high speed airplanes.

It will be understood that the above detailed description is illustrative of this invention and is not intended to be limiting over the scope of the claims appended hereto.

What I claim and desire to protect by Letters Patent is:

1. In a control surface for airplanes, in combination, a frame including a spar and a rib, an apron strip formed of plywood secured to the spar and rib, a nose skin formed from plywood secured to the apron strip, a main skin section secured to the apron strip and abutting the nose skin in the plane of the spar, a trailing edge strip formed of plywood secured to the rib in recessed relation to the rib and a wedge shaped strip of wood secured to a face of the trailing edge strip beyond the rib and secured to the main skin section at the trailing edge of the control surface.

2. In a control surface for airplanes, in combination, a frame including a spar and a rib, an apron strip formed of plywood secured to the spar and rib, the apron strip and nose skin being formed from plywood of about the same characteristics and thickness, a main skin section secured to the apron strip and abutting the nose skin in the plane of the spar, a trailing edge strip formed of plywood secured to the rib in recessed relation to the rib and a wedge shaped strip of wood secured to a face of the trailing edge strip beyond the rib and secured to the main skin section at the trailing edge of the control surface.

3. In a control surface for airplanes, in combination, a frame including a spar and a rib, an apron strip formed of plywood secured to the spar and rib, a nose skin formed from plywood secured to the apron strip, a main skin section secured to the apron strip and abutting the nose skin in the plane of the spar, a trailing edge strip formed of plywood secured to the rib in recessed relation to the rib with the grain direction of its surface plies running chordwise, and a wedge shaped strip of wood secured to a face of the trailing edge strip beyond the rib with its grain direction running spanwise and secured to the main skin section at the trailing edge of the control surface.

4. In a control surface for airplanes, in combination, a frame including a spar and opposite extending ribs, an apron strip formed of plywood secured to the spar and in recessed relation to the spar and ribs and secured to said spar and ribs, a nose skin formed from plywood secured to the apron strip and a main skin section secured to the apron strip and abutting the nose skin in the plane of the spar.

5. In a control surface for airplanes, in combination, a frame including a spar and a rib, a trailing edge strip formed of plywood secured to the rib in recessed relation to the rib and a wedge shaped strip of wood secured to a face of the trailing edge strip beyond the end of the rib and a skin of plywood secured to said wedge shaped strip and to the rib at the trailing edge of the control surface.

6. In a control surface for airplanes, in combination, a frame including a spar and oppositely extending ribs, an apron strip formed of plywood secured to the spar and in recessed relation to the spar and ribs and secured to said spar and ribs, a nose skin formed from plywood, and a main skin section glued to the apron strip and abutting the nose skin in the plane of the spar.

7. In a control surface for airplanes, in combination, a frame including a spar and a rib, a trailing edge strip formed of plywood secured to the rib in recessed relation to the rib with the grain direction of its surface plies running chordwise, and a wedge shaped strip of wood glued to a face of the trailing edge strip beyond the end of the rib with its grain direction running spanwise and a skin of plywood glued to said wedge shaped strip and to the rib at the trailing edge of the control surface.

8. A control surface frame for airplanes, comprising spaced parallel spacing, spacer members connected to the opposite faces of said spars, an apron strip connected to the outer face of each spar, and extending substantially the full length thereof, said apron strips extending laterally beyond the side faces of the spars, a plurality of spaced ribs abutting each of the side faces of each spar being secured for the reception of the apron strip, so that the outer faces of the apron strips and the portions of the ribs beyond the apron strips on the opposite sides of the spars are in the same plane for the reception of the skin, said ribs being connected to the ribs and the apron strips.

9. A control surface frame for airplanes, comprising spaced parallel spacing, spacer members connected to the opposite faces of said spars, an apron strip connected to the outer face of each spar, and extending substantially the full length thereof, said apron strips extending laterally beyond the side faces of the spars, a plurality of spaced ribs abutting each of the side faces of each spar being secured for the reception of the apron strip, so that the outer faces of the apron strips and the portions of the ribs beyond the apron strips on the opposite sides of the spars are in the same plane for the reception of the skin, said ribs being connected to the ribs and the apron strips, and transverse spacers normal to the first mentioned spacers connected to said first mentioned spacers and to ribs on opposite sides of the frame.

10. A control surface frame for airplanes, comprising spaced parallel spacing, spacer members connected to the opposite faces of said spars, an apron strip connected to the outer face of each spar, and extending substantially the full length thereof, said apron strips extending laterally beyond the side faces of the spars, a plurality of spaced ribs abutting each of the side faces of each spar being secured for the reception of the apron strip, so that the outer faces of the apron strips and the portions of the ribs beyond the apron strips on the opposite sides of the spars are in the same plane for the reception of the skin, said ribs being connected to the ribs and the apron strips.

11. A control surface frame for airplanes, comprising spaced parallel spacing, extending substantially the full length of the frame on opposite sides thereof, a spacer member secured to one side of each of the spars and arranged to main-
tain them in spaced relation from end to end of the frame, an apron strip connected to the outer face of each spar and arranged to maintain them in spaced relation from end to end of the frame, an apron strip connected to the outer face of each spar and extending a substantial distance beyond each side thereof, a plurality of spaced nose ribs on each side of the frame abutting one face of the spar, a plurality of spaced trailing edge ribs on each side of the frame abutting the opposite face of the spar in the same planes as the nose ribs, the ribs on one side of the frame being opposite those on the other side of the frame, each rib being recessed for the reception of the apron strip on that side of the frame, and transverse spacer members normal to the first spacer member and ribs on the opposite sides of the frame.

12. A control surface frame for airplanes, comprising spaced parallel spars extending substantially the full length of the frame on opposite sides thereof, a spacer member secured to one side of each of the spars and arranged to maintain them in spaced relation from end to end of the frame, an apron strip connected to the outer face of each spar and extending a substantial distance beyond each side thereof, a plurality of spar and nose ribs extending on a subside of the frame abutting one face of the spar, a plurality of spaced trailing edge ribs on each side of the frame abutting the opposite face of the spar in the same plane as the nose ribs, the ribs on one side of the frame being opposite those on the other side of the frame, each rib being recessed for the reception of the apron strip on that side of the frame, and four transverse spacer members normal to the first spacer member connected to the first spacer member and ribs on the opposite sides of the frame, the trailing ends of the trailing edge ribs on opposite sides of the frame being brought together and secured to a trailing edge strip.

13. A control surface frame for airplanes, comprising spaced parallel spars extending substantially the full length of the frame on opposite sides thereof, a spacer member secured to one side of each of the spars and arranged to maintain them in spaced relation from end to end of the frame, an apron strip connected to the outer face of each spar, a plurality of spaced nose ribs on each side of the frame abutting the spars, a plurality of spaced trailing edge ribs on each side of the frame abutting the spars in the same planes as the nose ribs, the ribs on one side of the frame being opposite those on the other side of the frame, each rib being recessed for the reception of the apron strip on that side of the frame, and four transverse spacer members normal to the first spacer member connected to the first spacer member and ribs on the opposite sides of the frame, the trailing ends of the trailing edge ribs on opposite sides of the frame being brought together and secured to a trailing edge strip.

Robert J. Nebesar.

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