Feb. 12, 1963 H. A. FROMSON 3,077,031

METHOD OF FORMING SHEET METAL PANELS

Filed May 10, 1960 2 Sheets-Sheet 1

Fig. 1.

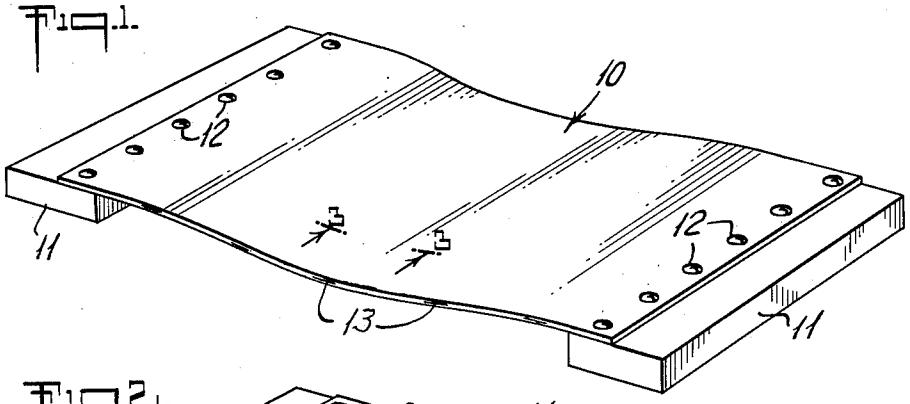


Fig. 2.

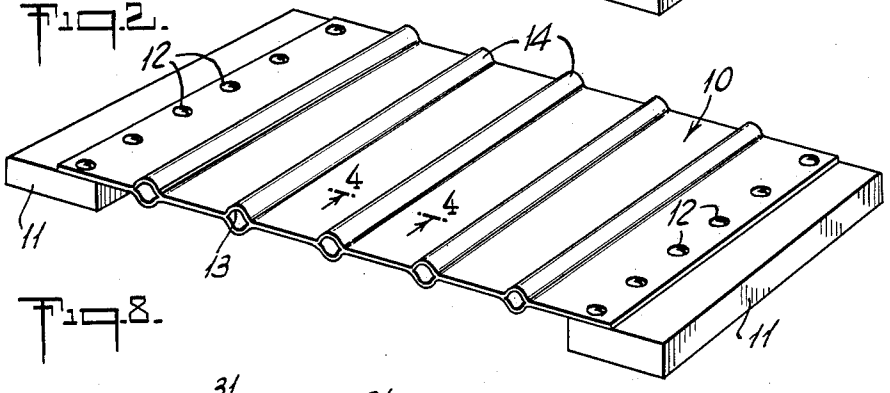


Fig. 8.

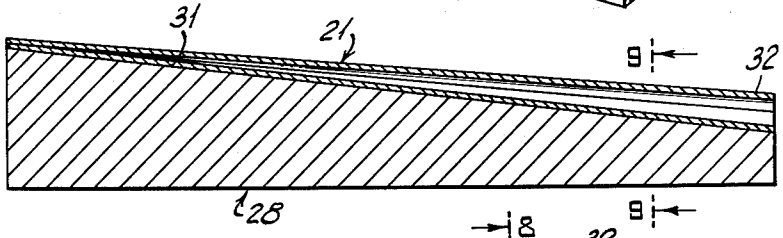


Fig. 9.

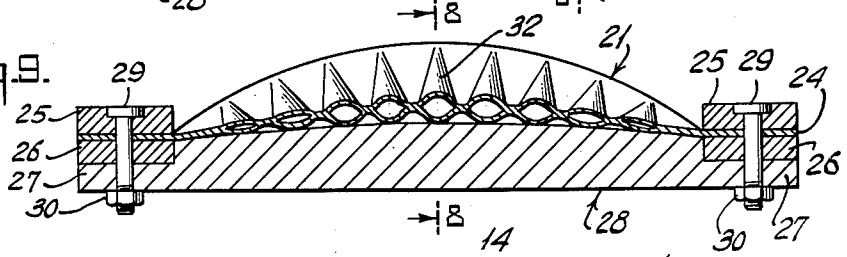


Fig. 3.

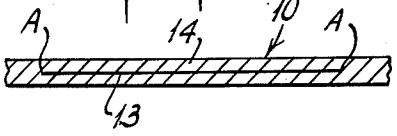
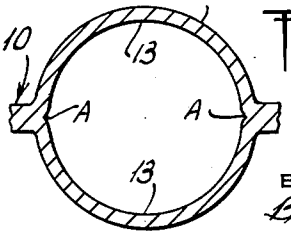


Fig. 4.



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Feb. 12, 1963 H. A. FROMSON 3,077,031

METHOD OF FORMING SHEET METAL PANELS

Filed May 10, 1960 2 Sheets-Sheet 2

Fig. 5.

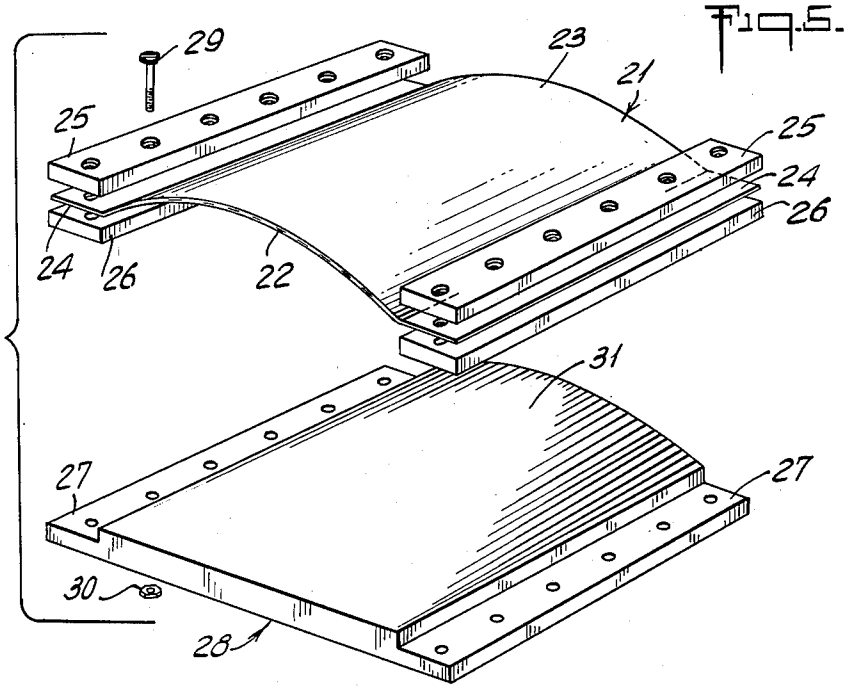


Fig. 6.

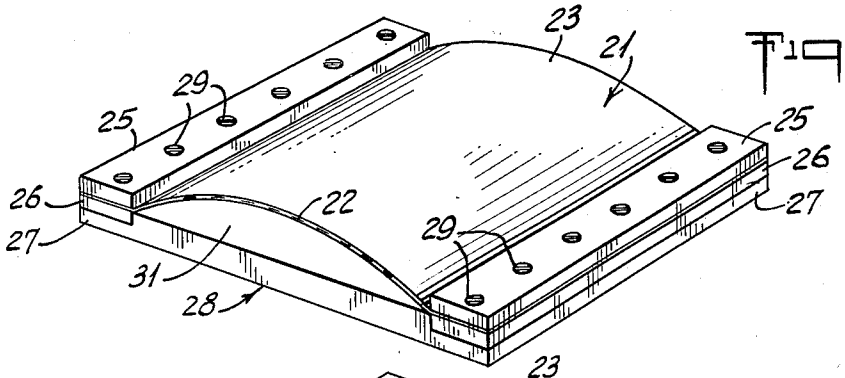
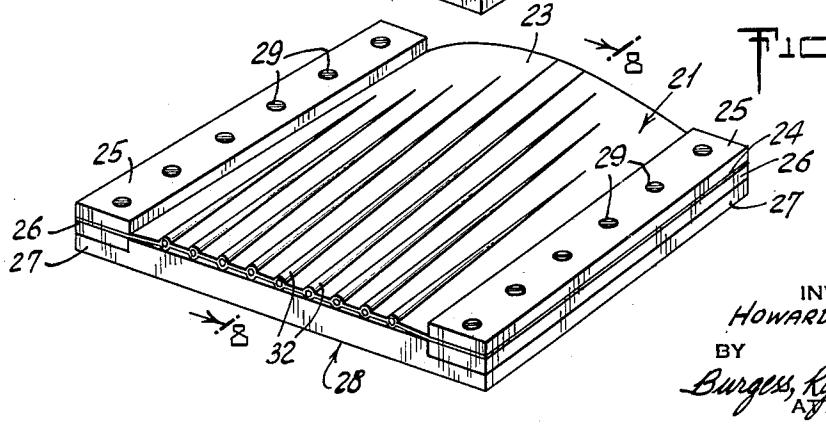


Fig. 7.



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METHOD OF FORMING SHEET METAL PANELS

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Filed May 10, 1960, Ser. No. 28,075
5 Claims. (Cl. 29—421)

The present invention relates to a method of forming or erecting sheet metal panels and relates, more particularly, to a method of forming or erecting a sheet metal panel having inflatable portions intermediate its side edges.

An object of the invention is to provide a method of forming or erecting a sheet metal panel in such a way that the panel is stressed and under tension when it forms part of a structure. Another object of the invention is to provide a method of forming or shaping sheet metal panels into a variety of curved structural shapes expeditiously and at low cost.

Other objects of the invention will become apparent and be better understood from the following description and the accompanying drawings in which:

FIG. 1 is a perspective view of a sheet metal panel as initially attached to a structure in accordance with the present invention;

FIG. 2 is a perspective view of the sheet metal panel shown in FIG. 1 after erection and stressing of the panel in accordance with the present invention;

FIG. 3 is a fragmentary view in section taken along line 3—3 of FIG. 1, but on an enlarged scale;

FIG. 4 is a fragmentary view in section taken along line 4—4 of FIG. 2, but on an enlarged scale;

FIG. 5 in assembled condition;

a step in the method of forming a sheet metal panel into a structural shape of a desired curvature in accordance with the invention;

FIG. 6 is a perspective view of the parts shown in FIG. 5 in assembled condition;

FIG. 7 is a perspective view illustrating the final step in the forming of a curved panel in accordance with the invention;

FIG. 8 is a section view taken along line 8—8 of FIG. 7; and

FIG. 9 is a section view taken along line 9—9 of FIG. 8.

In general, the present invention relates to the erecting or forming of a sheet metal panel having inflatable portions intermediate its side edges by inflating said portions, entirely or partially, while the side edges of the panel are held in fixed positions. As will be described hereinafter in detail, the panel may be erected in a stressed condition as part of a structure or it may be formed into a wide variety of curved structural shapes.

Referring to the drawings and to FIG. 1 in particular, there is a thin sheet metal panel 10 which is fastened along its side edges to spaced frame members 11 by rivets 12 or other suitable fastening means.

The panel 10 is formed with a plurality of inflatable portions formed by internal unbonded surfaces 13 defining internal slits which extend lengthwise of the panel in spaced and generally parallel relation to each other. However, the inflatable portions do not have to be parallel to each other or the side edges of the panel. Such a panel may be formed by rolling tubes which have been treated internally with a resist into the surface of a metal sheet as taught in my United States Letters Patent No. 2,828,533 issued April 1, 1958 for Method of Making Integral Sheet and Tubing Products. However, it will be inderstood that other methods of forming the panel may be employed if desired.

As shown in FIGS. 2 and 4, the portions of the panel defining the unbonded internal surfaces 13 may be separated and expanded into more or less tubular form, as indicated at 14, by introducing fluid under pressure between said surfaces. When the unbonded internal surfaces 13 are expanded, the distance between the points A at the ends of such surfaces is reduced, as shown in FIGS. 3 and 4, and this causes a reduction in distance between the edges of the panel as shown in FIG. 2.

The inflation is carried out with the side edges of the panel fixed to the frames, and the reduction in the width of the panel takes up any slack which may be present in the panel as initially installed on the frames (see FIG. 1), so that the panel, as finally installed, is tightly stretched and is under stress in a direction perpendicular to its side edges. In addition, the erected panel contains spaced tubular portions which not only lend strength and rigidity to the panel, but also provide a certain amount of give or stretchability to the panel which can accommodate transverse stresses or dimensional changes in the framework of the structure without rupturing or tearing the panel. For example, if the frames are separated by shifting, the tubular portions of the panel will collapse slightly and assume an elliptical form.

It should be noted that the panel does not have to be rectangular, but can be triangular or any other desired shape. Also, such a panel can be erected in a curved conformation, as in a domed structure, as well as in a given plane.

In addition to the erection of a metal panel as described above, the present invention also permits sheet metal panels to be formed into a wide variety of curved shapes prior to installation as part of a structure without the use of expensive presses and shaping dies or the like. An example of such a procedure is illustrated in in FIGS. 5 through 9.

In carrying out such an operation, a sheet metal panel 21 having inflatable portions formed by a series of spaced unbonded internal surfaces 22 extending lengthwise thereof, is formed initially with an arched center portion 23 and with flanges 24 extending along opposite sides thereof. Each of the flanges is placed between a pair of rigid clamping strips 25, 26 and the panel and the clamping strips are then attached to flanges 27 extending along opposite sides of a form 28 by means of bolts 29 and nuts 30 or other suitable fastening devices which extend through the flanges and the clamping strips at spaced points throughout their length. This prevents the panel edges from moving when the inflatable portions of the panel are expanded.

The center part 31 of the form 28 which underlies the arched center part of the panel, has a raised or convexly curved surface corresponding to the curvature to be imparted to the panel. Such a form may be made of wood, plaster or other suitable material. When the panel has been attached to the form, as shown in FIG. 6, the inflatable portions of the panel containing the unbonded internal surfaces 22 are then inflated, as indicated at 32, by the introduction of fluid under pressure between the unbonded surfaces. As explained above, this causes a contraction to take place in the width of the panel and such contraction, in this instance, draws the center portion of the panel down tightly against the curved surface of the form. When the panel is brought into contact with the surface of the rigid form, further expansion of the panel due to the pressure of the fluid at the points where such contact is made will cease. Thus, as shown in FIG. 8, the portions 32 of the panel defining the unbonded internal surfaces may be expanded non-uniformly throughout their length. In the form illustrated, the expanded portions of the panel are opened to a lesser extent toward their remote or high ends, due

to the fact that the panel first contacted the curved surface of the form at such remote ends as the expansion took place and that such contact progressed toward the near ends of the inflatable portions of the panel as the expansion thereof continued.

In addition, as shown in FIG. 9, the expansion of the portions of the panel defining the unbonded internal surfaces may also be non-uniform across the width of the panel, depending on the particular curvature of the surface of the form. In this connection, it should be noted that it is desirable, although it may not be essential, to inflate or expand the several portions defining the unbonded internal surfaces simultaneously and under substantially uniform pressure.

Substantially the same result may be obtained by fully inflating or expanding the portions of the panel defining the unbonded internal surfaces throughout their length and then drawing the panel down into contact with the curved surface of the form by means of the clamping strips. In such a case, the expanded portions will collapse and conform to the shape of the form as the panel contacts the form and they also permit the panel to be stretched as they are flattened.

It will be understood that various changes and modifications may be made in the methods of practicing the invention which have been described herein without departing from the scope of the invention as defined by the following claims.

I claim:

1. The method of erecting and forming a reinforced prestressed panel structure composed of frame members fixed in laterally spaced relation to each other and a sheet metal panel extending between said frame members and having its side edges respectively permanently secured to said frame members; comprising the steps of providing frame members in fixed laterally spaced relation to each other, providing a sheet metal panel having

elongated inflatable portions intermediate the side edges thereof extending generally lengthwise of said panel, permanently securing the side edges of said panel to said respective frame members, and thereafter inflating said inflatable portions until the panel is placed in tension between its side edges while maintaining the fixed spaced relationship of said frame members to complete the prestressed panel structure reinforced by the inflated portions.

2. The method defined in claim 1 wherein said panel is unsupported between said frame members during inflation.

3. The method defined in claim 1 wherein said inflatable portions extend generally lengthwise of said frame members.

4. The method defined in claim 3 wherein slack in said panel between said frame members is substantially taken up prior to inflation of said inflatable portions.

5. The method of forming a reinforced sheet metal panel having a desired configuration; comprising the steps of providing a sheet metal panel having elongated inflatable portions intermediate the side edges thereof extending generally lengthwise of said panel, securing the opposite side edges of said panel in fixed positions at opposite sides of a form such that the panel between said side edges bows in a direction away from a contoured surface of said form, and thereafter inflating said inflatable portions to contract said panel into surface engagement with said contoured surface.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,077,031 February 12, 1963

Howard A. Fromson

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 1, line 32, for "FIG. 5 in assembled condition;" read -- FIG. 5 is an exploded view in perspective illustrating --.

Signed and sealed this 3rd day of September 1963.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents