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 [73] Assignee **Olin Corporation**

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[54] **INFLATION APPARATUS FOR METAL STRIP OR PANELS HAVING INFLATABLE FLUID PASSAGEWAYS**
8 Claims, 6 Drawing Figs.

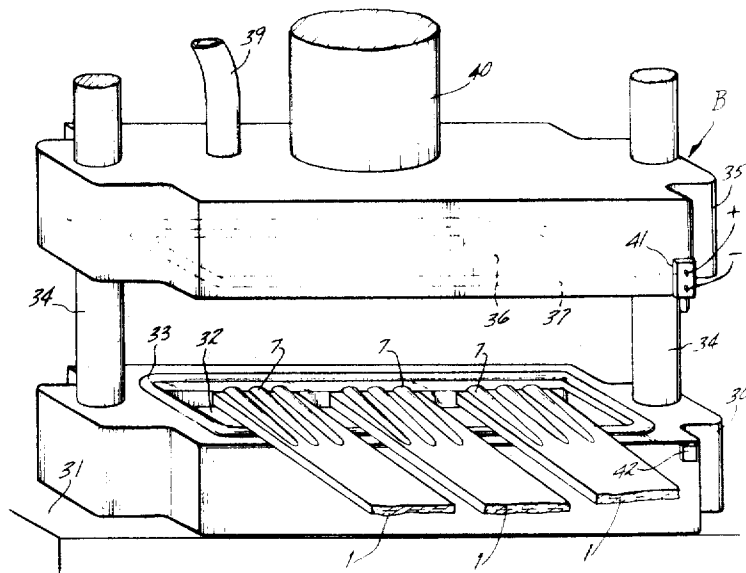
[52] U.S. Cl. 72/58,
 29/157.3 D, 29/157.3 V, 29/421, 72/57, 113/118 D
 [51] Int. Cl. **B21d 39/08**
 [50] Field of Search..... 29/421, 202
 D, 157.3 D, 157.3 V; 113/118 D, 118 V; 72/57,
 58, 60, 61

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ABSTRACT: An inflation apparatus for inflating metal strips or panels containing inflatable passageways connected to a preformed opening. The apparatus comprises two opposing plates which have resilient sealing means mounted on each of the opposing faces of the plates. At least one of the plates has a pressure cavity for supplying fluid under pressure to the preformed opening of the metal strip or panel for inflating the passageways therein. The apparatus also includes means for clamping plates about the preformed opening so that the resilient sealing means sealingly engage the metal strip or panel. This engagement results in crimping the preformed opening but does not close it completely. In operation, the plates are clamped about opposing surfaces of the panel or strip at the preformed opening and a suitable fluid under pressure is forced into the pressure cavity and through the preformed opening so as to inflate the passageways.



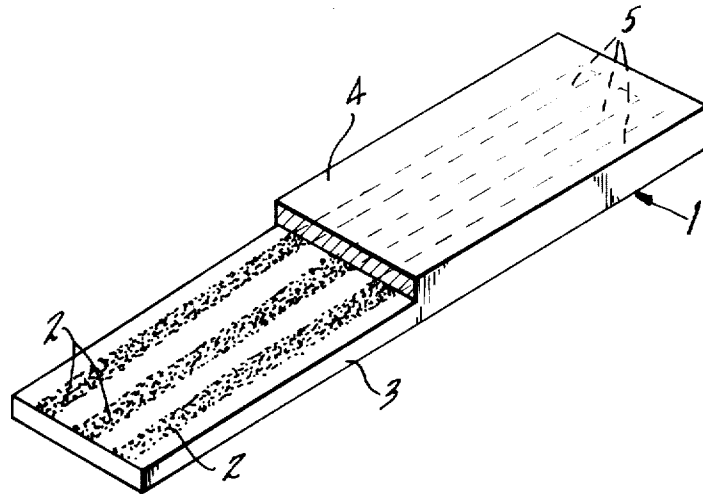


FIG-1A

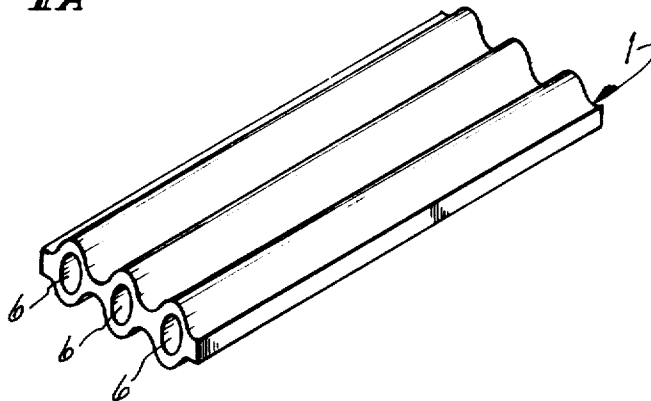


FIG-1B

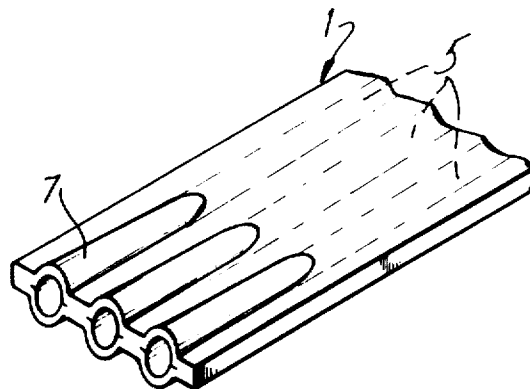
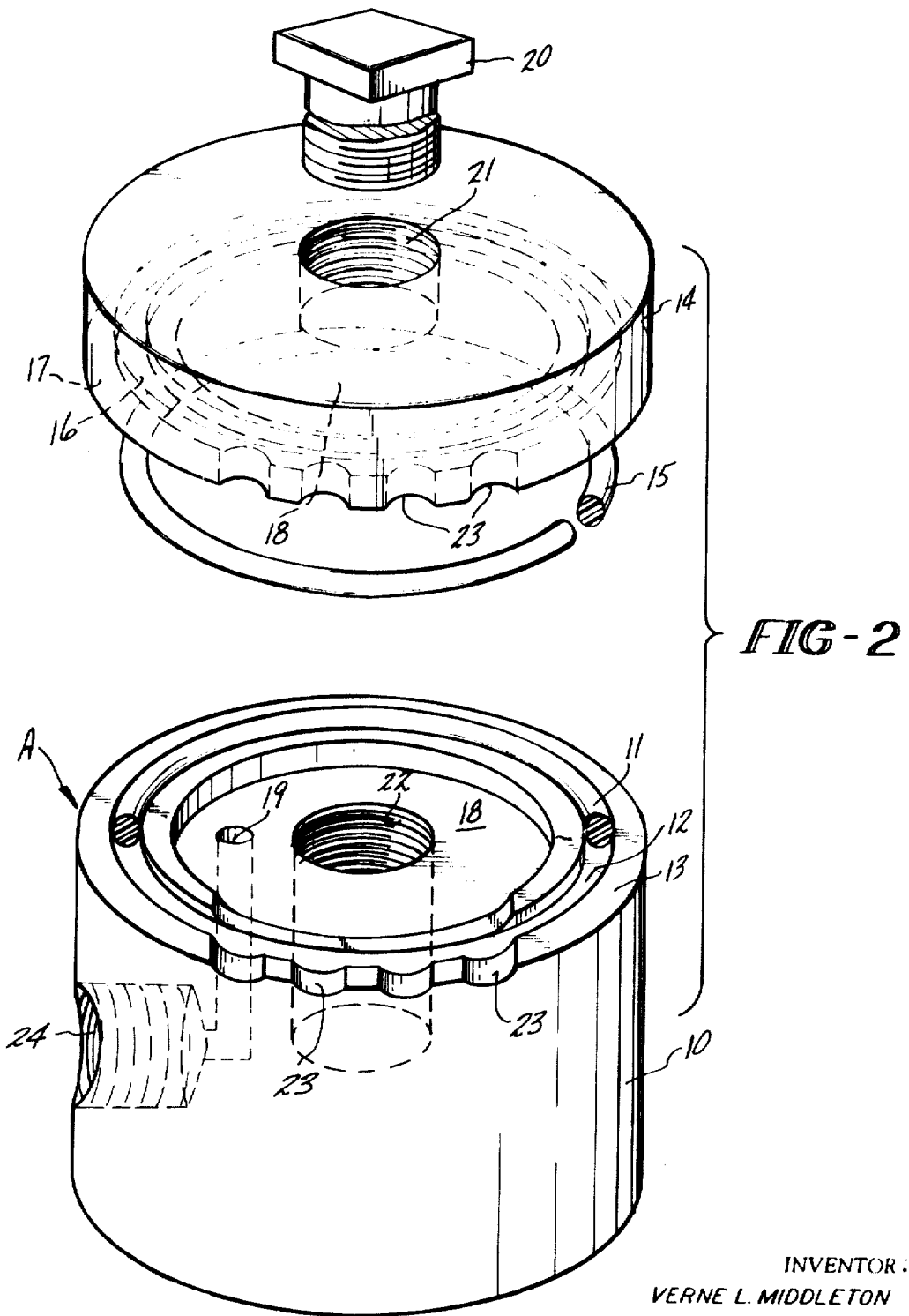


FIG-1c

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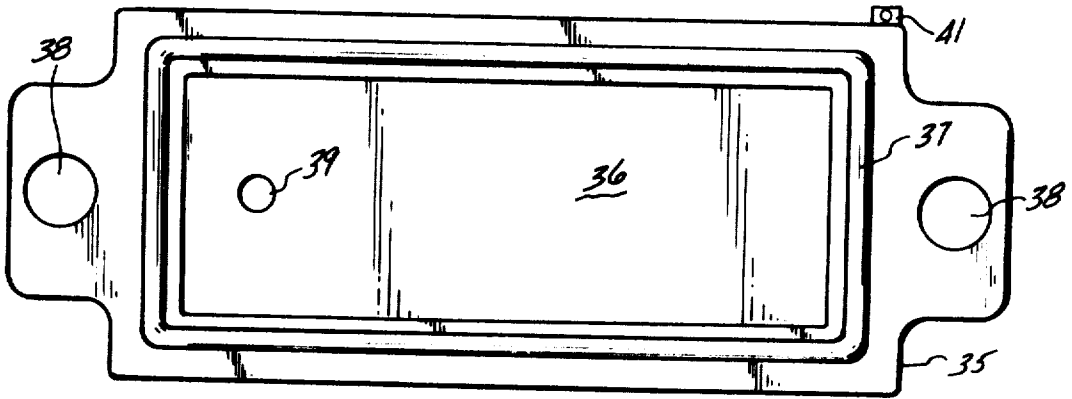


FIG-4

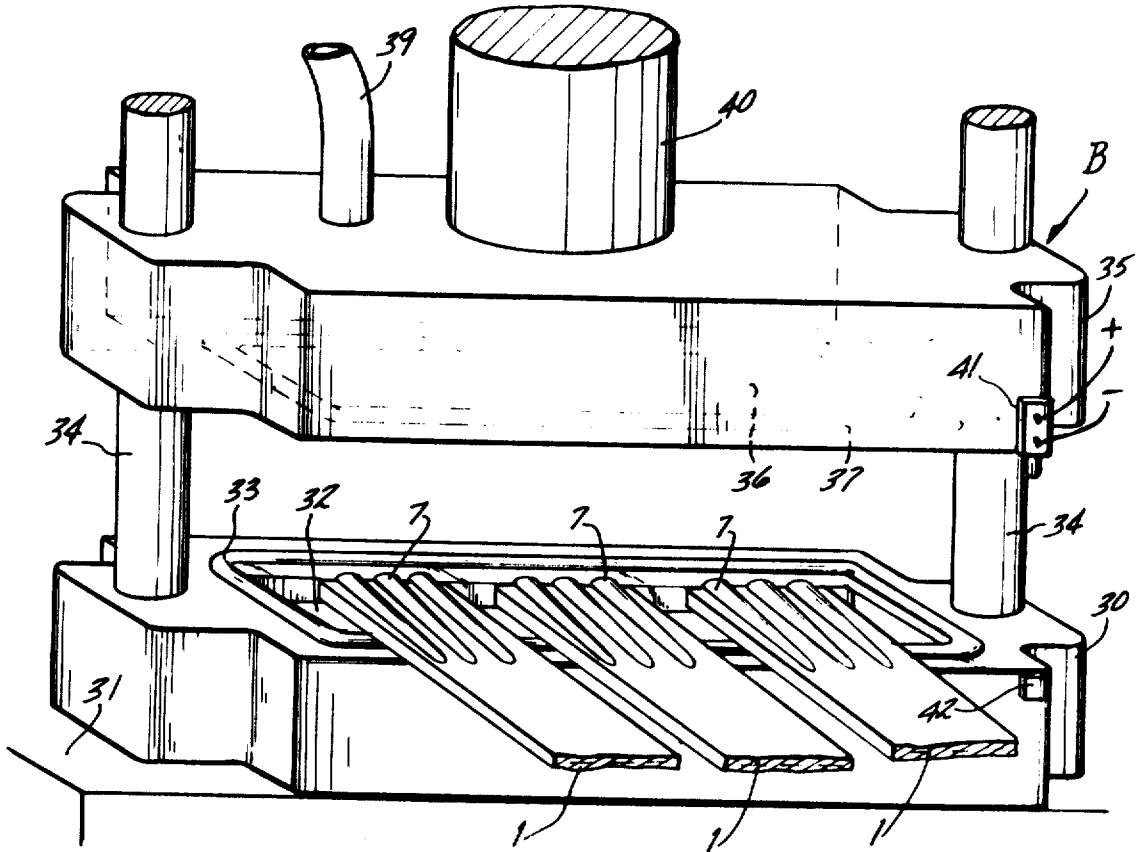


FIG-3

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INFLATION APPARATUS FOR METAL STRIP OR PANELS HAVING INFLATABLE FLUID PASSAGEWAYS

This invention relates to the inflation of metal articles having one or more inflatable passageways. The articles are normally in the form of a panel or strip and have at least one preformed opening connected to at least one passageway. The passageways in the panel or strip are inflated by clamping the preformed opening in an apparatus which has a pressure chamber for conveying fluid under pressure into the preformed opening. The preformed opening of the panel or strip is crimped but not completely closed when the panel or strip is clamped in the apparatus. Among the advantages of this approach are that it is more rapid than prior art techniques and more amenable to automatic operation.

In the past, a panel or strip having inflatable passageways was inflated by first preforming an opening, then placing the opening over an inflation needle, followed by clamping it in sealing engagement with the inflation needle.

This is not a desirable process because the panel or strip must be carefully positioned so that the inflation needle is within the preformed opening and then clamped as noted. Therefore, the process is slow and not amenable to automatic operation. Further, this process requires careful alignment between the panel or strip and the inflation needle, whereas the apparatus of the instant invention does not require such careful alignment.

It is accordingly an object of this invention to provide an apparatus for inflating metal panels or strips having inflatable fluid passageways.

It is a further object of this invention to provide an apparatus for inflating metal panels or strips having inflatable passageways, without the necessity of inserting members into the passageway.

It is a further object of this invention to provide a process for inflating metal strip or panels having inflatable fluid passageways.

Other objects and advantages will become apparent from the following description and drawings, in which:

FIG. 1 shows a series of perspective views of a typical strip to which this invention is applied.

FIG. 2 shows an exploded perspective view of an inflation apparatus in accordance with this invention adapted to manual operation.

FIG. 3 shows a perspective view of an inflation apparatus in accordance with this invention adapted to automatic operation.

FIG. 4 shows a bottom view of the top plate of the apparatus of FIG. 3.

Referring now to the drawings and especially to FIG. 1, there is illustrated a metal strip 1, exemplary of a metal panel or strip useful with this invention, after various stages of processing. The strip 1 with which this invention may be used may be fabricated by the method disclosed in U.S. Pat. No. 2,690,002, granted to Grenell on Sept. 28, 1954. For example, referring to FIG. 1A, a pattern of weld-inhibiting or stop-weld material 2 is applied to a clean surface of a strip of metal 3. A second strip of metal 4 having a clean surface is superimposed on the surface of the first strip 3, as shown, and the two strips 3 and 4 are secured together to prevent relative motion therebetween.

Thereafter, the two superimposed strips 3 and 4 are pressure welded together by rolling, so that the adjacent areas of the strips 3 and 4 which are not separated by the stop-weld material 2 become unified together. The rolling of the strips 3 and 4 results in reducing the thickness of the two superimposed strips 3 and 4 and in elongating the resultant strip 1 in the direction of rolling, while the width of the strip 1 remains substantially the same as in the initial width of the strips 3 and 4. Following the rolling operation, the resultant strip 1 is usually softened as by annealing to make it more pliable. If desired, it may be further rolled to the final gage, and again

softened as by annealing. The stop-weld material 2 results in the retention of unwelded portions 5 corresponding to the stop-weld pattern, which are sandwiched between the outer surfaces of the strip 1. After softening the strip 1, the unjoined portions 5 are usually expanded as in FIG. 1B to form passageways 6. This expansion is obtained by injecting a fluid under pressure of sufficient magnitude to permanently deform the strip 1 in the area of the unwelded portions 5 to form the desired passageways 6. It is to be understood, however, that other methods may be employed in the manufacture of the strip 1 or panels used with this invention. While the process has been described with respect to the formation of strip, it is equally applicable to the formation of panels.

In the past, strip or panels having inflatable fluid passageways were inflated by first preforming openings 7 connected to one or more of the inflatable fluid passageways, as shown in FIG. 1C. These preformed openings 7 were then positioned about an inflation needle (not shown) and clamped in sealing engagement to it. The instant invention provides a simple means for inflating such panels or strip 1 and eliminates completely the necessity of inserting an inflation needle or other similar device into the preformed openings 7 of the panels or strip 1.

In accordance with the instant invention, preformed openings 7 in the panels or strip 1 are made as in the past. They may be formed, for example, by using a vibrating chisel-like tool or mandrel which is forced into the end of the metal sandwich in the area of the stop-weld pattern to form the opening 7. Generally a preformed opening about one-half to 2 inches in length is satisfactory. A length of 1 inch is preferred.

Referring now to FIG. 2, there is shown an apparatus A in accordance with the instant invention. The apparatus comprises a first plate 10, a resilient sealing means 11 placed in a recess 12 in one face 13 of the plate 10; a second plate 14, a resilient sealing means 15 which is placed in a recess 16 in one face 17 of the second plate 14. A pressure cavity 18 in one or both of the plates 10 and 14, means 19 for communicating with the pressure cavity 18 for supplying a fluid under pressure, and means 20 for clamping the first plate 10 to the second plate 14 so that the resilient sealing means 11 and 15 in each plate, sealingly engage opposing surfaces of the strip or panel to be inflated.

The engagement is in the area of the strip 1 or panel which contains the preformed openings 7. As the first and second plates are clamped together, the preformed opening 7 is crimped at the point where the sealing means 11 and 15 engage it, but it is not completely closed, so that it is still possible to inflate the panel or strip. In the embodiment shown in FIG. 2, the sealing means 11 and 15 comprise O-rings. The clamping means 20 comprises a bolt which is passed through a hole 21 in the second plate 14 and screwed into a threaded hole 22 in the first plate 10.

In the embodiment shown, there is a pressure cavity 18 in each of the plates 10 and 14. Further, there is a relieved area 23 whose surface corresponds to the contour of the preformed openings of the panel or strip 1 which is to be engaged. The means for communicating with the cavity 18 for supplying the fluid under pressure, is merely a conduit 19 having a threaded portion at 24 which will accept a standard-type plumbing fitting.

In operation, the panel or strip 1 is placed on the first plate 10 so that its preformed opening 7 extends past the O-ring 11. The second plate 14 with its O-ring 15 is then placed over the top portion of the strip 1 and tightly clamped in place by means of the bolt 20. Then a suitable fluid under pressure is fed through the conduit 19 into a cavity 18 and from there into the preformed opening 7 of the panel or strip 1 so as to inflate the uninflated passageway therein.

The use of plates having relieved portions for easier alignment of the panel or strip 1 for inflation is not preferred. It is preferred to use unrelieved plates so that the apparatus may be employed with any type of strip or panel. In this preferred approach, the preformed openings are further crimped, how-

ever, they still remain open a sufficient amount for the fluid to pass through them to inflate the passageways. Generally, the sealing means completely surrounds the pressure cavity, however, other configuration could be designed. The sealing means may be a one piece O-ring or it may comprise a plurality of sections.

While the use of O-rings has been described, any suitable resilient sealing material having a desired configuration could be used. It is essential that the sealing means be resilient and extend out from the faces of the plates so the plates do not contact each other, for otherwise, the preformed openings in the panel or strip would be completely closed off. Further, the sealing means must be sufficiently resilient to provide an adequate seal under the pressures being employed without completely closing the preformed openings of the panel or strip.

In FIG. 3, there is shown a preferred apparatus B in accordance with this invention which is amenable to automatic operation. The first plate 30 is mounted to a suitable base 31. It contains a pressure cavity 32 surrounded by an O-ring 33 in a suitable groove. The first plate 30 has two shafts 34 mounted on it which guide the second plate 35 as it rides up and down them. The second plate 35 also contains a cavity 36 as shown in FIG. 4, and has an O-ring 37 in a groove surrounding the cavity 36. The second cavity has holes at 38 through which the shafts 34 mounted in the first plate 30 are placed, so that the second plate 35 can move up and down, and in and out of engagement with the first plate 30. The second plate 35 also has mounted within it a conduit 39 for supplying fluid under pressure to the cavity 32, 36. Also attached to the second plate 35, is a shaft 40 which is connected to a hydraulic cylinder or other press-type actuator (not shown). An electric switch at 41 on the second plate 35 engages an anvil 42 on the first plate 30 to stop the travel of the second plate 35 when it has sealingly engaged the first plate 30.

In operation, panels or strips 1 having preformed openings 7 are placed so that the preformed openings 7 traverse the O-rings and extend into the pressure cavity, defined by cavities 32 and 36. The second plate 35 is then lowered so that there is sealing engagement between the O-rings 33 and 32, and between the O-rings 33 and 37 and the panels or strips 1. A suitable fluid under pressure is fed into the cavity 32 and 36 and then into the panel or strips 1 through the preformed openings 7. This type of apparatus B is preferred because it does not require accurate positioning of the panel or strip 1 prior to inflation. It only requires that the preformed openings 7 be traversed by the O-rings 33 and 37.

The apparatus B is amenable to an automatic operation wherein a timed sequence of operations would take place. For example, the strip 1 would be fed to a point wherein the preformed openings 7 traverse the O-ring 33 and extend into the cavity 32. The second plate 35 would then drop so as to provide sealing engagement between the strips 1 and the O-rings 33 and 37. Movement of the second plate 35 could be controlled by means of a hydraulic cylinder (not shown) connected to a suitable external control circuit. The switch 41 is effective to stop the travel of the second plate when it is in sealing engagement as above noted. The pressure would be applied for a preset time sufficient to inflate the panel or strips 1. Then the second plate would be disengaged, the strip removed and the sequence repeated over again. Conventional techniques and circuits can be used to accomplish such a sequencing operation in an automatic fashion.

The process and apparatus of this invention are useful with panels or strips having a single inflatable fluid passageway or a plurality of such passageways. The passageways may have any desired configuration or pattern so long as they are connected to at least one preformed opening. Further, the panels or strips themselves may be formed from a plurality of sheets of metal.

The invention is applicable to sheet metal panels or strips as above described as well as to other forms of flat metal articles having inflatable fluid passageways. Examples are flattened seamless tubing, or other tubing which is in the flat condition and has uninflated passageways. Preferably, however, the invention is applicable to sheet metal articles as above described. The sheet metal employed may be made of aluminum, aluminum alloys, copper, copper alloys, steel or other suitable metal. The passageways are inflated using a suitable inflation medium such as air or water, at a pressure of approximately 100 to 3,000 p.s.i.

It is to be understood that the invention is not limited to the illustrations described and shown herein, which are deemed to be merely illustrative of the best modes of carrying out the invention, and which are suitable of modification of form, size, arrangement of parts and details of operation. The invention rather is intended to encompass all such modifications which are within its spirit and scope as defined by the claims.

1. An inflation apparatus for inflating at least one metal strip or panel containing at least one inflatable passageway with at least one preformed opening, comprising:

- a first plate;
- a first resilient sealing means mounted on one face of said plate, said first sealing means engaging one surface of said metal strip or panel at said preformed opening;
- a second plate;
- a second resilient sealing means mounted on one face of said second plate, said second sealing means engaging a second surface of said metal strip or panel at said preformed opening, said second surface being opposite said first surface;
- said first and second sealing means engaging said strip or panel so as to crimp, but not completely close, said preformed opening;
- at least one of said first and said second plates having a cavity for conveying fluid under pressure to said preformed opening of said strip or panel; and
- means communicating with said cavity for supplying fluid under pressure.

2. An inflation apparatus as in claim 1 wherein said first and said second resilient sealing means comprise O-rings

3. An inflation apparatus as in claim 2 wherein both said first and said second plates have a cavity for conveying fluid under pressure.

4. An inflation apparatus as in claim 3 wherein said O-rings completely surround said cavities.

5. An inflation apparatus as in claim 4 wherein said first plate and said second plate have a shape which is adapted to accept a plurality of panels or strips.

6. An inflation apparatus as in claim 1 which includes means for clamping said first plate to said second plate to provide said sealing engagement with said metal strip or panel.

7. An inflation apparatus as in claim 6 wherein said clamping means comprises a hydraulic press.

8. An inflation apparatus as in claim 7 which includes means for sensing the sealing engagement between said first and second sealing means and said metal strip or panel.

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