Aug. 15, 1944. G. E. FRANCK 2,355,792

METHOD FOR FORMING CLOSED TUBES

Original Filed Nov. 12, 1940

Fig. 1.

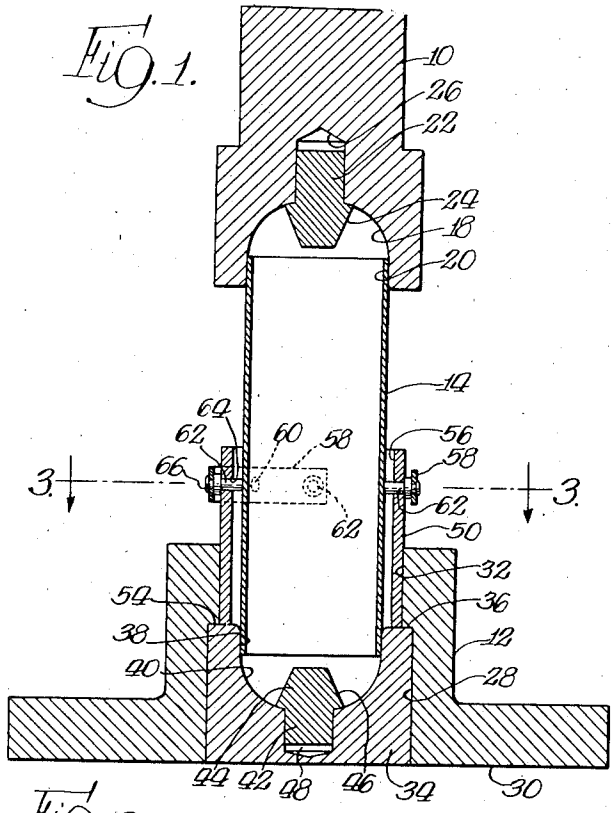


Fig. 2.

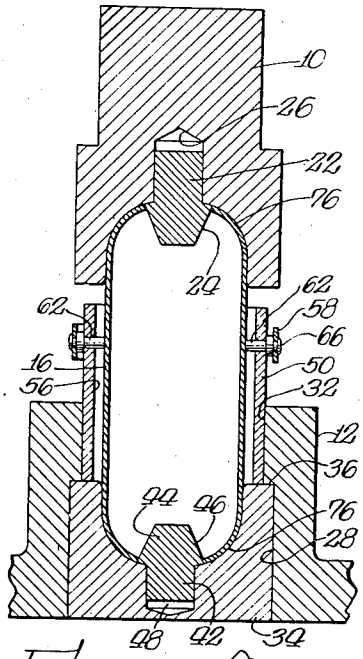


Fig. 3.

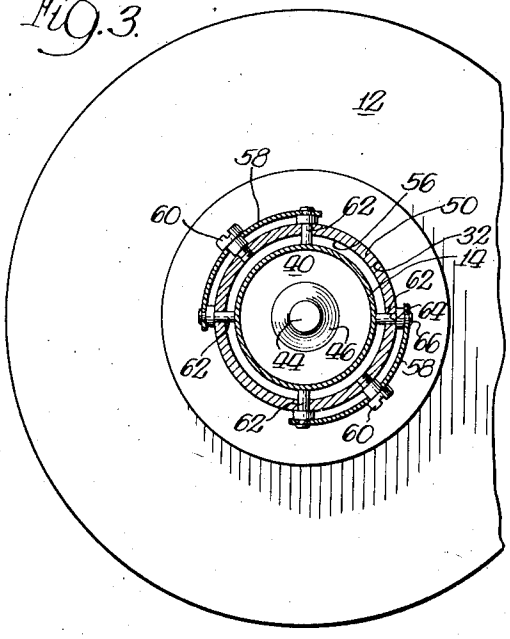
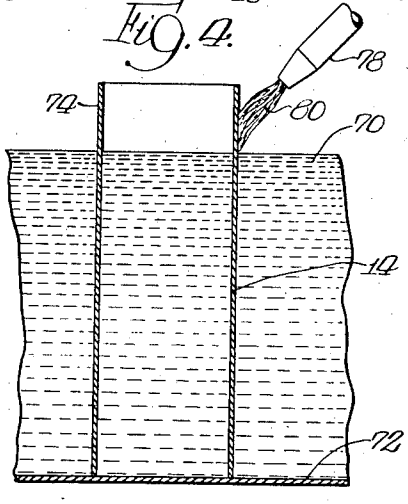


Fig. 4.



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2,355,792

METHOD FOR FORMING CLOSED TUBES

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Original application November 12, 1940, Serial No. 365,313. Divided and this application September 29, 1941, Serial No. 412,823

7 Claims. (Cl. 113—51)

My invention relates to containers or devices made of metal and formed from a single length of stock into tubes substantially closed at both ends.

This application is a division of my co-pending application Serial No. 365,313, filed November 12, 1940, Patent No. 2,309,181.

Among the objects of my invention is to provide a method for forming a new and improved metallic container body made from a single piece of tubular stock which is closed at both ends and which is of a design and character permitting it to be made quickly and inexpensively.

Another object of my invention is to provide a method of forming sections of ordinary tubular metallic stock into containers closed at both ends which includes a simple annealing step followed by a forming step which simultaneously substantially closes both ends of the tubular stock so that the resultant product is a closed container.

Still another object is to provide a method for making closed containers of tubular stock which includes an annealing step directed only to the portion of the stock which is to be formed followed by the steps of mounting the stock in suitable dies centering it precisely within the dies and then closing one or both of the previously annealed ends against a centering and spacing plug so that the closed end of the resultant product may have in it an aperture precisely centered, sized and forming a communicating passage through the end wall of the container.

With these and other objects in view, my invention consists in the combination of the various steps of my method whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in my claims and described herein, in which there is shown one way in which my method can be practiced, wherein:

Figure 1 is an elevational view in section showing upper and lower die platens and a length of stock in place prior to the forming operation.

Figure 2 is a vertical sectional view similar to Figure 1 showing the die platens in compressed position.

Figure 3 is a cross-sectional view taken on the line 3—3 of Figure 1.

Figure 4 shows a method of heat treating the end of the tubular stock which is to be formed.

It has previously been the custom to use tubular stock for devices such as filters, dehydrators, strainers, scale traps, etc., which are often used in liquid and gas lines where the liquid or gas is under considerable pressure or of such a nature as will leak out in quantity wherever even a very slight leak might occur.

It has likewise been the practice when making such devices to close the ends of the tubular stock either by providing threaded caps or when especially high pressures are encountered by attaching thereto flanges which are bolted together. Such constructions are relatively expensive and entail a large number of manufacturing operations. Moreover, even when so designed, the capped and threaded stock is unsuitable for very high pressures.

Metallic bodies having curved closed ends have frequently been found in the past to have great strength in proportion to the gauge of the metal formed into such rounded shapes. However, in providing a method for forming tubes of relatively small diameter into such shapes having rounded ends, a difficult problem is presented since all of the work must be performed upon the stock from the outside and no backing or supporting structure can be effectively positioned within the tube while the forming operation takes place.

This method and a similar apparatus therefore is directed to the provision of steps whereby tube stock of relatively small diameter may be cut and formed into containers comprising a single piece having rounded ends and which by reason of such construction have relatively great strength in proportion to the gauge of the metal forming the tubular stock.

One apparatus directed to the practice of such a method is shown on the drawing where an upper platen 10 is shown opposed to a lower platen 12 wherein each are provided with suitable recesses for positioning and compressing a length of tubular stock 14, as shown in Figure 1, into a desired form 16, shown in Figure 2.

The upper platen 10 has a recess comprising an annular curved portion 18 and a cylindrical portion 20. The cylindrical portion has a diameter substantially equal to the outer diameter of the tube stock 14 so that the stock may slide easily into the recess. At the center of the recess is a plug 22 having a conical end 24 extending into the recess and centered with respect thereto.

It will be noted that the conical surface 24 at its point of contact with the curved portion of the recess 18 is approximately at right angles thereto. An aperture 26 is provided in the platen for the reception of the plug, which plug might be provided with conical ends of various sizes.

The lower platen 12 has a cylindrical hole 28 extending inwardly from a bottom edge 30 and a cylindrical aperture 32 on the upper side smaller than the hole 28 and communicating therewith. Within the hole 28 is an insert 34 forming a part of the lower platen, with its lower surface flush with the surface 30 of the platen and an upper edge abutting a shoulder 36. The insert has a recess comprising a cylindrical portion 38 having a diameter substantially equal to the outer diameter of the tube stock 14 and an annular in-

wardly curved recess portion 40 similar to the recess portion 18 of the upper platen.

Likewise there is provided a plug 42 having an upper conical portion 44 extending centerably within the recess with the conical surface 46 at its point of contact with the curved portion 40 at substantially a right angle. The recess 48 is supplied for receiving the plug 42.

In the aperture 32 of the platen 12 a sleeve 50 is inserted until it abuts an upper annular rim 54 of the insert 34. The sleeve is designed to fit snugly within the aperture but has an inner diameter 56 substantially greater than the outside diameter of the tube stock 14. Opposed centering devices comprising spring members 58 are secured to the sleeve by means of screws 60. These spring members are normally arcuate in shape as shown in Figure 3, and of resilient material such as spring steel. These are secured to the sleeve in horizontal position.

At each end of each of the spring members there is provided a hole or slot within which is positioned a pin 62. The pin extends through a hole 64 in the sleeve within which it has a free sliding fit and has a cap 66 securing it to the end of the spring member.

In the apparatus shown, four pins are provided positioned in pairs and opposed to each other. The pins are permitted to move longitudinally with respect to their axes and are normally spring pressed into the position shown in Figure 3 by the spring members 58.

In Figure 4 there is shown a body 70 of relatively cool liquid such as water held in a container 72 and having a depth slightly less than the length of the tubular stock 14 permitting an end 74 to extend above the surface of the water. The length of the end 74 is substantially equal to the portion of the tube which is to be formed into a rounded closed end 76 as seen in Figure 2.

In the step illustrated in Figure 4, there is provided a torch 78 designed to impel a heat stream 80 against the exposed portion of the tubular stock. It is contemplated, however, and within the scope of my invention to provide a shallow bath of liquid such as lead heated to the temperature necessary for annealing the tubular stock in order that the stock might be dipped in it to the depth desired for forming the closed end 76.

Should pure lead not be available then the end to be dipped might be coated with grease or some similar substance in order to keep it clean during the heat or annealing operation. Similarly, electric means might be abutted against the tubular stock in order to properly heat it.

In operation a length of tubular stock is first measured to the proper size allowing for portions of it to be turned inwardly, then cut and the end edges properly squared. Next, using one of the forms of my method the stock is placed in a bath of relatively cool liquid to a depth such that the end protruding above the surface of the liquid is no longer than the length of the tubing stock desired to be heated and annealed.

The protruding end is then readily heated by a torch as shown in Figure 4, or by some suitable similar means, to a temperature preferably between 800° F. and 1200° F. The liquid bath prevents heat from passing to the central portion of the tubular stock. As soon as the stock has been heated to the proper temperature it can be quickly cooled as by tipping the stock over into the liquid or by dousing it in some acceptable manner by a cooling fluid. Next, where both ends of the tube are to be closed, the stock is inverted in the liquid bath and the opposite end heated and doused.

After this has been done the stock is placed in the cylindrical portion 38 of the recess in the lower platen as shown in Figure 1 by slipping it downwardly through the sleeve 50. When in this position the lower cylindrical portion 38 holds the bottom end and the pins 62 bearing against the side walls of the stock centered properly with respect to the recess and the conical end 44 of the plug 42. Next, the upper platen is lowered by suitable power machinery to the position shown in Figure 1, wherein the cylindrical portion 20 of the recess surrounds the upper annealed end of the tubular stock.

Then the platens 10 and 12 are forced together by power means and while being so forced together, the tubular stock is forced into the form 16, shown in Figure 2, while remaining in a carefully adjusted center position by the centering pins. During the compressing stroke the ends of the stock which have been annealed are formed over into the curved ends 76 lying flat against the annular curved portions 18 and 40, respectively, of the recesses. The end edges of the stock are driven inwardly into the recesses until they make edgewise contact with the conical surfaces 24 and 46 of the respective plugs 22 and 42.

When this operation has been completed, the platens can be readily separated one from another and the conical surfaces of the plugs withdrawn from the container thus formed. The container can then be readily lifted out of the lower platen and due to their resilient mounting the centering pins 62 will permit the withdrawal without obstruction. The apparatus is then ready for the next container forming operation.

In the meantime, the container 16 thus shaped may be further machined by reaming the ends formed by the plugs to size in preparation for the insertion of a standard fitting.

On occasions where a hot lead bath, or a hot liquid bath of some suitable character is used, the cut tube is dipped into it to a depth wherein annealing is required. The tube is permitted to remain in the bath until properly heated and is then removed and doused. Both ends are successively given the same treatment where both ends are to be formed.

There has thus been provided a method for making a single piece of tubular stock into a high-duty closed container which when equipped with the necessary fittings is suitable for use in high-pressure gas and liquid lines without danger of leaks and with a relatively minimum necessity for adjustment and repair.

Some changes may be made in the practice of the steps of my method without departing from the real spirit and purpose of my invention, and it is my intention to cover by my claims any modified method which may be reasonably included within their scope.

I claim as my invention:

1. The method of press forming a container having a relatively closed end from a single length of tubular stock of uniform wall thickness throughout its length comprising squaring the end, rendering said end softer and more easily worked than the body portion by heating the said end of said stock to an annealing temperature for a distance inwardly from the end less than the full length of said stock and not exceeding the portion thereof to be formed into said closed end, then applying pressure at both

ends and uniformly to all parts of said squared end and forcing in one operation said squared end from its initial position toward the body of the container and laterally inwardly at all sides thereof to its final position at a point spaced from the central axis and forming the wall of the stock adjacent said end into a smooth inwardly turned curve with the end terminating in an aperture substantially smaller in diameter than the diameter of said stock.

2. The method of using a single press movement for forming a container having relatively closed ends from a single length of tubular stock of uniform wall thickness normally of rigidity insufficient to resist the effect of applied pressure without buckling comprising squaring the ends to be formed, reducing the rigidity of the ends to an amount less than the mid-portion by heating both ends of said stock to an annealing temperature for a distance inwardly from each end less than half the length of said stock and not exceeding the portion thereof to be formed into said respective closed ends, allowing said heated ends to cool, then applying pressure uniformly to all parts of said squared ends and forcing said ends simultaneously toward each other and laterally inwardly at all sides thereof to a position spaced from the central axis forming the original tubular wall adjacent each end into a smooth inwardly turned curve with the end edge terminating in an aperture substantially smaller in diameter than the diameter of said stock.

3. The method of using a single press movement for forming a container having relatively closed ends from a single length of drawn metallic tubular stock of uniform wall thickness normally having a resistance to deformation insufficient to resist the effect of applied pressure comprising squaring the ends, rendering said ends less resistant to deformation without change in the shape thereof by heating both ends of said stock to a temperature of between 800° F. and 1200° F. for a distance inwardly from each end less than half the length of said stock and not exceeding the portion thereof to be formed into said respective closed ends, allowing an interval for said heated ends to cool, then applying pressure uniformly to all parts of the squared ends and forcing said ends simultaneously toward each other and laterally inwardly at all sides thereof to a position spaced from the central axis forming the original tubular wall adjacent each end into a smooth inwardly turned curve with the end edge terminating in an aperture substantially smaller in diameter than the diameter of said stock.

4. The method of forming a container having relatively closed ends from a single length of drawn metallic tubular stock adapted to be softened when subjected to heat comprising squaring the ends, placing the stock upright in a bath of relatively cool fluid, separating by means of liquid level the portion of the stock to be treated from the remaining portion of the stock, softening the end by heating the exposed end to an annealing temperature, reversing the stock end for end and softening the other end by heating said end to an annealing temperature, then applying pressure uniformly to all parts of the squared ends and simultaneously compressing both ends toward each other and laterally inwardly at all sides thereof forming the wall adjacent each end into a smooth inwardly turned curve with the end terminating in an aperture substantially smaller in diameter than the diameter of said stock.

5. The method of forming a container having relatively closed ends from a single length of metallic tubular stock of uniform wall thickness adapted to be softened when subjected to heat comprising squaring the ends, placing the stock upright in a bath of relatively cool fluid, exposing a portion of the end equal in length to the portion of said tube adapted to be formed into one of said closed ends, softening said end by heating the exposed end to a temperature of between 800° F. and 1200° F., immersing the heated end in said bath, reversing the stock end for end and softening a corresponding portion of the other end by heating to a temperature of between 800° F. and 1200° F., immersing said other end in said bath, then applying pressure simultaneously to all parts of the squared ends and compressing both ends toward each other and laterally inwardly at all sides thereof forming the wall adjacent each end into a smooth inwardly turned curve with the end terminating in an aperture substantially smaller in diameter than the diameter of said stock.

6. The method of forming a container having relatively closed ends from a single length of soft drawn brass tubular stock comprising squaring the ends of the stock, placing each end of said stock successively in a bath of liquid in the nature of pure molten lead having a temperature between one sufficient to soften the brass and one not greater than the annealing temperature of said brass to a predetermined depth not greater than the portion of said stock to be curved into said respective closed ends, removing and dousing said stock in relatively cool liquid, then applying pressure simultaneously to both ends and forcing said ends toward each other and at the same time laterally inwardly at all sides thereof forming the wall adjacent each end into a smooth inwardly turned curve with the end terminating in an aperture substantially smaller in diameter than the diameter of said stock.

7. The method of press forming a container having relatively closed ends from a single length of metallic annealable tubular stock comprising squaring the ends, greasing each end of said stock a predetermined distance inwardly not less than the length of said stock to be formed into said closed ends, placing each end of said stock in a bath of molten lead having a temperature between 800° F. and 1200° F. to a predetermined depth not greater than the portion of said stock to be closed, removing and dousing said stock in relatively cool water, then applying pressure uniformly to all parts of the squared ends and simultaneously pressing both ends toward each other and laterally inwardly at all sides thereof to a position spaced from the central axis of the tube forming the wall adjacent each end thereof into a smooth inwardly turned curve with the end terminating in an aperture substantially smaller in diameter than the diameter of said stock.

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