Aug. 20, 1946. C. J. BURCH 2,406,059

PROCESS OF SPINNING HOLLOW ARTICLES

Filed June 10, 1943

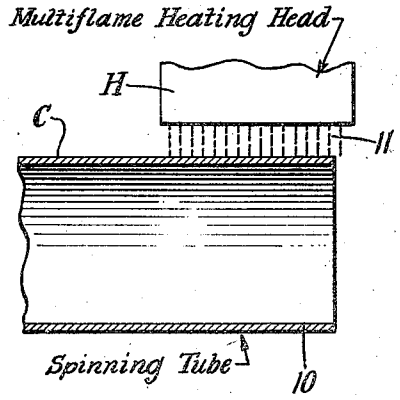


Fig. 1.

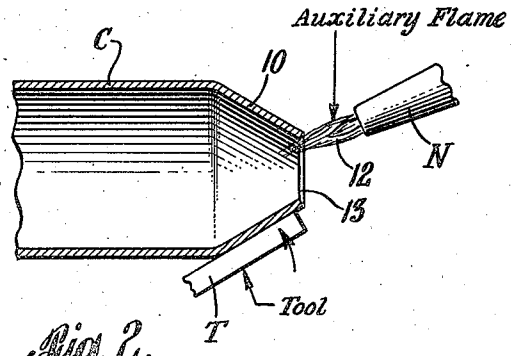


Fig. 2.

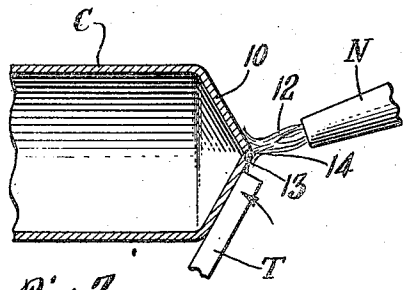


Fig. 3.

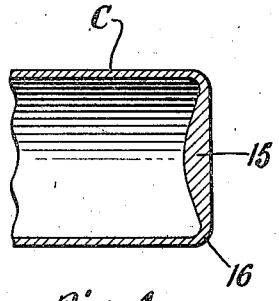


Fig. 4.

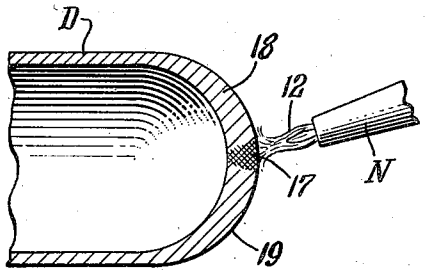


Fig. 5.

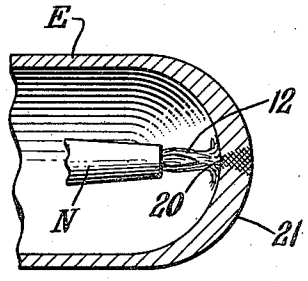


Fig. 6.

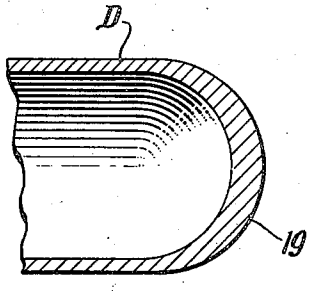


Fig. 7.

INVENTOR
CHARLES J. BURCH
BY
ATTORNEY

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PROCESS OF SPINNING HOLLOW ARTICLES

Charles J. Burch, Plainfield, N. J., assignor to The Linde Air Products Company, a corporation of Ohio

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2 Claims. (Cl. 29—148.2)

1

This invention relates to the art of metal working and more particularly to spinning end closures in hollow articles.

In spining the open end portion of a metal tube or cylinder, the end of the blank is closed at the center. The central portion of the closure, however, is non-homogeneous, being traversed by a hair-line pipe or valley, which is highly undesirable especially in chemical bombs and the like. To overcome this in the past it has been proposed to drill out the defective central portion of the spun closure and fill the resulting hole with a plug. It has also been proposed, in the case of brass parts, to put a drop of solder on the formed closure as a precaution against leaks. Such proposals involve additional material and added steps in making the finished product and are not entirely satisfactory in avoiding leaks in the case of gas containers in which the gas is under a minimum pressure of the order of 100 pounds per square inch, for example.

Therefore, the main object of this invention is to provide an improved spinning process of closing the open end of a metal cylinder or tube, which overcomes difficulties and disadvantages of the prior art and results in an end closure that is entirely free of oxide inclusions and is homogeneous throughout. Another object of the invention is to provide a tube end closure spinning process which eliminates the hair-line pipe from the resulting end wall. A further object of the invention is to provide an improved product.

In a hot spinning operation where the tube end is to be closed, it has been the practice to heat such end prior to, or during forming, to a temperature that would allow the metal to be easily spun inwardly. The center of the end closure would thus be formed shut, and a forge weld simulated. However, the formation of oxide on the metal surface thus forced together, led to oxide inclusions and a doubtful closure at the end. According to the present invention, by means of an auxiliary flame, directed at the center of the end just as the edge is being forced closed, a true fusion weld is made, thus assuring that the oxides will be melted and forced out, and solid metal result.

More particularly, according to the present invention, there is provided the process of forming hollow articles, which comprises closing the open end of a metal cylinder by a spinning operation, the final closure being incidentally subject to a hair-line of oxide inclusions, and preventing such hair-line by directing a high-temperature flame against the work so as to melt the metal in the closure immediately prior to the completion of the spinning operation, and extruding the melted metal and all oxide inclusions from the resulting closure, so that the metal is homogeneous throughout.

2

Referring to the drawing:

Fig. 1 is a fragmentary view partly in cross section and partly in side elevation of a rotating tube having its end portion heated by the flames of a multiflame heating head;

Fig. 2 is a similar view of the tube at the beginning of the spinning operation, an auxiliary flame being directed against the work so as to melt the metal at the zone of closure;

Fig. 3 is a similar view showing the auxiliary flame directed against the work at the zone of closure during the completion of the spinning operation;

Fig. 4 is a similar view of the completed closure without oxide inclusions;

Fig. 5 is a fragmentary view in cross section of a cylinder having a semi-spherical end closure made according to the invention;

Fig. 6 is a similar view with the auxiliary flame directed against the inside of the closure; and

Fig. 7 is a similar view of the resulting closure which is entirely free of oxide inclusions.

Referring to Figs. 1, 2, 3 and 4 of the drawing, the end portion 10 of a tube or cylinder C is heated by the group of flames 11 extending longitudinally of the end portion 10 and directed perpendicularly against the same from a multiflame heating head H which is mounted in proper lateral position with respect to the tube C, the latter being rotated about its longitudinal axis by any suitable machine (not shown). The flames 11 are preferably produced by burning a mixture of oxygen and acetylene which may be mixed either externally or internally of the head H. Post-mixed oxy-acetylene flames are preferred as the heating means, although the end portion 10 of the tube C may be heated in a furnace or by induction or in any suitable way including friction. After the end portion 10 of the tube C has been suitably heated, a tool T applies pressure inwardly against such heated portion 10 as the tube C rotates about its longitudinal axis, and the heated portion 10 is spun or turned inwardly, as shown by Fig. 2. In order to prevent hair-line cracks or oxide occlusions at the center of the resulting closure, according to the invention, an auxiliary flame 12, preferably an oxyacetylene flame from a blowpipe

nozzle N, is directed against the extreme annular end 13 of the rotating work C.

As the spinning operation continues, as shown by Fig. 3, the auxiliary flame 12 is kept directed against the edge 13 of the tube C, so that a puddle or appreciable amount 14 of molten metal is formed at the center of the closure. As the closing operation is completed, some of the melted metal and all of the oxide inclusions are axially displaced, leaving an end wall 15 the interior of which is entirely free of oxide inclusions, the metal being solid and homogeneous throughout such interior.

By way of example, a tube C having an outside diameter of 1.35 inches, and a wall thickness of 16 gauge, was heated by the multiflame oxy-acetylene heating head H, and a square end closure 15 formed by the flat faced tool T. While the end was being closed, a single auxiliary flame 12, burning about 9 cubic feet per hour of oxygen and a like amount of acetylene, was directed manually at the point of the closing cone just before it was completely closed. A true fusion weld thus was produced at the center of the closure, which closure was gas tight under 100 pounds per square inch of hydrogen.

Hair-line cracks or oxide inclusions at the center and all doubts as to whether the tubes are perfectly sealed are eliminated by the use of an auxiliary flame according to the present invention.

In the example given above, a No. 6 tip attached to a W–17 oxweld blowpipe was used to obtain the auxiliary flame 12. After the main heating head H was shut off, the forming operation was started. The auxiliary flame 12 was directed against the edge 13 of the tube C in a substantially axial direction. As the forming progressed, this edge 13 moved toward the center somewhat like a shutter, decreasing the diameter of the opening at the smaller end of the conical portion. When such diameter reached ⅜ inch to ¼ inch, the edge 13 was visibly molten and ran together forming a puddle 14 at the center. Thus, while the end portion was still in the form of a cone, the end of the tube was perfectly sealed. Further forming pushed in the cone, leaving a flat end 15 and a substantially square annular corner 16.

Referring to Fig. 5, the open end of a metal cylinder D is shown being closed by a hot spinning operation. Oxide inclusions in the final closure are entirely prevented, according to the invention, by directing the flame 12 against the work so as to melt the metal at 17 in the closure 18 immediately prior to the completion of the hot spinning operation which closes the end wall 19 of the cylinder D, as shown by Fig. 7. In this example, the end wall 19 of the cylinder is semi-spherical, and is entirely free of oxide inclusions, the metal being solid and homogeneous throughout.

Fig. 6 shows a modification wherein the flame 12 is directed continuously against the work E at the zone 20 of closure from the inside of the cylinder E, during the completion of the hot spinning operation to eliminate oxide inclusions entirely from the closed end 21 of the cylinder. The resulting product is like that shown in Fig. 7.

A feature of the invention is the actual melting of the metal at the edge before the opening is completely closed, to form a real fusion weld, as distinguished from a simulated forge weld of the prior art in which the metal is said to "weld" itself together at the line or point of closure. The latter produces an inferior weld that includes objectionable oxides which are eliminated by the present invention.

In the modification of the invention shown in Fig. 6, it will be understood that the internally disposed auxiliary flame 12 may be directed against the end closure in accordance with the invention while a forming tool is being applied to the outside of the semi-spherical end portion of the tube or cylinder E.

Practice of the present invention entirely eliminates the hair-line crack or oxide inclusions which was present in all closures formed by spinning operations known prior to the invention. Thus, the invention reduces the cost and improves the resulting product to such an extent that it has gone into commercial use on a large scale in the manufacture of chemical bomb burster tubes and the like.

What is claimed is:

1. A method of closing an end of a tubular metal article which comprises rotating said article about its longitudinal axis while initially applying a group of heating flames longitudinally to a portion of the article extending back from the open end to be closed; applying pressure inwardly against such heated end portion while the article is rotating, to spin inwardly said heated portion and the periphery of its end edge and thereby progressively close said end of said article; and, before said end is completely closed and while continuing such rotation and such application of inward pressure, directing an auxiliary flame, separate from said group of flames, against said end edge and the part adjacent thereto, to provide sufficient additional heat to melt metal along said edge at the final closing zone, whereby oxide inclusion is eliminated from said closing zone as said end is completely closed during the continuance of such rotation and such application of inward pressure.

2. A method of closing an end of a tubular metal article as claimed in claim 1, wherein said auxiliary flame is disposed within said tubular metal article and is directed against the interior side of said end edge and the interior surface of the part adjacent to said edge.

CHARLES J. BURCH.