Oct. 18, 1966 H. K. RADER 3,279,237

MANDREL FOR BENDING TUBING

Filed May 20, 1963 2 Sheets-Sheet 1

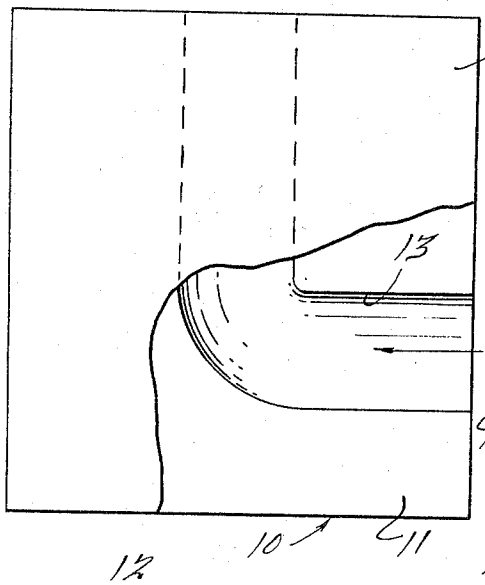
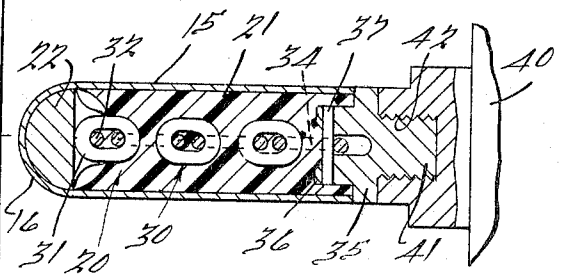


Fig. 1.



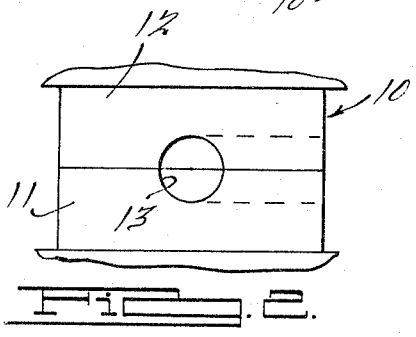


Fig. 2.

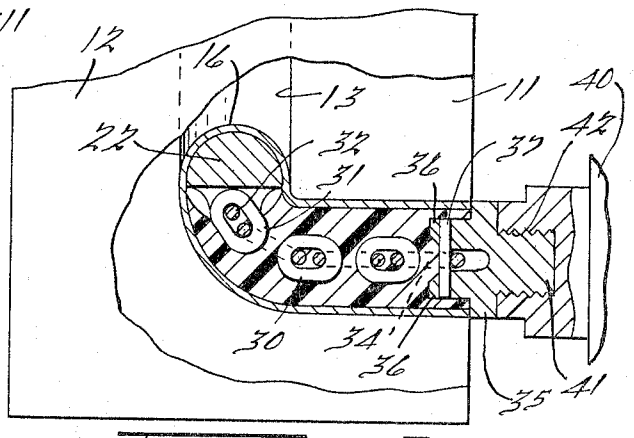


Fig. 3.

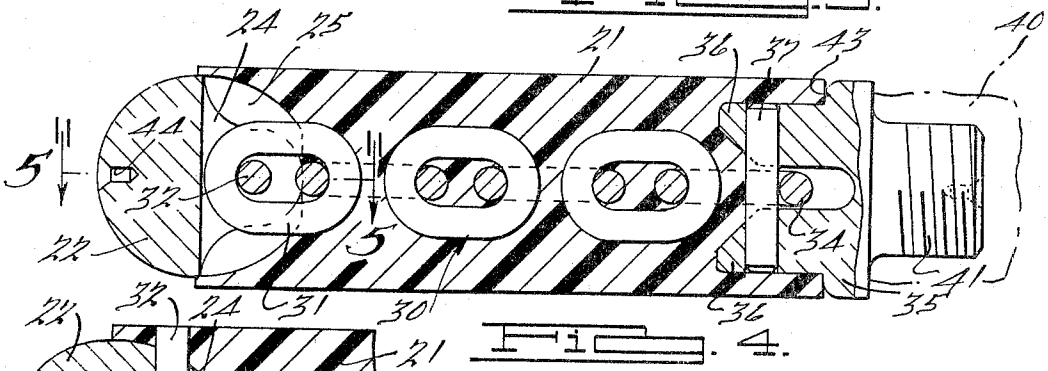


Fig. 4.

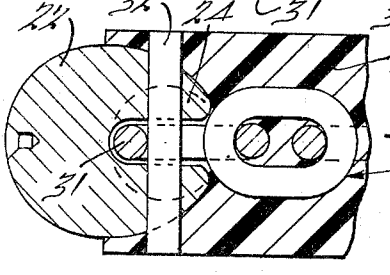


Fig. 5.

INVENTOR.
Harold K. Rader.
BY
Harness, Dickey & Pierce
ATTORNEYS

Oct. 18, 1966 H. K. RADER 3,279,237

MANDREL FOR BENDING TUBING

Filed May 20, 1963 2 Sheets-Sheet 2

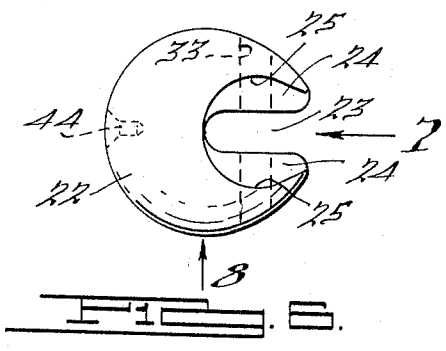


FIG. 6.

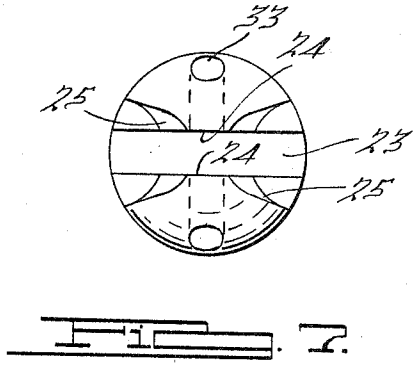


FIG. 7.

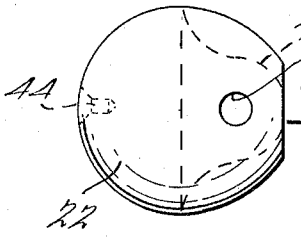


FIG. 8.

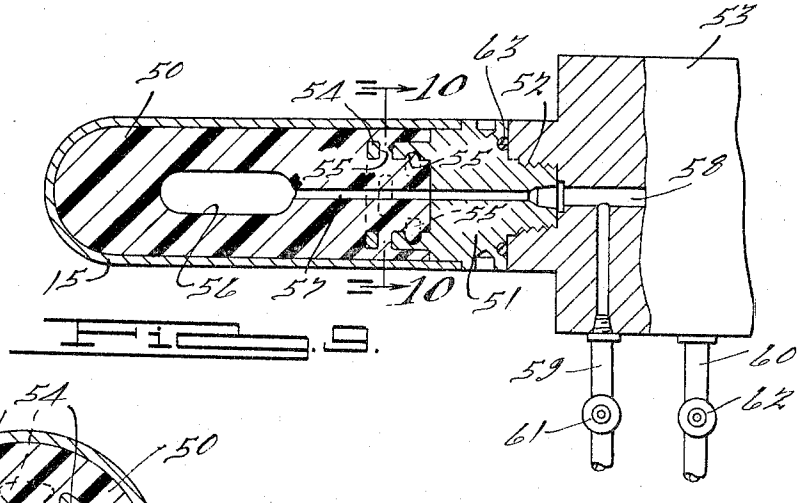


FIG. 9.

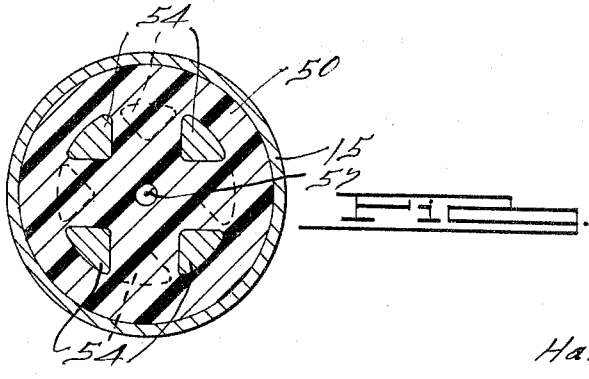


FIG. 10.

INVENTOR.
Harold K. Rader
BY
Harness, Dickey & Pierce.
ATTORNEYS

United States Patent Office 3,279,237 Patented Oct. 18, 1966

3,279,237

MANDREL FOR BENDING TUBING

Harold K. Rader, Port Huron, Mich., assignor to Mueller Brass Co., Port Huron, Mich., a corporation of Michigan

Filed May 20, 1963, Ser. No. 281,507
6 Claims. (Cl. 72—466)

This invention relates to apparatus for use in bending tubes, and more particularly to an improvement in mandrels for use in effecting bends in tube blanks by forcing the tube blanks into an arc having the desired configuration.

Heretofore, a conventional method of supporting a tube blank during bending in a die consisted of filling the tube blank with a low melting point material, such as a ductile metal alloy, prior to forming the tube into its bent shape by forcing it into the die. The low melting point alloy, when solidified, acted as a support to prevent the tubing from collapsing during the formation of the bend in the die, and after the tube was bent, the metal alloy was removed by melting the same by the application of heat.

It is an important object of the invention to eliminate the necessity for the use of such metal alloys and the objections incident to its use and to provide a permanent mandrel which will adequately support the tube during the bending operation but which may be quickly and easily withdrawn from the tube after the forming operation so that it may be repeatedly reused.

Another object of the invention is to provide a mandrel which has the required flexibility to readily bend with the tubing but which may be wihdrawn from the finished bends.

Another object of the invention is to provide a mandrel of this type, which while flexible, will adequately support the tube against collapsing or deformation during the bending operation.

Still another object of the invention is to provide a mandrel of this type which will eliminate or substantially reduce scratching of the interior surface of the tube during the bending thereof.

It is still a further object to provide a mandrel having great mechanical strength and which is capable of maintaining substantially unchanged the interior cross-sectional dimensions of the tube being bent.

The various objects of the invention, and other advantages, are attained by providing a mandrel with a body formed of a plastic material which is substantially incompressible so as to provide adequate lateral support for the tube during the bending operation but which has sufficient longitudinal flexibility to readily bend with the tubing as the blank is bent and which has sufficient longitudinal strength to permit it to be withdrawn from the finished bend.

The various objects and advantages, and the novel details of construction of two practical embodiments of the invention will become more apparent from the following description, the appended claims and the accompanying drawings, in which:

FIGURE 1 is a plan view showing a die and a tube blank on the mandrel in its preliminary position during the bending process;

FIGURE 2 is an end elevational view of the die in closed position, the same being reduced in size;

FIGURE 3 is a fragmentary view showing the die and the mandrel and tube blank in an intermediate position during the bending process;

FIGURE 4 is an enlarged longitudinal sectional view of the mandrel;

FIGURE 5 is a fragmentary sectional view taken substantially on the plane indicated by line 5—5 in FIGURE 4;

FIGURE 6 is a side elevational view of the nosepiece of the mandrel;

FIGURE 7 is a view of the nosepiece looking in the direction of the arrow 7 in FIGURE 6;

FIGURE 8 is a view of the nosepiece looking in the direction of the arrow 8 in FIGURE 6;

FIGURE 9 is a view showing a modified form of mandrel with a tube blank on the mandrel; and

FIGURE 10 is an enlarged transverse sectional view taken substantially on the plane indicated by line 10—10 in FIGURE 9.

Referring to the drawings and more particularly to FIGURES 1, 2 and 3, a conventional die 10 is illustrated which comprises a lower die member 11 and an upper die member 12 adapted to be clamped together and having confronting recesses to form a die cavity 13. The die cavity shown is of a shape to form a conventional elbow.

The tube blank 15, which is to be formed into the elbow, is shown as provided with a closed end 16 to prevent the extrusion of the mandrel 20 through the tube blank during the forming operation. However, it will be understood that instead of a closed end 16, the end may be only partially closed. The mandrel 20 shown in FIGURES 1 to 8 of the drawings comprises an elongated body 21 which is formed of a plastic material or of any other suitable type material which is relatively incompressible. In practice, it has been found that a plastic material of the polyurethane type is particularly adaptable for forming the body portion 21.

The material of the body portion 21 is relatively incompressible so as to provide adequate lateral support for the tube blank 15 during the bending operation. The material should also be sufficiently longitudinally flexible to readily bend with the tube as the blank is bent.

At one end of the body 21 a rounded nosepiece 22 is provided preferably formed of metal or other relatively hard material. This nosepiece 22 as shown particularly in FIGURES 6, 7 and 8, is provided with an opening or cutaway portion 23 adapted to receive a link of a connecting chain, yet to be described. The nosepiece is provided wih two lugs 24 which define the opening 23, and the adjacent material of the nosepiece is cut away as at 25 to provide clearance for the chain link which is to be secured within the opening 23. In the embodiment illustrated, the nosepiece is provided with a recess 44 which enables the nosepiece to be centered during its fabrication.

A flexible chain 30 is imbedded in the body 21 and has an end link 31 thereof located in the opening or cutaway portion 23. This link is secured to the nosepiece by means of an anchor pin 32 which extends through a transversely extending aperture 33 in the nosepiece which intersects the opening 23. Thus, the end link 31 of the chain is mounted in the opening 23 for relative pivotal movement with respect thereto as the nosepiece 22 travels around the bend in the die cavity 13.

The other end of the chain 30 has its end link 34 connected to a base 35. This link 34 extends through bifurcations 36 projecting from the base 35 and is secured in place by an anchor pin 37 passing through the bifurcations and intersecting the end link 34.

The base is secured to a plunger or ram 40 as, for instance, by having a threaded stud 41 thereon engaging a threaded opening 42 in the plunger or ram 40. The base 35 is provided with an annular forwardly presented shoulder 43 which engages the end of the body 21 so that

when the plunger or ram 40 moves forward, the mandrel 20 will move from the position shown in FIGURE 1 to that shown in FIGURE 3 so as to push the mandrel 20 and tube blank 15 into the die cavity 13. It will be understood that this movement is continued until the tube bending operation is complete and the elbow is formed.

With the mandrel thus far described, it will be apparent that the tube blank 15 and mandrel 20 are inserted as a unit into the die cavity and pushed therein until the forming operation is complete. During this time, the relatively incompressible material of the body 21 provides adequate lateral support for the tube to prevent collapsing or deformation thereof, the material of the body 21 having sufficient longitudinal flexibility to readily bend with the tubing as the blank is bent. When the bending operation is completed, the plunger or ram is retracted and through the chain 30 the mandrel is withdrawn so that it is then ready for the next bending operation. The closed or partially closed end portion of the tubing is thereafter cut off thereby forming an elbow open at each end which may thereafter be further processed as desired to form a finished product.

In FIGURES 8 and 9, a modified form of construction is illustrated. In this form of construction, the mandrel comprises a body 50 upon which the tube blank 15 is placed. The reference character 51 indicates the base or pressure applying member which is connected by a threaded portion 52 with a movable portion 53 of a ram mechanism (not shown). The base 51 is anchored to the mandrel body 50 by having apertured projections 54 provided with apertures 55 imbedded in the body. In this manner, the mandrel body 50 and the base 51 are integrated.

The mandrel body 50 is provided with a chamber 56 connected by a passageway 57 to a passageway 58 formed in the ram 53. Connected to the passageway 58 is a supply conduit 59 for supplying fluid under pressure to the chamber 56. The reference character 60 indicates a return line by means of which the pressure fluid may be released from the chamber 56. Control of the fluid pressure may be accomplished by means of valves 61 and 62 provided in the conduits 59 and 60, respectively.

The base 51 may be provided with an annular recess to receive a sealing gasket 63 so as to seal the connection between the ram 53 and base 51 against the passage of fluid pressure therebetween.

With this form of construction, the mandrel is expanded and forced into intimate contact with the tubing and is internally supported by supplying fluid under pressure to the chamber 56 during the forming operation. After the forming operation is completed, the pressure is released from the chamber 56 thereby reducing the diameter of the mandrel, and the mandrel may then be withdrawn by retracting the plunger or ram 53.

In this form of construction, the body 50 of the mandrel is preferably made of a material having the same characteristics as described in connection with the first form of construction so that the mandrel will provide lateral support for the tube and will bend longitudinally and follow the tube blank around the bend in the die cavity. However, in this form of construction, the lateral support for the tube is provided by the pressure in the chamber 56.

While preferred embodiments of the invention have been described and illustrated herein, it will be understood that various changes and modifications may be made without departing from the spirit of the invention.

What is claimed is:

1. A tube bending mandrel for bending a hollow tube blank having an open end and an, at least partially, closed opposite end, said mandrel comprising an elongated body portion adapted to extend into the tube blank, and a base connected to one end of said body portion, said body portion being formed of a relatively flexible plastic-like incompressible material and being longitudinally flexible, said body portion terminating in a nose portion with said body and nose portions being of a size to be generally insertable into the tube blank from its open end with said nose portion being of a size to engage the opposite end of the tube blank.

2. The mandrel of claim 1 with said body portion being cylindrical and having a selected cross-section no greater than the cross-section defined by the interior of the tube blank and said nose portion having a maximum cross-section in a plane extending transversely to the axis of said body portion no greater than said selected cross-section.

3. The mandrel of claim 1 with said nose portion being of an inflexible construction and further including flexible connection means connecting said nose portion and said base to prevent separation thereof when the mandrel is withdrawn from the tube blank.

4. The mandrel of claim 3 with said flexible connection means being a chain embedded in said body portion.

5. The mandrel of claim 3 with said base portion having a surface portion engageable with said one end of said body portion with said surface portion having a cross-section no greater than the cross-section of said body portion.

6. The mandrel of claim 1 with said body portion being cylindrical and having a selected cross-section no greater than the cross-section defined by the interior surface of the tube blank and said nose portion having a maximum cross-section in a plane extending transversely to the axis of said body portion no greater than said selected cross-section, said nose portion being of an inflexible construction, a flexible chain embedded in said body portion and connecting said nose portion and said base to prevent separation thereof when the mandrel is withdrawn from the tube blank, said base portion having a surface portion engageable with said one end of said body portion with said surface portion having a cross-section no greater than said selected cross-section.

References Cited by the Examiner

UNITED STATES PATENTS

406,992	7/1889	Burgrin	72—466
1,978,452	10/1934	Flodin	72—466
2,450,580	10/1948	Conzelman	72—166
2,918,102	12/1959	Klein	72—166
3,180,130	4/1965	Avera	72—465

CHARLES W. LANHAM, *Primary Examiner.*

L. A. LARSON, *Assistant Examiner.*