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TOOL FOR CLOSING AND OPENING A METAL TUBE

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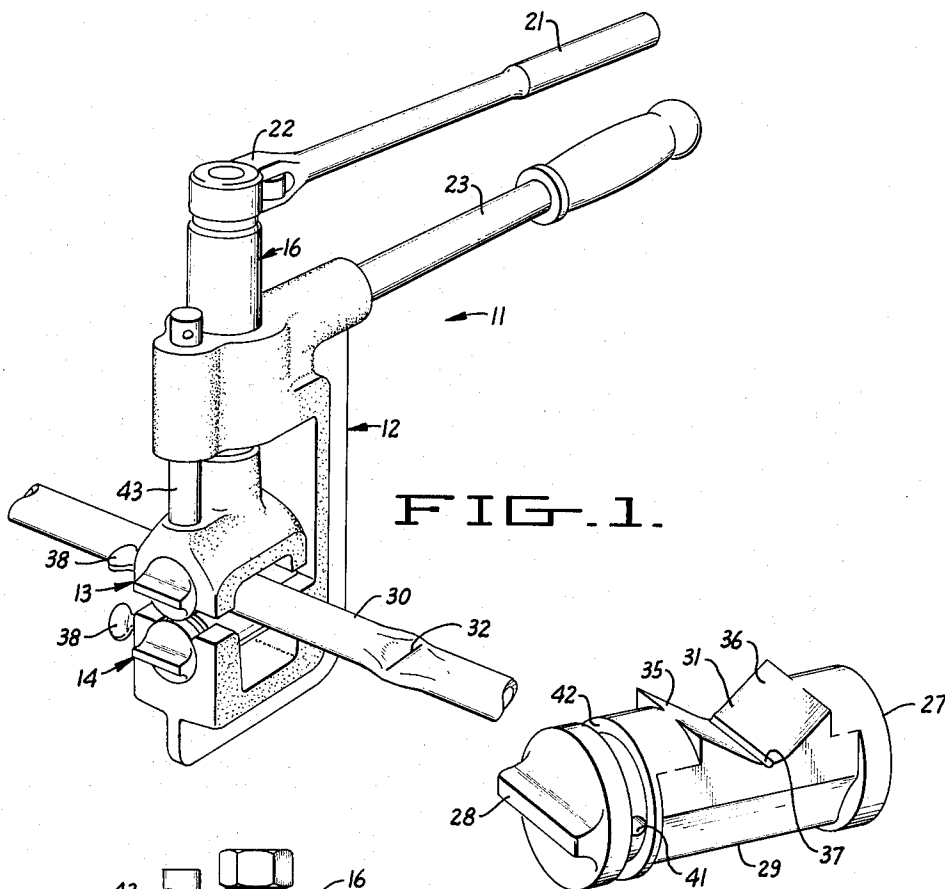


FIG. 1.

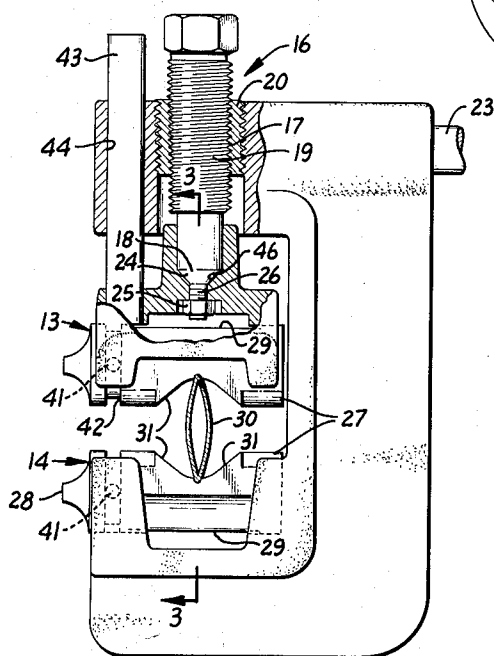


FIG. 2.

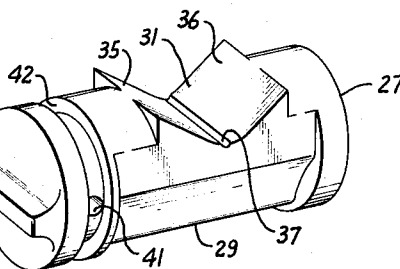


FIG. 4.

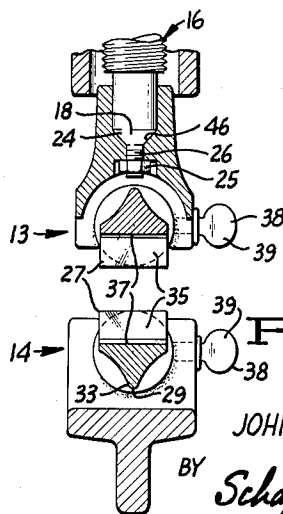


FIG. 3

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TOOL FOR CLOSING AND OPENING A METAL TUBE

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6 Claims. (Cl. 72-416)

The present invention relates to improvements in a Tool for Closing and Opening a Metal Tube, and more particularly to an improved tube shut-off tool or apparatus having die surfaces capable of squeezing a metal tube or pipe into a closed position and also die surfaces capable of substantially re-shaping the tube to an open position. In other words the invention relates to a tool having the function of a temporary shut-off valve capable of use anywhere on the pipe.

Frequently it is desirable to shut-off metal tubes serving as water lines, gas lines or the like at some point in the line without utilizing main valves that would necessarily shut-off other lines not under repair. It is known that where the pipes are composed of soft metal or other deformable material, the tube may be clamped shut and re-opened with a tool containing dies for this purpose and means for clamping the dies relatively toward each other. Certain tools of this nature have been provided which are satisfactory for the purpose, but which generally require that the dies be removed to convert the tool from the form capable of closing the tube to the form capable of opening the tube. In addition, certain of these tools require partial disassembly in order to position the tool in a clamping position on the pipe or tube.

Other problems which have arisen include the formation of microcracks where the tube is squeezed together and re-opened, and these cracks serve as a weak point for corrosion that will ultimately weaken the tube. Accordingly, it is desirable to provide a clamping tool of this nature in which various improvements are effected to solve these and other problems which have been encountered in this type of tool.

Such a tool has been developed and is the subject of my co-pending United States application Serial No. 183,581, filed March 29, 1962, entitled Method and Apparatus for Closing and Opening a Metal Tube and the present invention is a continuation-in-part of this application. The present invention is an improvement over the structure of my co-pending application and contains means for positively assuring alignment of the dies with respect to each other and means for retaining proper alignment of the pipe and the tool during re-opening of the pipe.

Thus it is a primary object of this invention to provide an improved clamping tool for closing and opening a permanently deformable tube such as a copper pipe with a pair of dies adapted for easy adjustment of the dies and simplified application of the tool to the pipe.

Another object is to provide a clamping tool of the character described having rounded contacting die surfaces for squeezing the tube shut which minimize injury to the pipe such as the formation of small cracks.

A further object of this invention is the provision of an improved apparatus for closing and opening a deformable tube which is capable of performing these operations without seriously reducing the capability of the tube for holding high fluid pressures.

Still another object is to provide an apparatus for closing and opening a deformable tube of the character described which opens the tube to substantially its original shape so as to not unduly restrict the flow of fluids there-through.

Yet another object is to provide a clamping tool for closing and opening a deformable tube in which the clamp-

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ing action is effected through a single screw means having a special thrust bearing.

Further objects and advantages of my invention will be apparent as the specification progresses, and the new and useful features of my Tool for Closing and Opening a Metal Tube will be fully defined in the claims attached hereto.

In general, any deformable tube may be closed and opened according to the present invention although the invention has been particularly directed to such an operation on copper tubes. It has been found that ordinary copper tubes and even those having relatively thick walls such as are used for standard water pipes may be closed and re-opened according to the invention with substantially no reduction of flow characteristics or pressure retaining ability. However, it is contemplated that this tool may be suitable for use with other tubes or pipes such as polyethylene or other shapable plastics, and even iron, steel or aluminum tubes where the walls are sufficiently thin and the metal is sufficiently deformable to be closed and re-opened by the closing and opening dies of this invention.

The preferred form of my invention is illustrated in the accompanying drawing forming a part of this specification, in which:

FIGURE 1 is a perspective view illustrating the apparatus for closing and re-opening a deformable tube in position preparatory to squeezing the tube closed and also illustrating how the pipe appears after being squeezed shut;

FIGURE 2, an elevational view, partly in section, illustrating the tool of the invention in operative position for reopening the tube;

FIGURE 3, a cross-sectional view substantially as seen from line 3-3 of FIGURE 1; and

FIGURE 4, an enlarged view of a die member utilized in the invention.

While I have shown only the preferred form of my invention, it should be understood that various changes or modifications may be made within the scope of the claims attached hereto without departing from the spirit of the invention.

Referring to the drawings in detail, there is shown a shut-off or clamping tool 11 for closing and re-opening a deformable tube, comprising a frame 12 which is preferably C-shaped as shown herein, and which carries a first section 13 and a second section 14 at a spaced distance from each other. The distance between the first and second section is variable through means 16, which is adapted to move the first section toward and away from the second section, and includes a screw 17 attached for free rotation on the first section by means of a thrust bearing 18. Screw 17 is threadably engaged with said frame by threads 19 which engage the internally threaded collar 20 mounted in the frame, see FIGURE 2. Preferably, screw 17 carries a handle 21 to supply leverage, and the handle preferably includes a ratchet 22 for easy operation. Frame 12 also carries a handle 23 in order to facilitate operation.

Although the preferred form illustrated in the drawings shows a single screw in combination with the above mentioned handles and ratchet, it is apparent that other forms may be used and that more than one screw could be used for clamping. However, the form here shown is preferred, because it provides an efficient operation with a comparatively simple structure. Clamping is effected through screw 17 by engagement of thrust surface 24 with the first section 13, while nut 25 which is fixed on threaded extension 26 serves to lift the first section operatively as the screw is rotated in reverse.

The clamping tool 11 also contains die members 27 carried on the first and second section respectively each

having cooperating die surfaces for closing and re-opening a tube when forced relatively together. As shown in the drawings, die members 27 are both rotatably mounted in their respective positions in frame 12 so that different surfaces of the die may be moved to operative positions. Rotation may be effected by raised handles 28 so as to be capable of being turned by hand.

The die members 27 each have a laterally extending die surface 29 on one side thereof for squeezing a tube such as copper pipe 30 to a closed position, and a die surface 31 on the other side thereof for opening a tube such as copper pipe 30 which has been squeezed to the closed position as seen at 32 of FIGURE 1. The die surface 29, which is adapted to clamp a tube or pipe closed, has a generally V-shaped cross-section and extends laterally across the full diameter of the pipe. Preferably the apex of the V is rounded into the legs of the V as at 33, see FIGURE 3 in order to avoid sharp corners or edges. It has been found that sharp edges form cuts or grooves into the pipe which form cracks when the pipe is re-opened and the use of rounded surfaces solves this problem.

Die surface 31 which is used for re-opening the pipe, includes a recess 34 formed by substantially rectangular faces 35 and 36 disposed substantially perpendicular to each other and adapted to fit over one-half of a pipe. Extending across the die surface 31 at the intersection of rectangular faces 35 and 36 is a grooved slot 37 adapted to fit over the edge of the pipe at the area where the pipe has been squeezed closed. These grooved slots are important in clamping the pipe within the die so as to return the pipe in proper position where it is being re-opened, and also to prevent the flattened edges of the pipe from being re-opened to such an extent that internal cracks may develop where the metal is worked.

In my copending application, the die surfaces were semicircular in configuration and cut into substantially round die members. However, it has been found in practice that the reopened tube does not return to the completely round shape due to incomplete re-rounding of the folds at each end of squeezed section 32. This incomplete re-shaping allowed slight variations from a completely aligned re-opened section.

The present invention solves this problem and provides perfect alignment by the use of rectangular faces 35 and 36. These faces are nearly flat although preferably slightly concave to hold the pipe as it fills out to nearly normal shape. The use of full rectangles or squares is important in assuring perfect alignment of the re-opened section of the tube.

In order to provide the desired die surfaces in precise position and in order to maintain such precise positions, lock means 38 are provided on each of the sections 13 and 14 of frame 12, see FIGURE 5. As shown herein, each lock means consists of a thumb screw 39 threaded into section 13 or 14 having an end adapted to fit into the holes 41 of die members 27. In the embodiment here shown, there are two die surfaces oppositely disposed on each of the dies and therefore hole 41 extends clear through the die members to present openings disposed 180° from each other. When the thumb screws 39 are retracted, their ends are held in guide slots 42 of the die members and ride therein as the die members are rotated.

In operation, the copper tube or similar pipe to be closed is examined and an appropriate place for closing selected by the operator. In the event that the pipe is in the ground, sufficient digging is carried out to allow the clamping tool to be placed in position and the handles operated. With the closing position selected and prepared, the clamping tool 11 is placed on the pipe by opening the screw 39 and positioning die members 27 so that the V-shaped die surfaces 29 are opposed and locking the die surfaces in position by tightening thumb screw 39 into the appropriate openings of holes 41. The first section is also moved away from the second section if

necessary by rotation of screw 17 so as to provide a sufficient opening for the pipe to fit therebetween.

The tool is then placed over pipe 30 as shown in FIGURES 1 and 2 by inserting the pipe 30 through the opening in the C frame 12. The proper alignment is held and clamping is begun by rotating handle 21 while holding the clamp against rotation by means of handle 23. In this way, the first section 13 is forced against second section 14 so that pipe 30 is squeezed flat as shown at 32. A more complete illustration of this closing operation is given in my copending application cited above and such material is incorporated herein by reference.

In order to achieve the best closure, it is important that the die members 27 of both sections retain their alignment. In order to resist the tendency of the first section to rotate on rotation of screw 17, holding means in the form of a post 43 is provided on the first section, and this post is held against lateral movement but free for axial movement in hole 44 of frame 12.

It has also been found that the large clamping forces obtained by screw 17 tend to cause slight misalignment as the sections are clamped over the pipe, particularly on re-opening of the pipe. Thus the present invention provides means for using these forces to maintain alignment. Specifically, thrust surface 24 of thrust bearing 18 is constructed in a frusto-conical configuration and socket 46 of the first section 13 has a conforming frusto-conical surface. Thus an increase of the clamping force causes an increased tendency for proper alignment.

With the pipe thus closed, work may be conducted on the downstream side of the fluid line without loss of material due to leakage, because an exceptionally good shut-off is obtained. When the work to be carried out is comparatively simple, and the off time comparatively short, it may be desirable to leave the shut-off tool in this position while work is being carried out. However, in the event that the work is to be of long duration, or it is desired to use the clamping tool for other jobs, it may be desirable to remove the clamping tool from pipe 30. When the clamping tool is thus removed, the pipe is no longer free from leakage. In such a case an auxiliary clamp may be used as described more completely in my co-pending application.

When it is desired to re-open the pipe, the clamping tool 11 is removed and adjusted for re-opening the pipe. This adjustment is achieved by opening thumb screws 39 and rotating the die members 27 180°. In this way, die surfaces 31 are brought into opposed position and locked by tightening thumb screws 39 so that the ends thereof engage in the holes 41.

With the clamping tool 11 prepared for re-opening the pipe, the tool is slipped on the pipe and an edge of the closed pipe is fitted into the grooved slot 37 of the die surface 31 in the second section 14 of the tool. Handle 21 is then rotated to bring the first section toward the second section with the clamping tool held so that grooved slot 37 of die surface 31 of the first section engages the other edge of the closed pipe. With both edges so engaged, handle 21 is rotated further and the pipe begins to re-open as shown in FIGURE 2. Handle 21 is then rotated further until the two die surfaces 33 meet, and at this time the pipe 32 is substantially re-shaped to its original configuration.

As pointed out above, the folded portions of the pipe are not flattened out and in this way the pipe is not completely re-rounded. This is desirable to preserve the strength characteristics of the pipe where the severe fold occurred. However, tests have shown that the frictional effect or pressure drop cross a piece of pipe which has been closed and re-opened in this manner is only a matter of say about three feet for a ¾" pipe. This three feet of equivalent pipe length is considerably less than that for most conventional pipe fittings.

From the foregoing description it is seen that I have provided an improved apparatus for opening and closing a deformable tube which is simple in construction and

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efficient in operation. In addition, it is seen that the use of my tool has very little adverse effect on the pipe closed and re-opened thereby.

I claim:

1. A shut-off tool for pinching closed and squeezing open a deformable metal tube, comprising a first section containing a first die member rotatably mounted therein, a second section containing a second die member rotatably mounted therein, said first and second die members each containing a pipe closing die surface and a pipe opening die surface on the opposite side thereof, lock means on each of said first and second sections for holding the die surfaces of the die members in operative position for closing the tube and in operative position for opening the tube, mounting means for holding the first and second sections in spaced relation, and screw means engaging the mounting means for moving the first and second section relatively toward each other with a clamping force to provide pinching and squeezing forces on the tube, said screw means containing a screw in threaded engagement with the mounting means and having a thrust bearing at an end thereof rotatable within a bearing socket carried by said first section for retaining proper alignment of the first section with the second section during pinching and squeezing operations.

2. The shut-off tool defined in claim 1 in which the thrust bearing has a frusto-conical surface and the socket has a conforming frusto-conical surface.

3. The shut-off tool defined in claim 1, in which the pipe closing die surfaces are each constructed with a pair of substantially rectangular surfaces intersecting at a common side of each with a groove being formed at the intersection thereof and the rectangular surfaces being disposed at substantially right angles.

4. A shut-off tool for pinching closed and squeezing open a deformable metal tube, comprising a first section containing a first die member rotatably mounted therein, a second section containing a second die member rotatably mounted therein, said first and second die members each containing a pipe closing die surface and a pipe opening die surface on the opposite side thereof, said pipe closing surfaces each being formed with a pair of substantially rectangular surfaces intersecting at a common side of each with a groove being formed at the intersection thereof and the rectangular surfaces being disposed at substantially right angles, lock means on each of said first and second sections for holding the die surfaces of the die members in operative position for closing the tube and in operative position for opening the tube, mounting means for holding the first and second sections in spaced relation, screw means engaging the mounting means for moving the first and second sections relatively toward each other with a clamping force to provide pinching and squeezing forces on the tube, said screw means containing a screw in threaded engagement with the mounting means and having a thrust bearing at an end thereof rotatable within a bearing socket carried by said first section for retaining proper alignment of the first section with the section during pinching and squeezing operations, said thrust bearing having frusto-conical surface and the socket having a conforming frusto-conical surface, and a guide post carried on the first section and slidable within the mounting means for holding the first section against rotation on rotation of the screw.

5. A shut-off tool for pinching closed and squeezing open a deformable metal tube, comprising a frame having

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a first section and a second section at a spaced distance from said first section with an open side whereby the frame may be moved laterally with respect to a tube to position the tube between said first and second section, screw means in threaded engagement with the frame and carrying the first section on one end thereof through a thrust bearing fitting within a bearing socket for allowing relative rotation and maintaining proper alignment of the first section with the second section during pinching and squeezing operations, said first section containing a first die member rotatably mounted therein, said second section containing a second die member rotatably mounted therein, said first and second die members each containing a pipe closing die surface and a pipe opening die surface on the opposite side thereof, and lock means on each of said first and second sections for holding the die surfaces of the die members in operative position for closing the tube and in operative position for opening the tube.

6. A shut-off tool for pinching closed and squeezing open a deformable metal tube, comprising a frame having a first section and a second section at a spaced distance from said first section with an open side whereby the frame may be moved laterally with respect to a tube to position the tube between said first and second section, screw means in threaded engagement with the frame and carrying the first section on one end thereof through a thrust bearing fitting within a bearing socket for allowing relative rotation and maintaining proper alignment of the first section with the second section during pinching and squeezing operations, said thrust bearing having a frusto-conical surface and the socket having a conforming frusto-conical surface, a guide post carried on the first section and slideable within the frame for holding the first section against rotation on rotation of the screw, said first section containing a first die member rotatably mounted therein, said second section containing a second die member rotatably mounted therein, said first and second die members each containing a pipe closing die surface and a pipe opening die surface on the opposite side thereof, said pipe closing die surfaces each being formed with a pair of substantially rectangular surfaces intersecting at a common side of each with a groove being formed at the intersection thereof and the rectangular surfaces being disposed at substantially right angles, and lock means on each of said first and second sections for holding the die surfaces of the die members in operative position for closing the tube and in operative position for opening the tube.

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