United States Patent [19]

Duffy

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[54] **BEADING TOOL**

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[52] **U.S. Cl.** **72/75,** 72/120
[51] **Int. Cl.** **B21d 39/14**
[58] **Field of Search** 72/75, 120

[56] **References Cited**

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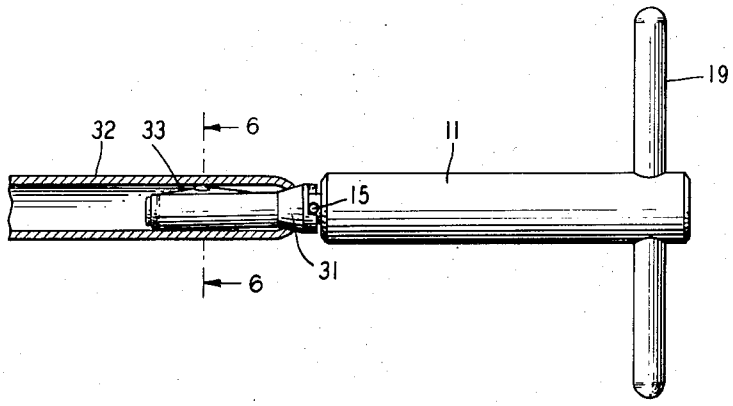
[57] **ABSTRACT**

A tool for manually forming outwardly shaped continuous beads in deformable tubing, for use with various tube fittings, is described. The beads are formed by a rolling member which is cam actuated outward during tool operation, to permanently deform tubing, thereby creating a fitting shoulder. The tool is shaped to eliminate the need for deburring, reaming or correcting minor deformation of tube diameter before use.

8 Claims, 7 Drawing Figures



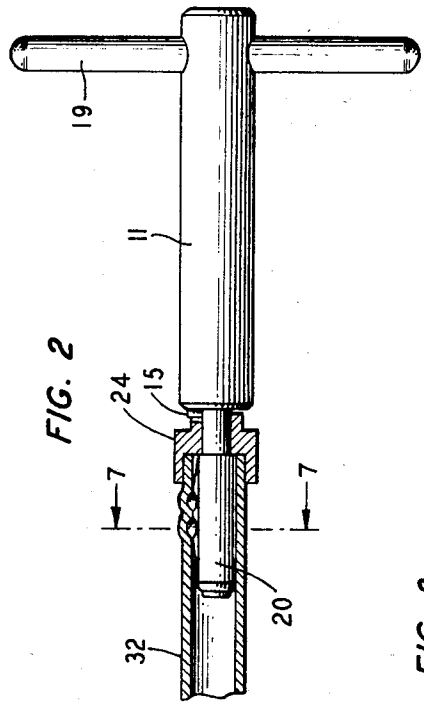


FIG. 2

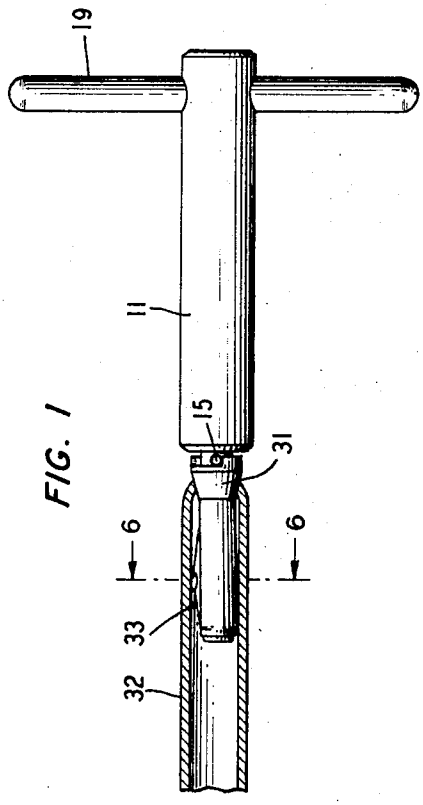


FIG. 1

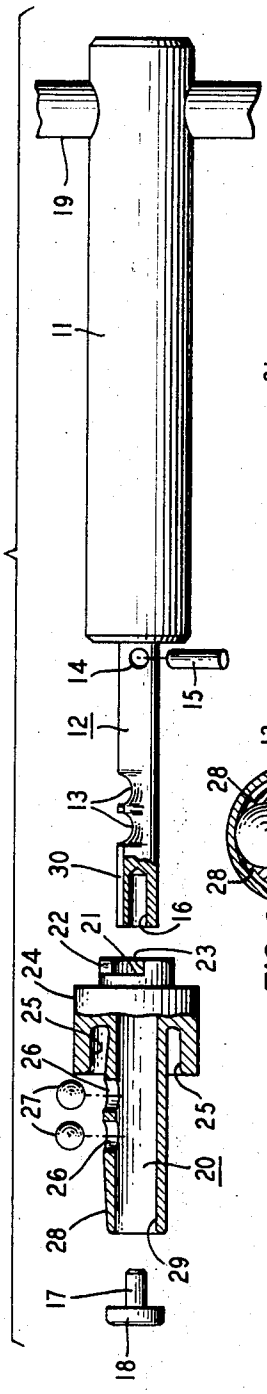


FIG. 3

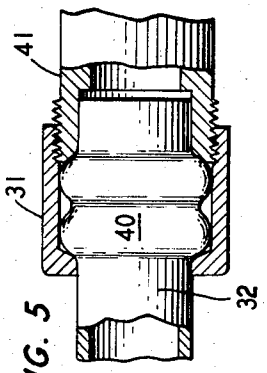


FIG. 5

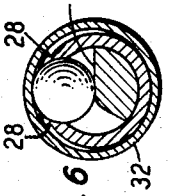


FIG. 6

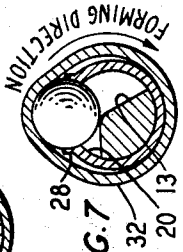


FIG. 7

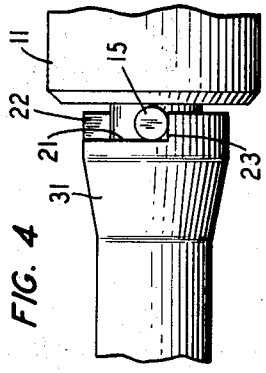


FIG. 4

BEADING TOOL

BACKGROUND OF THE INVENTION

This invention relates to arrangements for manually, or machine forming, a bead (or beads) in deformable tubing (copper, etc.). It also relates to a tool for forming a compression-type interfitting surface on such tubing.

One of the most widely used compression fitting makes use of a threaded coupling (tee or elbow, etc.) as a body, an internally threaded nut, and a ring (or ferrule) which is clamped between them to form gas/water pressure tight joint. In practice such fittings are often not pressure tight due mainly to the problem of sealing the interfitting surfaces. Poor fittings are a result of tubing deformation causing an out-of-round relationship between the ring and the tubing, or of improper torqueing of the nut. If too much torque is applied to the fitting, the tubing collapses and the collasped section must be cut away and a new ferrule obtained to remake the joint. Extra ferrules are not always on hand or not easily found among other spare parts because of their small size. Also the remaining tubing section may be of an unusable length, thereby creating the need for installing a completely new section of tubing plus the labor and parts cost needed to remake existing fittings.

Accordingly there is a need for a tool that can form in the tubing itself, an equivalent or superior shoulder for use with these standard fittings and thereby eliminate the dependencey on such rings.

There presently exists a tool used primarily in the plumbing trade that forms a narrow bead or shoulder on tubing for a special application such as lavatory and sink installations. To work with those bead surfaces special fittings have been developed. There are however various shortcomings in these tools. Before they can be used the tubing end must be deburred and reamed, and to a degree the tubing must be reshaped to restore its original true diameter. This is a time consuming process that often must be repeated. In addition a different tool with matching reamer/deburrer is required for each different tubing inside diameter. As stock tubing is normally specified in the trade by outside diameter and wall thicknesses there is a needless multiplicity of these tools to accomodate all possible diameters. Moreover, if one had a tool for every possible combination of tube diameter and wall thickness, they would probably fill an ordinary sized tool box. Another shortcoming of these existing tools concerns the shoulder for limiting tool entry into the tubing. These shoulders are customarily perpendicular to the tool axis and requires an inordinate amount of axial pressure for frictional engagement. Often an external radial clamping force, such as pliers, is additionally needed to start a bead which must be used with reasonable care to avoid accidently deforming the tubing.

Accordingly, it is an object of this invention to provide a beading tool that shapes the tubing itself in such a fashion as to act in place of a customary ring or ferrule in a compression fitting.

It is another object of this invention to furnish a beading tool which does not require deburring, reaming or reshaping of minor variations in tubing circumference prior to its use in a beading operation.

It is yet another object of this invention to furnish a beading tool that is universally useable for a particular tubing outer diameter within the range of commonly used wall thicknesses.

A further object of this invention is to provide a beading tool having a positive engagement with the tubing end thereby eliminating a need for an inordinate amount of axial pressure to form beads.

Still another object of this invention is to furnish a beading tool with greatly improved characteristics for extending the useful life of the tool.

SUMMARY OF THE INVENTION

These and other objects of the invention are achieved in accordance with an illustrative and preferred embodiment of the invention which comprises a bead forming tool usable with deformable tubing such as ordinary copper tubing. Advantageously the tool is particularly designed for ease of insertion in that it is shaped round and proportionally small at the extreme entry end, and has a tapered rib that enlarges axially to a point where a bead roller is retained in a positioning hole. This shape achieves a minimum profile objective, offers maximum strength at stress points and makes the tool useable over a wider range of tubing sizes. Moreover, this shape enables the tool to be used without deburring or reaming the tubing entrance.

Once the tool is inserted into the tubing a slight clockwise rotation of the handle lifts a rolling member radially outward relative to the tube axis and into engagement with the interior surface of the tubing. This lifting action is achieved by means of an internal shaft, contoured beneath the member, that moves a few degrees relative to an outer cylindrically shaped member containing the positioning hole. As the handle is turned further the rolling member or roller, is raised to its maximum radial height. Further clockwise rotation then forms a continuous bead in the tubing as determined by the proportions of all the components.

The tool also has an enlarged cylindrically shaped section beyond the tapered rib with contoured surfaces for creating a wedging action with the tube end to minify the axial pressure needed for starting and maintaining the beading action.

Two basic embodiments of this invention are disclosed. The first embodiment with all the aforementioned advantages forms a single bead about the circumference of a tube and is designed to be used with standard fittings developed for the plumbing industry.

The second embodiment simultaneously forms two parallel beads a precise distance apart and from the tubing end. This embodiment is considered unique in its advantages and also in the fact that no prior art tools exist for the purpose of eliminating the rings used in customary compression fittings. Since the tubing itself is shaped to cooperate with these standard fittings, a more effective seal is achieved with superior joint strength approaching the rating of the tube in use.

DESCRIPTION OF THE DRAWINGS

These and other objects and features, including the application of the principles of this invention to automatic machine processing of metals, will become more apparent upon a reading of the following description. It is intended that this description be considered in connection with the attached drawing which consists of:

FIG. 1 showing a single beading tool after insertion into a tubing section and prior to forming of the bead;

FIG. 2 showing a double beading tool inserted into a tubing section and depicting the engagement between the beading members and the inner tubing wall with the resultant deformation at start of bead forming;

FIG. 3 showing an exploded partially sectioned view of the double beading tool;

FIG. 4 showing an enlargement of the engaging taper and rotation limiting pin of the single beading tool;

FIG. 5 showing a sectionalized view of a standard compression fitting as used with a tube in which a double bead has been formed;

FIG. 6 showing a sectional view taken perpendicular to the axis of FIG. 1 showing the relation of the rolling member to cam actuating surface after initial insertion; and

FIG. 7 showing a sectional view taken perpendicular to axis of FIG. 2 showing the rolling member in a raised position due to cam actuation.

DETAILED DESCRIPTION

At the outset it is to be appreciated that the single bead and double bead tools are similar in many respect and for that reason the double bead tool only is fully detailed herein. Referring now to FIG. 3 the double bead tool is comprised of a cylindrically shaped handle body **11** with a projection of reduced diameter, hereinafter referred to as shaft **12** which embodies profile cam surfaces **13** (functionally described in greater detail hereinafter); hole **14** perpendicular to the axis and on the centerline of shaft **12** being angularly related to surfaces **13** and being sized for force fitting of limit pin **15** therein; and axially aligned hole **16** sized for force fitting of projection **17** on nose piece **18** shown at the left side of FIG. **3.** A tee handle **19** is shown fitted to body **11** for (hand) leverage in turning the tool during use.

To the left of shaft **12** in FIG. **3** is shown in sectional view, a compound, basically tubular member herein termed sleeve **20.** It includes limiting slot **21** at the right end of sleeve **20** which has shoulders **22** and **23** serving as rotational limit stops of sleeve **20** with respect to shaft **12**; a collar shaped member **24** with circular recess **25** functionally described in greater detail hereinafter; retaining holes **26** for rolling members **27** herein shown spherically shaped and above sleeve **20**; tapered rib surface **28,** described in more detail hereinafter; and inside diameter surface **29** sized to freely fit over shaft **12** at assembly.

These components are assembled in the following sequence: Pin **15** is force fitted into hole **14** to provide an effective rotation limiting projection; sleeve **20** is next assembled over shaft **12** with rollers **27** prepositioned in holes **26** so that limiting slot **21** engages pin **15.** Axial groove **30** in shaft **12** is provided for assembly clearance. Nose piece **18** is then force fitted into hole **16** thereby retaining sleeve **20** on shaft **12** but with clearance for free relative rotation of sleeve **20** on shaft **12.** Tee handle **19** is lastly force fitted to handle body **11.**

It can be anticipated and is hereby intended that handle body **11** and tee bar **19** can be replaced by a construction akin to drive sockets as is common in the various trades. For example, the shaft **12** could be a projection out of a female socket piece and the handle with tee bar would be a standard socket piece in the form of a ratchet wrench or a screwdriver type body. This construction would possibly best satisfy the needs of the user that has minimum tool storage space but one who needs several sizes of the beading tool. The manual use embodiment herein described can evidently take many forms and is not limited to the embodiment shown herein. Mechanization or machine use is within the scope of its use, as anyone versed in the art will appreciate.

The many unique features of this invention can be pointed out with the following description of the use of the tool in tee bar form. To shape a tubing end section so as to create the double bead on tubing as shown in FIG. **5,** sleeve **20** is pushed into the tube with a slight counter-clockwise turning motion, far enough to engage the tubing end firmly in the circular recess **25.** Recess **25** is curved to grip the inside diameter of the tube end snugly.

The ease of penetration of the sleeve **20** into tubing **32** of various wall thicknesses and with cut-off burrs or deformities is a function of the sleeve profile. Considering that profile further, it has a starting end minimum diameter and a shape which is generally cylindrical with a fixed diameter. On one side it comprises a tapered rib **28** which gives minimum cross-sectional profile radial growth and at the same time sufficient growth and radial thickness for maximum guided movement of roller **27.** After insertion, the rolling members **27** are in a position axially, relative to the end of the tubing, to begin to form a bead shape. To form these beads the handle body **11** is turned clockwise; this moves shaft **12** relative to sleeve **20,** which is in wedging contact with the tube end; thereby raising the rollers first into engagement and then into an upward deforming contact with the tubing inner wall. The maximum raised position of the rollers **27** is controlled by the angular rotation of sleeve **20** around shaft **12** and more specifically the limits of motion of slot **21** relative to pin **15** as determined by shoulders **22** and **23.** After the initial roller raising movement, further rotation creates the continuous, up-raised form in the tube **32** that is desired. This further rotation provides a retarding torque to the sleeve **20** and in turn maintains an outward force on the rollers **27** which reduces the axial frictional or wedging force which was required at the start of beading.

What is claimed is:

1. A bead forming tool useable for generating a raised substantially semi-cylindrical surface along the circumferential length of deformable tubular material at a fixed distance from an end of said material comprising, an entry sleeve having an upstanding tapered rib surface substantially parallel to an axis of said sleeve being adapted for insertion into the tubular end, a shaft rotably mounted inside said sleeve and having an axis of rotation congruent with said axis of said sleeve, said shaft having at least one profiled cam surface on an outer circumferential surface, said sleeve having a retaining hole therein in register with said profiled cam surface and a substantially spherically shaped member positioned on said profiled cam surface and adapted to be raised in limited engagement with said material as governed by a motion limiting pin as said shaft is rotated relative to said sleeve.

2. The bead forming tool set forth in claim **1** including a collar member having a slotted opening along a

portion of the circumferential length thereof, and said shaft includes a drill hole perpendicular to an axis thereof, and further including a pin mounted in said drill hole adapted to limit the relative rotation of said shaft with respect to said sleeve to the circumferential length of said slotted opening.

3. The bead forming tool set forth in claim **1** wherein said cam surface exerts a substantially radially directed outward force against said spherically shaped member as said shaft is rotated clockwise relative to said sleeve.

4. The bead forming tool set forth in claim **1** further including a handle assembly affixed to said shaft in axially alignment therewith suitable for manually imparting axially as well as rotating movement to said tool.

5. The bead forming tool set forth in claim **1** wherein said shaft contains a plurality of profiled cam surfaces along the circumferential surface thereof and generally formed perpendicular to the axis of said shaft, said sleeve having a like plurality of retaining holes therein, and further includes a like plurality of spherically shaped members each positioned in one of said profiled cam surfaces and adapted to be concurrently moved into engagement with said material as said shaft is rotated relative to said sleeve.

6. The invention set forth in claim **5** including a collar member which is contiguous with said sleeve and substantially cylindrically shaped, and a tube restrainer surface formed between a parallel interior surface of collar member and a parallel exterior surface of said sleeve, said restrainer surface having a curved section where said parallel surfaces are joined adapted to frictionally restrain relative rotation between said forming tool and said material to be formed until said spherically shaped members are in engagement with said material.

7. The invention set forth in claim **1** wherein said collar member has a first tapered surface symmetrical about the axis of said sleeve as well as a substantially cylindrically shaped body axially aligned with said first tapered surface, and said cylindrically shaped body contains a slotted opening along the circumference thereof adapted to engage an upstanding pin mounted in said shaft for determining the relative axial movement of said shaft with respect to said sleeve.

8. The invention set forth in claim **7** including a collar member contiguous with said shaft.

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