United States Patent

[11] 3,601,852

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[54] **PIPE FLARING TOOL**
11 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** ..... **18/19 TE,** 72/317
[51] **Int. Cl.** **B29c 17/02**
[50] **Field of Search** ..... 18/19 TE; 72/115, 317

[56] **References Cited**

UNITED STATES PATENTS

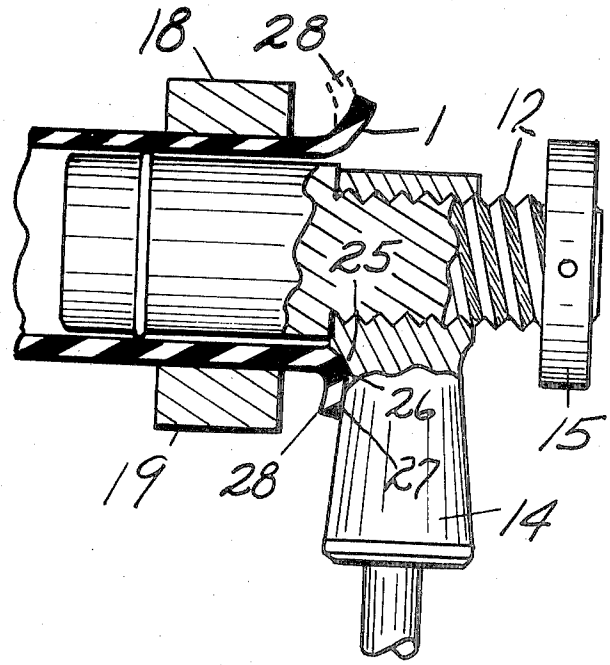
1,661,367	3/1928	Helminiak	72/317
3,341,894	9/1967	Flaming	18/19 TE
3,509,599	5/1970	Driza et al.	18/19 TE

FOREIGN PATENTS

1,112,223	11/1955	France	18/19 (TE)

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Assistant Examiner—L. R. Frye
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ABSTRACT: A pipe flaring tool for thermoplastic pipe such as polybutylene, polyethylene, polyvinyl, etc., used for domestic water service in which the pipe to be flared is solidly gripped against an internal mandrel while the flaring is accomplished by a spinning tool rotated about the axis of the pipe. The flare is effected by local deformation accompanied by heating by internal and external friction in the plastic.



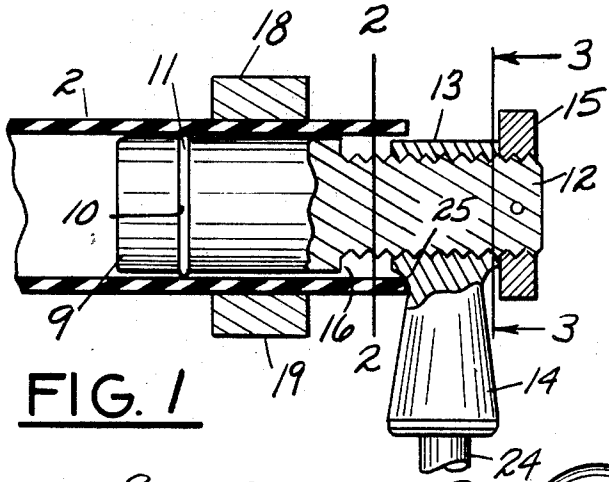


FIG. 1

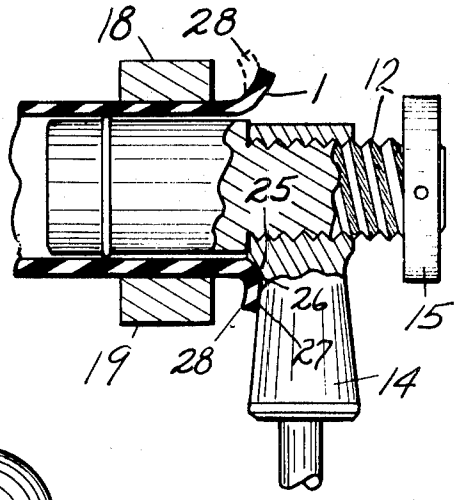


FIG. 4

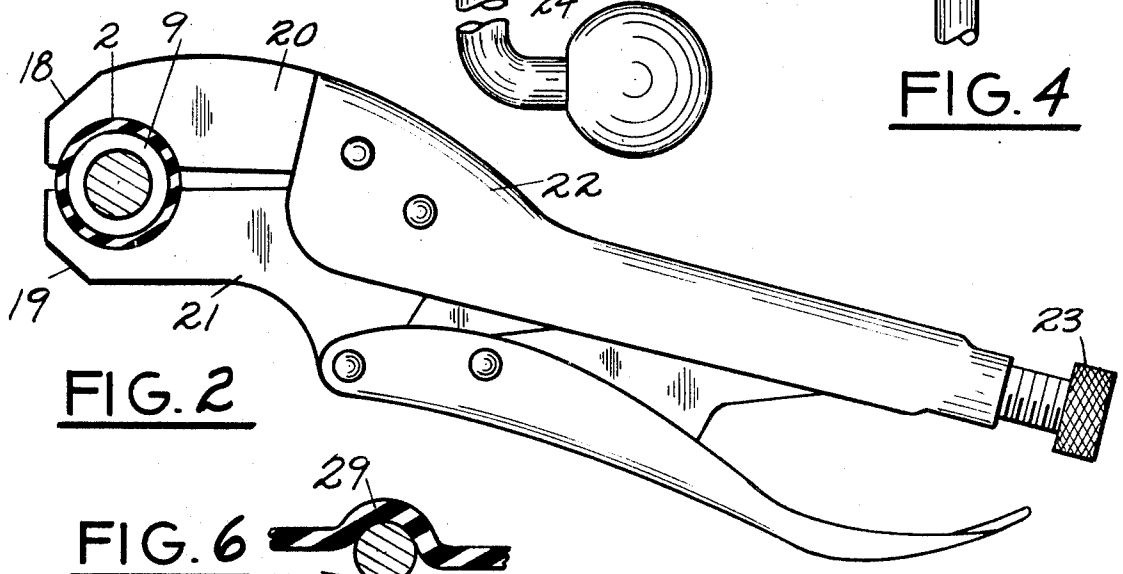
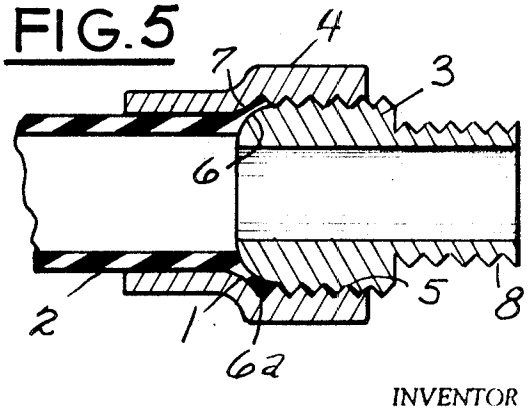


FIG. 2

FIG. 6

FIG. 5



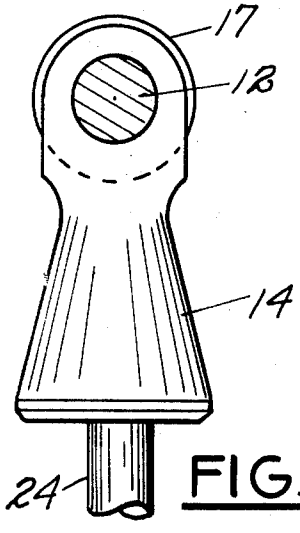


FIG. 3

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PIPE FLARING TOOL

This is a continuation in part of application Ser. No. 796,518, filed Feb. 4, 1969, incorporated by reference.

In a preferred form, this invention is intended to flare rigid and flexible thermoplastic pipe or tubing such as used for water service. The flaring is effected by a spinning tool rotatably supported by an internal arbor mandrel anchored in the bore of the pipe. The tool contacts the projecting end of the pipe and forces the pipe end into a flare as the tool sweeps around the pipe end. The internal heating due to repeated flexing of the plastic at the areas of contact with the spinning tool may be effective in causing the plastic to flow. The pullout strength of the flare is greater than the strength of the pipe.

In the drawing,

FIG. 1 is a side elevation, partly in section, showing the tool inserted in a pipe end in readiness for a flaring operation;

FIG. 2 is a section on line 2—2 of FIG. 1;

FIG. 3 is a section on line 3—3 of FIG. 1;

FIG. 4 is a sectional view showing the position of the tool at the end of the flaring operation;

FIG. 5 is a section through a pipe end flared with the tool and installed in a standard flare fitting such as used by American Water Works Association and others; and

FIG. 6 is a diagrammatic view illustrating the action of the tool.

The particular tool illustrated is intended to produce a flared end 1 on a pipe 2 of flexible thermoplastic such as polybutylene, polyethylene, polyvinyl, etc. Such plastic pipe is difficult to flare because the plastic resists flowing and tends to return to its initial unflared shape by reason of its memory. Heretofore, for polyethylene and rigid polyvinyl, hot flaring tools have been used in which the section to be flared is heated above its softening point. Heretofore it has been considered that polyvinyl and polyethylene could not be cold flared. For polybutylene, cold flaring has been used but the flares have been weak and the effort required has been huge.

The flared end is required for the standard A.W.W.A. type fitting comprising an inner member 3 and an outer member 4. The outer member is in the form of a nut screwed onto threads 5 on the inner member. As the fitting is tightened, the flared end is squeezed between opposed convex surfaces 6 and 7 respectively on the inner and outer members. The inner member 3 has a threaded projection 8 for connection to a water service line. The fitting part 3 is standard for copper tubing for which the plastic tubing 2 is a replacement. The fitting part 4 has convex surface 7 to adapt it to plastic tubing. The opposed convex surfaces 6, 7 cooperate to form a bead 6a which holds the tubing in place under pullout forces.

The tool shown in FIGS. 1–4 inclusive has a cylindrical arbor or plug 9 having a sliding fit in the bore of the pipe or tubing 2 to be flared. The plug has an external groove 10 receiving an expansible split ring 11 which in its unstressed condition is sufficiently larger than the bore of the pipe 2 so that it always provides a friction grip tending to hold the plug in place even though the pipe is over or under size. The plug has a reduced diameter externally threaded projection 12 on which is screwed the hub 13 of a flaring head 14. Rotation relative to the projection 12 causes the tool to move axially between a collar 15 pinned to the outer end of the projection and an annular shoulder 16 at the inner end of the projection. In order to insure the proper size of flare, the flaring head is rotated until it stops against the collar 15 and the plug is inserted in the bore of the pipe until the end 17 of the pipe stops against the flaring head 14. The free or unsupported pipe end projecting beyond the annular shoulder 16 on the plug 9 provides the proper material allowance for the flare. When the plug is adjusted to the position, clamping jaws 18 and 19 are tightened against the outside of the pipe, clamping the pipe between the jaws and the plug and rigidly supporting the pipe behind the annular shoulder 16. Substantially the entire section of the pipe between the plug and the jaws is subjected to a radial clamping pressure. The jaws 18 and 19 are conveniently attached to the stationary and movable jaw members 20 and 21 of a toggle wrench or vise grip pliers 22. This permits quick clamping and unclamping and ready adjustment by means of screw 23 for variations in the wall thickness or diameter of the pipe. The jaws 18, 19 can be on any suitable clamp or vise. After clamping, the jaws 18, 19, the plug 12 and the intervening wall of the pipe section are in fixed relation to each other.

After the jaws 18, 19 are tightened, the free end of the pipe is flared by rotating the flaring head 14 in the direction to feed the tool axially toward the pipe. This is conveniently done by a crank arm or handle 24 fixed to the flaring head. The initial contact of the pipe end 17 is with the inclined surface 25 which diverges outward and away from the pipe end at an acute angle to the axis of the pipe. As the flaring progresses, the pipe end successively contacts reverse curved or concave surface 26 and then surface 27 which is inclined at an obtuse angle to the axis of the pipe. This results in local overflaring of the pipe with the outer edge or rim 28 of the flare tending to curl as shown in FIG. 4. The flaring head exerts both an axial and a radial force on the pipe end so the plastic in the flare is both stretched to a larger diameter and compressed toward the portion of pipe gripped between the jaws 18, 19 and the plug.

As the spinning tool or flaring head 14 sweeps about the axis of the pipe it exerts a local flaring pressure on the pipe end deflecting the plastic in contact with the tool both axially and radially out of line with the remainder of the pipe end as shown at 29 in FIG. 6. As the tool passes one section and starts to deflect an adjoining section, the previously deflected section tends to return to its undeflected position. The tool causes a local back and forth movement of the plastic which generates internal heating of the plastic which reduces the tendency of the plastic to spring back. At each point of contact, the plastic is locally deformed by the pressure exerted by the flaring head and as the head sweeps past, the plastic does not return completely. The flare is accordingly made progressively in a plurality of revolutions. An apparently rigid plastic such as polyvinyl is very easily flared, as are the other thermoplastics used for water service such as polyethylene, polybutylene, etc. Thermoplastics do not have a yield point, as is the case with metals. Even after huge deflections there is no permanent set. The plastic by reason of its memory tends to return to the undeflected position. However, the local internal heating resulting from the spinning tool overcomes the memory and results in a permanent flare. At the end of the flaring operation, the hub 13 of the flaring head is in contact with the annular stop surface 16. At this stage, rotation of the tool is reversed to return it to the original position. There is some frictional contact with the flared rim at the initial reversal which improves the quality of the flare. At the top of FIG. 4, the flare is shown in its final position after the spring back of the plastic from the over flared condition. This results in a finished flare which will fit the standard flare fitting for tubing. Preferably the rim 28 of the flare has a diameter slightly greater than the inside diameter of the threads in the nut 4 of the fitting so the rim of the flare will be under both radial and axial compression when installed.

At the end of the flaring operation, the flare will be warm to touch. This indicates that there is a localized heating at the regions of contact of the spinning tool with the pipe end which causes local flowing of the pipe end and produces a sort of permanent set which reduces the amount of spring back at the end of the flaring operation. The flares produced by this tool are stronger than the pipe. The axial compression of the flare may contribute to the strength. In the previous flaring tools used for plastic water pipe, after assembly into a flare fitting as shown in FIG. 5, stress on the pipe always caused breaking at the flare. With the flare produced by the tool of this application, stress on the pipe produces breakage in the pipe itself rather than in the flare. Not only is the flare produced by the tool stronger than previous flares, but the power required to produce a flare is very slight compared to the power requirements for previous flaring tools.

Because the wall of the pipe adjacent the end being flared is securely clamped between the internal arbor or plug **9** and the external clamp **18, 19**, the flares produced by the tool are very uniform. The action of the flaring head is confined to the unsupported projecting end of the pipe.

The tool is adapted to produce flares on all sizes of thermoplastic pipe and for all standard flare fittings. No special fittings are required.

The flares produced by the tool are uniform. The collar **15** accurately controls the material allowance to be used for the flares. The shoulder **16** accurately terminates the flare. The screw threads on projection **12** provide a uniform feed rate preventing wrinkling of the material.

The flares are made quickly and with little effort. The number of turns of the tool required to produce a flare varies with the amount of plastic to be displaced. For 1¼-inch polybutylene tubing used for service entrance from water distribution lines, acceptable flares have been made with 14 revolutions of the flaring tool and in 20 seconds or less. The torque required increased as the flare was being made because of the larger amount of plastic being deflected. The maximum torque for the 14th revolution was 135 pound-inches. At the seventh revolution the torque was 75 pound-inches.

The heat developed by this tool is due to external and internal friction and is sufficient to heat the immediate contacting surfaces between the pipe and the tool. There is no overall softening of the plastic.

In use, the contact between the flaring head and the pipe is confined to the surfaces **25, 26, 27** (FIG. 4), each of which is of arcuate cross section. The curved or outwardly flaring surfaces **26, 27** produce an improved flare. The contact with the plastic is confined to a narrow section of the surfaces approaching line contact. The plastic in contact with the tool is deflected both axially and radially. While the tool is shown as of roughly frustoconical shape, this is not necessary. The portions of the tool out of contact with the pipe may obviously be of any suitable shape having the required strength.

By appropriate changes in dimensions to increase the amount of overflare, it is possible to overflare the pipe to such an extent that the flare has a 180° reverse curve with the rim extending backward from the end of the pipe.

I claim:

1. A pipe flaring tool for thermoplastic pipe comprising arbor means adapted to be received in the bore of a pipe adjacent the pipe end to be flared, means engaging the external surface of the pipe opposite the arbor means and cooperating with the arbor means to clamp the intervening pipe wall therebetween while leaving the pipe end to be flared free, a spinning tool, means for supporting the spinning tool on said arbor for rotation relative to the arbor about the axis of the pipe and for movement relative to the arbor along said axis, said spinning tool having a surface transverse to said axis, the projection of said surface of the tool on a plane including the axis of the pipe extending radially outside the bore of the pipe and the projection of said surface of the tool on a plane at right angles to the axis of the pipe having a circumferential extent which is a minor fraction of the circumference of the bore of the pipe, said surface locally engaging the inner surface of the wall of said pipe end and deflecting said locally engaged portion axially inward and radially outward of the axis of the pipe relative to the portion of said pipe end adjacent said locally engaged portion and progressively forming the wall of said pipe end into a continuous flare by relative rotation and axial movement of the spinning tool about the axis of the pipe and toward the arbor.

2. The tool of claim **1** in which the means for supporting the spinning tool comprises a screw-threaded projection on the arbor on which the spinning tool is screwed.

3. The tool of claim **1** in which said surface of the spinning tool is inclined at an acute angle to the axis of the pipe adjacent the bore of the pipe and at an obtuse angle to the axis of the pipe radially outward from the bore of the pipe.

4. The tool of claim **1** in which said surface of the spinning tool is concave in a plane including the axis of the pipe.

5. The tool of claim **1** in which said surface of the spinning tool is inclined at an acute angle to the axis of the pipe adjacent the bore of the pipe and in which the angle of inclination increases radially outward from the bore of the pipe.

6. The tool of claim **1** in which said surface of the spinning tool is convex in circumferential cross section.

7. The tool of claim in which said said surface of the spinning tool is convex in circumferential cross section and concave in radial cross section in a plane including the axis of the pipe.

8. Apparatus for flaring flexible thermoplastic pipe comprising, means for holding the wall of the pipe adjacent the end of the pipe to be flared while leaving said pipe end free, means for locally engaging a portion of the inner surface of the wall of said pipe end while leaving the portions of said pipe end adjacent said locally engaged portion free with a tool having surfaces transverse to the axis of the pipe, the projection of said surfaces on a plane at right angles to the axis of the pipe having a circumferential extent which is a minor fraction of the circumference of the bore of the pipe, said surfaces exerting an axial force from said tool to deflect the locally engaged portion of said pipe end axially inward and radially outward of the axis of the pipe relative to portions of said pipe end adjacent said locally engaged portion, and means for effecting relative rotation of the tool with respect to said pipe end about the axis of the pipe and for effecting relative axial movement of the tool with respect to said pipe end along the axis of the pipe to form said pipe end into a continuous flare.

9. The apparatus of claim **8** in which the angle between said surface of the tool and the axis of the pipe in an acute angle adjacent the bore of the pipe end is greater than an acute angle radially outward from the bore of the pipe.

10. The apparatus of claim **8** in which the inner and outer surfaces of the pipe adjacent the pipe end to be flared are rigidly held.

11. The apparatus of claim **8** in which said surface of the spinning tool extends radially outward from the axis of the pipe a distance greater than the radius of the bore of the pipe.