PATENT SPECIFICATION (11) 1 582 038

1 582 038

(21) Application No. 32771/77 (22) Filed 4 Aug. 1977 (19)
(31) Convention Application No. 721 454 (32) Filed 8 Sept. 1976 in
(33) United States of America (US)
(44) Complete Specification published 31 Dec. 1980
(51) INT. CL.³ B29C 17/07
(52) Index at acceptance
B5A 1R314C1B 1R314C1C 1R429B 2A4B 2E10 2E4C 2E4L 2E4X L T10P

(54) TOOL AND METHOD FOR FORMING A FLANGE ON PLASTICS TUBING

(71) We, RESISTOFLEX CORPORATION, a corporation organised under the laws of the State of New York, United States of America, of Woodland Road, Roseland, New Jersey 07068, United States of America,

do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to the production of a radially outwardly directed flange at the end of a plastics tube. More particularly, the invention relates to a tool and a method for accomplishing this.

In the construction of plastics lined metal pipe, the ends of the pipe are provided with metal flanges of one type or another and the plastics lining is formed into radially outwardly directed flanges extending over the faces of such metal flanges both to anchor the liner between pipe joints and for the purpose of providing an integral gasket seal as a part of such joint. Heretofore, metal pipes have been lined with various plastics such as polypropylene (PP), polyvinylidene fluoride (PVF_2) fluorinated ethylene propylene (FEP) perfluoroalkoxy resin (PFA); and polytetrafluoroethylene (PTFE). Flanges have been formed on liners of these various plastics by heating the projecting end of the plastics liner until it has softened somewhat, although substantially below the melting point of the resin, whereupon a forming tool, usually conical in shape, has been pressed onto the tube to expand the end radially outwardly and fold it back over the metal flange face. However, when the foregoing method has been employed to provide a flange on a liner of PVF_2, in particular resin sold by Pennwalt Corp. of Philadelphia, Pennsylvania, U.S.A., under its "KYNAR" trademark as "Kynar 450" resin, it has been found that the flange retains stresses which in the field tend to cause crazing and other adverse deformation of the flange.

Flanges have been formed on the ends of PP liners by heating the plastics materials at the end of the liner to a temperature close to its melting point whereupon the end has been literally remolded with flow of the resin to form the flange. However, it has not been found possible to produce satisfactory flanges on thin walled tubes of PVF_2 employing the latter method.

The present invention overcomes the defects in production flanges on the end of thin walled PVF_2 pipe liners and, as will appear from the ensuing discussion, is useful in production flanges on the end of any plastics pipe or tube.

In accordance with one aspect of the subject invention, there is provided a method of producing a radially outwardly directed flange at the end of a plastics tube which comprises heating the region to be flanged at the end of said tube until the plastics in said region becomes formable, thereupon radially displacing said region with a forming tool to form it against a radially extending face of a back-up member to form said flange, holding said flange while said plastics cools until the plastics in said region become form stable, and removing said tool, characterized in that said region is heated until the plastics in said region becomes sufficiently soft that it can be subjected to strain without retention of noticeable stress, and said tool has a radially expandable cylindrical elastomeric membrane that is applied to the plastics in said region and expanded to turn the end of the tube outwardly to form and hold said flange, whereupon only a portion of the membrane remains in contact with the end of the tube.

In accordance with a further aspect of the present invention, there is provided a tool for forming a radially outwardly directed flange at the end of a plastics tube, so as to overlie a radially extending face of a back-up member from which said tube projects, utilizing the method set forth above characterized in that said tool comprises a first portion for introduction within said tube beyond the region to be flanged, a cylindrical elastomeric membrane having a radially outwardly expandable section ex-

tending axially from said first portion to a point spaced from said first portion a distance greater than the width of the material to be turned outward, means for introducing fluid under pressure within said membrane to expand said expandable section radially outwardly, an enclosure disposed concentrically about said membrane and joined thereto at said point, said enclosure having an annular cavity formed therein for receiving said projecting end of the tube over said membrane section and constraining the radial expansion of said membrane section to a configuration arranged to turn radially outwardly said projecting end of the tube when the latter is in a heated softened state, and means for separably securing said tool to said back-up member.

The invention will be better understood after reading the following detailed description of the presently preferred embodiment thereof with reference to the appended drawings in which:

Figure 1 is a view partially in quarter section showing a tool constructed in accordance with the invention in position prior to forming a flange at the end of a plastics liner of a metal pipe having a loose flange ring on a lapped pipe end;

Figure 2 is a view smilar to Figure 1 showing the relationship of the tool and liner towards the end of the forming process; and

Figure 3 is a fragmentary view similar to a portion of Figure 2 but showing the cooperation of the tool with a pipe having a modified threaded flange on the end thereof.

Referring now to Figure 1, a metal pipe designated generally by the reference numeral 10 is shown with a lapped end 11 carrying a flange ring 12 provided with the usual bolt holes such as that shown at 13, 14 and 15. The pipe 10 is shown furnished with a plastics liner 16 having an end 17 projecting from the end of the pipe.

The tool constructed in accordance with the present invention is designated generally by the reference numeral 18 and is shown joined to the flange 12 prior to forming a radially outwardly directed flange at the end of the liner 16. The tool 18 consists of a core piece 19, an enclosure or housing 20, an expandable membrane 21, and a nose cap 22. A pair of toggle clamps 23 and 24 are secured to the outer circumference of the enclosure 20 at diametrically opposed points for engaging, as shown, bolt apertures such as 13 and 14 in the flange 12. The clamp 23 consists of a hook 25 for engaging the bolt aperture which hook is pivoted at 26 to a lever 27 which, in turn, is pivotally joined at 28 to a bracket 29 mounted on the enclosure 20. The toggle clamp will be recognized as embodying a conventional over-center arrangement affording quick release and engagement. The toggle clamp 24 is identical in construction to clamp 23 and the parts thereof are therefore identified by the same reference numerals.

The core piece 19 is generally cylindrical and provided with a mounting flange portion 30 by which it is fastened through the use of bolts such as that shown at 31 to a wall section 32 at the bottom of a counterbore 33 formed within the enclosure 20. The wall section 32 is provided with a central aperture 34 through which the main body portion of the core piece 19 projects with a slight clearance.

The front end or nose 35 of the core piece 19 is cylindrical and extends into the pipe liner 16 to a point beyond the projecting section 17 which is to be outturned to form a flange. Adjacent the nose section 35 is a radially enlarged region or shoulder 36 followed by an annular channel 37. A plurality of radial passages 38 spaced equidistantly about the axis of the core piece interconnects the channel 37 with a central longitudinal bore or passage 39 to the mouth of which is secured a suitable fitting 40 by means of which a fluid conduit can be connected to the passage 39 and from there to the radial passages 38. In the present example, four passages 38 are employed of which two are visible in the drawings. The number of passages 38 may be altered so long as fluid can be admitted to channel 37 uniformly about its circumference.

The membrane 21 is cup shape with a flange at 41. As best seen in the drawings, the membrane 21 closely surrounds the main body portion of the core piece 19 with its flange 41 secured between the flange 30 of the core piece and the wall section 32 of the enclosure 20. The nose cap 22 is also cup shape and fits snugly over the cylindrical nose 35 of the core piece with appropriate clearance to accommodate the membrane 21 therebetween. A bolt 42 secures the cap 22 at its center through an aperture in the membrane 21 to the core piece 19. An annular groove 43 is provided in the cap 22 for accommodating an enlarged rib or shoulder on the membrane which is placed under slight compression when the cap 22 is assembled to the core piece 19 for establishing a fluid seal between the shank of the bolt 42 and the adjacent members 22 and 19.

The enclosure 20 is provided with a cavity 44 of annular configuration whose function will best be appreciated from a consideration of Figure 2 wherein the radially outwardly expandable section 45 of the membrane 21 is shown in its expanded condition. It will be seen from Figure 1 that the annular cavity 44 in enclosure 20 receives the projecting end 17 of the liner 16 over

the membrane section 45. From Figure 2 it will be observed that the cavity 44 constrains the radial expansion of the membrane section 45 to a configuration arranged to turn radially outwardly the projecting end 17 of the liner 16 when the latter is being formed. In fact, it should be observed from Figure 2 that the tool is arranged to confine the radial expansion of the membrane section 45 to the region wherein force is applied to the portion of the pipe liner 16 which is to be turned outwardly to form a flange.

For the purpose of ensuring proper location of the tool with respect to the pipe flange 12 and the pipe 10, the enclosure 20 has a face 46 normal to the longitudinal axis of the tool for engaging the face 47 of the flange 12, and a plurality of locating pins of which one is shown at 48 projecting from the face 46 of the enclosure adapted to mate with corresponding bolt holes such as 14 in the flange 12. The pins cooperate with the bolt holes on the flange to center the tool with respect to the axis of the pipe 10. Two diametrically positioned locating pins have been found satisfactory.

Operation of the tool will now be explained, by way of example, in connection with the flaring of a pipe 10 provided with a liner 16 formed from "Kynar" PVF_2. In particular, the resin employed was "Kynar 450". It has a nominal melting point of 340°F. (171.11°C.).

With the tool removed from the pipe, the projecting end 17 of the plastics liner 16 is heated until the plastic material in the projecting region 17 becomes sufficiently soft that it can be subjected to strain without retention of noticeable stress. This condition is attained by PVF_2 when it is heated to the vicinity of its melting point. To achieve a stress free and uniform flange it is important to obtain even heating of the plastics. Successful heating has been accomplished through the use of a hot air gun capable of directing hot air both towards the interior and exterior of the projecting section 17 of the liner. As soon as the plastics has softened sufficiently, best determined experimentally, heating is interrupted and the tool 18 is quickly inserted and joined to the flange 12 as shown in Figure 1. Thereupon a suitable fluid, preferably water under low pressure from a high volume source, is supplied by way of a conduit (not shown) connected to the fitting 40 such that it enters the channel 37 and expands the radially expandable section 45 of the membrane 21. The fluid, which may alternatively be gaseous, should be introduced at such a rate as to form completely the flange in about four or five seconds whereupon the pressure is maintained for about one minute at which time it may be released. When used for forming a flange at the end of a 4″ pipe a pressure of 50 psi has been found satisfactory.

If the discharge of hot air during the heating step is properly controlled the temperature of the flange 12 and the lapped end 11 of the pipe 10 can be maintained at a suitably lower temperature than the temperature of the plastics material in the region 17 so that the flange 12 and lapped end 11 of the pipe will function as a heat sink when the end 17 of the liner is turned outwardly thereagainst. In this way there will result a rapid cooling of the liner so that within the one minute time that pressure is maintained the liner will cool sufficiently and harden to the point where it will hold its form and shape as the pressure is released and the membrane returned to its relaxed condition. If necessary, forced cooling can be applied to the flange and the enclosure of the tool. Moreover, it is also possible to immerse the pipe in a quench bath with the tool attached while the membrane is still under pressure.

As shown by Figure 2, after the membrane 21 has been expanded only a portion of it is in contact with the outurned end 17 of the liner.

In order to produce satisfactory results, the membrane 21 must have a uniform wall essentially bubble free and expand evenly within the cavity 44 of the enclosure 20. Extremely good results have been obtained by forming the membrane 21 from a room temperature curing silicone rubber compound. Such results have been obtained using a compound obtained from General Electric Company and identified by the designation RTV 700 B5. This is a two component material and care must be taken when blending the components to avoid having any significant quantity of "entrapped air". If this precaution is not heeded, the membrane produced therefrom may have air bubble weak spots causing non-uniform expansion and reduced tool life. A membrane made from this compound is capable of withstanding temperatures high enough to enable the tool to be used in the forming of flanges on all grades of PTFE as well as on type TE9705 PFA resin and FEP-160 resin, all sold by Du Pont. Additionally, satisfactory results have been obtained with PP resin. With most of the plastics forming is accomplished preferably near or slightly above the melting point although PTFE may be formed at a temperature well above its melt or gel point.

It has been found that using the tool in accordance with the present invention enables formation of a flange to be accomplished at higher temperatures thereby producing stress free flanges which do not tend to relax either before or after makeup of a joint with adjacent piping components.

Referring now to Figure 3, there is shown a modified pipe and flange arrangement to which the tool of the present invention can be applied in similar manner to that described with reference to Figures 1 and 2. As seen in Figure 3, the metal flange 50 (which here acts as a back-up member) is of modified construction such that the externally threaded pipe end 51 enters only partially through the center of the flange stopping at a shoulder 52 on the fiange. In this case, the pipe liner 53 is turned radially outwardly directly against the face 54 of the metal flange 50 rather than over the lapped end of the pipe as was the case illustrated in Figures 1 and 2. By comparing Figures 3 and 2, it will be observed that the expandable section 45 of the membrane takes a somewhat different shape when used in connection with the different types of flanged pipe. However, the configuration of the tool is such as to readily accommodate such differences in forming requirements.

Obviously, the tool is not limited to use with the two types of flanges shown in the drawings but can be used in various situations wherein a plastic tube is to be turned outwardly over the face of a back-up member from which the tube projects.

WHAT WE CLAIM IS:—

1. A method of producing a radially outwardly directed flange at the end of a plastics tube which comprises heating the region to be flanged at the end of said tube until the plastics in said region becomes formable, thereupon radially displacing said region with a forming tool to form it against a radially extending face of a back-up member to form said flange, holding said flange while said plastics cools until the plastics in said region becomes form stable, and removing said tool, characterized in that said region is heated until the plastics in said region becomes sufficiently soft that it can be subjected to strain without retention of noticeable stress, and said tool has a radially expandable cylindrical elastomeric membrane that is applied to the plastics in said region and expanded to turn the end of the tube outwardly to form and hold said flange, whereupon only a portion of the membrane remains in contact with the end of the tube.

2. The method according to claim 1, characterized in that said membrane is expanded and the flange formed in less than 5 seconds.

3. A tool for forming a radially outwardly directed flange at the end of a plastics tube, so as to overlie a radially extending face of a back-up member from which said tube projects, utilizing the method according to claim 1 or claim 2, characterized in that said tool comprises a first portion for introduction within said tube beyond the region to be flanged, a cylindrical elastomeric membrane having a radially outwardly expandable section extending axially from said first portion to a point spaced from said first portion a distance greater than the width of the material to be turned outward, means for introducing fluid under pressure within said membrane to expand said expandable section radially outwardly, an enclosure disposed concentrically about said membrane and joined thereto at said point, said enclosure having an annular cavity formed therein for receiving said projecting end of the tube over said membrane section and constraining the radial expansion of said membrane section to a configuration arranged to turn radially outwardly said projecting end of the tube when the latter is in a heated softened state, and means for separably securing said tool to said back-up member.

4. A tool according to claim 3, characterized in that said elastomeric membrane consists essentially of a cured room temperature curing silicone rubber.

5. A tool according to claim 3 or 4, characterized in that at least said expandable section has a uniform wall thickness and is essentially bubble free.

6. A tool according to any one of claims 3, 4 or 5, for use when said back-up member is a flange on the end of a pipe and said tube is the pipe liner, characterized in that said enclosure is constructed and arranged to be secured to said pipe flange and is joined to both said membrane and said first portion for positioning the latter concentrically within said pipe liner just beyond said region to be turned outward.

7. A tool according to claim 6, characterized in that said enclosure has a face normal to the longitudinal axis of the tool for engaging the face of said flange on the end of a pipe, and a plurality of locating pins projecting from said face of said enclosure adapted to mate with corresponding bolt holes in said flange on the end of a pipe for centering said tool with respect to the axis of said pipe.

8. A tool according to any one of claims 3 to 7, characterized in that said means for separably securing said tool to said back-up member comprises a plurality of rapidly engageable toggle clamps disposed about said enclosure for engaging said back up member to secure said enclosure thereto.

9. A tool for turning the end of a plastics tube outwardly to form a flange substantially as herein described with reference to the accompanying drawings.

10. A method of producing a flange sub-

stantially as herein described with reference to the accompanying drawings.

11. A tube having a flanged end produced by the method of any one of claims 1, 2 or 10 and/or with the tool of any one of claims 3 to 9.

MEWBURN ELLIS & CO.,
Chartered Patent Agents,
70/72 Chancery Lane,
London WC2A 1AD.
Agents for the Applicants.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1980.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY,
from which copies may be obtained.

1582038 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

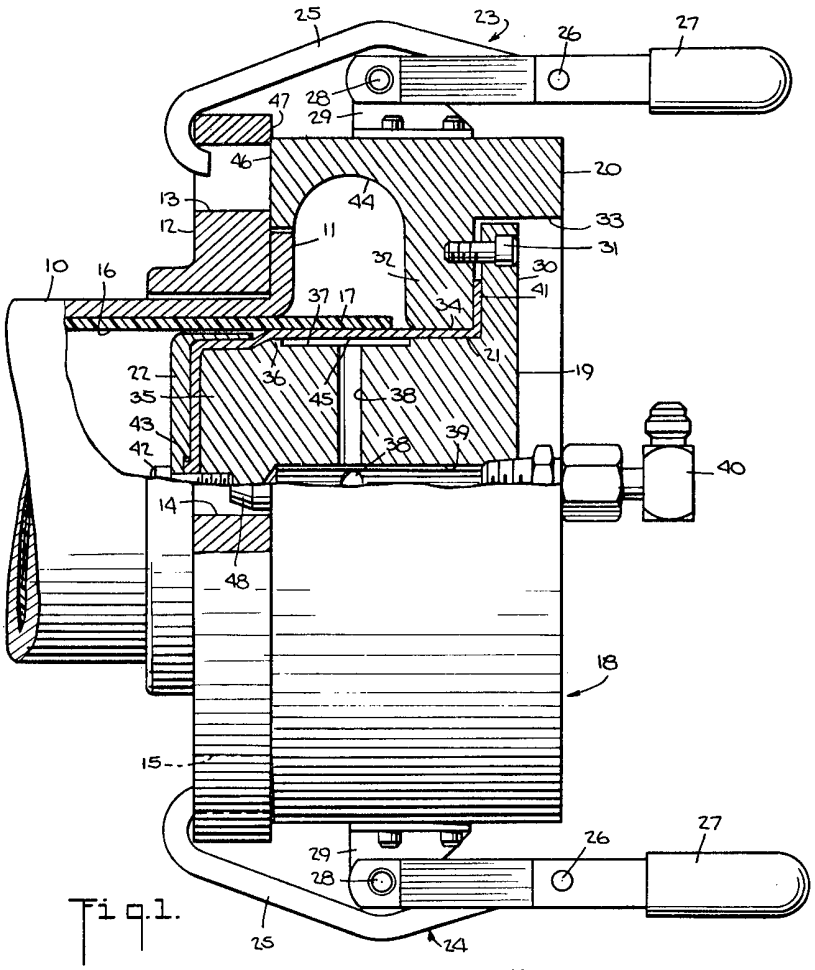

Fig.1.

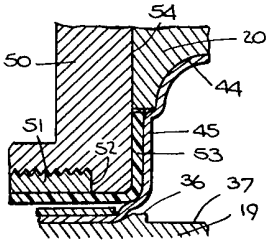

Fig.2.

1582038 COMPLETE SPECIFICATION

2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

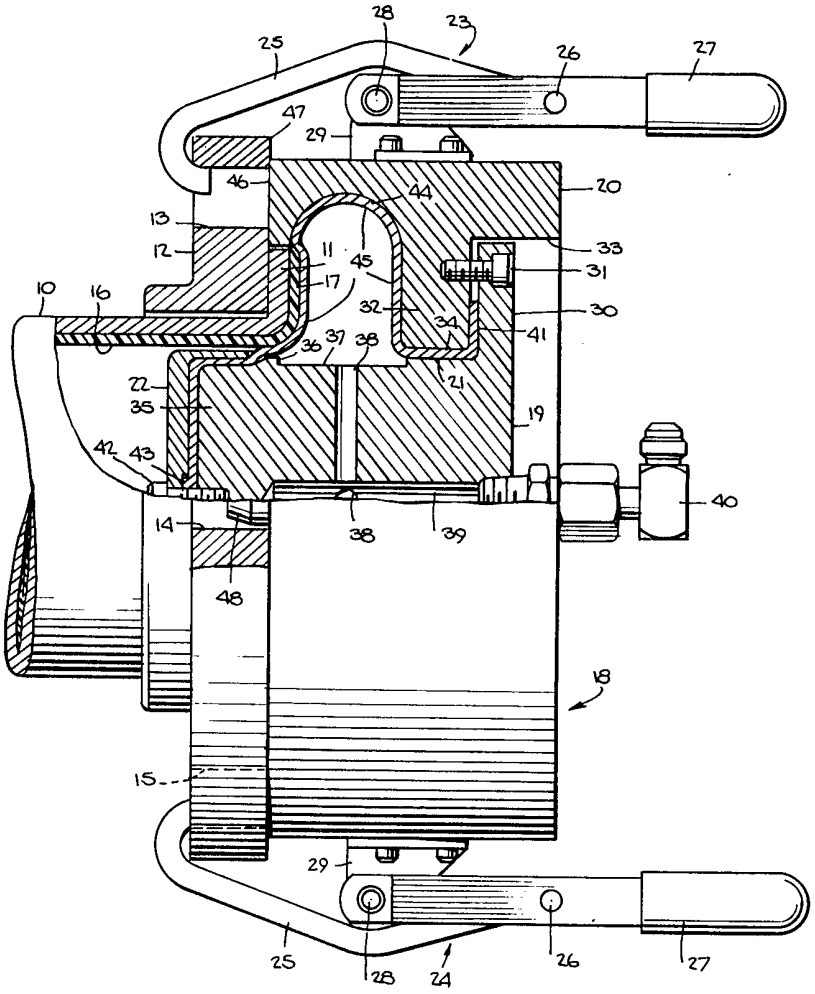

Fig.2.