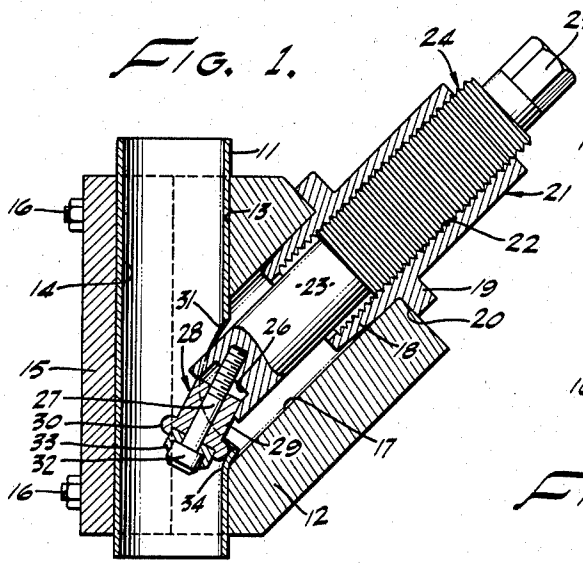
Jan. 14, 1958 W. D. KRAEMER 2,819,697

APPARATUS INCLUDING A ROTATING PART FOR FORMING FLANGES ON TUBULAR MATERIAL

Filed Oct. 12, 1953

FIG. 1.



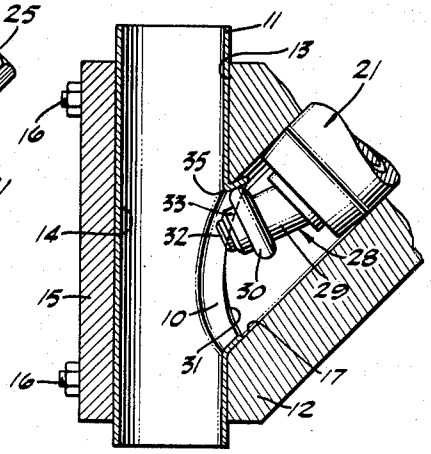


FIG. 2.

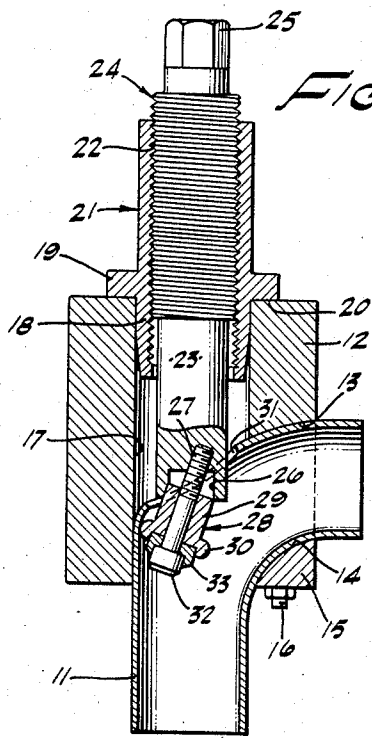


FIG. 3.

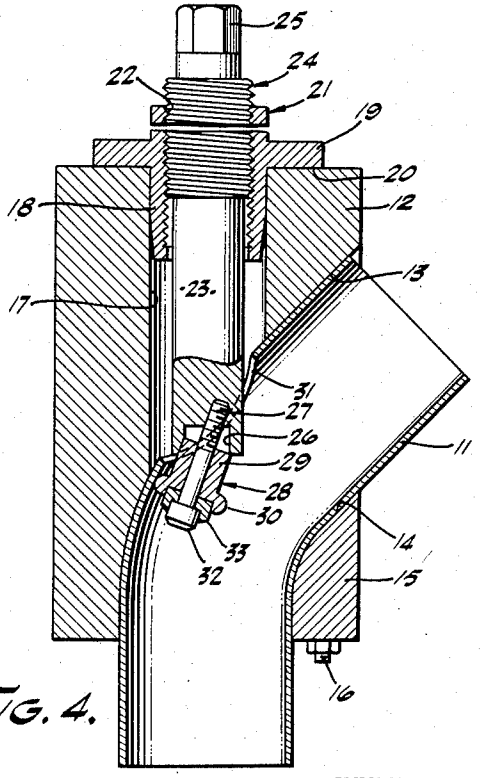


FIG. 4.

INVENTOR.
WILLIAM D. KRAEMER

BY

R. T. Sperry

ATTORNEY

United States Patent Office

2,819,697

Patented Jan. 14, 1958

2,819,697

APPARATUS INCLUDING A ROTATING PART FOR FORMING FLANGES ON TUBULAR MATERIAL

William D. Kraemer, Maywood, Calif.

Original application December 1, 1952, Serial No. 323,368. Divided and this application October 12, 1953, Serial No. 385,362

3 Claims. (Cl. 113—52)

This invention relates to flange forming apparatus and is particularly concerned with apparatus for the forming of connecting flanges on body tubing of thin ductile material by which branch connections may be secured to such flanges to form T's, Y's and multiple outlet fittings.

This application is a division of application Serial Number 323,368, filed December 1, 1952, now Patent No. 2,726,949, which later mentioned application is a continuation-in-part of application, Serial Number 191,196, filed October 20, 1950, now abandoned.

While certain aspects of the primary inventive concept may be generally applicable to various types of pipes formed of a wide variety of materials and useful in numerous arts, the invention as herein set forth in one of its preferred embodiments is directed to sanitary plumbing constructions in which the fittings are characterized by the absence of any internally protruding surface facing against the direction of drainage flow, thus providing a sweeping juncture between passageways so as to preclude steps, recesses, pockets, or traps by which fluids and solid materials entrained thereby may be detained to form obstructions.

Heretofore, sanitary or drainage fittings have been formed by casting ferrous metals or by the extrusion of nonferrous metals such as aluminum, copper and brass. In both instances such fittings are heavy, cumbersome and commensurately expensive. In the casting of ferrous branch connectors of this type, great expense is encountered in the provision of melting and casting equipment as well as in the provision of countless individual moulds for each size of each shape required and in addition the casting operation is time consuming, laborious and proportionately expensive. Furthermore such cast ferrous fittings are readily susceptible to corrosion and seldom have a useful life equal that of the building in which they are installed.

In the forming of such fixtures by extrusion, nonferrous metals may be employed, however, although nonferrous materials such as brass, copper or aluminum are more durable and corrosion resistant than ferrous metals the cost of material is considerably greater than that encountered with ferrous fittings since the size and weight of such fittings is but little less due to the requirements of substantial thickness to insure adequate strength and to exclude perforations and blow holes. It may also be noted that extrusion methods of forming pipe fittings are expensive and wasteful of the materials employed. An important factor of such waste and expense being the imperfections of extrusion methods and apparatus resulting in a high rate of rejected pieces.

Applicant recognizes that attempts have been made to form branch connectors for thin walled nonferrous

tubing, particularly in the musical instrument field. Such attempts have included methods providing for the perforation of the walls of thin sections and the extruding of flanges at the peripheries of such perforations by forcing outwardly from the interior of the tubing flange forming die of larger diameter than the perforation. Extension pipes have then been fitted over such flanges to complete the arrangement. While such methods may have been somewhat successful in the formation of right angular T's, they have not been successful in producing flanged apertures of other angularity due to their inability to fold back or return bend the flanged material. Furthermore, it is obvious that economical production of such fittings cannot be achieved since in each individual instance the die must be first inserted and then moved longitudinally within the tubing for initial registration with the aperture before it is pulled outwardly to form the peripheral flange. Quite obviously such methods do not lend themselves to the mass production of sanitary drainage plumbing fittings.

By the present apparatus, a peripheral flange is formed at any required angle to the axis of the body tubing by a continuous and progressive rolling and drawing operation. Thus the thin nonferrous material is formed and swaged without rupture or work hardening in such manner as to form a sweeping connecting flange to the interior of which a completion tubing may be readily applied and sealingly secured by silver solder, brazing or the like.

It is therefore among the more general objects of the present invention to provide a novel, simple, efficient, effective and economical means for forming side flanges from the body material of tubing.

A more specific general object is to provide improved means for forming side flanges on thin, ductile nonferrous tubing.

Another general object is to provide a flange forming apparatus operable to apply a finished forming operation progressively from the base portion of the flange to be formed outwardly to the periphery thereof. By such operation the supported base portion may bear the brunt of the deformation stresses and strains without subjecting the weaker free edge material to either the original or the maximum of such stresses and strains.

Similarly it is an object to provide an apparatus which will progressively apply the total deformation pressures progressively to successive areas of material being deformed so that only one pass of the tool is required and work hardening, embrittlement and heat generated will be maintained at a minimum.

More specifically it is an object of the present invention to provide a novel, simple, improved, efficient, effective and economical apparatus wherein means are incorporated for moving a forming element in an orbital path of fixed radius while the tool is moved axially of the axis of its orbit.

Another specific object is to provide an apparatus having means for inducing axial movement thereof as an incident to rotation so that the work preformed will follow a spiral path of fixed radius.

It is also an object to provide an apparatus of the class described in which a rotary forming tool is mounted for rotation on its own axis and for bodily movement in an orbital path preferably accompanied by longitudinal movement along the axis of the orbit, whereby each successively adjacent area of material being formed will be subjected to contact by successive areas of the tool.

The foregoing objects are coupled with that of providing an apparatus particularly adapted for application to a body tubing and embodying a combination of die configuration and tool guidance whereby a flange of desired angularity may be formed from the edge material of an aperture in the side of the tube.

These and numerous other objects and features of the present invention will be apparent from a consideration of the following specification taken in conjunction with the accompanying drawings, in which:

Figure 1 is a vertical sectional view of one preferred form of the present apparatus shown as applied to an apertured tube and in the initial stages of forming a circular flange the axis of which is less than 90° from that of the tube body;

Figure 2 is a detail view showing the position of the tool of Figure 1 during the final stages of flange formation;

Figure 3 is a vertical sectional view of a modified form of the apparatus used in forming a flange at the bend of a 90° sweep; and

Figure 4 is a similar view of further modification of the apparatus as adapted for the formation of a flange in a 45° sweep.

In general terms that form of the invention here presented by way of illustration may be broadly defined as including a tool head preferably designed to embrace the body tube and to include a die surface which may determine the outer surface configuration of the flange formed. The head is formed with a bore disposed at an angle to the tube determined by the angularity of the flange desired. Fitted through the bore is a tool shank mounted for rotation on a fixed axis. The inner end of the shank carries an angularly extending tool pintle and a roller type tool is loosely mounted on the pintle. Thus as the shank is rotated the roller type tool moves bodily in an orbital path. While alternative means may be resorted to to provide axial movement of the tool shank that preferred form of the invention provides jointly for such axial movement as an incident of shank rotation and for maintenance of the shank axis centrally of the bore head by threadedly engaging the shank in a bearing member mounted through the outer open end of the bore of the head.

With specific reference to the drawings in Figures 1 and 2 the apparatus is shown as designed to form a circular cylindrical flange (**10**, Figure 2) on a straight body tubing **11**, the angle of the axis of the flange **10** being at an acute angle to the axis of the body tubing **11**. As discussed in detail in my parent copending application, above referred to, the method carried out by the present apparatus is particularly applicable for the formation of flanges on thin, ductile, nonmetallic tubing as best exemplified by electrolytic copper tubing. Further as discussed in said parent application the flanges formed are particularly designed to receive therein branch tubings which may be silver soldered to form new and improved sanitary plumbing fittings.

The apparatus comprises a tool head **12** having a tube conforming inner curved surface **13** which cooperates with a companion inner curved surface **14** of a backing clamp **15** to encircle and firmly secure the apparatus to the tubing **10**. The clamp is detachably secured to the head by releasable securing means such as indicated at **16**. The head **12** is formed with a bore **17** conforming in angularity to that selected for the flange and a stationary internally threaded bearing sleeve **18** is mounted within outer open end of the bore **17**. Intermediate its ends the sleeve **18** is provided with an external shoulder **19** adapted to be seated on and secured to a bearing surface **20**. The bearing surface **20** is normal to the axis of the bore **17** and hence disposed at an angle to the axis of the tubing at a complement to the angle with respect thereto at which the axis of the bore extends.

Beyond the shoulder **19** outwardly thereof the bearing

sleeve **18** is formed with an extended body portion **21** and internally the entire central bore **22** of the sleeve is threaded, this threaded bore being coaxial with the bore **17** of the tool head. Threadedly engaging the bore **22** is the shank **23** of a rotatable tool post **24** the outer end **25** of which is shown as hexagonal to receive a rotating member of suitable character by which the post **24** may be turned and as an incident thereto feed inwardly or outwardly by virtue of the threaded engagement between bore **17** and shank **23**. The tool post **24** extends inwardly from its threaded shank **23** and is formed at its end with recess **26**. Threadedly engaged with the shank and extending outwardly from the recess there is provided a die or roller pintle **27**. The pintle **27** is disposed at an angle to the axis of the shank. A preferable angle being as here shown about one-half the angle of the shank with respect to the axis of the tubing. Rotatably mounted on the pintle **27** is the forming roller or die tool **28** the inner cylindrical end **29** of which is partially received within the recess **26** while the opposite end is formed with a peripheral forming edge **30** preferably constituting a rounded flange for smoothly engaging the peripheral edge of the aperture **51** of the tubing **11** to draw and work the material thereof outwardly without undue friction. The tool **28** is secured against axial displacement from the pintle **27** by the headed end **32** thereof together with a bearing element **33** which engages the head and seats within the outer end of the tool.

From a consideration of the above description it will be seen that due to the angularity of the pintle or arbor **27** for the tool **28** and the extension from the roller body of its flange like edge or head **30** one edge of the roller will at all times extend beyond an imaginary inner projection of the cylindrical surface of the tool shank. It will also be noted that the aperture **31** is substantially equal in size to such cylindrical projection at the surface of the shank. Thus it will be seen that the shank with the tool die or roller **30** assembled thereon may not be inserted by straight coaxial movement thereof within the bore **17** to dispose the tool within the tube **11**. Such initial location of the tool to take up the position shown may be achieved however by removal of the sleeve **21** from the head **12** until an angular movement of the shank with respect to the aperture permits passage of tool therethrough after which the sleeve may be threaded down the tool post for contact with and securement to the surface **20** or the sleeve may be threaded outwardly upon the tool post sufficiently to permit its inner end to disengage the bore permitting the required tilting movement of the tool post.

Such consideration will also disclose that after insertion of the tool through the aperture rotation of the tool post will bodily move the tool in an orbital path normal to the axis of the post and that in such movement the roller will itself always be maintained at an angle to such orbit as determined by the inclination of its pintle to the axis of the tool post. Thus it will be seen that the die presents as its leading edge in rotation and outward travel successive areas of its periphery as it turns on its pintle and furthermore that the area of contact with the inner surface of the aperture edge is limited at first and progresses only as such area is rolled, swaged or turned outwardly by contact with the roller or die. As clearly seen by a consideration of Figures 1 and 2 such flange forming working of the aperture edge will be completed at one side thereof before the opposite aperture edge is contacted by the roller.

It is of course clear that after insertion of the roller or die tool through the aperture its rotation with respect to the threaded relation of tool post to bearing is such that as the post is rotated and outward travel is imparted thereto and hence to the tool. Thus the orbital path of bodily travel of the die continuously moves from that angularly tangent to one edge of the tube aperture to a completion position angularly tangent to the outer edge

of the finished flange opposite the edge to which it was originally tangent.

An important feature of the construction and operation of this tool and consequently of the method carried out thereby is that such outward travel of the die or roller is progressive with and as an incident to its rotation and thus each successive area of aperture edge is successively turned further outward than the preceding area and therewith it will be noted the frictional contact will rotate the die or roller so that a fresh surface thereof contacts each successive area. While certain aspects of the present inventive concept could be fulfilled by a non-rotating die and/or by outward travel independent of rotation this preferred construction provides for the successive and progressive working of the material by successive areas of the roller to the end that heat and burnishing of the material is avoided and that cold working with minimum work hardening may be achieved. In practice it has been found that these combined characteristics of the tool permit a drawing operation to form flange **10** with a minimum of stress of material and without fracture, tearing or cracking of such materials as may otherwise occur.

It is important to note that the flange **10** is not only formed by outward flaring of the peripheral edge of the aperture but that as indicated at **35** the material is turned back upon itself at an acute angle. Heretofore it has not been possible to so form flanges from the edge material of apertures formed intermediate the ends of tubing. However the present method has been highly successful in this respect and hence the angularity of the aperture and flange may be any desired angle less than 90 degrees to the axis of the tubing and thus sanitary and/or sweep fittings may be formed by the present method and apparatus.

As heretofore pointed out the invention while susceptible of many applications and uses is primarily concerned with the formation of sweep or sanitary fittings formed of thin walled nonferrous material. While the angle here depicted is of 45 degrees it will of course be understood that the invention is in no way so limited however it is contemplated that its greatest utility lies in the formation of flanges the axis of which is other than 90 degrees. It should also be noted that while the apertures here shown in Figures 1, 2 and 3 and hence the flanges formed thereabout are depicted as commensurate in diameter with the diameter of the tubing **11** the invention contemplates, and has been successfully practiced by, the formation of branch connections of various sizes below that of the main tubing as in Figure 4. Thus a three inch tubing may have a two inch branch connection and a one and one half inch body may be provided with a one inch branch. Similarly while the present illustration discloses only one branch connection for each body tubing two or more are contemplated and are practical and such branch connections may differ in diameter from each other as well as from that of the main tubing and they may enter the tubing in the same transverse plane or be spaced from each other as desired.

A further and important distinguishing feature of the method carried out by the use of the present apparatus is the fact that the material of the tube adjacent the aperture is worked originally, not at the free edge where tearing may readily occur but as seen in Figure 1 the base portion 34 of the flange is first engaged by the tool. Since the tool is rotating on its own axis and is moved in an orbital path of fixed radius and axially of said path outwardly from the inside of the tube the original and greatest deformation pressures are applied to this supported base portion of the flange material.

As illustrated in Figures 3 and 4 the apparatus is not limited to forms applicable solely for the formation of flanges at intermediate points of straight tubing but by modification of the tool head and backing clamp the inventive concept may be applied to the formation of flanges on curved tubing such as the 90° and 45° sweeps shown in Figures 3 and 4 respectively.

Since the characteristic difference in the apparatus of Figures 3 and 4 is in the curvature of the inner faces of the head **12** and the clamp **15** by which they will embrace a curved tubing of whatever radius desired like numerals are employed and reference may be had to the discussion of Figures 1 and 2 for a full consideration thereof.

From the foregoing it will be seen that the present invention provides a novel, simple and effective apparatus neither complicated in design nor expensive to manufacture and one which may be used by unskilled operators to faithfully form an angularly or radially disposed cylindrical flange on either straight or curved tubing. It will be understood that the invention is not limited to specific details of construction here depicted and that the invention may be practiced by the full use of changes, modifications and equivalents without departing from the spirit or scope of the appended claims.

I claim:

1. In a device of the character described: means defining a cylindrical bore; a stem in said bore having a diameter substantially less than said bore to permit a limited tilting movement of said stem in said bore; a flanged roller, a pintle mounted at one end of said stem mounting said roller for rotation about an axis angularly related to the axis of said stem for planetary movement of said roller; said roller having an annular lip describing in said planetary movement of said roller, a path the diameter of which is less than, but substantially equal to that of said bore; and means detachably securing said stem against tilting movement and mounting said stem in coaxial relation with said bore, but permitting rotation of said stem about its axis as well as permitting axial retraction of said stem in said bore.

2. In apparatus of the character described: a pipe clamp forming a seat conforming to the exterior surface of a pipe; an extension attached to the clamp, said extension forming a through cylindrical bore terminating in said seat at an angle with the axis of said seat; a stem extending into the extension, and having a diameter less than that of said bore to permit limited tilting movement of said stem in said bore; a roller mounted on the stem for planetary movement with respect to said stem and insertible upon tilting of said stem through a pipe aperture smaller in diameter than that described in the planetary movement of said roller; and means detachably securing said stem to said extension to prevent tilting thereof, said securing means permitting rotation of said stem about its axis as well as permitting axial retraction thereof in said extension.

3. In apparatus of the character described: a pipe clamp forming a seat conforming to the exterior surface of a pipe; an extension attached to the clamp, said extension forming a through cylindrical bore terminating in said seat at an angle with the axis of said seat; an exteriorly threaded stem extending into the extension, and having a diameter less than that of said bore to permit limited tilting movement of said stem in said bore; a roller mounted on the stem for planetary movement with respect to said stem and insertible upon tilting of said stem through a pipe aperture smaller in diameter than that described in the planetary movement of said roller; and means detachably securing said stem to said extension to prevent tilting thereof, said securing means permitting rotation of said stem about its axis as well as permitting axial retraction thereof in said extension, comprising a nut having a cylindrical surface fitting within said extension as well as a flange resting on said extension, said nut threadedly engaging said stem.

(References on following page)

References Cited in the file of this patent

UNITED STATES PATENTS

Re. 19,790	Lindgen	Dec. 17, 1935
157,810	Garstang	Dec. 15, 1874
472,490	Wilhelm	Apr. 5, 1892
517,382	Haberman	Mar. 27, 1894
559,880	Wolff	May 12, 1896
656,425	Schilling et al.	Aug. 21, 1900
1,582,525	Lucas	Apr. 27, 1926
1,743,338	Field	Jan. 14, 1930
1,752,508	Schultis	Apr. 1, 1930
1,795,358	Arndt	Mar. 10, 1931
1,921,584	Robinson	Aug. 8, 1933
2,071,314	Andrus	Feb. 23, 1937
2,511,836	Cullen	June 20, 1950