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Ribbed and grooved tube forming.

An apparatus for the cold forming of longitudinal ribs and grooves in lengths of thin wall metal tubing, particularly cylindrical tubing, including a base support (2) mounting a tube end support (6) and an aligned roll-former assembly (4), and thrust means such as hydraulic ram thrust means (1) for moving either the tube end support (6) or roll-former assembly (4) towards and away from the other. The roll-former assembly (4) includes a planar support (7) with a central opening (8) about which a plurality of roll or wheel formers (11) are mounted in spaced relationship for rotation in substantially radial planes extending longitudinally of the apparatus; the inner peripheral parts of the roll or wheel formers being shaped and spaced, according to the desired form

and depth of the ribs and grooves to be formed in a tube length (5). The tube length (5) being mounted with one end of the tube end support (6) and the other end part co-axially located between the roll or wheel former inner peripheral parts, and forced longitudinally therebetween by the thrust means (1) in longitudinally cold forming the ribs (5b) and grooves (5a) from outside the tube length and without any inner co-operating mandrel or roller(s). For cylindrical tube lengths, partial axial rotation of the mounted tube length or the roll-former assembly (4) as the thrust means (1) is operated, will form at least partially helical longitudinal ribs (5b) and grooves (5a).

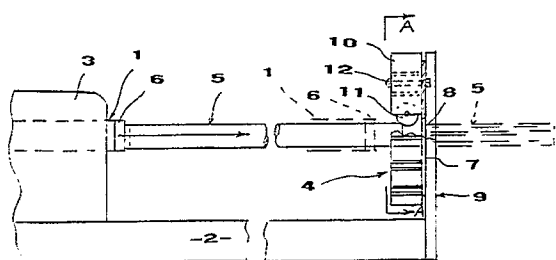


Figure 1

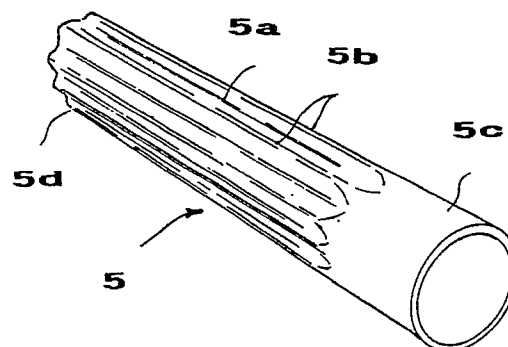


Figure 3

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RIBBED AND GROOVED TUBE FORMING

This invention relates to metal tubing, particularly thin or relatively thin walled metal tubing conventionally provided in regular cross-sectional form such as cylindrical, or square rectangular or other sectional forms; and the provision of a method and apparatus for reforming or reshaping such conventional tubing to provide such tubing with a longitudinal straight or spiral ribbed and grooved formation for added strength and aesthetic purposes.

An object of the present invention is to provide an economical and relatively simple means for providing longitudinally ribbed and grooved metal tubing by a non-extrusion and a cold forming process - it is of course known to provide longitudinally ribbed and grooved tubing by extrusion processes.

Other objects and advantages of the present invention will become apparent from the ensuing description.

According to a first aspect of this invention, there is provided apparatus for the forming of longitudinally ribbed and grooved metal tube lengths, comprising a base support mounting a tube end support, longitudinal thrust means, and a roll-former assembly in spaced relationship from the tube end support; the tube end support being movable relatively towards and away from said roll-former assembly (or vice versa) by said thrust means and being arranged to receive one end part of a length of uniform cross-section thin wall metal tube disposed coaxially of the direction of thrust of the thrust means and roll former assembly and between said tube end support and said roll-former assembly, whereby movement of the thrust means will force the tube length through the roll-former assembly for reshaping; said roll-former assembly comprising a plurality of external shaping rollers or wheels mounted for individual rotation in longitudinal planes intersecting or substantially parallel to the longitudinal axis of the tube length, and said rollers or wheels having inner peripheral parts spaced according to the external cross-sectional dimensions of the tube length and depth of the ribs and grooves to be formed therein, and being operable to form said ribs and grooves from outside the tube length without the provision of any co-operating mandrel(s) or roller(s) within the tube length.

According to another aspect of this invention, there is provided a method of forming longitudinally ribbed and grooved metal tubing comprising the steps of taking a length of preformed thin wall metal tube of uniform cross-section throughout its length, locating one end of said tube length on a mounting and the opposite end of said tube length

in juxtaposition with a roll-former assembly having a plurality of roll-formers mounted in spaced relationship for rotation in longitudinal planes intersecting or substantially parallel to the longitudinal axis of said tube length; the roll-formers being mounted with the innermost peripheral surface parts thereof transversely spaced about the tube periphery and shaped and positioned according to the tube external cross-sectional dimensions and depth of the ribs and grooves to be formed therein, and the tube length being positioned in co-axial relationship between said roll-formers innermost peripheral parts; and actuating a thrust means to longitudinally force said tube length between said inner peripheral surface parts of said roll-formers and depress a plurality of longitudinal grooves in the outer surface of said tube length in forming longitudinal ribs between said grooves from outside the tube length and without the employment of a co-operating mandrel or co-operating inner roll-former(s) within the tube length.

The invention is particularly applicable to the forming of tube lengths suitable for (but not necessarily confined to) such as ballustrading, gate and fence posts, lamp-posts, railings or the like requiring to be aesthetically pleasing and additionally having end parts facilitating assembly and fitting; and accordingly in a further aspect of the invention the method according to the preceding paragraph includes the further step of re-shaping one or each end part of the longitudinally ribbed and grooved tube length to a desired regular cross-sectional form differing from the ribbed and grooved form by location on an inner former or mandrel and applying external pressure to the tube end part to be shaped.

The terms "longitudinally ribbed and grooved", "longitudinal grooves" and "longitudinal ribs" can apply to straight ribs and grooves extending parallel with each other and the axis of the tube length, or can apply to helically or spirally formed ribs and grooves extending along the tube length. In the latter form the apparatus of the invention will include means for effecting either axial rotation of the tube length or axial rotation of the roll former assembly as the tube length is forced therethrough.

Some preferred aspects of the invention will now be described by way of example and with reference to the accompanying drawings, in which:-

FIGURE 1 is a diagrammatic side elevational view illustrating a first form of apparatus in accordance with the invention and the method of tube forming or reforming to provide similar parallel straight longitudinal ribs and grooves on a length of tube

FIGURE 2 is an end view in the direction of arrows A-A of figure 1 and more particularly illustrating the roll-former assembly

FIGURE 3 is an end perspective view illustrating one form of ribbed and grooved tube length formed in accordance with the invention

FIGURE 4 is a cross-sectional or end view of the tube length of figure 3

FIGURE 5 is an end perspective view of another form of tube length formed in accordance with the invention,

FIGURE 6 is a cross-sectional or end view of the tube length of figure 5

FIGURES 7 and 8 are part broken side views illustrating two modifications to end forming of the tubing,

FIGURE 9 is a side view illustrating a further modification to end forming of a tube length, and

FIGURE 10 is a part broken side view illustrating a jointer for joining lengths of similarly formed tubing.

The apparatus can employ a pneumatically extensible ram assembly or mechanically extensible ram assembly, but preferably and most conveniently employs a hydraulically operable extensible ram assembly; and existing hydraulic press apparatus can be adapted for this purpose. Most conveniently the apparatus is arranged with its hydraulically extensible ram 1 disposed in a horizontal plane so as to be extensible over the apparatus base 2 therefrom and retractable towards the base end unit 3 of the apparatus incorporating the hydraulic power system and related components.

The roll-former assembly, generally indicated by the arrow 4, for the invention is mounted at the opposite end of the apparatus from the base end unit 3 so that a selected length of preformed tube 5 such as cylindrical tube can be readily positioned horizontally over the base between the ram free end part and the roll-former assembly 4, the ram end being provided with an appropriately shaped mounting 6 ie for cylindrical tubing a circular mounting of stepped form and having part arranged as a close fit within one tube end. If required, the roll-former assembly 4 can be adjustably positionable on the apparatus base to accommodate prescribed lengths of the metal tube 5 to be reformed or reshaped and/or the stroke or length of extension of the extensible ram 1 may be readily adjusted or set according to the extent of rib and groove forming required for the respective tube lengths 5.

The roll-former assembly 4 in this exemplified form of the invention includes a planar mounting in the form of a circular backing plate 7 with a central aperture 8 through which the tube 5 can be passed, the backing plate 7 being mounted on a

strong upright frame support 9 secured to the apparatus base 2 and having its inner face side provided with a plurality of pairs of mounting brackets or plates 10 radially disposed on the inner side wall face of the backing or mounting plate 7 in equal spaced relationship; and extending in planes longitudinally of the apparatus and tube 5 to be reformed, which is coaxially aligned with the extensible ram 1 and backing plate aperture 8. The pairs of mounting plates or brackets rotatably mount at their inner ends roll or wheel former members 11 which rotate in planes extending radially and longitudinally of the apparatus and about transverse axes in the same general transverse plane normal to the longitudinal axis of the tube 5 and extensible ram 1; the roll or wheel formers 11 being disposed with their inner peripheral surface parts in spaced relationship concentrically about the said longitudinal axis and spaced at the desired positioning appropriate to the cylindrical tube diameter and depth of groove that each roll-former 11 is required to press into the tube wall, the peripheral parts conforming to the desired groove and rib shapes, in thus forming ribs between the longitudinal grooves in operation of the apparatus. The length of cylindrical tube 5 being positioned and mounted as aforesaid at one end on the extensible ram end mounting 6 with the ram 1 retracted, and the other end located adjacent to inner peripheral parts of the roll-formers 11; and by operation of the apparatus to extend the ram 1, the length of tube 5 is forced between the roll-formers 11 and through the central aperture 8 of the backing plate 7 so that the originally cylindrical tube 5 is reshaped with a plurality of similar equally spaced longitudinal grooves 5a between which the longitudinal ribs 5b formed on the tube wall.

The invention is of course not confined to the provision of similar equally spaced longitudinal grooves and ribs, but can alternatively provide for unequal spacing and/or differing rib and groove forms according to the positioning of the roll-formers 11 and their peripheral forming surface shapes.

The roll-former mounting plates or brackets 10 can be adjustably mounted on the backing plate 7 such as by locating the mounting plates or brackets 10 on each side of a securing mounting bolt 12 extending from the backing plate 7; and having the respective mounting plates or brackets 10 slidably mounted for radial adjustment and thus positioning the respective roll-former members 11 relative to the tube 5, for variance in groove 5a and rib 5b depth and/or so as to be adjustable according to different diameter tubing. A variety of mounting bolt (or other mounting means) positioning can be provided for, and interchangeable roll-formers 11 and mounting brackets can be provided for different rib

and groove forming.

The arrangement can provide for a length of tube 5 to be forced fully through the roll-former assembly 4 so that the ribs 5b and grooves 5a are formed for the full length thereof; but preferably for uses such as in ballustrading the cylindrical ram extension is arranged to terminate short of the roll-former assembly 4 so that a short cylindrical end part 5c remains on the length of tube 5, as illustrated in figures 3 and 4 of the drawings; thus providing a convenient mounting employing such as a connecting cylindrical spigot or a circular recess or aperture in a rail or other support.

The aforescribed apparatus provides that a straight thrust hydraulic ram provides the tube end mount and is the thrust means which forces the tube length through a stationery roll-former assembly in forming straight longitudinal ribs and grooves on the tube length; and in one variation of the invention it is envisaged that the tube end mount and tube can be held stationery and the thrust means (which may be hydraulic ram means or mechanical thrust means) can be arranged to move the roll former assembly longitudinally of the tube length to force such assembly thereover in forming the longitudinal ribs and grooves. And in a further modification the apparatus and method employed may provide that either the tube length is slowly axially rotated or the roll former assembly is slowly rotated about its and the tube length axis as the tube length passes therethrough (or the roll former assembly passes over the tube length), to thus provide helical or spiral ribs and grooves.

As further alternatives to hydraulic ram means being employed as the thrust means, the tube end mounting or roll former assembly can be longitudinally movable by mounting on one or more axially rotatable screw-threaded shafts or on slide and guide means movable by such screw threaded shaft or shafts; or such as driven chain thrust means can be employed. Unlike conventional roll forming apparatus and methods of effecting roll forming of sheet metal or other metal products, the present apparatus and method do not employ any co-operating mandrel(s) or roller(s) on the opposite side of the metal being shaped ie in this case on the inner side of the tube lengths, in the cold forming of the longitudinal grooves and ribs such grooves and ribs being formed only by externally applied forces.

If desired, the end part 5d of the length of tube 5 remote from the uniformed end 5c can be reformed back to the same circular form readily by location over an appropriate cylindrical former or mandrel, and by the application of a pressure force to the outside of the end part so that the balustrade tubing is similarly formed with a mounting part at each end.

Whilst it is envisaged that square tube lengths can be provided for grooving and ribbing, and to thus provide squared end formation to the tube lengths as shown in figures 5 and 6; as cylindrical tubing is the most economically provided it is preferable to use such cylindrical tubing and to reform the ends into the square form as indicated with any suitable outer press and inner anvil, mandrel or like means. Other end shapes can of course be similarly formed with appropriately shaped press parts.

It is also envisaged that one or both end parts of a length of the grooved and ribbed tube can be further reformed to provide a splayed or belled end 5e as shown in figure 7, for stable abutment against a flat surface 13, and for aesthetic reasons; and if required an inner flat plate member 14 with a central screw or bolt receiving aperture 15, or a fixed stud or screw 16, can be welded within the mouth of the tube end part to provide a convenient means of fixing the tube length to a flat surface 13. This provision may have applications in such as balustrating or employment of the tube lengths in the construction of furniture eg as a set of ornamental table legs.

The tube length end parts can alternatively be fitted, such as by welding, with an outer flange plate with or without outer peripheral fixing screw or bolt holes; or, as exemplified in figure 8 the tube end(s) can be further reshaped with any appropriate forming tool or press means to provide an integral outer peripheral end flange 5f.

A further modification, illustrated by way of example in figure 9 is the subsequent provision of a bullet nose shape 5g to one or both end parts of a tube length eg for fixing to another component or to receive a decorative end closure, by forcing a conical or frustoconical former 17 or like tool of appropriate shape axially over a ribbed and groove end part to collapse such end part inwardly to the desired extent - the rib and groove formation facilitating uniform collapsing.

Open tube ends can be readily sealed or plugged if required and jointer members, as exemplified in figure 10, can be employed for end joining of similar tube lengths.

Thus, by this invention, there is provided an economical and effective way of reforming readily available cylindrical tubing into aesthetically pleasing and stronger ribbed tubing which may have a variety of applications and uses.

Some preferred aspects of the invention have been described and illustrated by way of example, but it will be appreciated that other variations of and modifications to the invention can take place without departing from the scope of the appended claims.

Claims

1. Apparatus for the forming of longitudinally ribbed apparatus and grooved metal tube lengths, comprising a base support mounting a tube end support, longitudinal thrust means, and a roll-former assembly in spaced relationship from the tube end support; the tube end support being movable relatively towards and away from said roll-former assembly (or vice versa) by said thrust means and being arranged to receive one end part of a length of uniform cross-section thin wall metal tube disposed coaxially of the direction of thrust of the thrust means and roll former assembly and between said tube end support and said roll-former assembly, whereby movement of the thrust means will force the tube length through the roll-former assembly for reshaping; said roll-former assembly comprising a plurality of external shaping rollers or wheels mounted for individual rotation in longitudinal planes intersecting or substantially parallel to the longitudinal axis of the tube length, and said rollers or wheels having inner peripheral parts spaced according to the external cross-sectional dimensions of the tube length and depth of the ribs and grooves to be formed therein, and being operable to form said ribs and grooves from outside the tube length without the provision of any co-operating mandrel(s) or roller(s) within the tube length.

2. Apparatus as claimed in claim 1, wherein said longitudinal thrust means comprises a longitudinally extensible and retractable hydraulic ram assembly with an end mounting defining said tube end support and adapted to receive one end part of a tube length, said roll-former assembly being supported by stationary support means.

3. Apparatus as claimed in claim 2, wherein said stationary support means for the roll former assembly is adjustably mounted relative to the base support for selective stationary positioning for the accommodation of prescribed lengths of the tube to be re-shaped.

4. Apparatus as claimed in claim 1, wherein said longitudinal thrust means comprises one or more axially rotatable screw threaded shafts supporting or provided with said tube end support, said shaft or shafts being longitudinally movable relative to the base support and roll-former assembly.

5. Apparatus as claimed in claim 1, wherein said longitudinal thrust means comprises one or more axially rotatable screw threaded shafts mounted for non-longitudinal movement relative to the base support but mounting slide or guide means provided with the tube end mounting or the roll-former assembly for longitudinal movement over the base support.

6. Apparatus as claimed in any one of the preced-

ing claims, wherein said roll-former assembly comprises a planar mounting mounted transverse to the longitudinal axis of said thrust means and tube length to be re-shaped and having an aperture coaxial with said longitudinal axis and arranged for the tube to pass therethrough in the re-shaping process, said planar mounting being provided on one face thereof with a plurality of similar pairs of mounting brackets or plates disposed in planes extending longitudinally of the apparatus and about said co-axial aperture, each pair of brackets rotatably mounting a roll or wheel former for rotation about a transverse axis in a plane substantially radially disposed relative to the said longitudinal axis and aperture; said roll or wheel formers being mounted with their inner peripheral parts positioned and projecting inwardly of said aperture so as to engage the periphery of the tube length to be re-shaped and to form the longitudinally peripheral grooves therein as the tube length is forced longitudinally therebetween.

7. Apparatus as claimed in claim 6, wherein said roll-former mounting brackets or plates are radially adjustable relative to said planar mounting and aperture thereof.

8. Apparatus as claimed in any one of the preceding claims, wherein the tube length to be re-shaped is of uniform circular cross section and said roll-former assembly is mounted for at least partial rotation about said longitudinal axis of the thrust means and tube length as relative longitudinal movement takes place between said tube length and roll-former assembly, in the forming of at least partly helical grooves and ribs longitudinally of said tube length.

9. Apparatus as claimed in claim 11, or claim 6 or claim 7 when dependant upon claim 1, wherein the tube length to be re-shaped is of uniform circular cross-section and said thrust means and tube end mounting are arranged to effect at least partial rotation of the tube length about its longitudinal axis as relative longitudinal movement takes place between said tube length and roll-former assembly, in the forming of at least partly helical grooves and ribs longitudinally of said tube length.

10. Apparatus for the forming of longitudinally ribbed and grooved metal tube lengths, arranged constructed and operable substantially as hereinbefore described with reference to the accompanying drawings.

11. A method of forming longitudinally ribbed and grooved metal tubing comprising the steps of taking a length of preformed thin wall metal tube of uniform cross-section throughout its length, locating one end of said tube length on a mounting and the opposite end of said tube length in juxtaposition with a roll-former assembly having a plurality of roll-formers mounted in spaced relationship for ro-

tation in longitudinal planes intersecting or substantially parallel to the longitudinal axis of said tube length, the roll-formers being mounted with the innermost peripheral surface parts thereof transversely spaced about the tube periphery and shaped and positioned according to the tube external cross-sectional dimensions and depth of the ribs and grooves to be formed therein, and the tube length being positioned in co-axial relationship between said roll-formers innermost peripheral parts; and actuating a thrust means to longitudinally force said tube length between said inner peripheral surface parts of said roll-formers and depress a plurality of longitudinal grooves in the outer surface of said tube length in forming longitudinal ribs between said grooves from outside the tube length and without the employment of a cooperating mandrel or co-operating inner roll-former(s) within the tube length.

12. A method as claimed in claim 11, wherein said roll-former assembly is held stationary against longitudinal movement whilst the tube length is forced longitudinally therethrough by said thrust means.

13. A method as claimed in claim 11, wherein said tube length is supported stationary against longitudinal movement whilst the roll-former assembly is forced longitudinally thereover by said thrust means.

14. A method as claimed in claim 11, claim 12 or claim 13, wherein the tube length to be re-shaped is of uniform cylindrical cross-section and said tube length or said roll-former assembly is at least partially rotated about said longitudinal axis as relative longitudinal movement between the tube length and roll-former assembly takes place, in forming at least partly helical grooves and ribs longitudinally of said tube length.

15. A method as claimed in any one of claims 11 to 14 inclusive, wherein the longitudinal groove and rib forming is terminated short of the end of the tube length located on said mounting.

16. A method as claimed in any one of claims 11 to 15 inclusive, and including the additional step of further re-shaping a grooved and ribbed end part of the tube length back to its original cross-sectional form or a selected alternative form by location on an inner former or mandrel and applying external pressure to the said tube length end part to be further re-shaped.

17. A method as claimed in any one of claims 11 to 16 inclusive, wherein at least one end part of the tube length is, after forming of the longitudinal grooves and ribs in the tube length, subjected to further shaping by end former means to define an integral outwardly projecting transverse end flange for end mounting of said tube length.

18. A method as claimed in any one of claims 11 to 14 inclusive, wherein at least one end part of the

tube length formed with the longitudinal grooves and ribs is subjected to further compressive shaping by an axially movable substantially conical or frusto-conical former to collapse the said one end part into a tapered or bullet nose end part.

19. A method of cold forming longitudinally ribbed and grooved thin wall metal tubing substantially as hereinbefore described with reference to the accompanying drawings.

20. A longitudinally grooved and ribbed length of metal tube formed and shaped or re-shaped in accordance with the method of any one of claims 11 to 19 inclusive.

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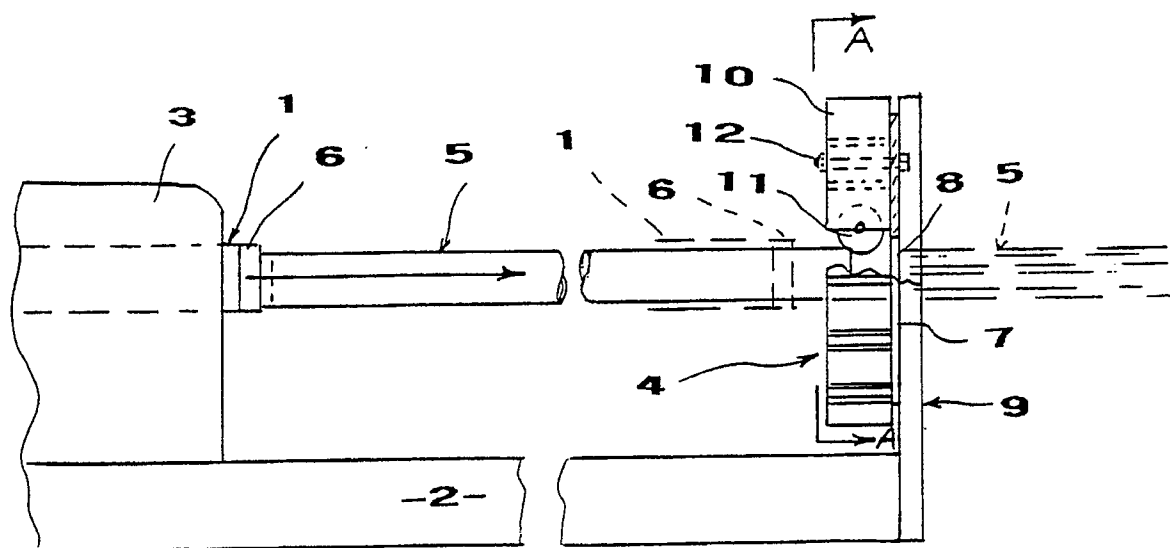


Figure 1

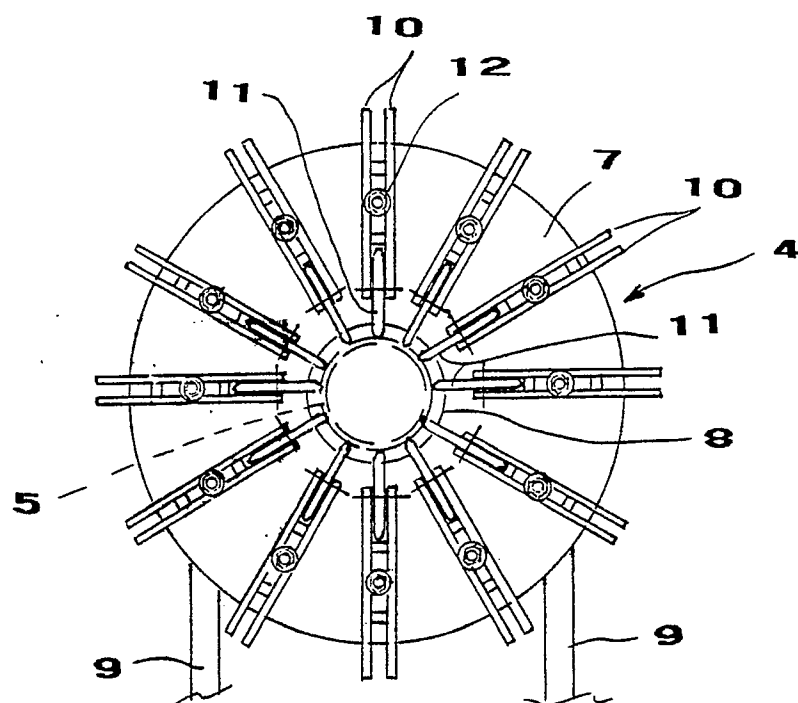


Figure 2

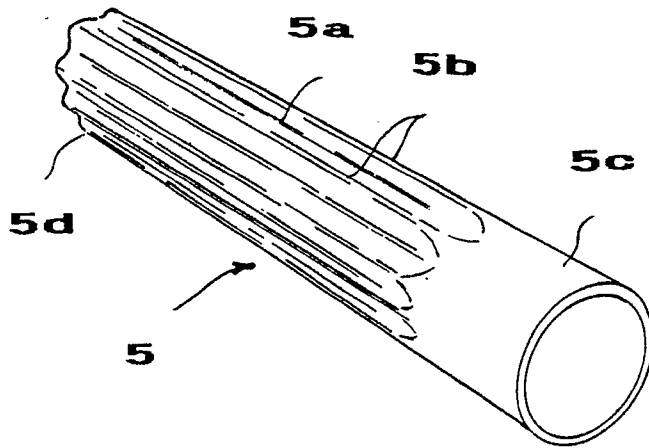


Figure 3

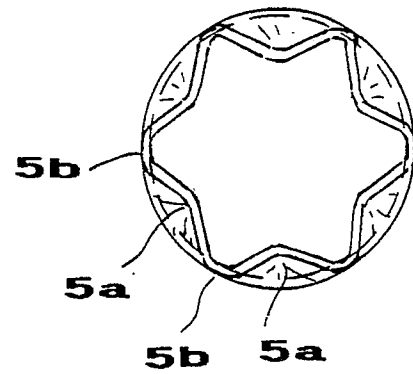


Figure 4

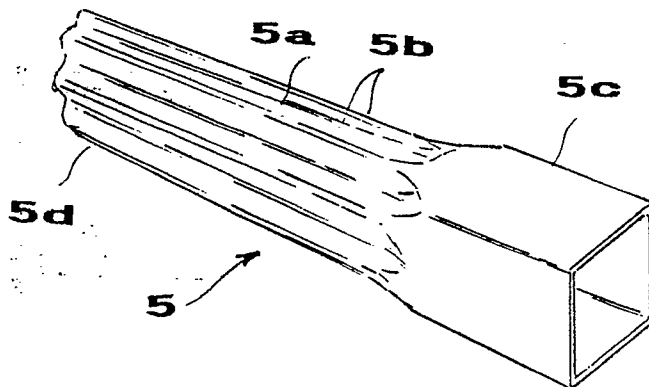


Figure 5

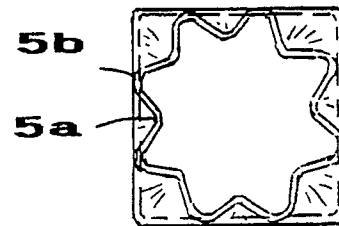


Figure 6

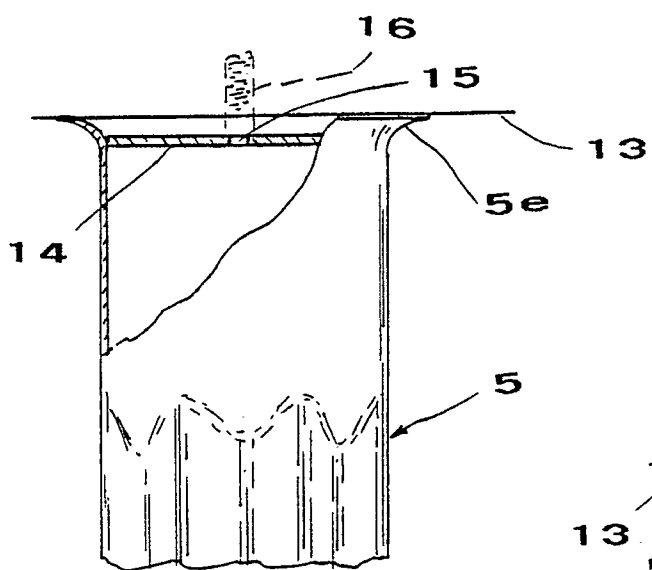


Figure 7

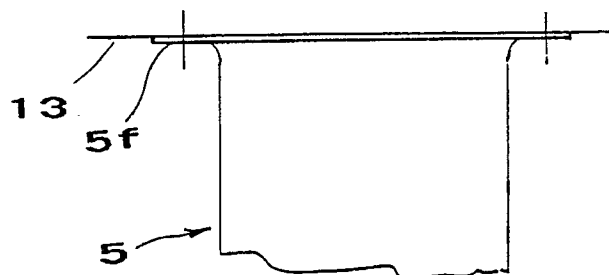


Figure 8

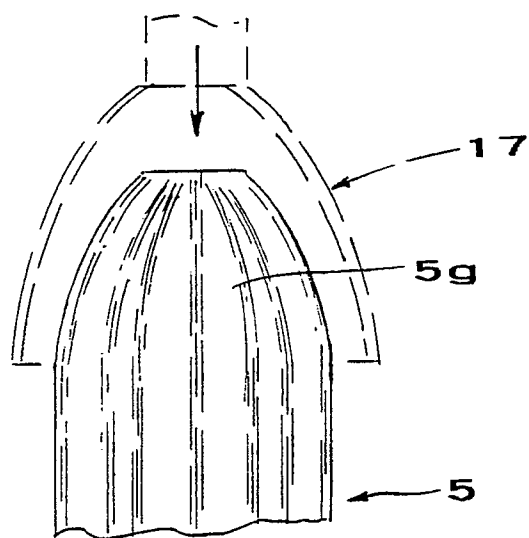


Figure 9

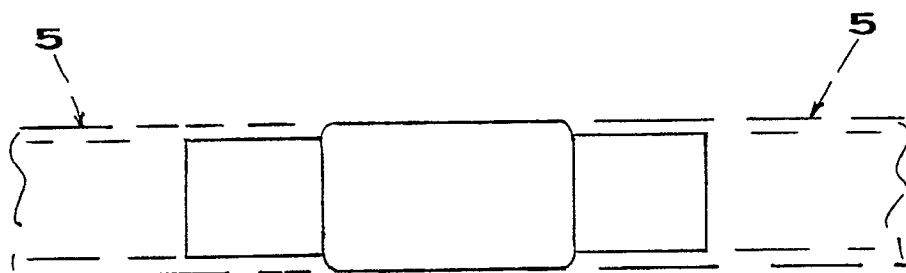


Figure 10