Nov. 3, 1964 R. B. J. LACKINGER 3,155,229

DRAWING MANDREL

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Fig.1

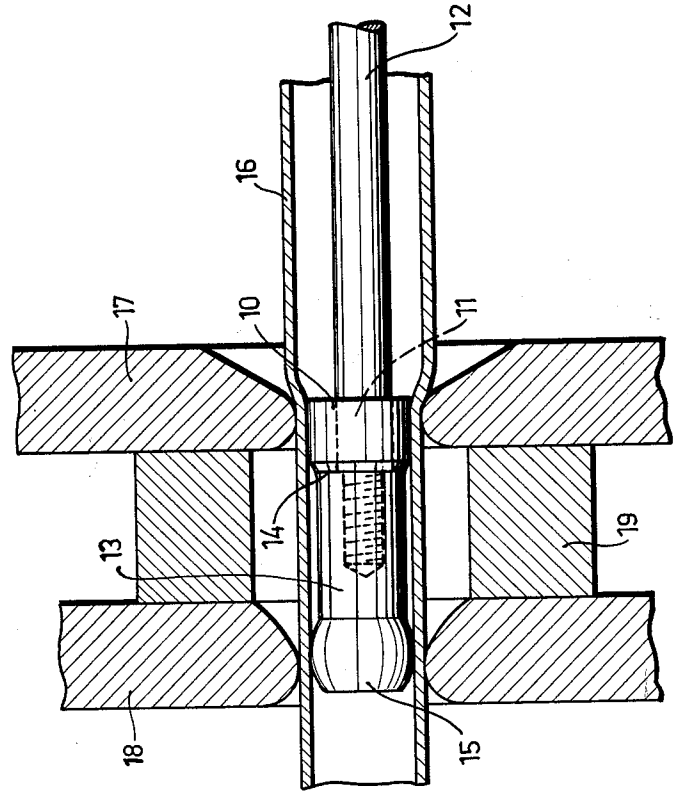

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Fig.3

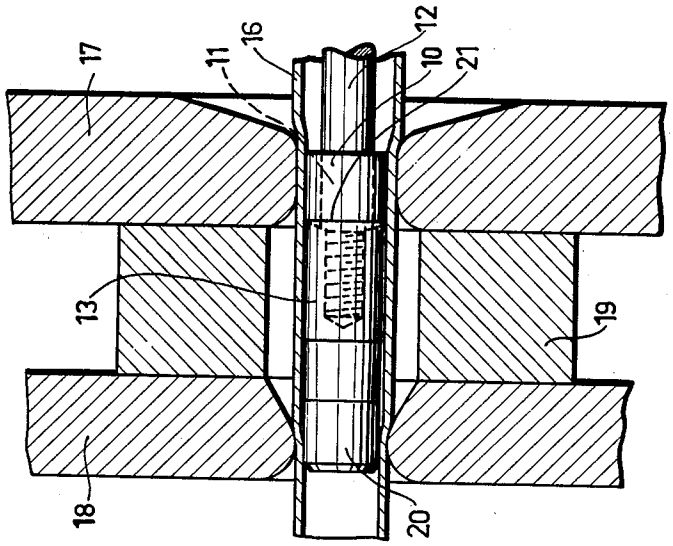
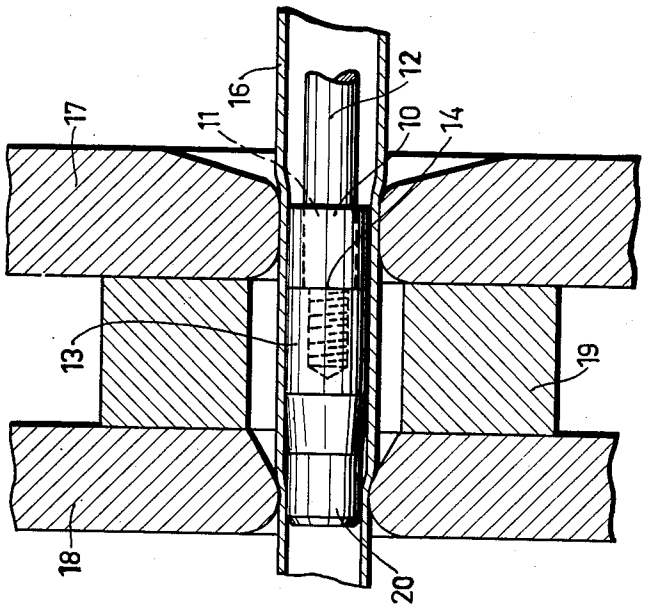


Fig.2



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3,155,229
DRAWING MANDREL

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4 Claims. (Cl. 205—7)

The present invention relates to a drawing mandrel of the kind used for cold reduction of metal pipe in a drawing bench. Such mandrels are subject to extraordinarily high abrasion which necessitates their replacement after a relatively short period of useful service, which involves trouble and cost.

It has been proposed, in order to obtain increased useful service life, to make drawing mandrels of hard metal, which material, as is well known, has an extraordinarily high abrasion strength. On the other hand, hard metal is brittle, and it has been found that drawing mandrels of conventional designs made of hard metal are frequently broken by impact as, after the termination of a drawing operation, the mandrel leaves the pipe end opening, this being presumably due to the sudden elastic contraction of both pipe and pull rod taking place in conjunction with the interruption of the tensile loading.

In accordance with the present invention the above-mentioned drawback of drawing mandrels made of hard metal has been obviated by the feature of providing the hard metal mandrel with an extension made of a steel which is resistant to impact stresses and which extension, when, upon completion of the drawing operation, the hard-metal mandrel is suddenly pulled out through the end opening of the pipe, will remain within the pipe in guiding engagement with the walls of the latter and will not until after that moment slowly pass out of the pipe, and to let the pipe, after the drawing die, pass through a guiding member which supports the pipe as the end of the latter is suddenly pulled off the drawing mandrel, the pipe after a while leaving this guiding member at the slow drawing speed. The guiding of the pipe on the drawing bench and the guiding of the drawing mandrel during the moments following after the sudden pulling-out of the drawing mandrel will prevent effectively any development of rapid lateral movements of the mandrel which could cause damage to the same by impact.

In a preferred embodiment of the invention, the guiding extension of the hard metal mandrel is designed in the form of an elongated supporting nut which is screwed onto the screw-threaded end portion of the pull rod and with which the hard metal mandrel, which is formed with a bore for passing the pull rod, is connected by a soldered joint. In order to reduce the shearing stresses on this soldered joint, the drawing mandrel should be of such design and should be maintained, during the drawing operation, in such a position relative to the drawing die, that the soldered joint will be situated externally of the zone within which the deformation of the pipe wall is being effected. Alternatively, or in addition, the mandrel ring of hard metal may be pushed with a force fit onto the pull rod, thereby affording further security against any relative displacement of the hard metal ring relative to the supporting nut. A reinforcement of the soldered joint may be obtained by making the same conical in shape, for example.

The guiding extension need not necessarily fit snugly within the pipe, but a certain, relatively large clearance may be allowed. As a rule, however, it will be preferable to dimension the guiding extension to slidingly engage the pipe wall peripherally with its extreme end portion. Such a safe guiding action can be obtained by making the

end portion of the guiding extension resiliently expansible. It would also be conceivable to form a die serving for guiding the pipe as a further pipe-diameter reducing drawing die adapted to force the pipe into engagement with the end portion of the guiding extension, this end portion being then formed as a second drawing mandrel. During the passage through the second drawing die a certain reduction of the pipe-wall thickness could, in addition, possibly be effected. It should be ascertained, however, that the pipe reduction effected at the second drawing die will be maintained within sufficiently close limits, not to cause the abrasion of the second drawing mandrel, which is usually made of hardened steel, to become noticeably higher than that of the drawing mandrel, made of hard metal.

The invention will now be described more in detail in conjunction with the accompanying drawings, in which:

FIG. 1 illustrates a first embodiment,

FIG. 2 a second embodiment of a drawing mandral constructed in accordance with the invention; and

FIG. 3 shows a modified form of soldered joint between the hard metal drawing mandrel and the supporting nut for the latter.

Referring to FIG. 1, the drawing mandrel proper comprises a cylindrical ring **10** of hard metal which is passed with a snug or force fit over a cylindrical portion **11** of the pull rod **12** close to the screw-threaded end portion of the latter. The hard metal mandrel **10** is supported against an elongated nut **15** of hardened steel into which the pull rod is screwed. The hard metal mandrel **10** is rigidly connected to the nut **13** by a soldered joint **14**. The nut is formed at its free end with a ball-shaped enenlargement **15** of a diameter slightly less than that of the hard metal mandrel **10**. The pipe **16** to be cold-reduced is drawn in the conventional manner over the mandrel **19** and through a drawing die **17** where a reduction of the pipe diameter and, possibly, also of the wall thickness is effected. In this operation, the mandrel **10** is held by the pull rod **12** in the position shown relative to the drawing die **17**, in which position the soldered joint **14** is situated ahead of the zone within which the pipe-wall material is being deformed, whereby the soldered joint will remain relieved of shearing stresses tending to destroy the soldered connection. Positioned opposite the ball-shaped end **15** of the supporting nut in the operating position of the mandrel is a second drawing die **18** which is maintained in properly spaced relation to the first drawing die **17** by a spacer ring **19**. The second drawing die **18** serves exclusively as a guiding member for the pipe **16** and, therefore, has an opening diameter which is equal to, or slightly larger than that of the first drawing die **17** serving to reduce the pipe diameter, whereby the pipe will pass through the second drawing die with unnoticeable friction. The diameter of the ball **15** is slightly less than that of the mandrel **10** so that the ball will slide through the pipe with a certain clearance relative thereto. At the moment of completion of the drawing operation, at which, because of the elastic contraction of the pipe **16** and of the pull rod **12**, as the load is relieved, the mandrel **10** will suddenly leave the end opening of the pipe, the extended supporting nut will remain with its ball-shaped end **15** within the pipe and will co-operate with the pipe wall to prevent the brittle hard-metal mandrel **10** from getting broken by impacting adjacent parts of the drawing bench. In the course of the continued slow motion of pipe **16** the guiding extension will gently emerge from the pipe, thus eliminating the risk of causing damage to the hard metal mandrel.

Improved guiding action can be obtained if, in the embodiment of FIG. 1, the ball **15** is given a slightly larger diameter than that of the drawing mandrel **10**, and,

additionally, is slitted from the extreme end of the guiding extension to form a plurality of ball-segments adapted to engage the pipe wall in a resilient manner.

By modifying the design of the guiding extension of the supporting nut and imparting to the second drawing die **18** an opening diameter slightly smaller than that of the first drawing die **17**, it is possible to obtain a further reduction of the pipe diameter and/or the pipe-wall thickness as the pipe passes through the second drawing die. One conceivable embodiment is illustrated in FIG. 2. In this case the end of the supporting nut **13** is designed to serve as a second cylindrical drawing mandrel **20**. Due to the fact that this second drawing mandrel **20** is made of a material of less abrasion strength than that of the first drawing mandrel **10**, it should be ascertained that the second or trailing mandrel will not be subjected to higher wear than that corresponding to a useful service life approximately equal to that of the leading drawing mandrel **10**. It should be suitable, therefore, to keep the pipe reduction effected by the second drawing die **18** within much closer limits than that effected by the first drawing die **17**.

FIG. 3 illustrates an alternative method of securing the hard-metal mandrel **10** to the supporting nut **13**. In this case the punch ring is formed with a conical inner end face engaging a correspondingly concave-conical end face of the supporting nut **13**, whereby the soldered joint **21** will have an enlarged connection interface, and will, in addition, no longer be exactly perpendicular to the drawing direction. A soldered joint designed in accordance with FIG. 3, or in other similar way, will be more resistant to transversely directed forces than a soldered joint according to FIGS. 1 and 2.

A mandrel mandrel having its active portion made of hard metal, as proposed according to the present invention, could, if its leading edge is formed as a sharp scraping edge and the guiding extension is designed for proper guiding cooperation with the pipe wall, be used to particular advantage as a scraper mandrel for removing the internal weld or burrs from welded slotted pipe formed from strip of sheet-metal.

What I claim is:

1. An apparatus for the cold reduction of the diameter of metal tube in a drawing bench which comprises in combination:

(*a*) a reducing die through which the tubing is adapted to be drawn,

(*b*) a pull rod,

(*c*) a mandrel of hard metal secured near the end of said pull rod, said hard metal having high abrasion resistance and relatively low resistance to impact stresses,

(*d*) said mandrel of hard metal being positioned within the region of said reducing die,

(*e*) a trailing guide extension on said hard metal mandrel that is further out with respect to the end of said pull rod,

(*f*) said trailing guide extension being made of a steel which is less resistant to abrasive forces but more resistant to impact stresses than the hard metal of said mandrel, and

(*g*) an external guide for the tube positioned in the region around said guide extension.

2. An apparatus according to claim 1 wherein said external guide consists of a guide ring.

3. An apparatus according to claim 1 wherein said trailing guide extension has a diameter that leaves a clearance between itself and the tube.

4. An apparatus according to claim 1 wherein said external guide is in the form of a second reducing die and said trailing guide extension is in the form of a second mandrel being dimensioned to effect a further reduction in the diameter of said tube.

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