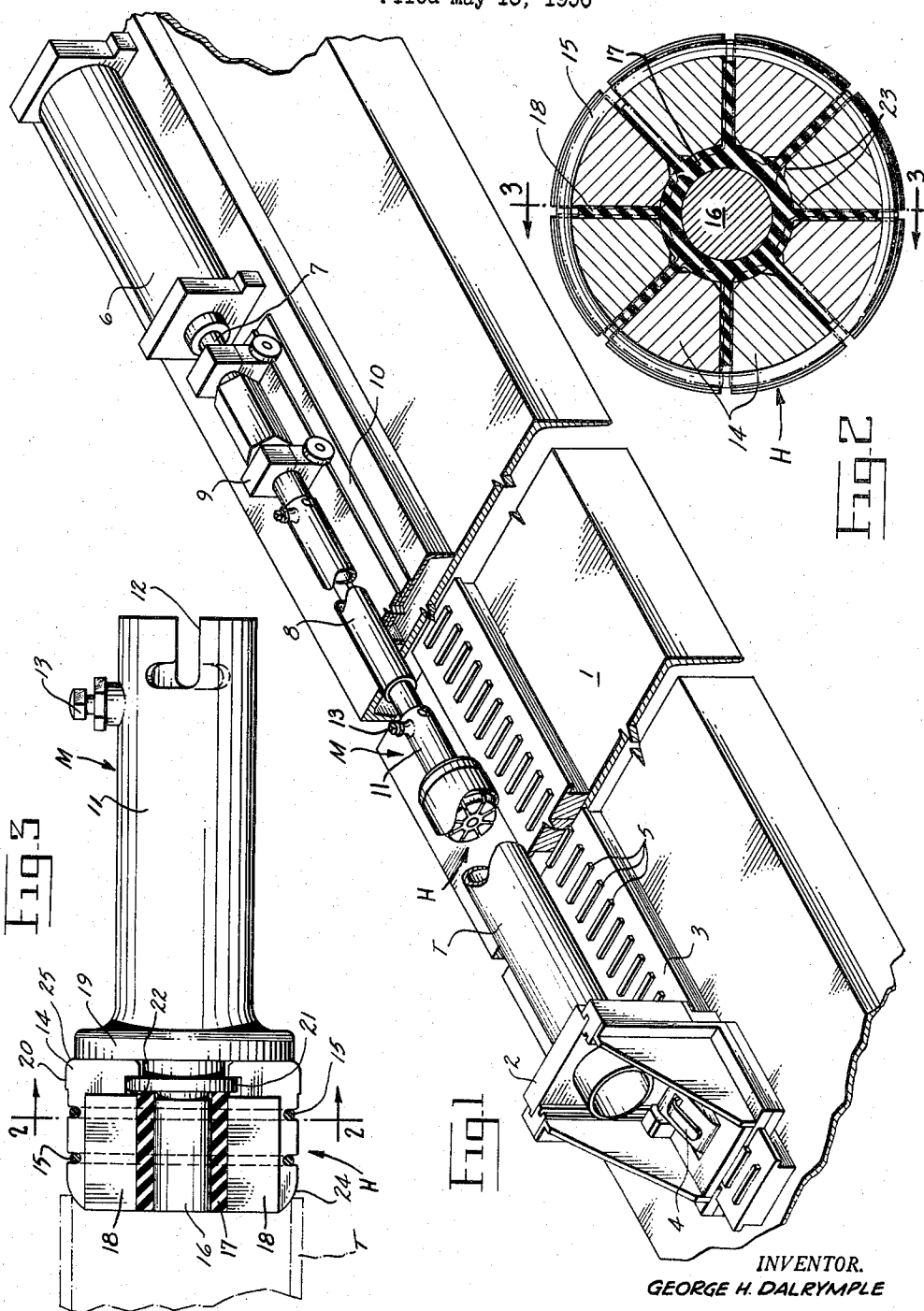


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CONTRACTABLE RAM MANDRELS

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CONTRACTABLE RAM MANDRELS

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This invention pertains to a mandrel which is contractable from a normal size for insertion in a tube to support it while being pushed through a constricting die.

Standard tube making machines frequently do not form tubes to close tolerances. For certain applications, however, it is important that the dimensions of tube diameter and particularly external tube diameter be quite exact, such for example as when such tubes are to be bent in bending machines of some types. Otherwise it is found that the portion of a tube at the inner side of a bend, particularly if of small radius, will be creased or corrugated, which is undesirable. It has therefore been the practice to constrict oversize tubes by a sizing operation where exact dimensions are required. The sizing is accomplished by forcing the tube through a constricting die of proper size. In such operations it has been customary to clamp the tube end in some fashion, which would prevent the clamped end of the tube from passing through the constricting die. It was therefore necessary to cut off and discard the gripped end of the tube.

The principal object of the present invention is to provide a mandrel which will engage a tube end both to support it and to push the tube through a constricting die which will enable the entire tube to be pushed through the die, so as to eliminate the necessity of cutting off a piece of the tube end, which both wastes tubing and requires an extra operation following the sizing operation.

More specifically it is an object to provide a resiliently contractable mandrel which can be fitted into an end of a tube to be constricted, and which will abut the tube end so as to push it through the constricting die, but which is small enough so that the mandrel supported portion of the tube can be moved through the die, and which will contract during such movement so as to enable the mandrel supported portion of the tube to be constricted.

A further object is to provide such a contractable mandrel which is of simple construction and economical to manufacture.

Another object is to provide such a mandrel which can be inserted readily into a tube prior to constriction of the tube, which will support the tube adequately for pushing it through a constricting die, and which can be removed easily from the constricted tube following the sizing operation.

These objects can be accomplished by a mandrel incorporating a segmented head, the segments of which are received respectively between the fins of a resilient spider, deformable to enable the segments to contract collectively. The cluster of segments is integrated by encircling bands, and the segments have bosses cooperating to abut a tube end for exerting on it thrust in a direction lengthwise of the tube.

Figure 1 is a top perspective view of tube constricting

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apparatus utilizing a contractable ram mandrel, parts of such apparatus being broken away.

Figure 2 is a transverse sectional view through the mandrel, taken on line 2—2 of Figure 3, and Figure 3 is a side elevation view of the mandrel with the segmented head being shown in section along line 3—3 of Figure 2.

The sizing apparatus comprises a bed 1 on one end of which is mounted the constricting die 2. This die may be shifted along ways 3 to an appropriate location, depending upon the length of the tube T to be sized, and secured in the proper adjusted position by a latch 4 engageable with an appropriate cleat 5. At the other end of the bed 1 a fluid pressure cylinder 6 is mounted, in which is received a piston for the purpose of reciprocating the piston rod 7 of the ram.

The tube T is pushed through the constricting die 2 by the mandrel M shown generally in Figure 1 and in detail in Figures 2 and 3. This mandrel is engaged with the tube and is supported and reciprocated by a connecting bar 8 extending between the mandrel and a reciprocable carriage 9. This carriage supports one end of the connecting bar 8 and is connected to the end of connecting rod 7 to transmit reciprocatory motion to the connecting bar. The carriage is guided for movement on the tracks 10. For the purposes of the present invention it is assumed that the constricting die, the ram, the connecting bar and the carriage described above are all conventional. This invention is directed to the particular type of tube supporting and driving mandrel M.

The mandrel includes a shank 11 having a hollow end which can receive a complementary end of a connecting bar 8 and be connected to it by a bayonet joint incorporating the angle slots 12 capable of receiving pins projecting radially from the end of connecting bar 8. The mandrel shank may be secured to the connecting bar against relative rotation by a set screw 13.

The important structure of the mandrel is carried by the shank 11 and includes a contractable mandrel head H insertable within the end of the tube T upon contraction. This head preferably is of segmented type incorporating a plurality of hard and preferably metal segments 14 arranged in a cluster and resiliently mounted. As shown best in Figure 2, each of the segments is of arcuate shape, but is of considerable radial extent. Such segments are intergrated by one or more encircling bands, two O-rings 15 of elastomer material being shown as confining the segments. Such rings are spaced axially of the segments, and the outer sides of the segments are grooved to receive such rings.

The segments 14 are clustered about a rod tip 16 projecting axially from the shank 11 of the mandrel. The segments are mounted for resilient radial movement relative to the rod tip by interposing between such tip and the segments a spider of elastomer material including an annular hub 17 closely embracing the rod tip 16 and having circumferentially spaced radial fins 18 projecting radially from the hub. The segments 14 are received respectively between such fins. The elastomer material of which the O-rings 15 and the spider 17, 18 are made may be Neoprene or other material which preferably is resistant to deterioration by petroleum products.

About the root of the rod tip 16 is a backing flange 19 against which the ends of the segments 14 abut. This flange is integral with the shank 11 so that pressure exerted by the piston within cylinder 6 and transmitted through the connecting bar 8 to the mandrel may in turn be transmitted by the flange 19 directly to the segments 14.

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Such segments may transmit this thrust force to the tube by bosses 20, projecting outward from the outer sides of the mandrel head segments adjacent to the flange 19, which can abut the tube end. The segments are retained on the rod tip by provision of an annular rib 21 adjacent to the flange 19 portions of which rib are received in notches or grooves 22 formed in the inner sides of the segments 14.

Prior to insertion of the segmented mandrel head H into a tube end, the resilient spider 17, 18 will be substantially relaxed, so as to hold the segments 14 in their outermost positions. The segments are retained in their clustered relationship against axial movement by inter-engagement of the rib 21 and grooves 22 and are confined against radially outward movement by the bands 15. If radially inward pressure is exerted collectively on the segments, both the hub 17 and, because of the outwardly flared cross-section of the segments, the fins 18 of the resilient spider will be deformed. By the resulting radially inward movement of the segments 14 the fins 18 will be contracted circumferentially and distended radially. The hub 17, on the contrary, will be contracted radially and will seek to expand circumferentially. In order to facilitate such deformation of the spider the inner sides of the segments 14 are relieved, such as by being provided with chamfers 23, as shown in Figure 2. Because the elements of the spider are not appreciably compressible, although they are readily deformable, it will be evident that as a practical matter the radially inward movement of the segments 14 will be limited to quite a small range. When in relaxed condition, therefore, the segmented mandrel head should have an external diameter only slightly larger than the internal diameter of the tube T to be sized.

To facilitate insertion of the segmented mandrel head H into the end of a tube it is preferred that the radially inward constricting force for contracting the mandrel head be effected by the act of inserting such head into the tube end. To produce such a radially inward force the ends of the segments 14 remote from the flange 19 are chamfered at 24 so as to provide a cooperatively tapered end on the mandrel head. As such head is forced axially against the end of the tube, therefore, the tube end will effect a wedging action on the chamfered ends of the segments and draw them radially inward against the resilient resistance of the deformable spider 17, 18. Continued application of axial force will cause the segments to slide the tapered entering end of the mandrel fully into the tube and inserting movement of the mandrel head will continue until the bosses 20 are brought into abutment with the tube end wall.

It is preferred that the flange 19 be smaller than the largest portion of the segmented mandrel head H when in its condition of greatest contraction. Also the projection of the bosses 20 beyond the adjacent portions of the outer surfaces of the segments should be less than the thickness of the thinnest tube T in which the mandrel is to be engaged. With a mandrel having such proportions the entire mandrel as well as the entire tube T can be pushed through a sizing die 2, while the mandrel is contracted and confined within the tube end. When the tube has thus been moved completely through the die, it can be withdrawn from the mandrel and can be used in its entirety.

When the tube has been withdrawn from the contractable mandrel head H, it will be evident that the resilience of spider 17, 18 will immediately expand the mandrel head again until the stress in the spider is virtually completely relieved, but the bands 15 will retain the segments in their clustered relationship. In this relaxed condition shown in Figure 3 the greatest diameter of the mandrel head should not exceed the outer diameter of the tube T, and consequently should not exceed appreciably, if at all, the opening through the die 2. If in such relaxed condition the mandrel head is smaller than the

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die opening, the head can be withdrawn through the die without change of shape and without the necessity of removing the mandrel from the connecting bar 8. If the ends of the segments 14 adjacent to flange 19 are chamfered as at 25 in Figure 3, the mandrel may be withdrawn through the opening of die 2 anyway, because engagement of the mandrel segment chamfers 25 with the die would simply contract the mandrel head sufficiently so that it could be withdrawn through the die opening.

I claim as my invention:

1. A mandrel comprising a shank, a spider of resiliently deformable elastomer material supported by said shank and including a central portion and fins integral with and radiating from said central portion, and a segmented head including a plurality of segments received respectively between the fins of said spider and yieldingly movable toward the central portion of said spider against the resistance of said central portion and fins of said spider deformed thereby.

2. The mandrel defined in claim 1, in which the segments have relieved inner sides facilitating deformation of the central portion of the spider upon movement of the segments toward the central portion of the spider.

3. A mandrel comprising a shank and an end carried by said shank, including a rod tip, a backing flange at the root of said tip, a spider of resiliently deformable elastomer material including a hub portion mounted on said tip and radial fins integral with and radiating from said hub portion, a segmented head including a plurality of arcuate segments received respectively between the fins of said spider and yieldingly movable toward said hub portion against the resistance of said hub portion and fins of said spider deformed thereby, and means retaining each such segment in a position engageable with the face of said backing flange adjacent to said rod tip.

4. A mandrel comprising a shank and an end carried by said shank, including a rod tip, a backing flange at the root of said tip, an annular rib adjacent to the root of said tip, a spider of resiliently deformable elastomer material including a hub portion mounted on said tip and radial fins integral with and radiating from said hub portion, and a segmented head including a plurality of arcuate segments received respectively between the fins of said spider and yieldingly movable toward said hub portion against the resistance of said hub portion and fins of said spider deformed thereby, the inner side of each segment having a notch therein receiving a portion of said rib for retaining each such segment in a position engageable with the face of said backing flange adjacent to said rod tip.

5. A mandrel comprising a plurality of segments arranged in an annular cluster and having circumferentially adjacent sides of circumferentially adjacent segments spaced apart circumferentially and the inner surfaces of opposite segments spaced apart, resiliently contractable means disposed radially inwardly of said segments, engaged by inner surface portions thereof and yieldable inward to enable conjoint contracting movement of said segments when inward pressure is exerted on their outer sides, and resilient means received between circumferentially adjacent portions of circumferentially adjacent segments and contractable circumferentially by inward movement of said segments.

6. A mandrel comprising a plurality of separate, outwardly flared, rigid segments arranged in an annular cluster to be bisected respectively by radii of the annulus in which they are arranged and having circumferentially adjacent sides of circumferentially adjacent segments spaced apart circumferentially and the inner surfaces of opposite segments spaced apart, and means resiliently contractable from an unstressed condition, received in the spaces between such circumferentially adjacent sides of the circumferentially adjacent segments, engaged with such segment sides and contractable circumferentially under stress by wedging pressure of said segments there-

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against by inward movement of said segments when inward pressure is exerted on their outer sides.

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