Our present invention relates to a die for forming tubes by either restricting the open end thereof or closing it.

One object of the invention is to provide a forming die which may be mounted in a machine for rotation and has a socket into which the tube such as a copper tube may be inserted and forcibly fed into the die, the die during rotation progressively contracting the end of the tube and closing it if desired.

Another object is to provide a die capable of closing a tube end, the die being of simple and inexpensive construction and designed to operate effectively in its intended capacity.

Still another object is to provide a die having therein a roller for contacting the end of the tube inserted into the die and effecting a heating of the tube end to aid in the contraction thereof.

A further object is to provide a die from which the roller can be readily removed and replaced after it is worn away.

With these and other objects in view, our invention consists in the construction, arrangement and combination of the various parts of our device, whereby the objects contemplated are attained, as hereinafter more fully set forth, pointed out in our claims, and illustrated in the attached drawings, in which:

Figure 1 is a partial sectional view through a die embodying our invention and showing a tube being formed therein.

Figure 2 is a side elevation of the roller of the die.

Figure 3 is a sectional view of the body of the die from which the roller with its retainer plug has been removed.

Figure 4 is a side elevation of a retainer plug for the roller.

Figure 5 is a sectional view similar to a portion of Figure 1 showing the tube completely closed.

Figure 6 is a sectional view of an end of the partially closed tube showing a capillary tube soldered thereto.

Figure 7 is a sectional view on the line 7—7 of Figure 1 to show the coaction of the roller and a seat in the tube during the forming operation.

On the accompanying drawings, we have used the reference numeral 10 to indicate the body of the die formed of suitable steel or the like and of any suitable length for holding in a machine, whereby the die is rotated. The die, for instance, may be chucked in a lathe or the body 10 may constitute a shaft suitably mounted in bearings and driven by an electric motor or the like. The speed of rotation may vary considerably and we have found speeds of 500 to 1000 R. P. M. suitable for the size of tubing 12 illustrated in the drawing. Of course, larger and smaller sizes of dies may be made for other sizes of tubing, and the speed of rotation of the die may be varied to obtain best results. The tube 12 may be held against rotation by a clamp or the like 13.

The body 10 has a bore 14 formed therein for the purpose of forming a seat for substantially one-half of the tube as will hereinafter appear. Into the side of the body 10, a socket 16 is cut and the upper portion thereof is threaded as indicated at 17. A hole 18 extends downwardly from the center of the socket 16 as viewed in Figure 3 to receive a pin.

The pin is illustrated at 19 and rotateably mounted on it is a roller R. The roller R has a disc-like portion 20 and a concave shaped cone portion 21. A spacing shoulder is provided at 22. The roller R is journalled on the pin 19 and the outer end of the pin is mounted in a socket 23 of a retainer plug 24. The plug 24 may be positioned and removed by a suitable spanner wrench.

Practical operation

In the operation of our tube forming die, assuming the body 10 to be rotating at the proper speed, the tube 12 may be inserted into the bore 14 and forced against the concave portion 21 of the roller R. Manual force can be used against the clamp 13 or a screw or hydraulic means may be provided for advancing the clamp while holding it against rotation. As the body 10 rotates, the roller R will be rotated by its friction against the stationary tube 12.

Due to the concavity 21 and the heat generated by the friction between the tube and the roller and also between the lower half of the bore 14 and the tube, the tube will start deforming on its inner end as shown in Figure 1. The deformation may be continued until the tube is entirely closed, as in Figure 6, and we have found that such closing of the tube results in a gas and liquid tight closed end on the tube, so that our die is suitable for forming capillary bulbs from short lengths of tubing.

The other end of the tube may then be partially closed as in Figure 6, leaving only enough opening to receive a capillary tube 25 of the desired size. The capillary tube may be inserted into the bulb and soldered as at 26 in the usual manner. To insure against any possible leakage at the closed end of the bulb, it may also be sol-
ordered, thus providing a seal in addition to the pressure closing operation on the tube end. We have found in many tests that such soldering of the closed end is unnecessary if the tube closing operation is performed carefully.

During the rotation of the die 10, the tube end is progressively deformed and since the bore 14 contacts only the lower half of the tube while the roller R contacts it with little more than line contact, there are spaces indicated at 27 in Figure 7, which serve as relief points into which the tube end may deform during the forming operation. We have found that this arrangement permits the roller R to partially or fully close the end of the tube with a maximum of efficiency and accuracy.

Some changes may be made in the construction and arrangement of the parts of our device without departing from the real spirit and purpose of our invention, and it is our intention to cover by our claims, any modified forms of structure or use of mechanical equivalents, which may be reasonably included within their scope without sacrificing any of the advantages thereof.

We claim as our invention:

1. In a tube forming die of the character disclosed, a rotatable body having a bore therein adapted to receive the end of a tube to be formed, said body having a lateral socket intersecting said bore, a roller in said socket for contacting the tube end and for being rotated by contact therewith as said die is rotated and said tube is held against rotation, a plug in said socket outside said roller, a pin on which said roller rotates, said pin being carried by said plug and the portion of said body at the bottom of said socket, said roller having a concaved cone-shaped portion to progressively bend the inner end of the tube toward a closed position while the tube is forced into said bore, said bore constituting a seat opposing said roller for substantially one-half the circumference of the tube received therein.

2. In a tube forming die of the character disclosed, a rotatable body having a bore therein adapted to receive the end of a tube to be formed, a socket in the side of said body and intersecting said bore to a depth which terminates at substantially the axis of rotation of said body, a roller in said socket for contacting the tube end, said roller having a concaved cone-shaped portion to progressively bend the inner end of the tube toward a closed position while the tube is forced into said bore, means for retaining said roller in said socket comprising a plug threaded into the outer portion of said socket.

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