

Oct. 10, 1950

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MANDREL FOR TUBE DRAWING

2,525,258

Filed Dec. 28, 1945

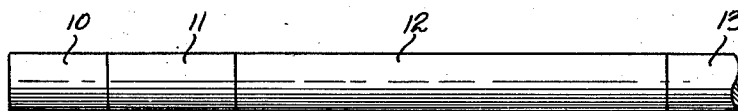


*Fig. 1*

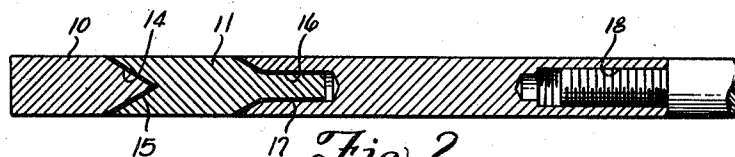


*Fig. 2*

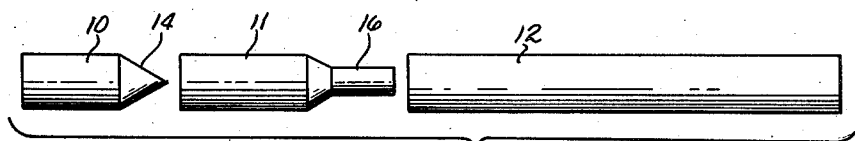


*Fig. 3*

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## UNITED STATES PATENT OFFICE

2,525,258

## MANDREL FOR TUBE DRAWING

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Application December 28, 1945, Serial No. 637,677

1 Claim. (Cl. 205—7)

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My invention relates in general to tube forming tools, and more particularly to a mandrel for drawing a tube in a manufacturing process.

In the manufacture of tubing that is required to be held within close limits of inside diameter and outside diameter, as well as wall thickness, the tubing is usually provided approximately to the correct dimension, but somewhat oversize, and then the tubing is drawn through suitable dies to bring the tube to the final desired finished dimension.

The usual method of bringing the roughly formed tubing to the finished dimension, is to provide a mandrel having an outside diameter of exactly the size and shape as the desired inside diameter of the tubing, to operate in conjunction with a die having an opening therethrough of exactly the desired outside form and size of the finished tubing. By the use of the die and the mandrel, the tubing is drawn through the die with the mandrel positioned inside the tubing concentrically within the die. Thus, the tubing is forced through an opening between the outside of the mandrel and the inside of the die of exactly the desired wall thickness and dimension.

The mandrels used in conjunction with the described dies, are generally of two types: the floating pin type, and the rod mounted type. It is the rod mounted type with which this application deals.

It is readily apparent, that the mandrel used in the described method of tube drawing will receive severe wear and will be subjected to a considerable amount of heat. Thus, material which will readily withstand extreme pressure and heat is required in order to preclude the necessity of changing mandrels after each tube is drawn, with the accompanying expense and delay in operation. To meet the demand for a pressure and heat resisting tool, several very satisfactory hard metallic alloys have been developed. Among these are the tungsten carbide sintered products, known as Carboloy. This material, however, is extremely hard and brittle with a very low tensile strength, and is easily shattered by a direct blow. Further, these wear resisting hard alloys are extremely expensive and very difficult to form into usable shapes. In fact, they are so extremely hard that the only practical method of machining them is by grinding.

Therefore, the practice has been developed to employ a tough steel backing material and provide a small insert of the hard alloy at the tip of the tool where the extreme wear resistance is required. Much development work has been done

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on the problem of securing the tip of hard material to the tough steel backing material. Among the problems to be overcome, is the extremely high shatterability of the tip. Thus, a solid piece of Carboloy is much preferred to a hollow cylindrical body of Carboloy, or to a Carboloy body having an intricate shape or an unsupported portion.

In the production of tube drawing mandrels, the problem of providing a Carboloy surface at the point of extreme wear and heat has also been extremely difficult. In the development of these mandrels as it stands today, the general accepted practice falls into either one of two categories. First, mandrels have been made with hollow centers which may be filled with tough steel cores for support. However, because of the extremely small amount of expansion of the Carboloy under heat, and the relatively large amount of expansion of steel under heat, various types of expansion joints have been required to be placed between the steel core and the Carboloy tip in order to prevent the force of the expanding steel from shattering the Carboloy. Further, in applications of this kind, a threaded construction of some type is generally required to hold the tip of Carboloy in place. Generally, this takes the form of a screw thread on the end of the steel core with a cap member to screw thereon and clamp the Carboloy tip in place. However, irregular surfaces between the Carboloy and the cap member will cause undue strain in the tip and promote shattering after very little use.

The second, and as yet the least developed method, has been to bond a solid piece of Carboloy axially coextensively of the steel support member by direct bonding. The problem has been very acute in producing this type of mandrel, because of two distressing factors. First, the coefficient of expansion of the two materials is so widely different, that any bonding material used to bind the materials directly together is placed under an unduly large strain. Thus, the tip is caused to crack away from the steel backing member or a fracture is introduced in the Carboloy tip because of the large stresses. Secondly, while in use, the tip is positioned concentrically within the die, and is generally held rigidly in place by the material flowing thereabout. However, the steel rod used to hold the tip is generally ten to fifteen feet in length, and of course will be caused to deflect a small amount by the tube whipping thereabout, and by other outside influences. As a result, an extremely large stress is set up at the juncture between the two ma-

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terials. Again, therefore, rupture is brought about and the tool fails.

An object of my invention, therefore, is to provide a means for securing a hard alloy nib or tip to a supporting rod in a tube drawing mandrel which will allow the rod to be deflected relative to the tip thereof.

Another object of my invention is to provide a means for attaching a hard alloy nib or tip to a supporting rod in a tube drawing mandrel, which means for attaching will allow the nib and rod to flex relative to one another in the order of micro-inches or fractions thereof to relieve strain in the nib and rod.

Another object of my invention is to provide a tube drawing mandrel having a hard brittle wear resisting nib tip having a low tensile and shear strength, mounted on a tough support member, with means to reduce the stress developed between the nib and support member during operation to a value below the shattering value and shear strength of the nib tip.

Another object of my invention is the provision of a solid tube drawing nib bonded to the end of a supporting rod with sufficient bonding strength therebetween to resist separation thereof under longitudinal pulling stresses developed during operation.

Another object of my invention is the provision of coupling two relatively rigid members of a tube drawing mandrel together by means of a relatively flexible coupler member.

Another object of my invention is the provision of inserting a relatively flexible copper alloy element between two relatively inflexible members, with the provision of tapering complementary interfitting surfaces therebetween to resist shearing stresses, and the provision of bonding material therebetween of sufficient strength to resist longitudinal stresses at least great enough to exceed the tensile strength of one of the relatively rigid members.

Other objects and a fuller understanding of my invention may be had by referring to the following description and claim taken, in conjunction with the accompanying drawings, in which:

Figure 1 is a side elevational view of my improved tube drawing mandrel;

Figure 2 is a cross-sectional view along the center line of the Figure 1; and

Figure 3 is an exploded view of the component parts of my improved tube drawing mandrel.

With reference to the Figure 1, the preferred embodiment of my improved tube drawing mandrel is illustrated. This embodiment is considered to be the preferred embodiment because of a balancing between the factors of practicability and ease of manufacture. It is understood, that other variations of the mandrel employing the basic principle of our invention may be produced, but it is believed that the illustrated and described embodiment is to be preferred.

In the Figure 1, the reference character 10 represents a hard, wear-resisting nib, preferably of Carboloy or other hard wear-resisting material. A hardened steel shank 12 is provided to carry the nib 10. Of course, the nib 10 must be positioned some 10 to 15 feet away from the final place of attachment to the tube drawing machine, and therefore could be placed directly at the end of a 10 to 15 foot steel rod. However, it is generally preferred to employ the relatively short shank member 12 to mount the nib 10, and provide means to secure the shank 12 to

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the extension rod supporting the mandrel. In machinery that is used to draw tubing, it is generally the practice to pull the tubing through an opening between the outside of the mandrel and the inside of the die as before described. Therefore, the mandrel is placed under an extremely high longitudinal pull. It is not believed, that an elaborate discussion of the tube drawing machinery is required, because this machinery is well known and understood by those skilled in the art. Therefore, the illustration and description will be confined to the mandrel itself. The shank 12, is illustrated as being threaded, as indicated by the reference character 18, in order to conveniently attach the shank 12 to the extension rod 13.

During many years of observation, I have been unable to attribute the failures of the mandrels having hard alloy material bonded to the shank to any one thing. It occurred to me, however, that the extreme stress experienced in the mandrel must produce severe bending shocks under operation which were conveyed to the several joined parts, and that these severe bending shocks led to the failures. Regardless of the cause of the failures, I have found that a stress relieving coupler or slug 11 positioned to bridge between the shank 12 and the nib 10 almost completely limited failures. I have further found that several types of material might well be used to relieve the stress between the shank 12 and the nib 10, but I have also found that copper alloys are much to be preferred. Among the copper alloy materials which we have used, I have found that the copper alloys known as brasses are relatively flexible as compared to steel and Carboloy, and also possess sufficient strength to prevent "necking" under the longitudinal pulling stresses developed in the drawing of the tubing. Broadly speaking, however, the coupler 11 is to be made of a material having a greater flexibility than either the steel shank or the Carboloy nib, but also possessing sufficient tensile strength to withstand the applied forces tending to stretch the mandrel longitudinally. Copper alloys have proven themselves worthy in actual practice, and the copper alloys known as the brass series are particularly useful, but the use of other material possessing the desired properties is not precluded.

As seen in the Figure 2, I have provided a conical projecting surface 14 on the nib 10 and a complementary recess surface 15 on one end of the coupler 11. In a somewhat similar manner I have provided a recess 17 on one end of the shank 12 and a complementary insert portion 16 on the coupler 11 to fit into the recess 17. All surfaces are finished to provide smooth contacts therebetween. I have found, that by providing interfitting surfaces as illustrated, the members may be bonded together more securely than would be possible with straight cross-sectional surfaces. That is, by providing a cone shape, such as the surfaces 14 and 15, or a composite form such as the cone and cylindrical projections 16 and 17, the material used to bond the members together will be placed more under shearing stress than tensile stress. Of course, placing the complementary surfaces in such a manner as to take advantage of the greatest strength of the bonding material will add greatly to the final strength of the assembled mandrel.

Further, by the provision of the strain relieving coupler member 11, I have found that strain has been relieved to such an extent that various

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bonding materials which heretofore have been considered unsatisfactory, are suitable to bond the various sections together with sufficient strength to resist the maximum tensile pull applied to the mandrel. For example, I have found that a material known as "Easy-Flo No. 3," or a bonding material made of silico-manganese, ferro-silicon, nickel and powdered borax glass may be used with satisfactory results. Of course, many other similar bonding materials will be found suitable. Any bonding material chosen, however, must have sufficient shear and tensile strength to be at least strong enough to resist the longitudinal pull equal to the minimum tensile strength of the nib 10.

In operation, it appears that the coupler member 11 when connecting the nib 10 and the shank 12 in end to end relationship along a central axis, will provide the required amount of flexing to absorb the shock between the nib 10 and the shank 12. That is, during operation a certain amount of "whipping" will be experienced in the supporting members 12 and 13 and the constrained nib 10. Inasmuch as these two members 12 and 13 are relatively inflexible, a great strain would be produced at the mandrel point end but for the strain relieving action of the coupler 11. Further, since the nib 10 is not weakened by the use of screws or bolts in order to hold the nib to the shank 12, the almost infinite resistance to crushing possessed by a solid piece of Carboloy may be fully utilized.

It is understood, that the principle involved in this invention is the compounding of a tool comprising a first hard section, a second flexible member, and a third supporting member, the second member serving as a strain relieving member between the two relatively hard and inflexible members of the tool by serving as a more flexible piece bridging therebetween.

Although I have described my invention with a certain degree of particularity in its preferred form, it is understood that the present disclosure of the preferred form has been made only by way of example and that numerous changes in the details of construction and the combination

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and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

What is claimed is:

5 A mandrel comprising an elongated mandrel nib of hard wear-resisting material having a low tensile strength, an elongated tough steel shank member adapted to be supported at one end and to carry said nib at the other end, and an elongated shock absorbing coupler member of copper alloy, said shock absorbing coupler member being of high tensile strength, having a greater flexibility than either said nib member or said shank member, and being of sufficient length to 10 absorb tensile, torque and bending stresses, said nib member and said coupler member having mutually complementary surfaces bonded to each other by a bonding material having a strength greater than the tensile strength of said nib member, said coupler member and said shank member having mutually complementary surfaces bonded to each other by a bonding material having a strength greater than the tensile strength of said nib member, said nib, shank and coupler being arranged in longitudinal end-to-end relationship along a common central axis. 25

TITO FABRIZIO.

#### REFERENCES CITED

30 The following references are of record in the file of this patent:

#### UNITED STATES PATENTS

| Number       | Name     | Date          |
|--------------|----------|---------------|
| 35 1,887,372 | Emmons   | Nov. 8, 1932  |
| 1,903,077    | Wolf     | Mar. 28, 1933 |
| 1,989,507    | Diescher | Jan. 29, 1935 |

#### FOREIGN PATENTS

| Number     | Country       | Date          |
|------------|---------------|---------------|
| 40 458,737 | Great Britain | Dec. 24, 1936 |

#### OTHER REFERENCES

45 Tool & Die Journal, July 1946, pages 80 to 83.  
Huebner Publications, 2460 Fairmount Boulevard, Cleveland 6, Ohio.