July 22, 1952 B. M. NASE 2,604,137

TUBE-FORMING MACHINE

Original Filed Jan. 10, 1947 3 Sheets-Sheet 1

Fig. 2

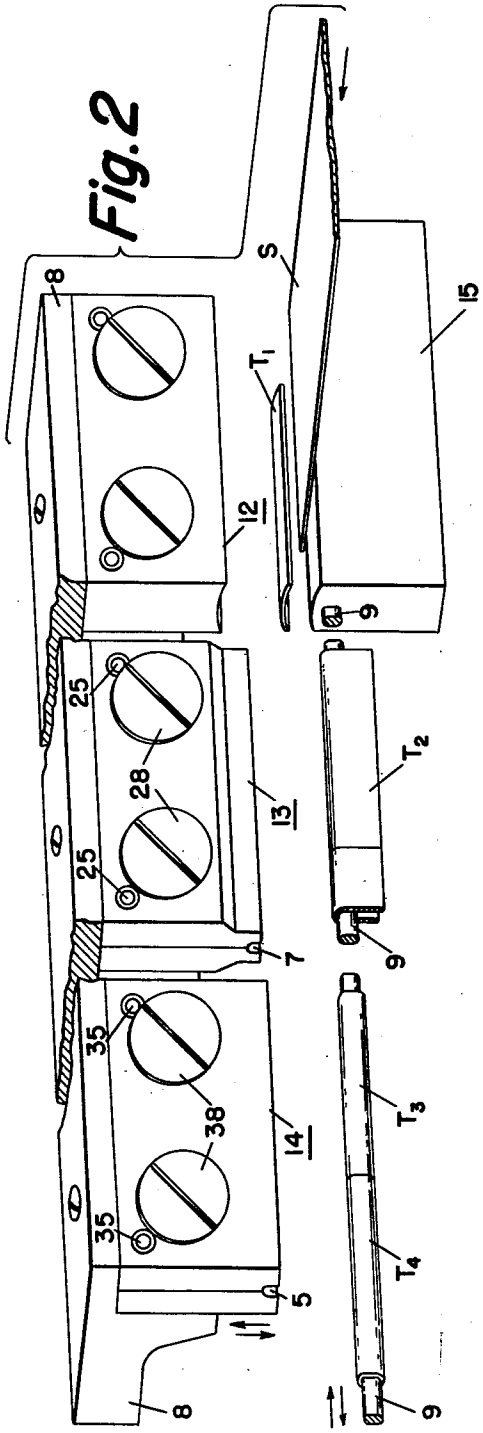


Fig. 3

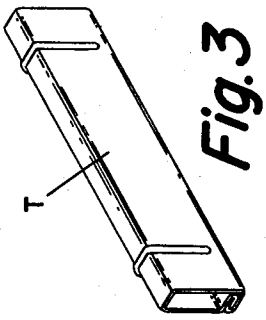
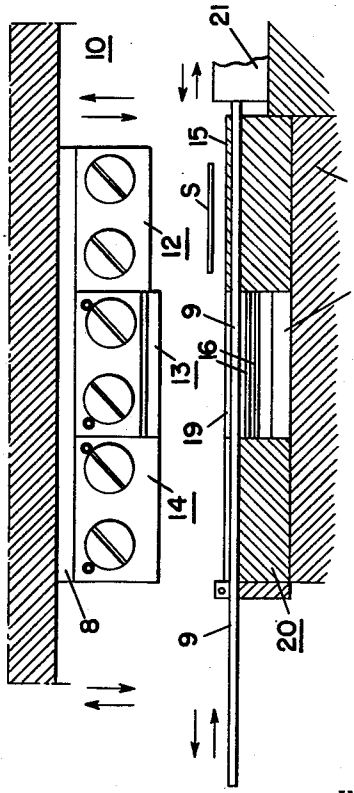


Fig. 1



INVENTOR.
BENJAMIN M. NASE

BY

Woodcock and Phelan
ATTORNEYS

July 22, 1952 B. M. NASE 2,604,137

TUBE-FORMING MACHINE

Original Filed Jan. 10, 1947 3 Sheets-Sheet 2

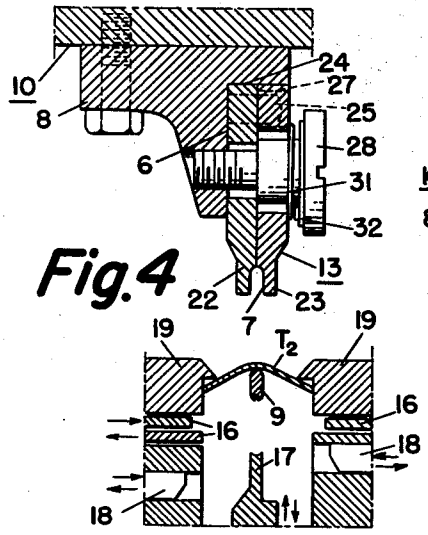


Fig.4

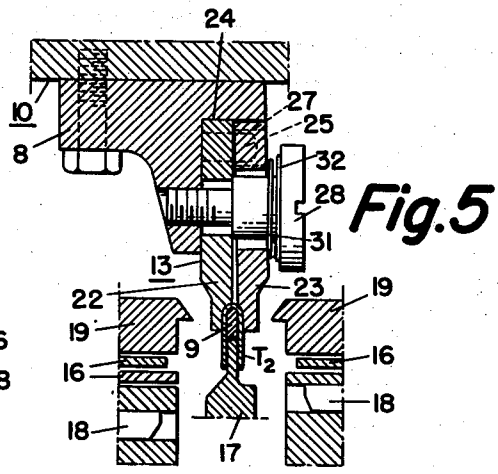


Fig.5

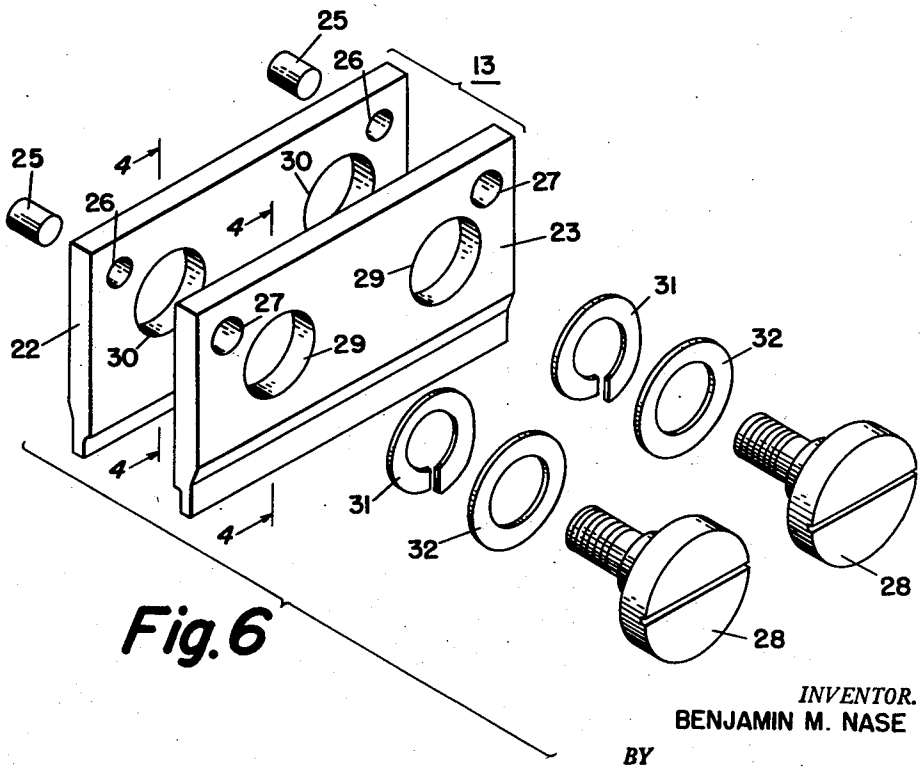


Fig.6

INVENTOR.
BENJAMIN M. NASE
BY

Woodcock and Phelan
ATTORNEYS

July 22, 1952 B. M. NASE 2,604,137

TUBE-FORMING MACHINE

Original Filed Jan. 10, 1947 3 Sheets-Sheet 3

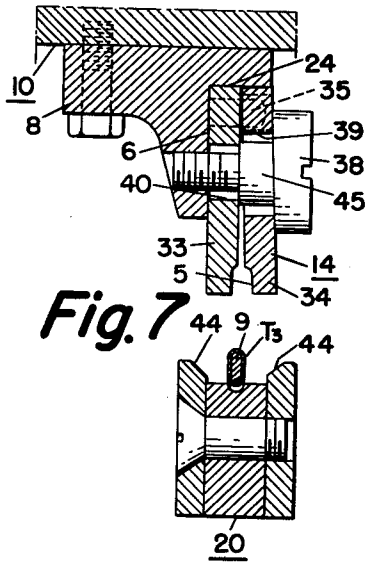


Fig. 7

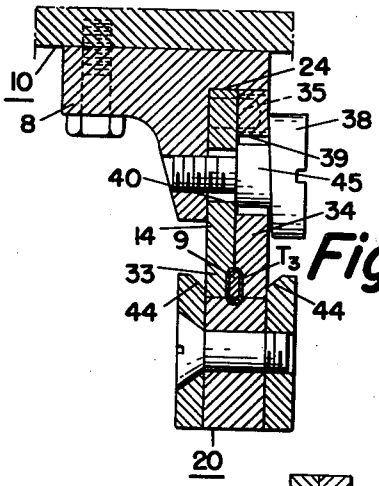


Fig. 8

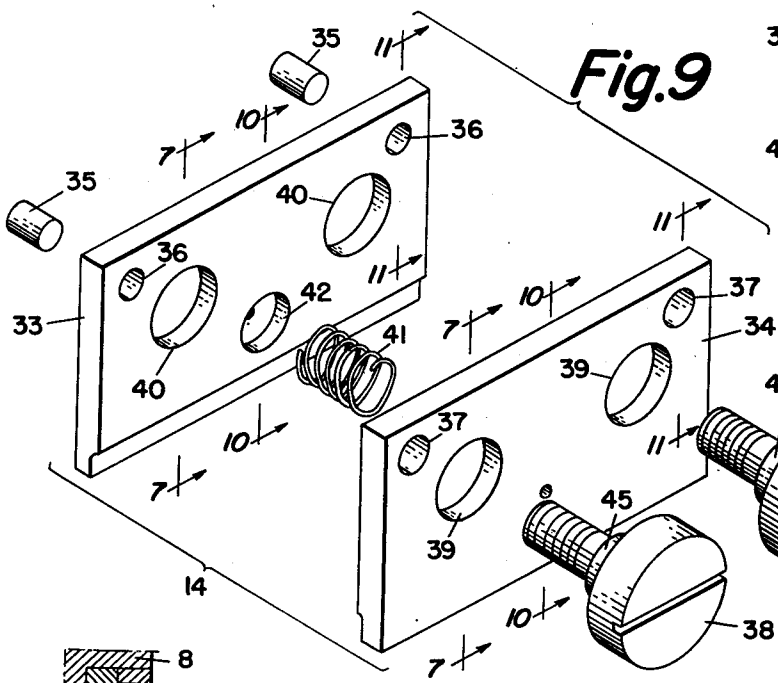


Fig. 9

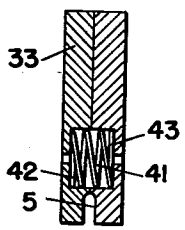


Fig. 10

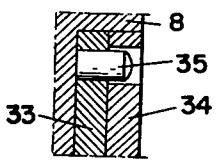


Fig. 11

INVENTOR.
BENJAMIN M. NASE
BY
Woodcock and Phelan
ATTORNEYS

Patented July 22, 1952

2,604,137

UNITED STATES PATENT OFFICE

2,604,137

TUBE-FORMING MACHINE

Benjamin M. Nase, Lederach, Pa., assignor to Superior Tube Company, Norristown, Pa., a corporation of Pennsylvania

Original application January 10, 1947, Serial No. 721,354. Divided and this application March 6, 1952, Serial No. 275,115

3 Claims. (Cl. 153—48)

1

This invention relates to tube-forming machines, particularly to machines for making tubular electrodes for thermionic tubes.

In the manufacture of tubular electrodes from blanks which are shaped over a mandrel by bending, seaming and finishing dies, certain difficulties arise especially when the tubular electrodes are of flattened oval shape or similar cross section. For example, when the bending die is of the type shown in U. S. Letters Patent No. 2,116,971 to Haslauer, it is difficult in event of jamming at the bending station to clear the machine for prompt resumption of normal operation; furthermore, when the finishing die is of the type therein disclosed, it is difficult to meet exacting requirements of size and shape of the finished electrodes.

In accordance with the present invention, these difficulties are overcome by use of the bending and finishing dies which each comprise a pair of die members complementarily recessed to embrace the mandrel and so mounted on the movable die-block structure that they are capable of restricted movement relative to each other upon engagement with a blank or tube on the mandrel. The bending die members are normally maintained in engagement with each other by a biasing spring arrangement which allows them to separate slightly in event of jamming at the mandrel: the finishing die members are held slightly apart by a spring arrangement whose bias is progressively overcome as the mandrel and tube thereon more and more deeply enter the die recesses. The improved bending-die arrangement is herein claimed; the improved finishing-die arrangement is claimed in application Serial No. 721,354 of which this application is a division.

The invention further resides in features of construction, combination and arrangement hereinafter described and claimed.

For a more detailed understanding of the invention, reference is made to the accompanying drawings, in which:

Fig. 1 is a side view, partly in section, showing the upper and lower die-blocks of a tube-forming machine in separated position;

Fig. 2 is a perspective view of the upper dies and illustrates the successive steps of forming finished electrodes from blank stock;

Fig. 3 is a perspective view of a finished tube or electrode;

Fig. 4 is a sectional end view on enlarged scale showing details of construction of the bending die and associated elements, the section of the die being taken on lines 4—4 of Fig. 6;

2

Fig. 5 is similar to Fig. 4 but shows the bending die in its lowermost position;

Fig. 6 is an exploded view showing the elements of the bending die;

Fig. 7 is a sectional end view of the finishing die and associated parts; the section through the finishing die is taken on lines 7—7 of Fig. 9;

Fig. 8 is similar to Fig. 7 but shows the finishing die in its lowermost position;

Fig. 9 is an exploded view showing the various elements of the finishing die;

Fig. 10 is a sectional view of the finishing die taken on lines 10—10 of Fig. 9; and

Fig. 11 is a sectional view taken on line 11—11 of Fig. 9.

Referring to Fig. 1, the upper die-block 10 which reciprocates toward and from the lower die-block 11 carries a blanking die 12, a bending die 13 and a finishing die 14. During each cycle of the machine, the movable blanking die 12 cooperates with the lower, stationary blanking die 15 to sever a tube blank T1, Fig. 2, from a thin metal strip S. When the electrodes are to be provided with a bead, the beading operation may be performed by dies 12 and 15, or by a pair of dies which operate upon strip S in advance of the blanking station. During this cutting or forming of a blank by the dies 12 and 15, the bending die 13 presses a previously cut blank over the mandrel 9 and before the return upward movement of the die-block, the bent blank is operated upon by the seam-forming and seam-locking tools 16 and 17 to form a seamed tube T2 about the mandrel. The operation of the actuating members 18, Figs. 4 and 5, for the mandrel-supporting and seam-locking tool 17 is fully described in the aforesaid Haslauer Patent. Preferably, the lower surface of the mandrel is grooved to receive the lock-seam formed from the margins of the blank by the tools 16 and 17. During each cycle of the machine, the finishing dies 14 and 20 operate upon a previously seamed tube T3 more accurately to dimension it. The mandrel 9 about which the blanks are bent is reciprocated by block 21, Fig. 1. Upon each retraction of the mandrel, the tubes are prevented from moving therewith because of engagement of the last formed tube T2 with the left end, Fig. 1, of the blanking die 15; during the next forward movement of the mandrel all tubes move with it, each to the next station. Thus, by the repeated reciprocation of the mandrel there is effected step-by-step movement of the tubes on the mandrel to and beyond the finishing dies to the position of the finished tube T4, Fig. 2, with eventual discharge of the

tubes in succession from the free end of the mandrel. The finished electrode T, when of the beaded type, is shown in Fig. 3. Concurrently with each forward or feeding movement of the mandrel 9 a carriage, not shown, pushes a blank T1 from between the then separated blanking dies 12 and 15 to position below the bending die 13. Control of the blank is maintained during this transfer of the guides or nest members 19, Figs. 4 and 5.

The foregoing brief description of the general purpose and function of the various dies is believed sufficient for an understanding of the present invention; for a more complete and detailed explanation, reference is made to the aforesaid Haslauer patent.

As mentioned briefly above, when the bending die is of the type shown in the Haslauer patent, difficulty is experienced in the event of jamming at the bending station. This may occur, for example, because of maladjustment of the guides 19, incomplete transfer of a blank to, or of a tube from, the bending station, or feeding of two blanks instead of one from the blanking station. In any event, whenever jamming occurred, extensive damage occurred and much time and labor was required again to put the machine into operation. Specifically, in practically all cases of jamming, the bending die broke; and in most cases, in addition to breakage of the die, there was breakage of one or more of the seam-forming and locking tools and serious deformation of the mandrel. From the fact that for smaller sizes of the electrodes the minor and major axes of the mandrel are respectively only about 0.030 inch and 0.10 inch, it can readily be appreciated the machine parts mentioned must necessarily be small, accurately dimensioned and precisely positioned, and that they are inevitably broken or seriously damaged if any jamming occurs.

As shown most clearly in Figs. 4, 5 and 6, the present bending die 13, which overcomes these difficulties, comprises a pair of die members 22 and 23 complementarily shaped at their lower end to form the recess 7 which coacts with the mandrel 9 in bending of the blanks and formation of the lock-seams. The positioning pins 25 which extend from the detachable portion 8 of the upper die-block 10 fit tightly in openings 26 in the left-hand die member 22 and project into the somewhat larger openings 27 in the right-hand die member 23. The pair of die members 22, 23 are mounted upon the block member 8 for movement in unison therewith and for limited relative movement by an arrangement comprising a pair of screws 28, spring washers 31 and washers 32. Each of the screws 28 passes through openings 29 and 30 in the die members 23 and 22 respectively and into threaded engagement with the die-holder 8. The openings 30 somewhat loosely fit the shanks of the screws 28 to allow precise determination of the position of the die member 22 axially of the mandrel. The openings 27 and 29 in the right-hand die member 23, however, provide greater clearance for the pins 25 and screws 28 for additional reasons which later appear.

The spring washers 31, 31 provide a biasing means which normally maintains the two die members 22 and 23 firmly in face-to-face engagement as shown in Fig. 4. Normally, the vertical faces of the die members 22, 23 are parallel to the surface 6 of block 8 which in turn is parallel to the plane of the major axis of the flattened oval mandrel 9.

In each cycle of the machine, as the block 10 moves downwardly a blank T2, Fig. 4, is bent over the mandrel by the die members 22, 23 whose thrust during this blank-bending operation is received by the horizontal surface 24 of the die-block member 8. Surface 24 is parallel to the minor axis of the mandrel 9 and engages the upper face of each of the die members 22, 23. The biasing forces exerted by the springs or lock-washers 31 are sufficiently great to maintain the members 22 and 23 immovably in engagement with each other during the normal bending, seam-forming and seam-locking operations performed at this station of the machine.

If, however, there is jamming at the mandrel, the springs 31 yield so to allow the die members 22 and 23 to separate slightly, generally as shown in Fig. 5. The clearance afforded pins 25 and screws 28 by the larger openings 27 and 29 in the die member 23 permits it to tilt slightly to open the recess 7 and so avoids "freezing" of the die, mandrel and the tube. The heads of the screws 28 (or nuts, if studs are used instead of screws) serve as stops which suitably restrict the extent to which the die members 22, 23 may be forced apart, whether that separation be effected by the jamming itself or by insertion of a tool by the operator to permit him to withdraw from the machine the blanks or tubes causing the jamming. In any event, the extent of separation is ordinarily sufficient to allow the machine easily to be cleared so that normal operation may quickly be resumed without need to remove or replace any of the dies or any of the seam-forming or locking tools. When the offending obstruction is removed, the springs 31 are at once effective to return the die members 22, 23 to their original normal positions in engagement with each other, Fig. 4, and the machine is in readiness for resumption of its operation.

Referring to Figs. 7–10 inclusive, the movable finishing die 14 also comprises a pair of die members movable vertically in unison with the upper die-block and capable of lateral movement with respect to one another. The two die members 33 and 34 are complementarily shaped at their lower ends to form a recess 5 suited snugly to receive a seamed tube 73 on the mandrel 9. The pins 35 tightly fit the openings 36 near the upper end of the die member 33 and project into the larger openings 37 in the die member 35. The pair of die members are held parallel to aforesaid surface 6 of the die-block 8 by the screws 38 which pass through the openings 39 and 40 in the die members 34 and 33 respectively. As indicated, the openings 39 in member 34 are substantially larger than those in the die member 33, the former openings affording appreciable clearance for the enlarged portions 45 of the shanks of screws 38 and the openings 40 affording clearance for the smaller shank portions of the screws which extend through the die-block member 8; the clearance afforded by enlarged openings 40 permits accurate positioning of the die axially of the mandrel; the greater clearance afforded openings 39 has the additional purpose later herein described. The aforesaid ledge surface 24 of block member 8 overlies the supper faces of die members 33, 34 to receive the thrust incident to their coaction with the mandrel and the lower finishing die 20.

The spring 41 disposed between the die members 33 and 34 and preferably received by the recesses 42 and 41 in the adjoining faces thereof, Fig. 10, forces the die members 33 and 34 apart,

generally as shown in Fig. 7. The maximum separation is determined by the heads of the screws 38, 38 which thus serve as stops limiting the extent to which the die members may be forced apart by the spring 41. When the die-block 10 is in its upper position away from the mandrel 9, the two finishing die members 33 and 34 are separated, Fig. 7, the right-hand die member 34 assuming a slightly tilted position determined by the specially tapered or shaped rear face of the screw heads 38, thus to open the recess 5 so that its width is somewhat greater than the desired outer minor width of the finished electrodes. As the die-block moves downwardly toward the mandrel, the outer lower edges of the die members 33 and 34 engage the fixed cam surfaces 44 which are directed downwardly and inwardly. As downward movement of the upper die-block continues, the finishing die members 33 and 34 in addition to moving vertically with respect to the mandrel also move horizontally towards one another and toward the sides of the mandrel to narrow the recess 5, coming into engagement with each other just before the end of the down stroke for the remainder of which the outer faces and the die members 33 and 34 are in engagement with the lower, vertical portions of the cams 44, 44. As the die-block moves upwardly, the spring 41 causes the die members 33, 34 again to assume their separated position, Fig. 7.

With the die members 33, 34 approaching their lowermost position, Fig. 8, the narrowing recess 5 and the shallow recess in the upper face of the stationary finishing die 20 cooperates with the mandrel 9 precisely to determine the shape and dimensions of the finished electrode or tube. During this operation, the shaping pressure is well distributed over the entire tube area and is applied directly to the sides as well as to the upper and lower faces of the tube. This mode of dimensioning and shaping the seamed tubes on the mandrel 9 affords results which are markedly superior to those attained with finishing dies of the type shown in the aforesaid Haslauer patent and is particularly suited for finishing of tubes of flattened oval or similar cross section including elliptical, oblong or other shape having unequal major and minor axes and has made it possible to meet very exacting requirements as to their shape and size; and without need to reduce the rate of production of the machine. With the die arrangement described, the major and minor axis dimensions of electrodes produced by the machine are within a tolerance of not more than one or two-thousandths of an inch.

As shown in the drawings and as above described, both pairs of die members 22, 23 and 33, 34 are attached to block 8 forming therewith a detachable die-block assembly which is attached as by bolts shown in Figs. 4, 5, 7 and 8 to the upper die-block 10. The faces 6 and 24 of block 8, as above described, align both pairs of die members with respect to mutually perpendicular planes which, when the die-block assembly is in the tube-forming machine, respectively coincide with a vertical plane in which lies the longitudinal axis of the mandrel 9 and with a horizontal plane parallel to a horizontal plane in which lies the longitudinal axis of the mandrel: the positioning pins 25, 25 and 35, 35 extending from the aforesaid face 6 of block 8 cooperate with the pairs of die members to fix their proper relative position so that when the assembly is attached to the upper die-block of the machine they are simultaneously properly positioned longitudinally of the mandrel.

It shall be understood the invention is not limited to the particular arrangements specifically disclosed, but that changes and modifications within the scope of the appended claims may be made.

What is claimed is:

1. A die-block assembly for a tube-forming mechanism comprising a mandrel, a die-block movable toward and from said mandrel, a pair of normally engaged die members carried by said die-block and having complementary recesses at one end to embrace the mandrel, said die-block assembly being characterized in that said die-block has a thrust-receiving surface for engaging the other ends of said die members and a positioning surface for engaging a side of one of said die members, in that locating pins extend from said positioning surface through said die members, and in that said die members are detachably mounted on said die-block by means comprising a member extending from said positioning surface through said die members and having a head portion for limiting the separation of the normally engaged die members, and resilient means disposed normally to maintain engagement of said die members but yielding in event of jamming on the mandrel.

2. A die-block assembly for tube-forming mechanism comprising a mandrel, a die-block movable toward and away from said mandrel, a pair of normally engaged die members carried by said die-block and having complementary recesses at one end to embrace the mandrel, said die-block assembly being characterized in that said die-block has a thrust-receiving surface for engaging the other ends of said die members and a positioning surface for engaging a side of one of said die members, and in that said die members are detachably mounted on said die-block by means comprising a member extending from said positioning surface through said die members and having a head portion for limiting the separation of the normally engaged die members, and resilient means disposed normally to maintain engagement of said die members but yielding in event of jamming on the mandrel.

3. A die-block assembly for a tube-forming machine comprising a mandrel of cross-section having unequal major and minor axes, a die-block movable toward and away from said mandrel, a pair of normally engaged die members carried by said die-block and having complementary recesses at one end to embrace said mandrel, said die-block assembly being characterized in that said die-block has a thrust-receiving surface parallel to the minor axis of the mandrel for engaging the other ends of said die members and a positioning surface parallel to the major axis of the mandrel for engaging a side of one of said die members, and in that said die members are detachably mounted on said die-block by means comprising a member extending from said positioning surface through said die members and having a head portion for limiting the separation of the normally engaged die members, and resilient means disposed normally to maintain engagement of said die members but yielding in event of jamming on the mandrel.

BENJAMIN M. NASE.

No references cited.