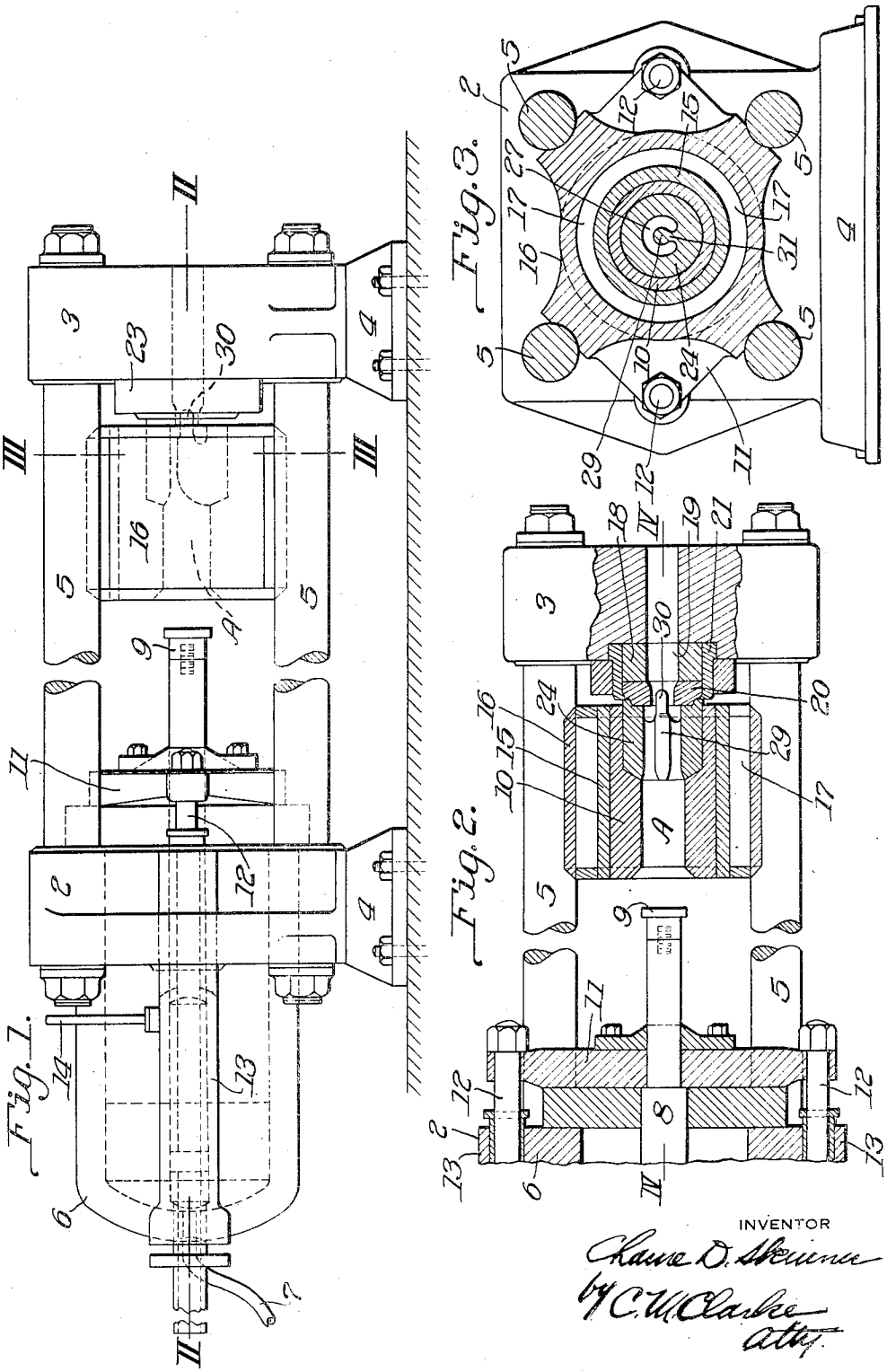
March 1, 1932 C. D. SKINNER 1,847,365

EXTRUSION OF METAL

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Fig. 4.

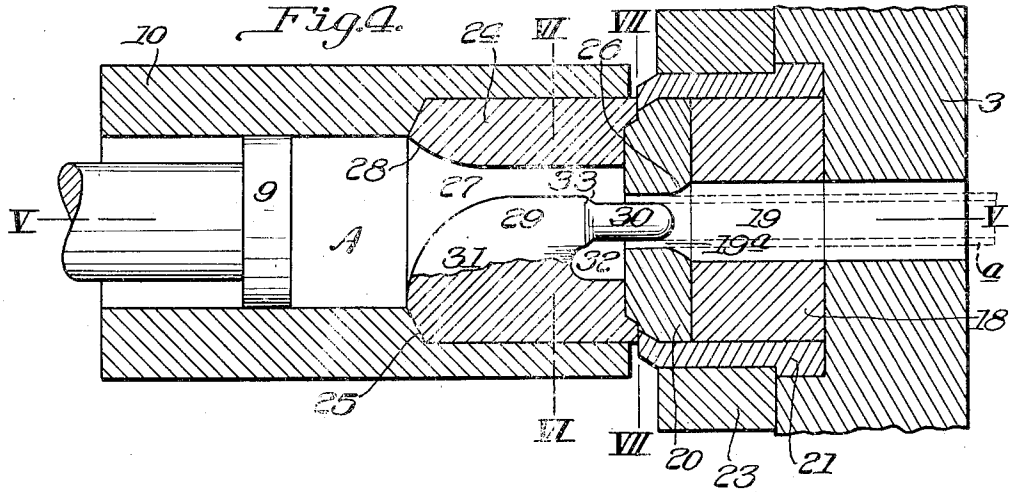


Fig. 5.

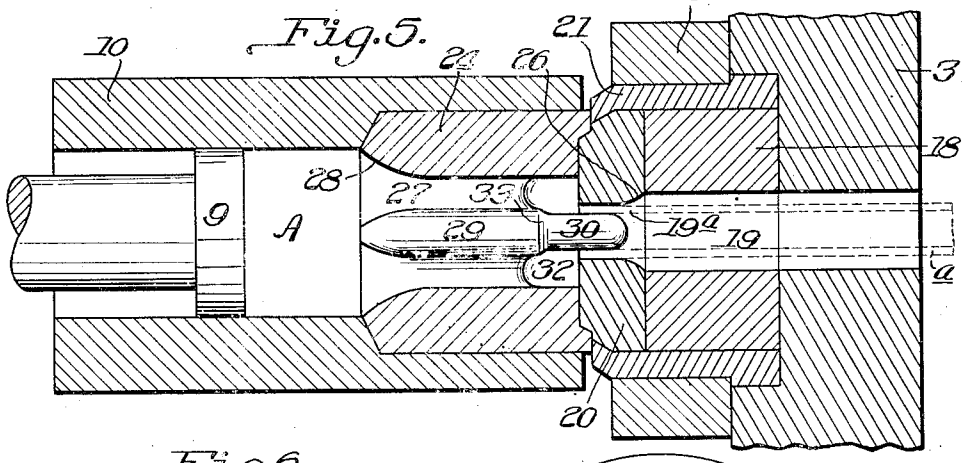


Fig. 6.

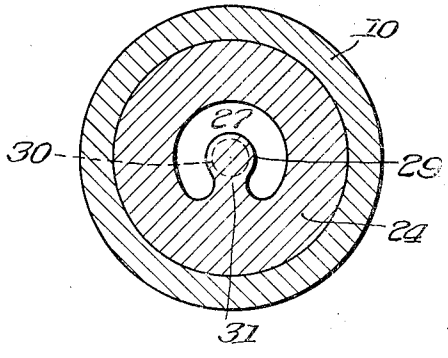
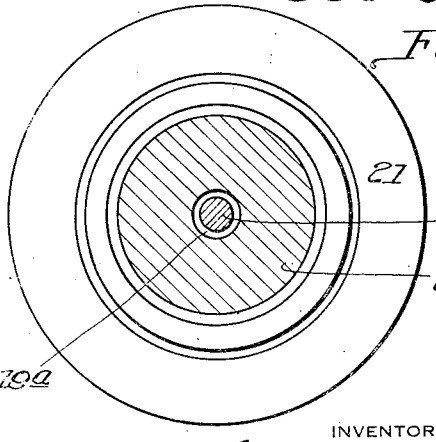


Fig. 7.



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Patented Mar. 1, 1932 1,847,365

UNITED STATES PATENT OFFICE

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EXTRUSION OF METAL

Application filed March 25, 1930. Serial No. 438,661.

My invention consists of an improvement in means for extruding metal, as in the manufacture of tubing or the like.

It has in view to provide a die construction utilizing male and female elements so combined and constructed as to facilitate easy flow of the metal under pressure, rigid holding of the central opening-forming die, means for mounting said elements in a completely operative machine, and various other features of construction and advantage, as shall be more fully hereinafter described.

In the manufacture of tubing, particularly seamless tubing, various methods have been utilized and in the practice of extrusion of metals the art has utilized full floating and semi-floating mandrels, which are however objectionable in that they are apt to result in a variation in wall thickness due to eccentric variations in the mandrel location. Such defects are objectionable and when within allowable limits usually involve supplemental drawing operations to reduce the walls to uniform thickness, all of which involves additional expense.

In my present invention I so locate a mandrel which I have termed a filler mandrel, with relation to an adjacent outer diameter die that the core forming portion of the filler mandrel will be continuously maintained in concentric relation to the adjacent die mechanism.

In the drawings illustrating the invention:

Fig. 1 is a view in side elevation partly broken away, showing the mechanism in connection with a standard plunger machine;

Fig. 2 is a horizontal section of a portion of said machine on the line II—II of Fig. 1;

Fig. 3 is a transverse section on the line III—III of Fig. 1;

Fig. 4 is an enlarged sectional view on the line IV—IV of Fig. 2;

Fig. 5 is a similar view showing a horizontal section on the line V—V of Fig. 4;

Figs. 6 and 7 are cross sections on the lines VI—VI and VII—VII respectively of Fig. 4.

The machine as a whole, embodying the particular improvement in die mechanism, is of standard construction.

It comprises two main housing members 2 and 3 mounted by their bases 4 on any suitable foundation to which they are securely connected by bolts or the like. Housings 2 and 3 are connected by a series of four connecting rods or columns 5, shouldered and provided with outer nuts so as to rigidly maintain the housings in fixed relationship to each other under the strains of operation and to contribute to the stability and efficiency of the machine as a whole.

Extending outwardly beyond housing 2, with which it is incorporated, is the main plunger casing 6 having a high pressure supply line 7 and enclosing a plunger for imparting forward movement to the piston rod or plunger extension 8.

Said plunger is provided at its outer end with a pressure imparting terminal 9 adapted to enter the core opening of the extrusion cylinder 10 embodying the improved die mechanism, hereinafter described.

The cross head 11 is adapted to move outwardly with the plunger during the working operation of the die mechanism, and to be retracted by connecting rods 12 extending rearwardly through suitable bearings into the lateral withdrawing cylinders 13 by application of pressure thereto from supply pipes 14.

The construction in respect of the plunger mechanism and withdrawal mechanism is of standard well known construction and need not be further described in detail. It will be understood however that any suitable plunger mechanism may be utilized in connection with the extrusion die devices of the present invention.

It will be noted that the cross head 11 has sliding engagement outwardly and inwardly with the several frame members 5.

The extrusion cylinder 10 is of cylindrical form and is mounted within a surrounding casing 15 having an outwardly spaced wall 16 for circulation of heating fuel gases around and through the intervening space 17.

Fixedly mounted in housing 3 is a collar 18 having a central opening 19 in axial alinement with the center of plunger 8, and which

collar provides a resisting bearing for the female extrusion die member 20.

Said die 20 is set within a surrounding collar member 21, and die 20 in turn also abuts against collar 18, and the collar 21 surrounding collar 18 also provides a surrounding backing for extrusion die 20, for firm holding thereof, as in Fig. 4. The terminal of collar 21 is contracted around the outer edge of die 20 as shown, tightly clamping it in position.

The several parts 18, 20 and 21 as thus made are capable of mounting in the housing of the standard machine and of being changed or replaced by other corresponding members of varying size when it is desired to operate the mill for different gauges and diameters of extruded products.

Ring 21 is also surrounded by the outer enclosing head or ring 23, all of the several parts being thus maintained in compact operative relation.

The filler mandrel piece 24 is fitted concentrically within the discharging end of extrusion cylinder 10, bearing against the inner shoulder 25 of said cylinder and also at its other end against extrusion die 20, by annular beveled engagement, as clearly shown in Fig. 4. Such construction and arrangement facilitates concentric location and maintenance of position at all times.

The extrusion die 20 is provided with the central annular opening of the desired external diameter of the formed product *a*, indicated in dotted lines, shouldered at its inner end at substantially right angles and tapering outwardly in flaring formation, as at 26, providing increasing clearance for the formed product passing through the openings 19 and 19*a* of collars 18 and die 20 respectively.

The filler mandrel piece 24 is provided with a central opening 27 flaring outwardly at its inner end, as at 28, and tapering outwardly to the maximum diameter of the plunger opening of the extrusion cylinder 10, through which the plunger terminal 9 operates. Opening 27 is part cylindrical only, and the center of the opening is occupied by the centrally arranged core forming male mandrel die 29 having the final mandrel terminal 30.

It will be understood, of course, that the surrounding female extrusion die 20 or of male die opening 27 may be non-circular if desired, the invention not being limited to exactly circular or cylindrical products.

Said terminal 30 as shown extends inwardly within the opening of die 20, exactly concentric therewith and with the intervening surrounding space through which the extruded metal *a* emerges. Terminal 30 extends beyond the main die 29, which is connected laterally with the main filler mandrel piece 24 by the wall or web 31.

Said web, as shown in Fig. 6, is as thin as it can consistently be made, the sides rounding into the main opening 27 for rigid connection with the outer metallic wall, and facilitating free flow of the metal under pressure.

As indicated in Fig. 4 there is an opening 32 backwardly from the face of die 20 sufficiently long to allow for flow of the metal thereinto from both opposite sides, providing a continuously annular body of metal for some distance back of the annular extrustion space between terminal 30 and die 20.

The exposed surfaces of the various elements are preferably rounded and curved, as indicated, avoiding where possible abrupt shoulders to facilitate the flow toward the annular outlet space.

The outer shoulder 33 of member 29 is rounded as shown, also facilitating flow and merging of the metal under pressure.

In operation, plunger 9 is withdrawn from the main cavity A of cylinder 10 by application of pressure to the rear terminals of plungers 12 in cylinders 13 by supply pipes 14 so that the plunger terminal 9 is withdrawn backwardly sufficiently far from cavity A to allow for introduction of a billet or other suitable piece of metal.

Thereafter plunger 9 is advanced into the outer end of cavity A and the extrusion operation is commenced by gradually applying power to the rear plunger head through supply connection 7. The billet being forced forwardly, the metal flows into cavity 27 completely filling it, continued pressure effecting extrusion through the die forming annular space between terminal 30 and die 20, the extruded tubular product *a* advancing outwardly therefrom and through opening 19 of the machine continuously during the application of pressure to available metal.

The construction and operation of the invention will be readily understood and appreciated by all those familiar with this class of mechanism, and will be found to contribute materially to the rapid, efficient and economical operation of extrusion.

The construction of the die mechanism facilitates its placement, removal, or substitution when desirable to make a change due to wear or breakage or for a different sized product.

While the manner of mounting and locating the parts and their detail construction as shown contributes to the successful operation of the machine, it will be understood that it may be variously changed or modified in detail construction or otherwise by the skilled mechanic, but that all such changes are to be understood as within the scope of the following claims.

What I claim is:

1. Extruding die mechanism comprising a hollow extrusion die having a major diameter cylindrical opening, a mandrel die abutting thereagainst having a larger cylindrical opening concentric therewith and flaring outwardly at its other end for registering connection

with a plunger cylinder, and a centrally arranged mandrel integral with the side wall thereof extending inwardly and axially of said openings and having laterally disposed concaved connecting web portions terminating backwardly from the outlet end of the delivery die providing annular circulation clearance, said mandrel having a cylindrical terminal projecting concentrically into the opening of the extrusion die.

2. Extruding die mechanism comprising a hollow extrusion die having a major diameter cylindrical opening, a mandrel die abutting thereagainst having a larger cylindrical opening concentric therewith and flaring outwardly at its other end for registering connection with a plunger cylinder, a centrally arranged mandrel integral with the side wall thereof extending inwardly and axially of said openings and having an annularly shouldered reduced cylindrical terminal projecting concentrically into the opening of the extrusion die, and means maintaining thrust resistance to said parts.

3. In combination with a plunger cylinder and an extrusion die having a major diameter controlling opening and means for mounting it in pressure resisting position, a mandrel die between the cylinder and die and abutting against each and having an enlarged opening concentric with the die and widening in the opposite direction concentric with the cylinder, a centrally arranged mandrel connected laterally with the wall of the mandrel die by concaved surfaces and having a reduced terminal projecting concentrically into the opening of the extrusion die, the plunger cylinder embracing the mandrel die having a plunger for forcing metal around the mandrel and through the openings of the mandrel die and the extrusion die.

4. In combination with a plunger cylinder, a female extrusion die having a flat outer face and a major diameter-controlling cylindrical opening flaring outwardly beyond the opening, a resisting block having an enlarged clearance opening concentric therewith, means providing pressure resisting mounting therefor, a mandrel die having an enlarged opening in axial concentric alinement with the opening of the extrusion die and abutting thereagainst and provided with an integral laterally connected mandrel having a cylindrical reduced extension projecting into the opening of the extrusion die, said mandrel die being mounted within the end and having an enlarged flaring connection with the plunger cavity of the plunger cylinder, and a plunger in said cylinder adapted to force metal through said cylindrical openings and around the mandrel of the mandrel die.

5. A mandrel die as described having a longitudinal cylindrical opening flaring outwardly at one end for communication with a plunger cylinder provided with a centrally located mandrel having a concaved and rounded wall connection with the inner wall face of the opening and a cylindrical reduced terminal adapted to project concentrically through and beyond an opposite die opening.

6. A mandrel die as described having a longitudinal cylindrical opening flaring outwardly at one end for communication with a plunger cylinder provided with a centrally located mandrel having a concaved and rounded wall connection with the inner wall face of the opening and a cylindrical reduced terminal extending through a continuously annular clearance opening at the outlet end of the mandrel die beyond its inner wall connection, adapted to project concentrically through an opposite cylindrical die opening.

7. A mandrel die as described having a longitudinal cylindrical opening flaring outwardly at one end for communication with a plunger cylinder provided with a centrally located mandrel having a concaved and rounded wall connection with the inner wall face of the opening and a cylindrical reduced terminal extending through a continuously annular clearance opening at the outlet end of the mandrel die beyond its inner wall connection, and a female extrusion die abutting the outer end of the mandrel die having a concentric cylindrical opening through which the mandrel terminal extends, and an outer resisting collar therefor having an enlarged opening concentric therewith.

8. In combination with a plunger cylinder having a die embracing socket, a female extrusion die having a flat outer face and a cylindrical opening, a centrally open collar in register therewith, a surrounding collar embracing said die and collar and having an inwardly turned lip engaging the extrusion die, supporting and embracing mounting therefor, and a mandrel die in the cylinder socket abutting the cylinder and extrusion die respectively having a longitudinal cylindrical opening concentric with the opening of the cylinder and extrusion die and provided with an integral rounded shoulder mandrel having a terminal annularly spaced from the outlet opening of the mandrel die and projecting inwardly through the opening of the extrusion die.

In testimony whereof I hereunto affix my signature.

CHAME D. SKINNER.