July 28, 1959 C. G. A. SWANSON 2,896,783

MANDREL POSITIONING AND RAM ARRESTING APPARATUS

Filed July 6, 1954 6 Sheets-Sheet 1

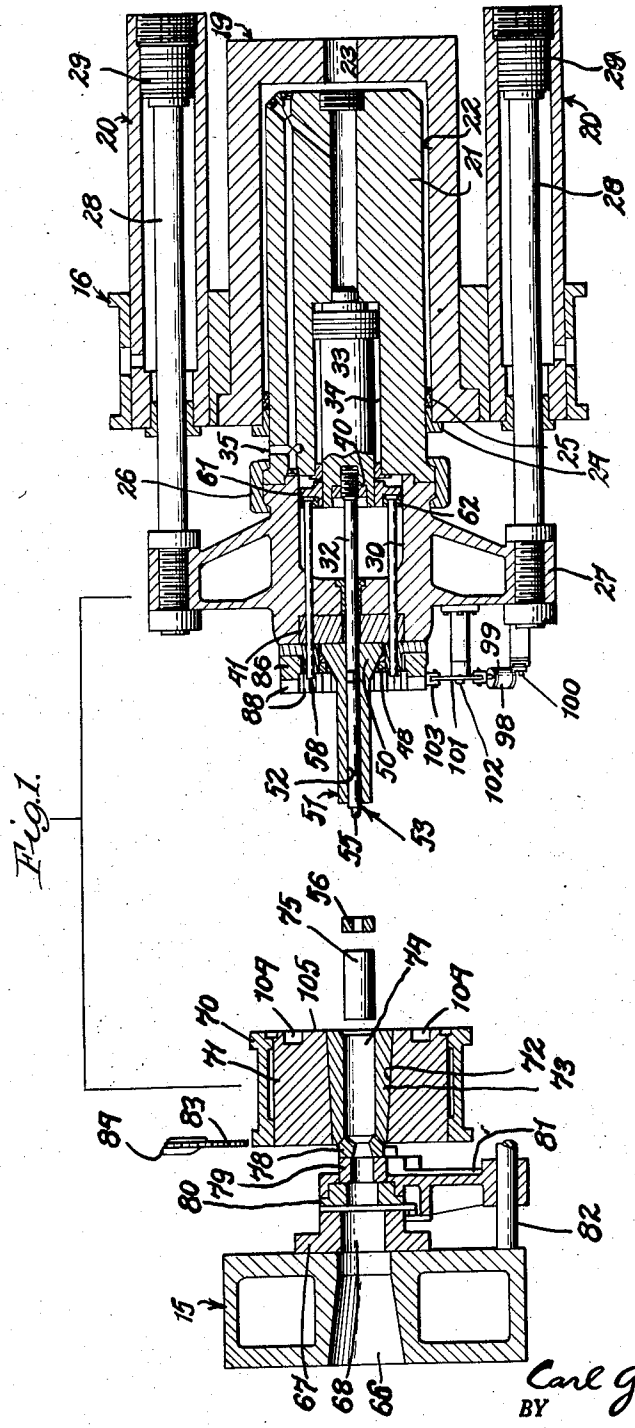


Fig. 1.

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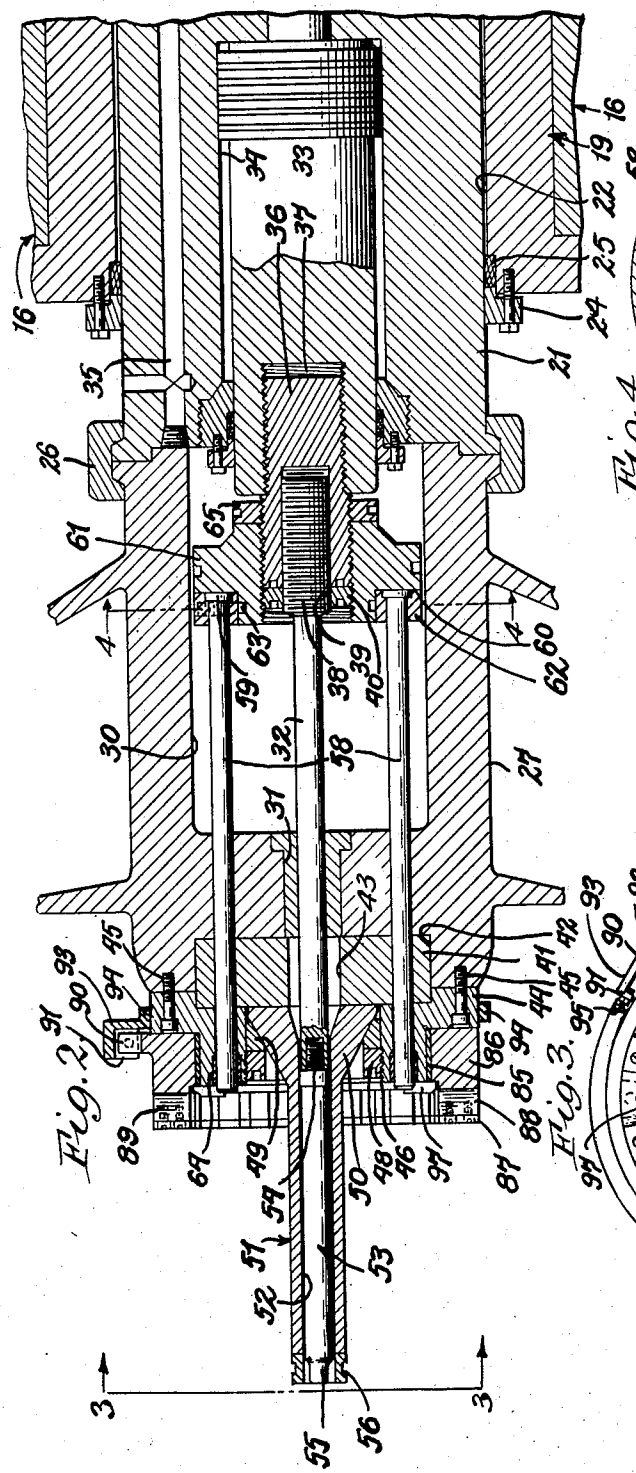


Fig. 2.

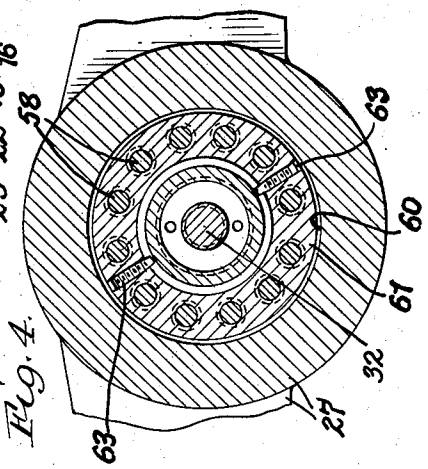


Fig. 4.

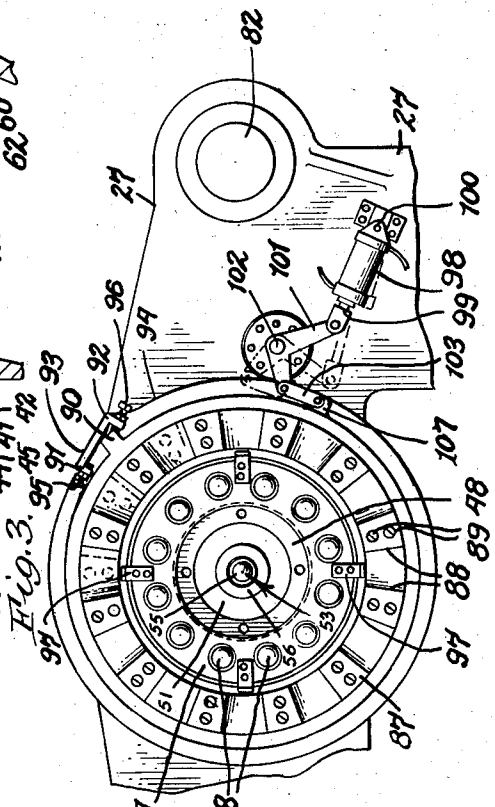


Fig. 3.

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MANDREL POSITIONING AND RAM ARRESTING APPARATUS

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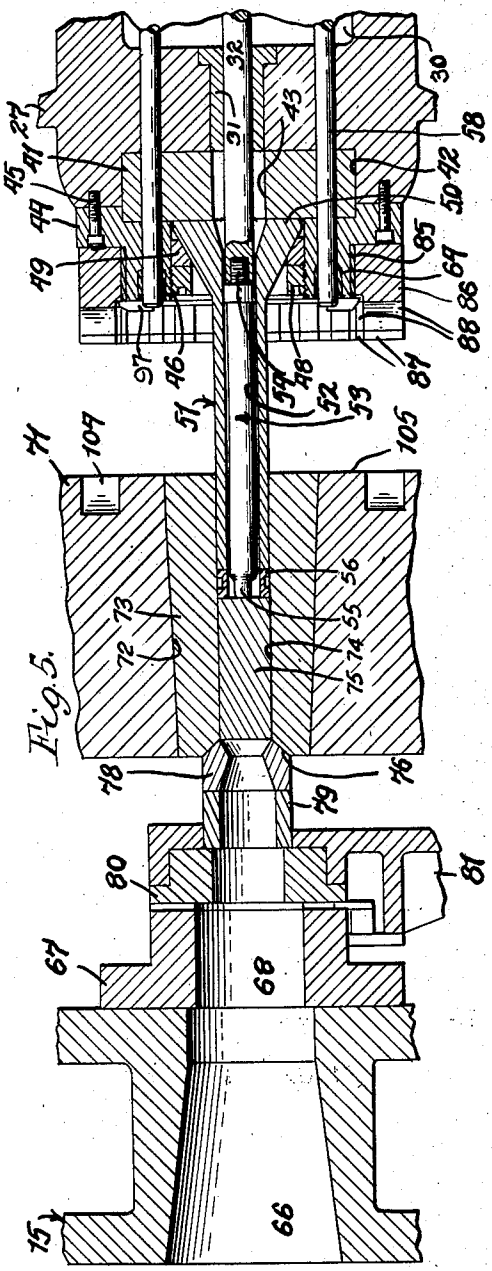


Fig. 5.

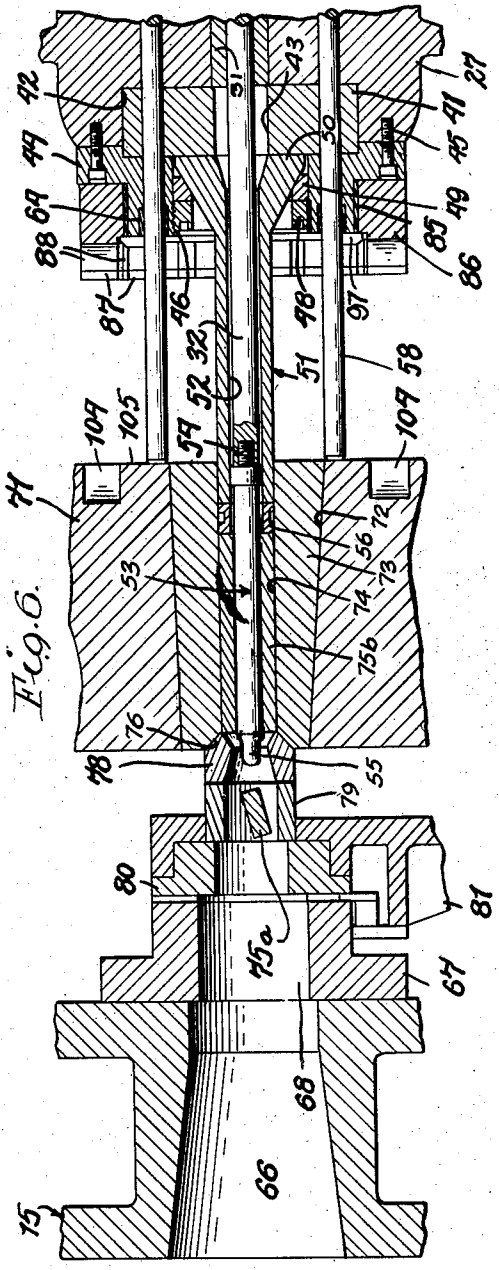


Fig. 6.

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MANDREL POSITIONING AND RAM ARRESTING APPARATUS

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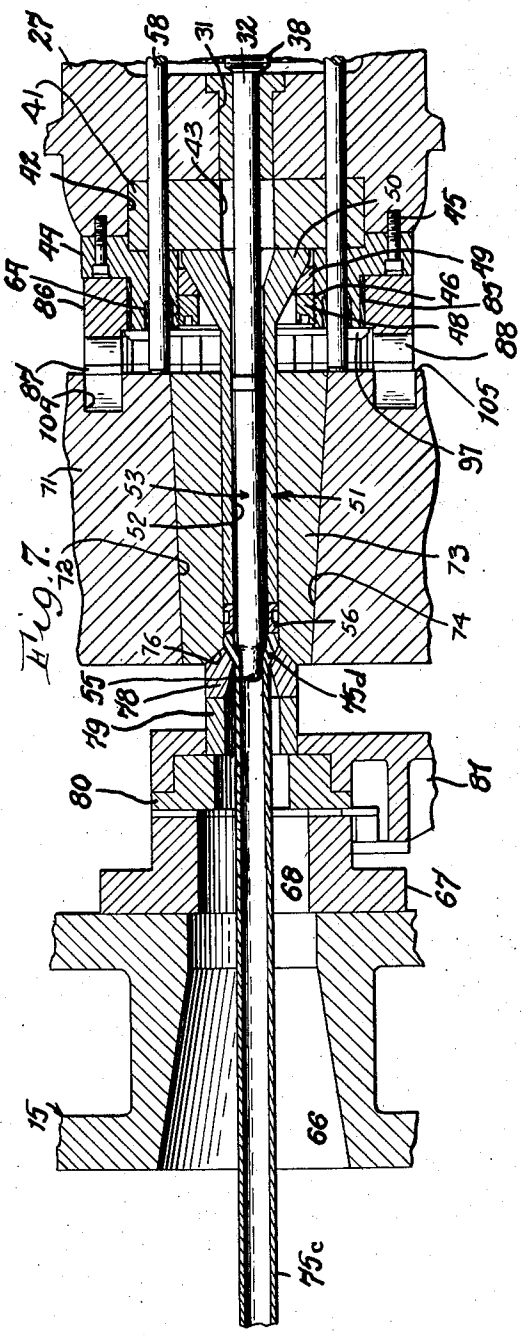


Fig. 7.

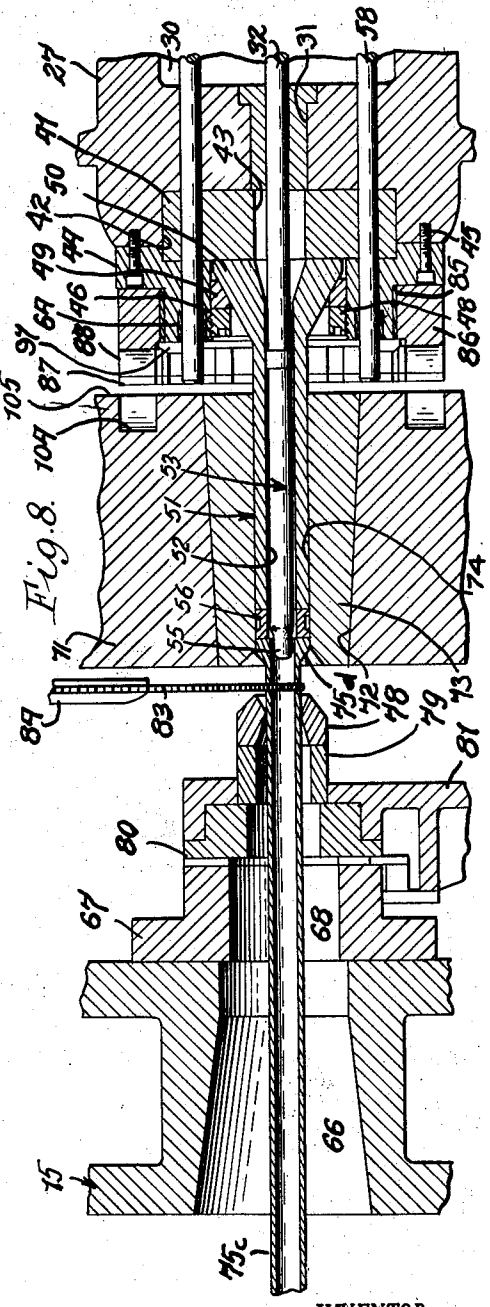


Fig. 8.

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MANDREL POSITIONING AND RAM ARRESTING APPARATUS

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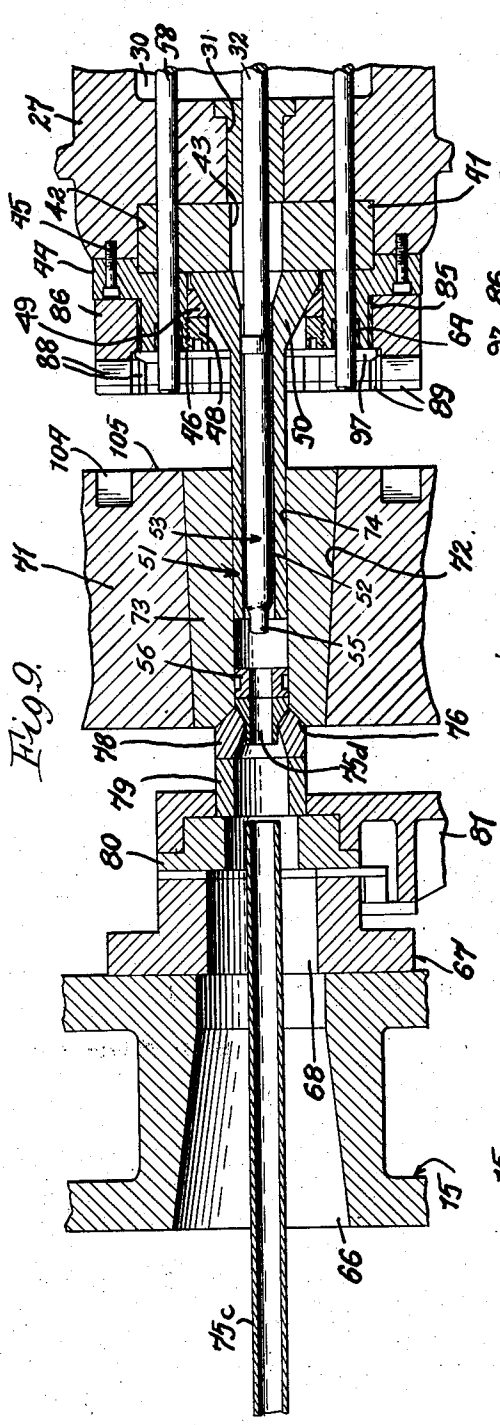


Fig. 9.

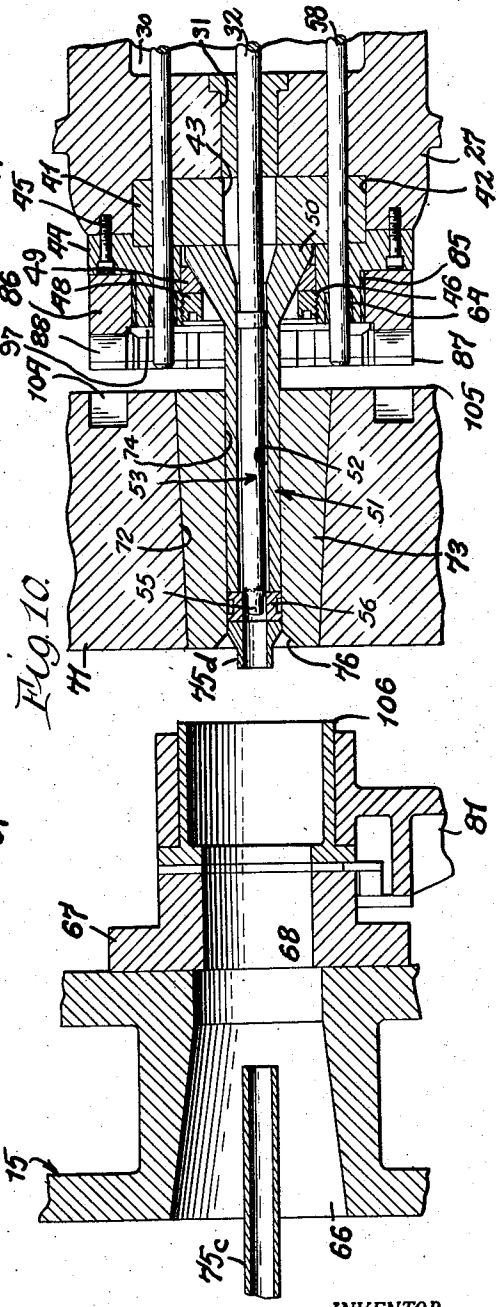


Fig. 10.

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MANDREL POSITIONING AND RAM ARRESTING APPARATUS

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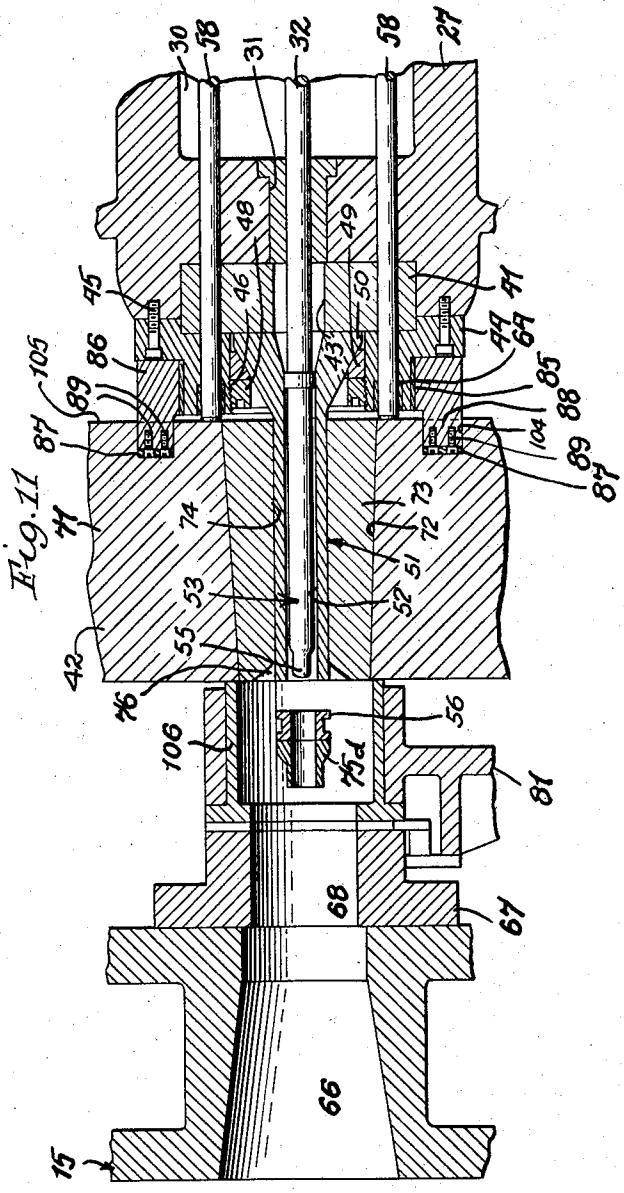


Fig. 11

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United States Patent Office 2,896,783 Patented July 28, 1959

2,896,783

MANDREL POSITIONING AND RAM ARRESTING APPARATUS

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Application July 6, 1954, Serial No. 441,225

6 Claims. (Cl. 207—3)

This invention relates to an extrusion press and more particularly to a hydraulic press for extruding relatively small internal diameter tubing from hot hollow or pierced billets although features of the invention can be embodied in presses for extruding other shapes.

In extruding tubes from hot billets, either solid or of preformed hollow, cylindrical form, it is the usual practice to provide an extrusion stem having a bore containing a mandrel. If the billet is a solid billet, the billet is pierced by the mandrel which is brought into operative relation with the die following which the extrusion stem is forced against the billet under main ram pressure to extrude the billet through the die and around the end of the mandrel thereby to produce a tubular extrusion. If the billet has been preformed into a hollow cylindrical form by casting or machining the same into such form, the mandrel does not pierce the billet but merely enters its hollow interior and is then brought into operative relation to the die. This mandrel can be of the floating type or it can be under control of a piston with a stop to accurately place it in proper position with reference to the die. This latter type is particularly useful for extruding small internal diameter tubing where the mandrel must be of small diameter at the die. With a positively positioned mandrel it can be necked to have a small diameter at its die end and a large diameter body, thereby to have the required body size to avoid buckling or breaking under the very high frictional forces imposed on the mandrel. This latter type of mandrel, that is, the positively positioned mandrel, has only been designed with an external cylinder, that is, a cylinder arranged externally of the main ram and containing a piston operatively connected with the mandrel. Since the mandrel is housed within the extrusion stem and since the extrusion stem is actuated by the main ram, it will be seen that the use of such an external cylinder for the mandrel poses the problem of a mechanism passing through the extrusion stem, main ram or main cylinder to connect the mandrel with the piston in the external cylinder.

It is one of the principal objects of the present invention to provide a mandrel which is positively stopped in its operative position (in contradistinction to a floating mandrel) which is actuated by a piston in an internal cylinder, that is, in a cylinder formed within the main ram itself. By such arrangement the problem of providing a mandrel actuating mechanism which must pass through the extrusion stem, main ram or main cylinder is obviated.

Another object is to provide such a positively stopped mandrel actuated by a piston in an internal cylinder in which the positive stop means are very simple, rugged and positive in construction and action.

Another object is to provide such a positive stop which is readily adjustable to meet all conditions.

At the end of an extrusion stroke a part of the billet cannot be forced through the die and when this part is cut off of the extrusion it forms a discard which must be removed from the press together with a dummy block.

It is another object of the invention to provide a mechanism for extending the effective stroke of the main ram and extrusion stem following the shorter extrusion stroke and also following the cutting off of the discard and which longer effective stroke is operative to eject the discard.

It is another object to provide such a mechanism for extending the effective stroke of the main ram which is in the form of a simple adjustable stop for limiting the forward movement of the main ram and which in one position permits a longer stroke than in another.

Another object is to provide such an adjustable stop which is adjusted by a rotary movement thereof and in which such rotary movement from one position to another can be effected by a simple piston and cylinder.

Another object is to provide such a press which is extremely simple and rugged in construction and not liable to get out of order or require repairs even under conditions of severe and continuous use.

Other objects and advantages of the invention will be apparent from the following description and drawings in which:

Fig. 1 is a simplified and somewhat diagrammatic horizontal longitudinal section through the axis of extrusion of a tube extruding press embodying the features of the present invention, parts being eliminated.

Fig. 2 is an enlarged fragmentary view of a part of Fig. 1 and showing the actuating mechanism for the mandrel, as well as the adjustable rotary stop for the movement of the main ram, in greater detail.

Fig. 3 is a fragmentary elevtional view, viewed from line 3—3, Fig. 2.

Fig. 4 is a fragmentary vertical section taken on line 4—4, Fig. 2.

Figs. 5–11 are enlarged fragmentary views with parts being eliminated, similarly to Fig. 1 to simplify the illustration of the invention, and these figures illustrate the successive steps in producing an extruded tube, in cutting the discard therefrom, and in ejecting this discard from the press.

The tube extrusion press forming the subject of the present invention is shown as having a fixed platen **15** and a cylinder platen **16** both of which are secured in fixed relation to each other and to the common bed or base (not shown) of the press. The usual main cylinder **19** and fast approach and pullback cylinders **20** are inserted into and fixed to the cylinder platen **16**. The main ram **21** works in the bore **22** of the main cylinder **19** to which fluid is admitted and withdrawn through a passage **23**. A large gland or stuffing box **24** and packing **25** are provided in the open end of the bore **22** around the main ram **21**.

The forward end of the main ram **21** is connected by a large split coupling ring **26** with the main movable cross head **27** to which the rods **28** of the fast approach and pullback pistons **29** in the fast approach and pullback cylinders **20** are connected. This cross head is provided with a large bore **30** which opens against the main ram **21** and is also provided with a small through bore **31** in communicating coaxial relation to the large bore **30** and the main ram **21** and slidingly supports a mandrel actuating rod **32**. This actuating rod is coupled with a piston or ram **33** fitted in an internal cylinder or bore **34** provided in the main ram **21**. Fluid for actuating the piston **33** is supplied to and relieved from the cylinder **34** through a passage **35**. The connection between the piston **33** and the mandrel actuating rod **32** is shown as effected through an internally and externally threaded cylindrical coupling member **36** screwed into a threaded bore **37** in the piston or ram **33** and having an enlarged threaded end **38** of the mandrel actuating rod **32** screwed into its internally threaded bore **39**. An

externally threaded lock ring 40 preferably locks this coupling member 36 in position, this lock ring being screwed into a stop collar hereinafter described.

An annular backup block 41 is set into a recess 42 in the end of the main cross head 27 opposing the fixed platen 15, this backup block being provided with a large bore through which the mandrel actuating rod 32 extends. This annular backup block is held in position by a large retaining collar 44 which is secured to the main cross head 27 by an annular series of screws 45. This retaining collar 44 is internally threaded as indicated at 46, and in these threads is screwed a retaining ring 48. This retaining ring bears against a ring 49 having a cylindrical exterior fitting the bore of the retaining collar 44 and having a conical internal face which enlarges toward the backup block 41. This conical internal face fits the conical enlargement 50 at one end of a tubular extrusion stem 51. This tubular extrusion stem 51 has an axial through bore 52 in register with the central bore 43 through the backup block 41 and in this bore 52 is arranged the mandrel 53. One end of this mandrel 53 is provided with a threaded stem 54 which is screwed into a threaded bore in the end of the mandrel actuating rod 32 and the other end of this mandrel is of reduced cylindrical form, as indicated at 55, this reduced cylindrical end 55 of the mandrel determining the internal diameter of the tube produced by the extrusion press and it being a feature of the present invention that this reduced end 55 of the mandrel be positively held in predetermined relation to the die which forms the exterior of the tube being extruded. A dummy block 56 is shown as secured to the free end of the extrusion stem 51.

A feature of the present invention resides in the provision of a plurality of stop pins 58 to fix the position of the reduced end 55 of the mandrel 53 with reference to the extrusion die. Each of these stop pins 58 has a head 59 at one end and which heads bear against an annular peripheral recess 60 at one end of a stop collar or head 61. The heads 59 of the stop pins 58 are held in abutting relation to the recess 60 by a retaining ring 62 having an annular series of bores or openings through which the stop pins 58 extend and which retaining ring is secured in the annular peripheral recess 60 by radially extending screws 63 as best shown in Fig. 4. The stop pins 58 each extends through registering bores provided in the main cross head 27, annular backup block 41, and retaining collar 44 and are severally slidingly supported by guide means in the form of bearing bushings 64 carried by the retaining collar 44. The stop collar 61 is screwed on the external threads of the cylindrical coupling member 36 and is held in adjusted relation by a locking nut or screw ring 65.

The fixed platen 15 is stationary and is provided with a horizontal through opening 66 in line with the extrusion stem 51 and through which the extrusion passes. A large rear die backup block 67 is suitably secured to the face of the fixed platen 15 opposing the extrusion stem 51 and is provided with a through opening 68 through which the extrusion passes and which registers with the opening 66 in the fixed platen 15. It will be seen that the fixed platen 15 and the backup block 67 constitutes a composite structure, this composite structure being referred to as the die platen in the accompanying claims.

A billet container holder 70 is mounted in any suitable manner (not shown) for horizontal movement along the extrusion axis of the press. This billet container holder houses the container 71 which can be secured therein in any suitable manner and which has a tapered bore 72 receiving an externally tapered liner 73. This liner has a cylindrical bore 74 of the same diameter as the extrusion stem 51 with which it alines and which is adapted to receive the billet 75 (Figs. 1 and 5) as well as the dummy block 56. A bevel 76 is provided around the bore 74 of the liner at that end adjacent the die platen 15. The parts 70–73 constitute a billet container structure.

Into this bevel 76 is fitted the beveled end of an annular die 78 which, together with a small backup block 79 and larger backup block 80 for the die, are mounted in the outer end of a swinging arm 81. This swinging arm 81 is pivoted to the fixed platen 15 at 82 to swing about an axis in parallel, eccentric relation to the axis of extrusion so that the die 75, together with its backup blocks 79 and 80, can be swung into and out of operative coaxial relation to the extrusion stem, the die being readily removable from this swinging arm to permit replacement of the die, after each extrusion, with a cooled and lubricated fresh die. The detailed construction of the die, its backup blocks and their mounting on the swinging arm form no part of the present invention, reference being made to the copending application of Thweatt and Swanson, Serial No. 242,382, filed August 17, 1951, now Patent No. 2,728,453, issued December 27, 1955, for Extrusion Press for a detailed disclosure of this part of the present extrusion press.

Also as disclosed in detail in said Thweatt and Swanson patent, a rotary power driven saw 83 is mounted on a swinging arm 84 to saw the discard from the extruded tube.

To permit the ejection of the discard and dummy block 56 from the container liner 73, means are provided for increasing the effective length of the stroke of the extrusion stem 51 at that stage in the sequence of operations when the discard and dummy block are to be so ejected. This is effected through a rotary stop which is preferably constructed as follows:

The large retaining collar 44 is provided with a cylindrical neck of reduced diameter projecting toward the die platen 15, 67 and carrying a bearing sleeve 85. On this bearing sleeve is rotatably mounted a castellated ring or collar 86 having an annular series of uniformly spaced and shaped castellations, jaws or protuberances 88 projecting axially toward the die platen 15, 67. These protuberances or jaws can have face wear plates 87 and each of which plates can be removably secured by a pair of screws 89.

The castellated ring 86 is designed to be rotated by a predetermined number of degrees, from one position to a second position. To this end the castellated ring 86 is provided with a radially extending lug 90 (Fig. 3) and this lug is arranged to move between two arms 91, 92 of a stationary C-shaped projection 93 which is shown as being part of a ring 94 and which ring can be fixed to the large retaining collar 44 in any suitable manner. This ring 94 is not shown in Figs. 1 and 5–11 in order to simplify the illustration of the invention. The arm 91 carries an adjusting screw 95 and the arm 92 carries an adjusting screw 96, the opposing ends of these adjusting screws engaging the lug 90 so that by adjusting these screws the degree of permitted movement as well as the position of the arc of such movement can be adjusted. The castellated ring 86 is retained in position by a plurality of removable lugs 97 attached to the end of the large collar 44.

Such movement can be effected by a piston (Fig. 3) contained in a cylinder 98 and actuating a piston rod 99, the cylinder being pivoted, as at 100, to the cross head 27. The piston rod 99 connects with one arm of a bell crank lever 101 pivoted as at 102 to the main cross head 27. The other arm of this bell crank lever is connected by a link 103 with a lug 107 or the like projecting from the castellated ring 86. In one rotary position of the castellated ring 86, as determined by the piston rod 99 and, say, stop 95, the castellations, jaws or protuberances 88 are in register with correspondingly shaped and spaced recesses or pockets 104 in the billet container 71. In the other rotary position of the castellated ring 86, as determined by the piston rod 99 and,

say, stop 96, the castellations, jaws or protuberances 88 are in register with the opposing face 105 of the container 71. It will be seen that in said one position the main cross head 27 and hence the main ram 21 and extrusion stem 51 have a longer stroke than in said other position because the pockets or recesses 104 receive the castellations, jaws or protuberances to permit such longer stroke.

The arm 81 which carries the die 78 also carries a receiver 106 having an open side adapted to be brought into line with the extrusion axis to receive the severed discard from the extrusion and the dummy block 56 as hereinafter described.

Operation

As described in greater detail in said Thweatt and Swanson patent, a successoin of dies 78 are used, it being necessary to cool and clean each die following each extrusion. For this purpose the die is removably carried by the swinging arm 81, the operator swinging this arm to bring the die and its backup blocks out of alinement with the extrusion axis of the press and to a position where the used die is discharged and then to a position where he can conveniently place a fresh die in the swinging arm.

At the time of so loading the die 78 in the swinging arm, the billet container holder 70 had been retracted toward the cylinder platen 16. With the billet container holder 70 so retracted, the operator then swings the swinging arm 81 to the position shown in Fig. 1 in which position the die 78 is in axial alinement with the bore of the liner 73 of the billet container 71.

Contemporaneously with so loading the die 78, a hot billet 75 is also brought in line with the bore 74 of the liner 73 as shown in Fig. 1 by a billet loader (not shown) which also inserts the billet 75 in the bore 74 of the container liner 73. At this time the dummy block 56 is also arranged in line with the billet to also be inserted in the bore 74 in rear of the billet. The dummy block 56 is then pushed into the bore 74 by the forward movement of the extrusion stem 51 by the main ram 21. This forward movement of the main ram 21 and extrusion stem 51 is effected through introduction of fluid pressure in the main cylinder 19 through the passage 23, and while the extrusion stem 51 is so moving forwardly to push the billet 75 and dummy block 56 into the bore 74, the billet container holder 70 is also being moved toward the fixed platen 15 until the front bevel 76 of its liner 73 is firmly engaged with the bevel of the die 78. This position of the parts is illustrated in Fig. 5. At this time the reduced end 55 of the mandrel 53 is flush with the end of the dummy block 56.

At this time fluid is introduced through the passage 35 into the cylinder 34 and at the same time fluid is relieved through the passage 23 from the main cylinder 22. The former drives the internal piston or ram 33 toward the fixed platen 15 thereby, through the screw coupling member 36 and mandrel actuating rod 32, forcing the mandrel 53 to pierce the billet 75. This piercing removes a core piece 75*a* from the billet which becomes a pierced or tubular billet designated at 75*b*, Fig. 6. A part of the core of the billet 75 is also displaced radially outwardly and by backing up the main ram 21 and extrusion stem 51 during this piercing operation, reverse extrusion takes place, that is, the billet is elongated toward the cylinder platen 16. This position of the parts is illustrated in Fig. 6.

An important feature of the invention is that during this operation culminating in the position shown in Fig. 6, the mandrel 53 is positively positioned with its reduced end 55 in position with reference to the die 78 to produce the required tube. This positioning is effected by engagement of the stop pins 58 with the face 105 of the billet container 71 as shown in Fig. 6. This engagement positively stops further movement of the stop coller 61 to the left as viewed in Figs. 2 and 6 since this stop collar is positively connected to the mandrel 53 through the screw coupling 36 and mandrel actuating rod 32, the movement of this mandrel is positively stopped and the reduced end 55 of the mandrel held in fixed relation to the die 78. It will be noted that this positive positioning of the mandrel is effected by the use of the cylinder 34 arranged internally of the main ram 21 and by the simple expedient of the stop pins 58.

Following this, full pressure is introduced through the passage 23 into the main cylinder 19 to drive the ram 21, main cross head 27, backup block 41, and extrusion stem 51 forwardly. This extrusion stem 51 moves forwardly in the liner 73 and presses against the dummy block 56 at the rear of the pierced billet 75*b* so as to force the forward end of the billet between the opening in the die 78 and the reduced end 55 of the mandrel 53. This forms the tubular extrusion 75*c*. The jaws, castellations or protuberances engage the face 105 of the billet container 71 these parts forming fixed stops opposing further movement of the main ram 21 so that a discard 75*d* is left attached to the extrusion 75*c*. This position of the parts is illustrated in Fig. 7.

The billet container holder 70 is then moved to the right as viewed in Figs. 1 and 7 a short distance so as to bring the billet container 71 to the position shown in Fig. 8 and at the same time fluid under pressure is introduced into the left hand ends of the cylinders 20 as viewed in Fig. 1 to move, through the pistons 29, piston rods 28 and cross head 27, the ram 21, mandrel 53 and extrusion stem 51 to the position shown in Fig. 8 in which the billet container assembly is separated from the die assembly, the extrusion 75*c* and its attached discard 75*d* being drawn rearwardly so that the discard can be sawed from the extrusion. This is done by swinging the arm 84 carrying the rotary power saw 83 between the die 78 and liner 73 so as to sever the discard 75*d* from the tubular extrusion 75*c* as shown in Fig. 8.

The saw 83 is then withdrawn and the container carrier 70 and its container 71 and liner 73 moved to the left as viewed in Figs. 1 and 8, the severed discard 75*d* thereupon reengaging the tubular extrusion 75*c* and giving it a push to initiate its longitudinal discharge from the press.

The container carrier 70 and its container 71 and liner 73 are then moved to the right and the arm 81 is swung so as to remove the die 78 from alinement with the extrusion axis of the press and to bring the receiver 106 into alinement with this axis. At the same time fluid is admitted to the small cylinder 98 (Fig. 3) to rotate, through the bell crank 101 and link 103, the castellated ring 86 so as to bring its jaws, protuberances or castellations 88 into alinement with the mating recesses 104 in the container 71. This position of the parts is illustrated in Fig. 10.

Pressure is now applied through the passage 23 to the main cylinder 19 to move the main ram 21 to the left as viewed in Fig. 1. This moves the main cross head 27, backup block 41, extrusion stem 51 and castellated ring 86 toward the die platen 15, 67. Since the castellations 88 now aline with the recesses 104, the main ram now has a longer stroke, the length of the stroke being increased by the depth of the castellations 88 which now enter the recesses 104. This gives the necessary increase in effective length to the extrusion stem 51 to push the discard 75*d* and dummy block 56 into the receiver 106 as shown in Fig. 11.

A fresh die 78 is then inserted in the arm 81 and the parts are returned to the position shown in Fig. 1 and the castellated ring 86 is indexed back to its original position by the piston in the cylinder 98. The operating cycle as above described can then be repeated.

On the matter of adjusting the apparatus, it will be seen that by loosening the lock ring 40 (Fig. 2) the enlarged threaded end 38 of the mandrel actuating rod

32 can be screwed in or out to adjust the effective length of the mandrel 53. The lock ring 40 can then be retightened. This adjustment permits of adjusting the effective length of the mandrel 53 to substantially exactly equal the combined length of the extrusion stem 51 and dummy block 56 so that the reduced end 55 is flush with the far end of the dummy block 56 before the extrusion starts.

To adjust the effective length of the stop pins 58 and hence to locate the reduced end 55 of the mandrel 53 in proper relation to the die during the extrusion, the radial screws 63 (Fig. 2) can be loosened; the locking ring 65 released and the large stop collar 61 turned until it is adjusted longitudinally along the screw coupling 36 to provide the desired effective length of the stop pins 58.

While the apparatus has been described as operating upon solid hot billets 75 which are pierced by the mandrel 53 as shown in Fig. 6, it will be apparent that the apparatus could be used in conjunction with so-called hollow billets, that is, billets which have been cast or machined into cylindrical form so that the necked end of the mandrel 53 merely enters the hollow billet and is then positively positioned with reference to the die 78 as above described.

From the foregoing it will be seen that the present invention accomplishes the objectives enumerated, particularly in holding the mandrel in fixed position to the die without requiring a cylinder external to the main ram and in providing a simple rotary stop to increase the effective length of the extrusion stem in ejecting the discard and dummy block.

I claim:

1. In a press for extruding metal shapes, a die platen adapted to carry a die forming the exterior of said shapes, a cylinder platen carrying a main cylinder housing a main ram structure projectable toward and from said die platen, an extrusion stem projecting from said main ram structure toward said die, a billet container structure having a through bore in line with said die and extrusion stem and movably mounted between said main ram structure and die for movement parallel with said extrusion stem; the combination therewith of means for ejecting the severed discard and any dummy block from said through bore following the forming of the extrusion, and severing the end of the extrusion at which the discard is formed, comprising a ring rotatably mounted on one of said structures on an axis generally parallel with the movement of said ram structure, a protuberance on said ring projecting toward the other of said structures, said other of said structures being provided with a recess to receive said protuberance, and means arranged to rotate said ring to bring it into and out of register with said recess.

2. A press as set forth in claim 1 wherein said ring is in the form of a castellated ring with each castellation thereof forming said protuberance.

3. A press as set forth in claim 2 wherein said castellated ring is provided with a lug and wherein said one of said structures is provided with a pair of opposed adjustable stops limiting the arcuate movement of said lug.

4. A press as set forth in claim 3 wherein a piston and cylinder rotates said castellated ring, one being connected with said castellated ring and the other connected with said one of said structures.

5. In an extrusion press for extruding metal tubes, a die platen adapted to carry a die forming the exterior of said tubes, a cylinder platen carrying a main cylinder, a main ram in said main cylinder projectable toward said die platen and having a generally concentric cylinder provided with an end head opposing said die platen, a tubular extrusion stem projecting concentrically from said end head and having a longitudinal through bore in line with a bore through said end head, a billet container structure having a through bore in line with said die and tubular extrusion stem and movably mounted between said main ram and die for movement parallel with said tubular extrusion stem, a piston arranged in said generally concentric cylinder and having an internally threaded bore opening toward said end head, a mandrel slidingly fitting in said tubular extrusion stem, a mandrel holder having a threaded end adjustably screwed into said threaded bore and having its opposite end connected with the said mandrel, the outer end of said mandrel being of reduced size to coact with said die in producing the desired cross sectional form of said tubes, a plurality of pins fixed to project from said piston through bores in said end head toward said billet container structure, the ends of said pins engaging said billet container structure when said end of a reduced size of said mandrel comes into predetermined closely spaced relation to said die thereby to position said end of reduced size of said mandrel in a definite relation to said die as said tube is extruded.

6. In an extrusion press for extruding metal tubes, a die platen adapted to carry a die forming the exterior of said tubes, a cylinder platen carrying a main cylinder, a main ram in said main cylinder projectable toward said die platen and having a generally concentric cylinder provided with an end head opposing said die platen, a tubular extrusion stem projecting concentrically from said end head and having a longitudinal through bore in line with a bore through said end head, a billet container structure having a through bore in line with said die and tubular extrusion stem and movably mounted between said main ram and die for movement parallel with said tubular extrusion stem, a piston arranged in said generally concentric cylinder and having a coaxially externally threaded coupling member projecting toward said end head, a mandrel projecting from said piston and slidingly fitting in said tubular extrusion stem and in said bore through said end head, the outer end of said mandrel being of reduced size to coact with said die in producing the desired cross-sectional form of said tubes, an internally threaded collar screwed on said coupling member, a plurality of pins fixed to project from said collar through bores in said end head toward said billet container structure, the ends of said pins engaging said billet container structure when said end of a reduced size of said mandrel comes into predetermined closely spaced relation of said die thereby to position said end of reduced size of said mandrel in a definite relation to said die as said tube is extruded.

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