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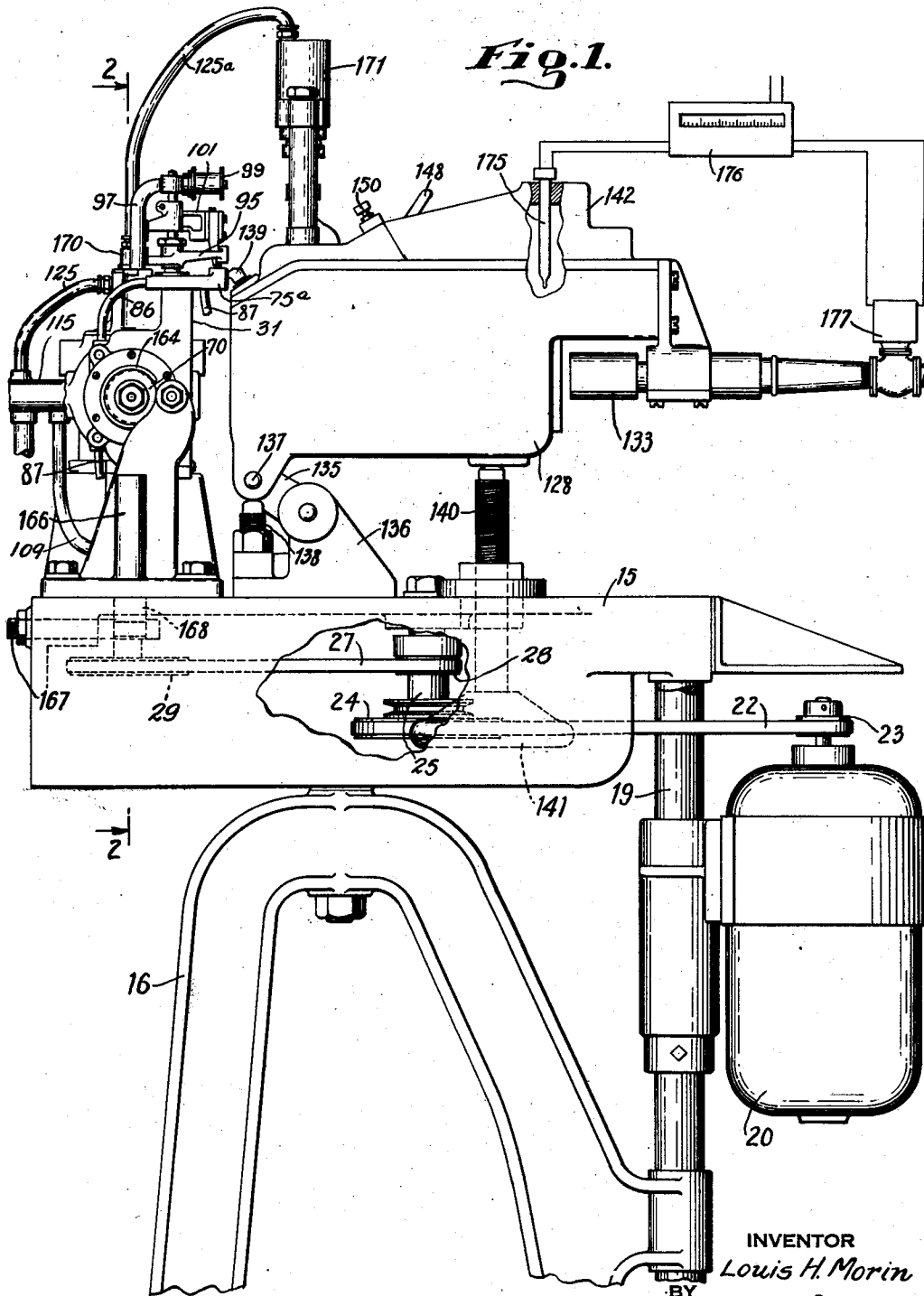
L. H. MORIN

2,224,977

HIGH SPEED DIE CASTING MACHINE

Filed Feb. 8, 1938

6 Sheets-Sheet 1



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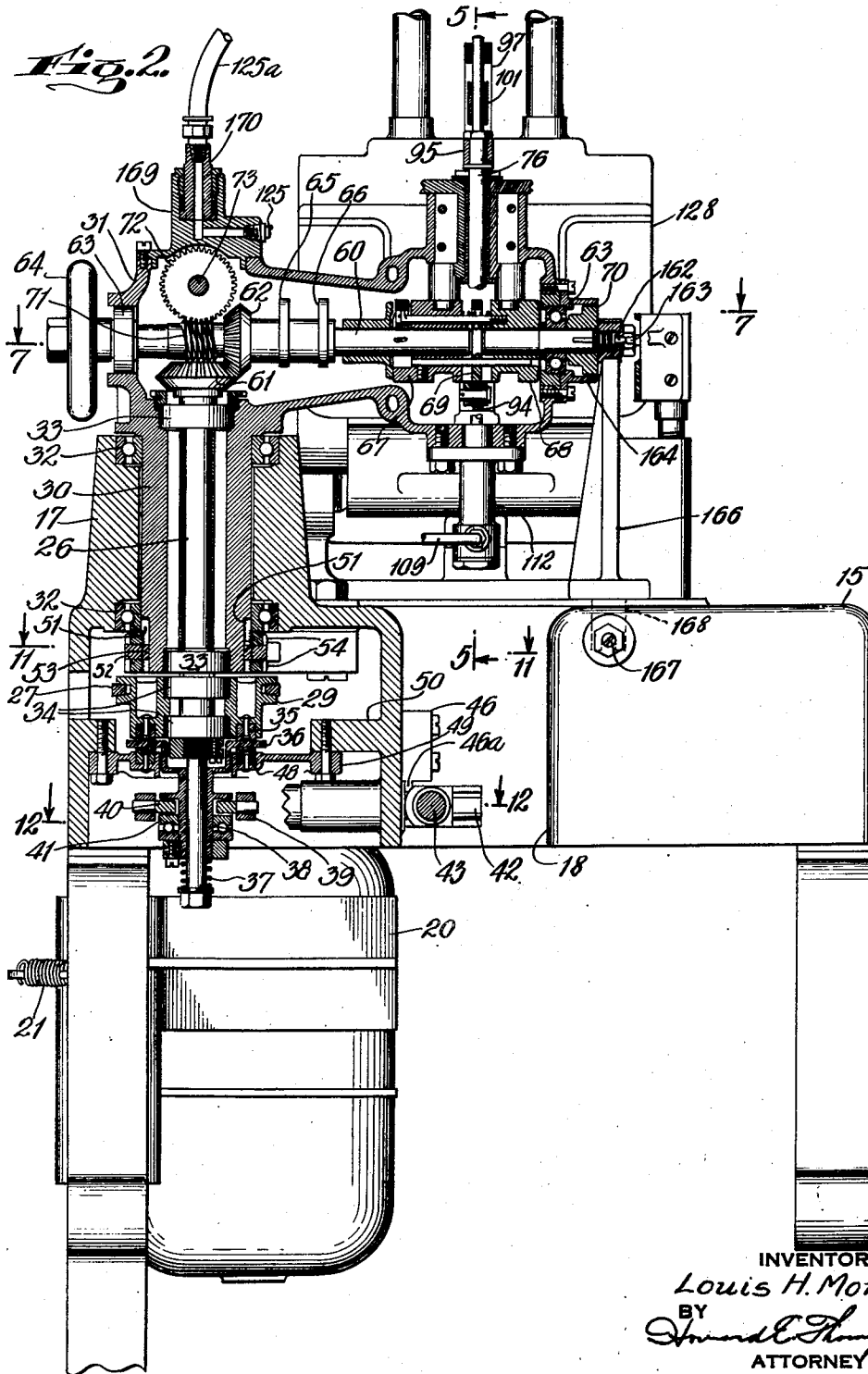
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6 Sheets-Sheet 2



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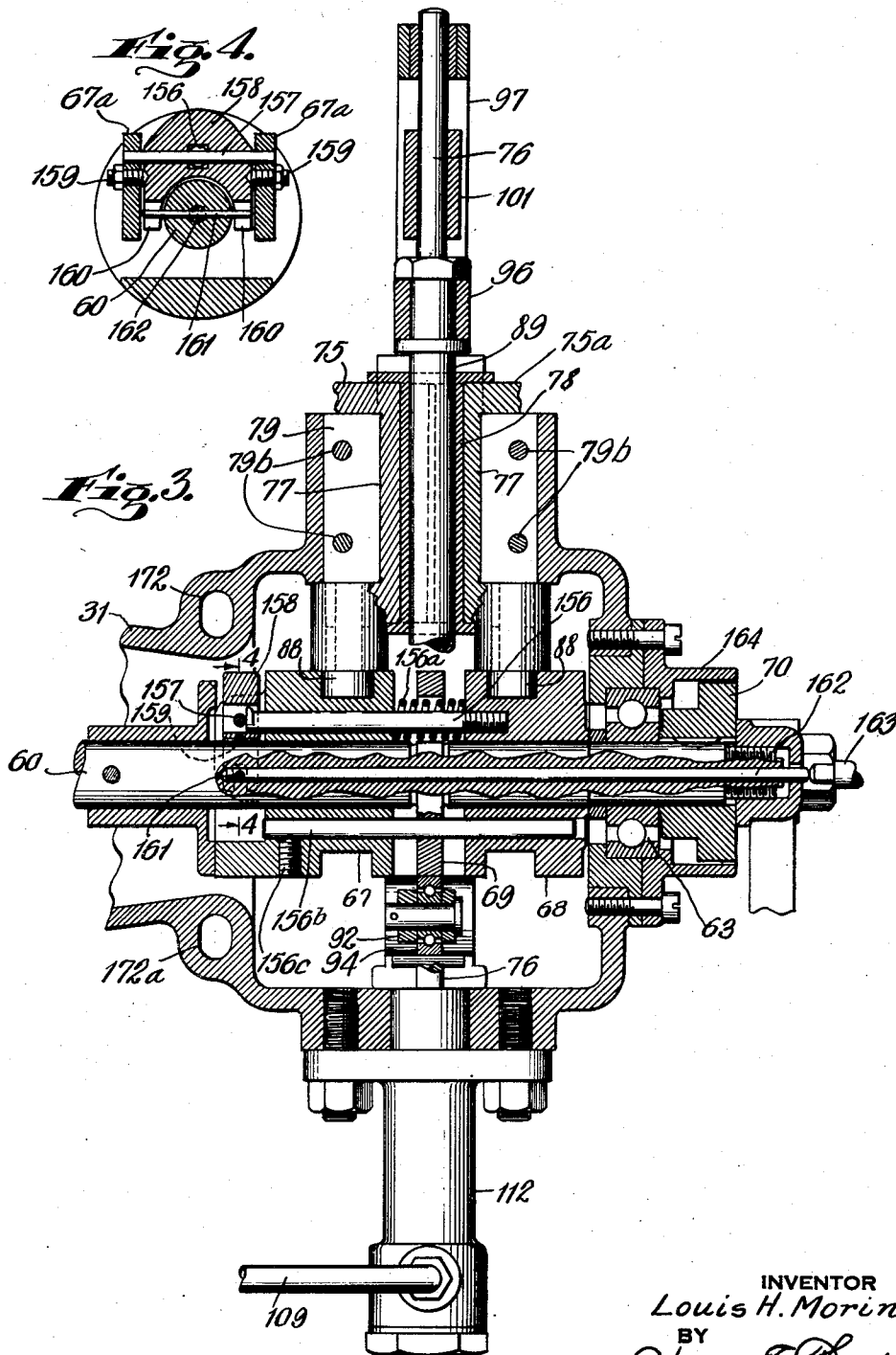
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6 Sheets-Sheet 3



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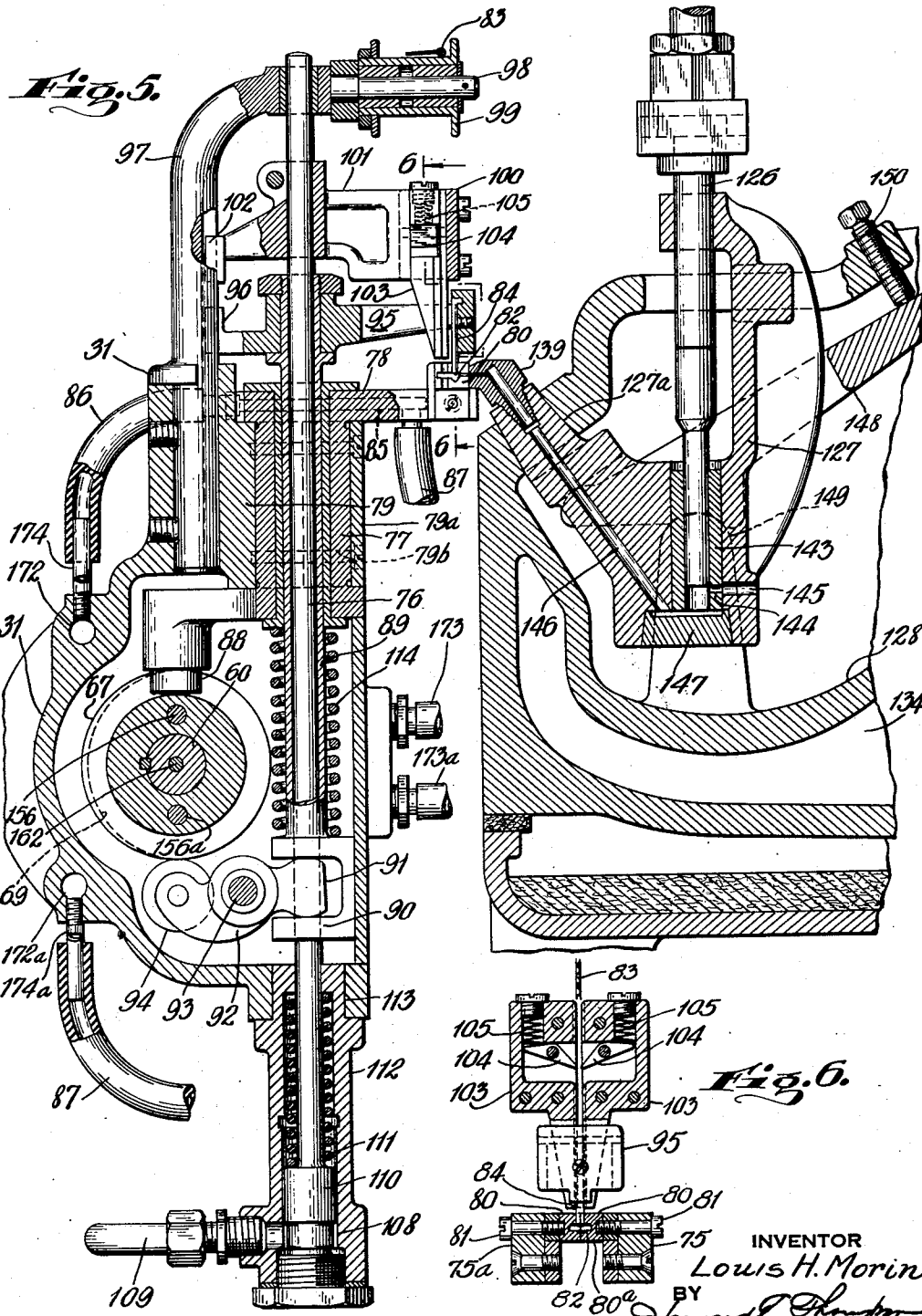
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6 Sheets-Sheet 4



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HIGH SPEED DIE CASTING MACHINE

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6 Sheets-Sheet 5

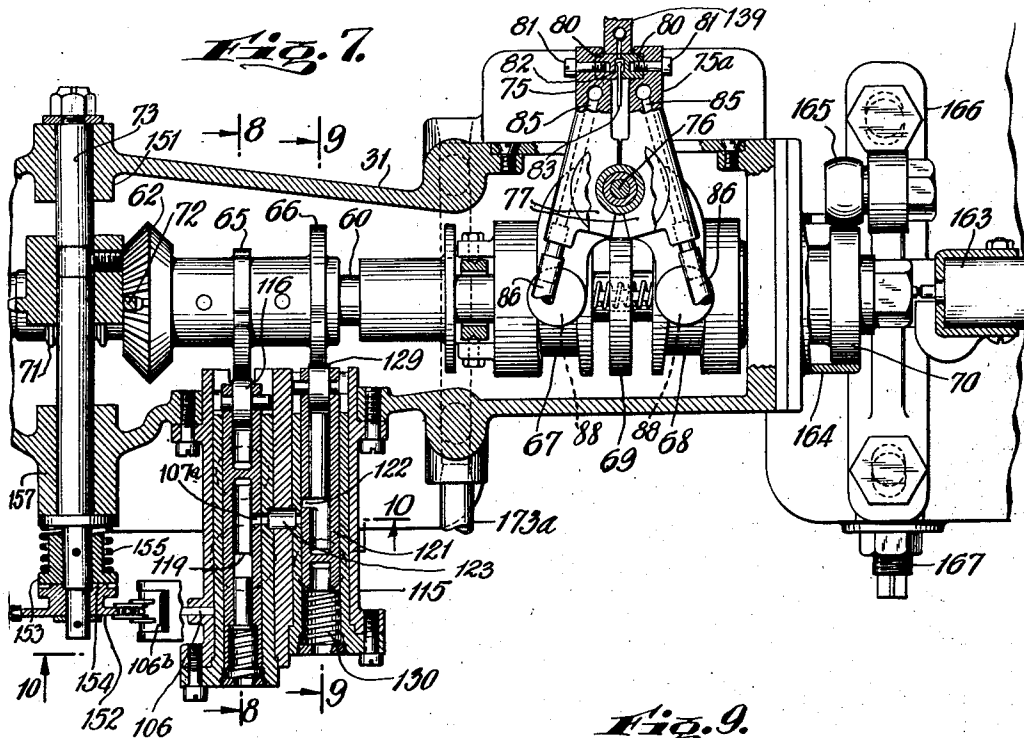
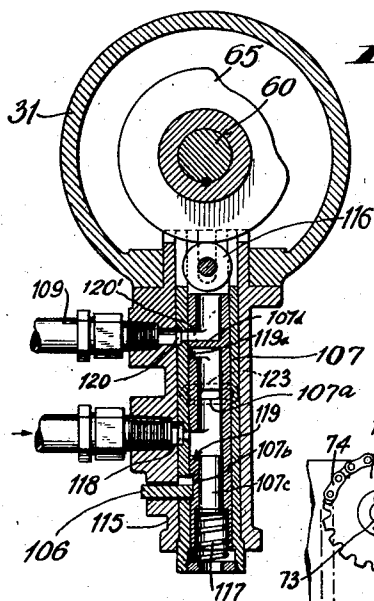


Fig. 9.

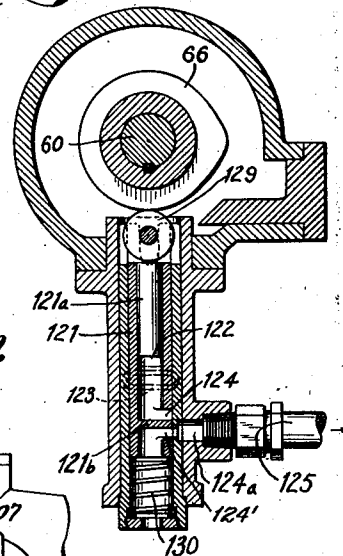
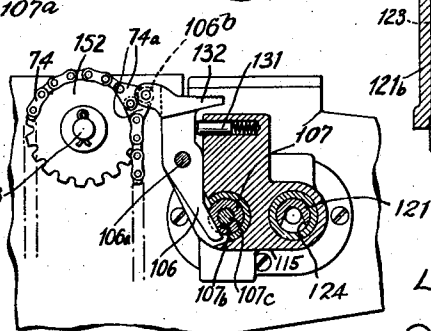


Fig. 10.



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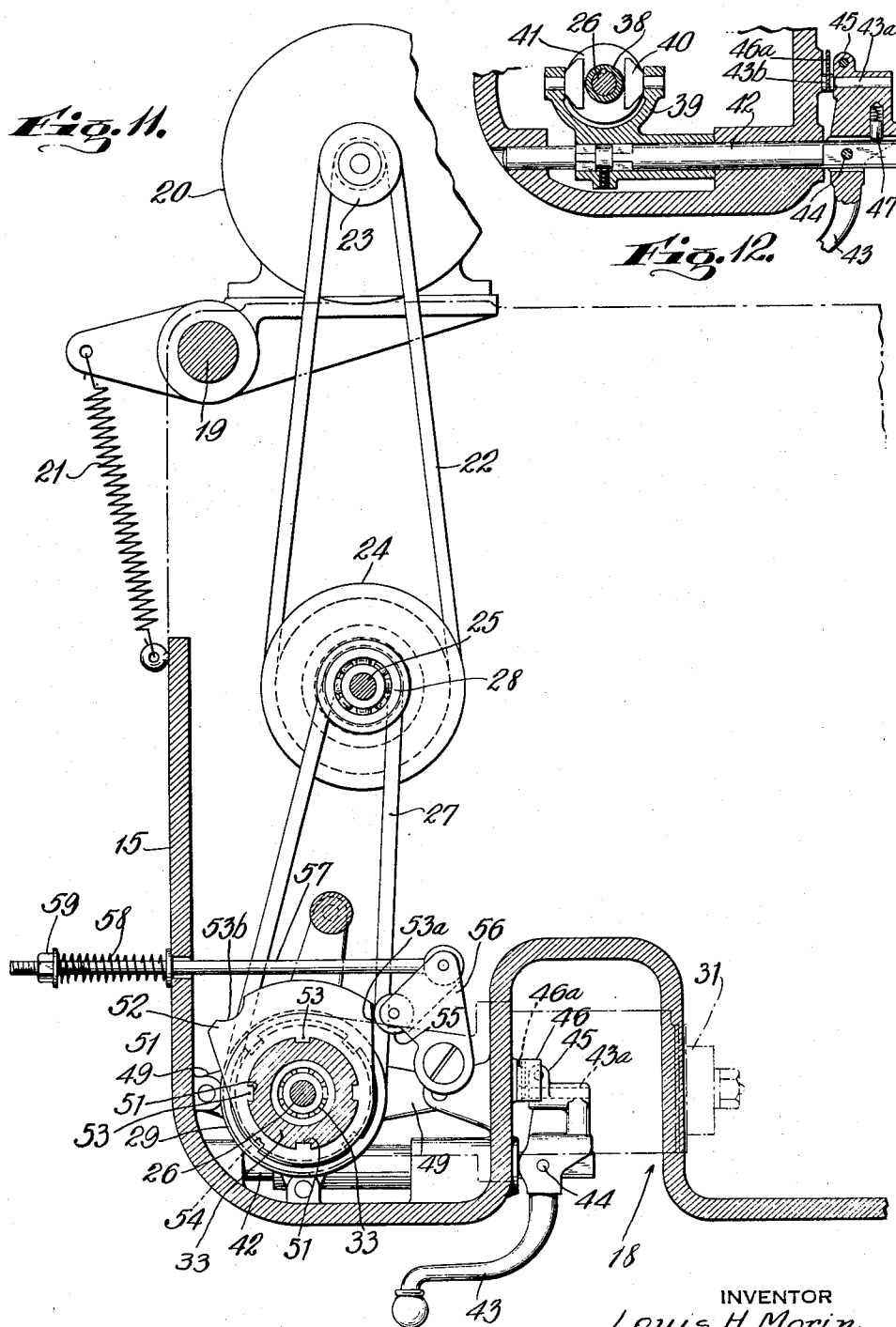
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HIGH SPEED DIE CASTING MACHINE

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6 Sheets-Sheet 6



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UNITED STATES PATENT OFFICE

2,224,977

HIGH SPEED DIE CASTING MACHINE

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Application February 8, 1938, Serial No. 189,309

16 Claims. (Cl. 22—57)

This invention relates to die casting machines and particularly to machines of this kind designed for use in die casting the coupling links or elements of separable fastener devices, and still more particularly to casting such devices upon a mounting strip, strand or tape in forming what is known as stringers of devices of this kind. More particularly, the invention relates to a machine of the character described which is designed for the high speed production of relatively small die castings; that is to say, in the production of die castings at a rate of five hundred to a thousand per minute, thereby materially increasing the production of devices of the character under consideration. The novel features of the invention will be best understood from the following description and annexed drawings in which one embodiment of the invention is disclosed and in which the separate parts of the machine are designated by suitable reference characters in each of the views and in which:

Fig. 1 is a side elevation of the machine with parts of the structure broken away and in section.

Fig. 2 is an enlarged sectional view substantially on the line 2—2 of Fig. 1.

Fig. 3 is an enlarged sectional view of a part of the construction shown in Fig. 2.

Fig. 4 is a section substantially on the line 4—4 of Fig. 3.

Fig. 5 is a section substantially on the line 5—5 of Fig. 2.

Fig. 6 is a sectional detail view on the line 6—6 of Fig. 5.

Fig. 7 is a partial section substantially on the line 7—7 of Fig. 2.

Fig. 8 is a partial section on the line 8—8 of Fig. 7.

Fig. 9 is a partial section on the line 9—9 of Fig. 7.

Fig. 10 is a partial section on the broken line 10—10 of Fig. 7.

Fig. 11 is a partial section substantially on the line 11—11 of Fig. 2 indicating the swinging arm in dot and dash lines, and

Fig. 12 is a partial section on the line 12—12 of Fig. 2.

In the accompanying drawings 15 represents the main frame of the machine which may be referred to as a bed-plate or table arranged upon suitable supports 16, and consists of a hollow casting substantially rectangular in form. The frame is provided with an upwardly projecting bearing 17 in one corner portion thereof. Adjacent this corner one side of the frame is recessed as seen at 18. At another corner of the

frame is arranged a vertical rod 19 which also has a bearing in one of the legs or uprights 16, note Fig. 1. This rod provides a swinging mounting for an electric drive motor 20, a spring 21 being employed to provide the desired tension on a drive belt 22 passing over a pulley 23 on the motor shaft and also over a pulley 24 on an intermediate shaft 25. At 26 is shown a vertically arranged drive shaft which is driven from a belt 27 passed around a pulley 28 on the shaft 25 and a pulley 10 29 on the shaft 26.

Arranged in the bearing 17 is a downwardly directed tubular spindle 30 of a swinging arm or frame 31. Ball bearing mountings 32 are provided for the spindle in the bearing 17, and the shaft 26 is provided with ball bearing mountings 33 in the spindle 30. Other ball bearing mountings 34 are provided for the pulley 29 upon the shaft 26, the pulley carrying a friction clutch face 35 adapted to engage a clutch drive disc 36 20 which is held in engagement with the clutch of the pulley 29 by a spring 37 operating upon a tubular extension 38 of the disc 36.

The disc is keyed to the shaft 26 and free to move longitudinally thereon. The clutch disc 36 25 is operated by a clutch operating yoke 39 carrying suitable shoes 40 fitting within an annular channel or clutch collar 41, note Figs. 2 and 12. The yoke 39 is operated by a rocker shaft 42 arranged in suitable bearings in the frame and 30 which extends into the recess 18. An operating handle 43 is pivoted to the shaft 42 as seen at 44. The handle carries a projection 45 adapted to cooperate with a suitable catch 46 to hold the clutch in operative position. A spring actuated 35 pin 47 is employed to support the arm in position, note Fig. 12. It will be understood that the arm may be swung free of the catch 46 whenever it is desired to support or disengage the clutch.

A brake friction ring 48 is arranged to engage the opposite surface of the clutch disc 36 when the disc is disengaged from the pulley 29 to brake or retard the rotation of the shaft in the gradual stopping of the machine. The ring 48 is supported in connection with a plate 49 secured to 45 suitable projections 50 in the frame 15, note Fig. 2.

The spindle 30 protrudes below the top wall of the frame 15, and the lower end thereof is externally threaded and provided with longitudinal key ways 51. An arm controlling element 52 has projections 53 entering the key slots 51 50 to key the element 52 against rotation on said spindle. Two sleeves nuts 54 are employed to retain the element 52 in position. The element 52 operates to control the position of the arm 55

or swinging frame, and has a flat surface 53a which normally is engaged by a roller 55 on a swinging link 56. The roller is also adapted to enter a recess 53b in the element 52 in retaining the arm in what might be termed the open position. The purpose of this construction is to swing the dies and other mechanism supported in connection with the arm away from the nozzle of the machine for replacement of dies, repairs, and any other purpose, and renders the mechanisms freely accessible, as will be apparent.

A long rod 57 is coupled with the link 56 and extends outwardly through the frame 15, and a spring 58 is employed on the rod, the tension of which is adjusted by a nut 59 to control the applied pressure on the swinging arm or frame 31 in moving the dies carried thereby into engagement with the nozzle, while at the same time easing this pressure by means later described.

Arranged longitudinally of the arm or swinging frame 31 is a cam shaft 60 which is geared to the drive shaft 26 through beveled gears 61 and 62, note Fig. 2. The shaft 60 is arranged in suitable ball bearings 63 in the end portions of the arm 31. The shaft protrudes through one end of the arm and is provided with a hand wheel 64 by means of which the shaft may be rotated, at will independent of the power drive of the machine, for any desired purpose.

Arranged longitudinally of the shaft 60 are a series of cams, two cams 65, 66 being employed to actuate air valves, as later described. Two other die operating cams 67 and 68 are arranged in close proximity to each other and between which is a cam 69 for actuating the core pin employed. At 70 is a cam for providing the relief of the spring pressure 58 upon the arm to relieve the pressure of the dies upon the nozzle in between successive casting operations. On the shaft 60 is a worm 71 cooperating with a worm wheel 72 on a shaft 73, which controls the feed or operation of a trip chain 74, note Fig. 10.

A pair of substantially similar scissor or tong die supporting members 75, 75a are arranged to swing about a vertical shaft 76. Each member 75, 75a is provided with a downwardly extending semicircular bearing portion 77 arranged upon a bushing 78 and supported within a tubular bearing consisting of a semicircular portion 79 of the casing 31 and a clamp block 79a secured thereto by screws 79b. Sufficient clearance is provided between adjacent surfaces of the bearings 77 to permit the scissor-like action of the members 75, 75a in moving the die parts 80 toward and from each other. Screws 81 are provided for detachably supporting the dies in connection with the members 75.

In the construction shown, adjacent abutting surfaces of the dies are provided with an impression 82 of the contour of a link or scoop of a separable fastener stringer. The dies are recessed to receive a mounting tape 83, commonly referred to as a stringer tape, and also to receive a core pin 84 upon which the cast links are formed substantially in accordance with the teachings in Patents No. 1,966,256 and 1,975,966.

The members 75, 75a are provided with water circulating passages 85 for the circulation of water or other cooling agents therethrough. Flexible inlet tubes 86 are coupled with said members, and discharge tubes 87 are provided adjacent the dies 80.

At the lower ends of each of the bearings 77 are supported rollers 88 which operate in the cams 67, 68 respectively, in controlling the move-

ment of the dies toward and from each other in the successive series of casting operations. The cams control the relative movement of the dies not only to open and close the same, but in partially closing the same in the operation of stripping the castings from the core pin 84 and also in controlling the spacing of the links upon the tape 83 in the manner taught in said earlier patents.

Arranged upon the shaft 76 within the bushing 78 and projecting beyond the ends of said bushing is a sleeve 89. The lower end of this sleeve carries a yoke 90 in connection with which the fork end 91 of a lever 92 operates. The lever is pivoted as seen at 93, and carried at its other end is a roller bearing 94 which operates upon the cam 69 which controls the feed of the core pin 84. This pin is supported in connection with an arm 95, supported upon the upper end of the sleeve, and held against rotation by a key element 96 engaging a bracket 97. The bracket is supported upon the top of the swinging frame 31 and forms a bearing for the shaft 76. This bracket also carries a horizontal pin 98 for supporting a guide spool or pulley 99 for the tape 83 prior to its passage downwardly through a tape feeding device 100.

The device 100 is supported in connection with an arm 101 secured to the shaft 76 above the sleeve 89, the arm 101 having a key member 102 engaging the bracket 97 to prevent rotation thereof. Supported in connection with the arm 101 is a tape guiding block 103 carrying two pivoted tape grippers 104 normally held in engagement with the tape 83 by springs 105 so that a slight pressure is always provided upon the tape 83 to support the same in proper position, especially in the intermittent casting of links at spaced intervals on the tape and so that the tape is drawn through the grippers 104 under slight tension in the feed thereof so as to definitely control the spacing of the links. It is understood in this connection that in the upward movement of the arm 101, including the block 103, the dies 80 will hold the tape against upward movement permitting the grippers 104 to pass thereover. At the end of the upward movement of the arm 101, the dies 80 are opened and the tape still held by the grippers 104 is fed downwardly by said grippers a distance equal to the previous upward movement of the arm in the downward movement of said arm. This operation may be performed in one or two stages, depending upon the spacing to be performed between the groups of links on the tape which controls what is commonly referred to as the stringer lengths.

In this connection, trip links 74a are provided on the chain 74 which control the movement of a dog or catch 106, note Fig. 10, to release one of the valve cylinders 107, so as to operate the shaft 76 and the arm 101 thereon by admitting air into an annular chamber 108 through a pipe 109 connecting with the cylinder 107. The lower end of the shaft 76 directly adjacent the chamber 108 is provided with a piston 110 against which the air operates in raising said shaft against the action of a spring 111. The piston 110 and spring 111 is arranged to operate in a cylinder 112 which is coupled with the swinging frame as seen at 113. It will be understood that the spring 111 moves the arm 101 as well as the shaft 76 downwardly when the air pressure is released, the latter being performed when the cylinder 107 is in the position shown in Fig. 8.

In this connection it will also be apparent that a spring 114, which cooperates with the sleeve 89 or the yoke 90 thereon, serves to hold the roller 94 in constant engagement with the cam 69 in controlling the operation of the core pin 84.

The valve cylinder 107 is arranged in a valve casing 115 supported in connection with the swinging frame 31 as clearly seen in Fig. 7 of the drawings. The cylinder 107 carries at one end a roller 116 operating upon the cam 65, and is held against the cam or against the dog 106 by a spring 117. It is understood that the dog 106 supports the roller 116 out of active engagement with the cam 65 as in Fig. 8, so that the cylinder 107 remains idle except during the cycle of operation in widely spacing the links as above described.

The casing 115 is provided with an air inlet passage 118 for the admission of air under pressure into the cylinder through a passage 119, note Fig. 8. In the normal position of the cylinder 107, the chamber thereof or the exhaust port 119a is out of engagement with an exhaust passage 120 with which the pipe 109 communicates, so that the supply of air to the chamber 108 is normally shut off.

Another cylinder 121 is disposed at the other side of the casing 115 and is provided with an admission port or passage 122 which is adapted to register with a by-pass 123 arranged between the cylinders 107 and 121. This controls the admission of air into the cylinder 121 and the discharge of air through an exhaust port 124 opening into an exhaust passage 124a, having a pipe 125 communicating therewith which leads to and is adapted to operate a plunger 126 of the gooseneck 127 of the pot or container 128 for the casting material employed, as later described. It will be noted that both valve cylinders 107 and 121 can open to atmosphere for the release of air pressure in the pipes 109 and 125. Suitable ports 120' and 124' are provided to register with the passages 120 and 124a respectively as well as with the exhaust through the open ends of the cylinders for this purpose and as seen in Figs. 8 and 9 of the drawings. One end of the cylinder 107 is plugged as seen at 107c, and one end of the cylinder 121 is plugged as seen at 121a. A transverse partition 107d and 121b is provided in each cylinder. The cylinder 121 carries a roller 129 operating upon the cam 66 which controls the registration of the port 122 with the by-pass 123. A spring 130 is employed to support the roller 129 in constant engagement with the cam 66. It will appear upon a consideration of Figs. 7, 8 and 9 that each cylinder 107, 121 forms the valve member and are each disposed within a bushing and arranged within the casing 15 simply as a matter of good design, so that the bushings actually become part of the casing. The term cylinder as used in describing the valves is simply to identify the tubular structure thereof.

At this time attention is directed to the fact that when the cylinder 107 is released from the position shown in Fig. 8 by tripping the dog 106, this cylinder will be then free to be operated by the cam 65. In this cycle of operation the cylinder will be moved into such position as to bring the port 107a thereof out of registering alignment with the by-pass 123, so that no air can be passed into the cylinder 121. While the dies are operated to perform their normal movement in the cycle of operation above referred to, no casting material will be discharged from the pot 128 by reason of the fact that no air is supplied

to the cylinder 121 and thus the plunger 126 is not operated.

Upon consideration of Fig. 10, it will be seen that a spring actuated pin 131 is employed to support the dog 106, normally in operative position, in the slot or groove 107b of the cylinder 107. A finger piece 132 is provided on the dog to facilitate manual tripping or releasing of the dog at will in testing or other operations of the machine. The dog 106 is mounted on a pivot 106a and carries at its free end a roller 106b which cooperates with the chain 74 and the trips 74a thereon.

The pot 128 may be heated by the passage of a flame from a gas burner 133 around circulating chambers 134 of the pot proper. This pot is pivotally supported upon the frame or bed-plate 15 by means of a link 135 pivoted to a bracket 136 in the frame and to the pot, as seen at 137. An adjustable screw 138 is provided to raise and lower the height of the pot so as to bring a discharge nozzle 139 in proper registering alignment with the impression 82 of the dies or the usual gate leading to said impression.

At 140 is shown a vertically adjustable screw which may be operated by a suitable handle member 141 for the purpose of tilting the entire pot by lowering said screw so as to bring the molten metal of the pot away from the gooseneck 127 for repairs or other purposes. A cover 142 is provided for the top of the pot 128 to control, by the removal thereof, the insertion of casting material into the chamber thereof from time to time. The plunger 126 is movable vertically in a bushing 143 provided in the gooseneck. The bushing has an aperture 144 registering with another aperture 145 in the gooseneck to control admission of casting material into the bushing 143 below the plunger 126.

A discharge passage 146 extends upwardly from the lower end of the gooseneck to the nozzle 139. A clean-out plug 147 is provided at the lower end of the gooseneck and in registering alignment with the bore of the bushing 143 and the passage 146. A yoke-shaped lever 148 is pivoted upon rounded bearings 149 in the pot 128 at opposite sides of the gooseneck. Pressure is applied to the lever 148 through an adjustable screw 150 to firmly support the tapered end 127a of the gooseneck in a corresponding socket formed in the pot.

The shaft 73 is mounted in suitable bearings 151 in the swinging frame 31. On the outer end of the shaft 73 is mounted a sprocket 152 upon which the chain 74 is mounted. Adjacent this sprocket a clutch collar 153 is keyed to the shaft and has a tooth clutch engagement 154, with the sprocket 152, normally held in engagement therewith by a spring 155. This construction permits a free rotation of the sprocket 152 to adjust the chain to any desired position in governing the cycle of operation of the trips 74a on said chain.

In the event of foreign particles coming between the dies 80, which would interfere with the proper functioning of the dies, means are provided to stop the operation of the machine. To accomplish this result, a rod 156 is secured to the cam 68 and passes through the cam 69 and through the cam 67. The free end of the rod 156 engages a cross pin 157 mounted in a yoke-shaped block 158, supported between projecting ears 67a on the cam 67, the block 158 being supported on pivots 159. The lower ends of the block 158 are forked as seen at 160 to engage another cross pin 161 which is coupled with a

long switch operating rod 162 slidably arranged in the shaft 60, and the free end of which cooperates with a microelectric switch 163. The switch will instantaneously stop the operation of the electric motor 20, especially in providing a motor of this type incorporating the quick braking function, thus providing a substantially instantaneous stoppage of the machine.

It will be understood that if for any reason the dies are not brought into proper relationship to each other in the casting operation, the cams 67 and 68 being slidably mounted on and keyed to the shaft 60 will move toward each other against the action of the spring 156a as seen in Fig. 3, which will move the rod 162 to the right in actuating the switch 163. In this action of the cams it will be apparent that the yoke-shaped member 158 is moved on its pivots 159 to actuate the rod 162.

One of the bearings 63 of the cam shaft 60 is held in position by a housing 164 which substantially envelops the cam 70. The housing is recessed at one side, as noted in Fig. 1 of the drawing, to receive a roller 165 which operates upon the cam and which forms a stop limiting the swinging movement of the arm or swinging frame 31. The roller 165 is supported in an adjustable bracket 166 mounted upon the bed-plate 15 and adjustable thereon. The adjustment is made by a screw 167 supported in the bed-plate and engaging a downwardly projecting portion 168 on the bracket 166, note Fig. 1 of the drawings.

The purpose of the cam 70 engaging the roller 165 is to move the swinging frame 31 or the dies 80 thereof slightly away from the nozzle 139 intermediate the casting operations, while at the same time permitting the spring 58 to support the dies 80 in firm engagement with the nozzle 139 during the casting operation. In this latter operation, the roller 55 engages the surface 53a of the element 52.

The pipe 125 communicating with the air cylinder 121 does not connect directly with the cylinder for actuating the plunger 126, but is first coupled with a cap 169 secured to the swinging frame 31, note Fig. 2. In this cap is a swivel connection 170 in communication with the pipe 125, and coupled with the swivel connection is a suitable flexible tube 125a which connects with a plunger cylinder 171 as diagrammatically illustrated in Fig. 1 of the drawings.

The casting of the swinging frame or arm 31 is provided with two water circulating chambers 172, 172a. The chamber 172 has an inlet passage 173, note Fig. 5, and the chamber 172a an outlet passage 173a, so that circulating water may be passed into the chamber 172 through the flexible tube 173 and then out through a Y-connection 174 to the separate tubes 86 leading to the die supporting members 75, 75a, and then discharged from said members through the tubes 87 which connect with another Y-connection 174a communicating with the chamber 172a and thus passing outwardly through the exhaust tube 173a.

By passing cooling water through at least a part of the casting, a means is provided to prevent the transfer of heat from the pot through the frame to the dies. It is understood that by cooling the casting of the swinging frame, the work of chilling the dies by directly circulating water through the members 75, 75a is simplified.

In connection with the latching of the clutch operating lever 43, it will appear that this lever carries a pin 43a, note Fig. 12, having a grooved head 43b in connection with which a metal strip

46a on the catch 46 operates to retain the lever 43 against accidental displacement.

In Fig. 1 of the drawings I have diagrammatically indicated at 175 a pyrometer electric control for maintaining the desired temperature of the casting material through the medium of a temperature indicator 176, and in the circuit of which is a suitable valve 177 controlling the action of the burner 133. As these control units are known in the art, no detail description thereof is essential.

The operation of the machine will be readily understood from the foregoing description when taken in connection with the drawings and the following statement. Assuming that the dies are first brought in to closed position and upon a predetermined section of the tape 83, upon which a casting is to be formed, and the core 84 is arranged within and between the dies with a part thereof in the impression 82, the swinging frame controlled through the action of the cam 70 as previously described, is moved to bring the nozzle 139 in positive and firm engagement with the dies. The plunger 126 now moves downwardly shutting off the passages 144, 145, and the casting material is discharged upwardly through the passage 146 in the gooseneck and out through the nozzle 139 into the impression 82. Immediately after this injection operation, the piston or plunger 126 moves upwardly drawing or sucking the casting material downwardly through the passage 146 and again opening the passages 144, 145 to admit a new charge of casting material into the gooseneck beneath the plunger.

The next step in the operation is to open the dies, in which operation the core 84 acts as a means of ejecting the casting material from the dies. The core 84 together with the tape 83 upon which the formed casting is arranged, now moves downwardly to a position adjacent the lower surface 80a of the dies. The dies are then partially closed and the core pin 84 is then moved upwardly, thus stripping the casting therefrom. This operation forms the means for accurately spacing the successive links one with respect to the other on the tape 83. The dies are then again closed and the next cycle of operation is performed.

It will be understood that in the above operation, the various cams will function in a manner heretofore described. After a predetermined number of links have been formed on the tape, to define what is known as a stringer length, the dog 106 is tripped and the wide spacing of the tape is performed in the manner heretofore specifically described.

From the foregoing it will be apparent that when the links are being cast on the tape, the cylinder 107 is retained in the position shown in Fig. 8 by the dog 106. That is to say, the roller 116 is retained in a fixed position so that the cam 65 is free to rotate without acting upon the cylinder 107. In this position of the cylinder, air under pressure admitted into the cylinder will pass through the by-pass 123 and into the cylinder 121 when the port 122 registers with the by-pass 123, and will be discharged through the passage 124 into the pipe 125 and thus to the plunger cylinder 171 through the swivel connection 170 and the tube 125a. In this connection it will be understood that the cam 66 is continuously operating to actuate the cylinder 121 so as to intermittently supply air under pressure to the plunger cylinder 171, thus causing inter-

mittent operation of the plunger 126. It will be understood that in each intermittent operation of the cylinder 121, air is exhausted from the pipe 125 through the exhaust 124' as is seen in Fig. 9 of the drawings. In these successive series of operations, the communication to the pipe 109 is shut off as long as the cylinder 107 is held in the position shown in Fig. 8.

When the wide spacing of the links is to take place in forming predetermined stringer lengths, the dog 106 is tripped by the trip links 74a on the chain 74, note Fig. 10, two of the links being employed in the construction shown to provide two successive feeds of the tape to give the required spacing between adjacent links. When the dog is released, as above stated, the spring 117 moves the cylinder 107 in the direction of the cam 65 so that the roller 116 will be actuated by the cam. In this cycle of operation the movement of the cylinder 107 will cause the port 107a to register with the by-pass 123 at regular intervals. However, the cams 65 and 66 are so designed and their timing is such that the by-pass 123 is closed to the cylinder 121 as is plainly seen in Fig. 7. Thus, no air under pressure will be permitted to enter the cylinder 121 and instead the air will be discharged from the cylinder 107 through the port 119a, and thus into the pipe 109 and into the chamber 108 to raise the rod 76 together with the member 101 and the grippers 104 supported thereon. In this connection it will be understood that when the cylinder 107 returns to the position shown in Fig. 8, air pressure in the pipe 109 and chamber 108 will be released through the exhaust 120', and the spring 111 will move the grippers downwardly. This operation is repeated a second time by the second trip in producing the double spacing above referred to. During these two operations it will be understood that the dies go through the same motions but no castings will be formed on the tape by reason of the fact that air under pressure is cut off from the cylinder 121. The two trips 74a employed will release the cylinder 107 for two successive cycles of operation of the machine to provide the desired wide spacing of the tape. After the two spacing operations above referred to, the dog 106 again enters the recess 107b of the cylinder 107. The cylinder will remain supported in this position until another series of castings are formed and then the above spacing operation is repeated.

One of the distinctive features of the present machine resides in the fact that the machine is designed primarily for high speed operation. It is possible to actuate a machine of this type to produce castings of the kind and class under consideration at the rate of substantially a thousand a minute, in comparison with other known types of machines of this kind operating at a speed of substantially two hundred a minute. This is made possible due to the fact that the time allowed for the injection of the casting material into the die cavities and for allowing the casting material to chill or set, would be substantially the same as that in other machines of this kind. It is understood, however, that in the present machine, that part of the cycle of the machine operation, during which the various other mechanical functions are being performed, has been proportionately reduced. However, to counteract for this, the present machine has incorporated working parts, the weight of which have been materially reduced, and further in the reduction of the movement of the parts to a

minimum; that is to say to a point sufficient to perform the desired functions. Thus it will be obvious that the additional strain engendered by this greater speed of machine operation is more than compensated for by the less motion required and less weight prevailing in the various moving parts employed.

While the machine has been shown as supporting dies for the casting of the links of separable fastener stringers, it will be apparent that this is only illustrative of one use of the invention. Various kinds and classes of dies may be employed for the production of numerous kinds of castings in the art generally known as the die casting or pressure casting art. While the machine as disclosed is designed for the production of relatively small castings, it will also be apparent that the principle of operation is also adapted to dies of larger size in forming larger castings. In this latter event, the speed of operation of the machine may be reduced to be consistent with the size of the castings formed. Further the various parts of the machine may be modified as to size and construction to suit such larger castings.

It will also be understood that the machine as herein disclosed is adapted for use in casting various types and kinds of metals or metal alloys. Other die casting materials such as thermoplastic material may be employed, in which latter event, suitable means will be provided for heating and injecting the material into the dies; In all such cases, the speed of operation of the machine will be regulated to suit the various kinds and classes of casting materials employed. It will of course be understood that where the tape or mounting member is not employed in the making of castings, the mechanism controlling the tape feed will be dispensed with, and other adaptations and uses of the invention will be apparent to those skilled in the art to which the invention relates.

It will appear that a key rod 156b is also employed to key the cams 67 and 68 together. The rod 156b is secured to the cam 67 by a set screw 156c, note Fig. 3 of the drawings.

The swinging arm or casing 31 may be said to comprise a unit incorporating most of the operative mechanisms of the machine which are mounted in connection with and movable with this unit. The unit may be manually swung about the axis of the drive shaft from the normal position of the unit to what may be termed the open or accessible position thereof, in which operation the roller 55 passes over the element 52 until said roller enters the recess 53b, the spring 58 serving to tensionally support the unit in its extended position. However, by exerting slight manual pressure, the unit may again be swung to return it to the position shown in Fig. 11. It will appear that the flexible connections which are provided for the compressed air lines and the water circulating system will compensate for the swinging movement of the unit.

The feed of the tape 83 is controlled between the dies and the grippers 104, the grippers firmly but yieldably supporting the tape at all times. By arranging the grippers in close proximity to the dies, castings may be formed down to the last inch or so of the tape. It will also appear that all stretching of the tape caused by feeding takes place prior to the formation of the castings thereon. By definitely measuring the wide spaced feeding of the tape, a reasonably accu-

rate measuring of tape consumed in the machine is made possible.

Having fully described my invention what I claim as new and desire to secure by Letters Patent, is:

1. A die casting machine of the class described comprising a stationary frame, a drive shaft, a swinging frame rotatable about the axis of said drive shaft, a cam shaft rotatably mounted in said swinging frame and in operative engagement with the drive shaft, two die supporting members mounted to swing about a common axis in the swinging frame and in operative engagement with cams on said cam shaft controlling the movement of dies supported in said members toward and from each other in the successive casting operations of the machine.
2. A die casting machine of the class described comprising a stationary frame, a drive shaft, a swinging frame rotatable about the axis of said drive shaft, a cam shaft rotatably mounted in said swinging frame and in operative engagement with the drive shaft, two die supporting members mounted to swing about a common axis in the swinging frame and in operative engagement with cams on said cam shaft controlling the movement of dies supported in said members toward and from each other in the successive casting operations of the machine, means including a discharge nozzle adjustably supported on the stationary frame for supplying casting material under pressure to the impression of the dies supported in said members, and means including a cam on said cam shaft for controlling movement of the dies toward and from said nozzle in the successive casting operations of the machine.
3. A casting machine of the class described comprising a drive shaft, a frame in the form of an arm mounted to swing about the axis of said drive shaft, adjustable means at the free end of the arm for limiting the movement of the arm in one direction, tensional means for moving the arm in the direction of said last named means, a pair of die supporting members movably supported in connection with said arm, a core movably supported in connection with the arm and movable relatively to said dies, and means involving cams arranged in said arm and in operative engagement with said drive shaft for controlling the operation of said die supporting members and said core.
4. A casting machine of the class described comprising a drive shaft, a frame in the form of an arm mounted to swing about the axis of said drive shaft, adjustable means at the free end of the arm for limiting the movement of the arm in one direction, tensional means for moving the arm in the direction of said last named means, a pair of die supporting members movably supported in connection with said arm, a core movably supported in connection with the arm and movable relatively to said dies, means involving cams arranged in said arm and in operative engagement with said drive shaft for controlling the operation of said die supporting members and said core, and means for supporting said arm with the free end portion thereof in widely spaced relationship to said first named means to give access to the mechanisms supported in connection with said arm.
5. In a die casting machine of the class described employing relatively movable die supporting members with dies arranged on adjacent surfaces of said members, a drive shaft, an elec-

tric motor of the quick brake stopping type for actuating said shaft, a cam shaft in operative engagement with the drive shaft, two cams arranged on said shaft in juxtaposition and in operative engagement with said die supporting members for actuating said members, tensional means for normally supporting the cams in spaced relation to each other and to permit movement toward each other in the improper closure of dies supported in connection with said members, and means in operative engagement with said cams for actuating an electric switch controlling said electric motor for stopping the motor in the movement of said cams toward each other.

6. A casting machine of the class described comprising a frame consisting of a bed-plate, a drive shaft arranged vertically in the frame and projecting above the surface of said bed-plate, an arm having a swivel mounting on said shaft and arranged horizontally over said bed-plate, means adjustably supported on the bed-plate forming the source of supply for the casting material employed and from which casting material is discharged under pressure through a suitable nozzle, a pair of relatively movable dies supported on and movable with said arm toward and from the nozzle of said first named means, means adjustable on the bed-plate and in connection with which the arm operates for regulating relative position of the dies with respect to said nozzle, and means controlling movement of the arm or the dies thereon toward and from the nozzle in the adjusted position thereof in successive casting operations of the machine to insure firm engagement of the dies with said nozzle in injecting the casting material into the impression of said dies.

7. In a high speed die casting machine of the class described having means for pressure discharging heated casting material, a pair of tong-like members mounted to move about a common axis, means at one end portion of said members for supporting dies in connection therewith to move in registering positions with each other when closed, said dies when closed registering with the discharge means of the heated casting material, resiliently backed means cooperating with said members to move the dies toward and from each other in the successive casting operations of the machine, means for actuating a tape to move vertically and downwardly between adjacent surfaces of said relatively movable dies, means feeding the tape relatively to the dies in forming successive castings at relatively close arrangement on said tape, means above said dies to feed said tape in the wide spacing thereof between cast elements on the tape, and compressed air actuated means for operating said last named means.

8. A high speed die casting machine of the class described comprising a drive shaft, an arm mounted to swing about the axis of said drive shaft, a discharge nozzle, compressed air actuated means for pressure discharging heated casting material from said nozzle, a pair of die supporting members movably supported in connection with said arm and movable toward and from said nozzle in the swinging movement of the arm to bring the dies into registering position with said nozzle, means retaining said arm against movement in successive casting operations of the machine, and means on said arm in operative engagement with said drive shaft for actuating said die supporting members to move dies

supported therein toward and from each other in successive casting operations.

9. A high speed die casting machine of the class described comprising a drive shaft, an arm mounted to swing about the axis of said drive shaft, a discharge nozzle, compressed air actuated means for pressure discharging heated casting material from said nozzle, a pair of die supporting members movably supported in connection with said arm and movable toward and from said nozzle in the swinging movement of the arm to bring the dies into registering position with said nozzle, means retaining said arm against movement in successive casting operations of the machine, means on said arm in operative engagement with said drive shaft for actuating said die supporting members to move dies supported therein toward and from each other in successive casting operations, means on said arm for guiding a tape between dies supported in said members in forming successive series of castings on said tape, and compressed air operated means on said arm engaging the tape before entering said dies for intermittently feeding the tape to provide wide spacing of the tape between predetermined successive castings arranged thereon.

10. A high speed die casting machine of the class described comprising a drive shaft, an arm mounted to swing about the axis of said drive shaft, a discharge nozzle, compressed air actuated means for pressure discharging heated casting material from said nozzle, a pair of die supporting members movably supported in connection with said arm and movable toward and from said nozzle in the swinging movement of the arm to bring the dies into registering position with said nozzle, means retaining said arm against movement in successive casting operations of the machine, means on said arm in operative engagement with said drive shaft for actuating said die supporting members to move dies supported therein toward and from each other in successive casting operations, and means for circulating a cooling agent through said die supporting members and through said arm for cooling the same.

11. In a die casting machine, two dies having adjacent faces formed with recesses therein, a cam shaft having two cams thereon, two connections, one from each of said cams to one of said dies, and arranged to reciprocate said dies to and from a position wherein said faces contact so that said recesses together form a mold cavity, said cams being movable along said shaft relative to each other, and a spring normally holding said cams in spaced relation on the shaft but yielding to permit relative motion between the cams if said die faces fail to contact with each other when moved towards each other.

12. In a die casting machine, two dies having adjacent faces formed with recesses therein, means to reciprocate said dies to and from a position wherein said faces contact so that said recesses together form a mold cavity, a nozzle arranged to contact with said dies to discharge

casting material into said mold cavity, a movable arm supporting said dies and the means to reciprocate them, spring means moving the arm to support the dies, in pressure engagement with said nozzle, and means cooperating with the free end portion of said arm to move the dies away from pressure engagement with said nozzle against the action of said spring means between casting operations.

13. In a die casting machine, two horizontally disposed dies having vertical faces formed with recesses therein, means to reciprocate said dies to and from a position wherein said faces contact so that said recesses together form a mold cavity, means to guide a tape between said faces and through said cavity to cast the elements thereon, and means engaging the tape before entering the dies to feed said tape in the wide spacing thereof between cast elements on said tape.

14. In a die casting machine, two horizontally disposed dies having vertical faces formed with recesses therein, means to reciprocate said dies to and from a position wherein said faces contact so that said recesses together form a mold cavity, means to guide a tape between said faces and through said cavity to cast the elements thereon, means engaging the tape before entering the dies to feed said tape in the wide spacing thereof between cast elements on said tape, fluid pressure actuating means for operating said tape feeding means, a valve controlling the operation of said last named means, and automatically actuated means cooperating with said valve to control intervals of wide spacing of said tape in governing the number of cast elements arranged in groups between said wide spacings on the tape.

15. In a die casting machine, two dies having adjacent faces formed with recesses therein, means supporting the dies to swing upon a common axis, a cam shaft, cams slidably mounted on said shaft to reciprocate the dies to and from a position where said faces contact so that said recesses together form a mold cavity, and means involving a rod extending through said cam shaft and projecting therefrom for operative engagement with at least one of said cams to automatically stop the machine when said faces of the dies fail to contact when moved toward each other.

16. In a high speed die casting machine of the class described having means for pressure discharging heated casting material, a pair of tong-like members mounted to move about a common axis, means at one end portion of said members for supporting dies in connection therewith to move in registering positions with each other when closed, said dies when closed registering with the discharge means of the heated casting material, means cooperating with said members to move the dies toward and from each other in the successive casting operations of the machine, and a spring operatively engaging said last named means to provide yieldable operation of said members when moved toward each other.

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