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MACHINE AND METHOD FOR AUTOMATICALLY MOLDING WHEEL WEIGHTS AND THE LIKE

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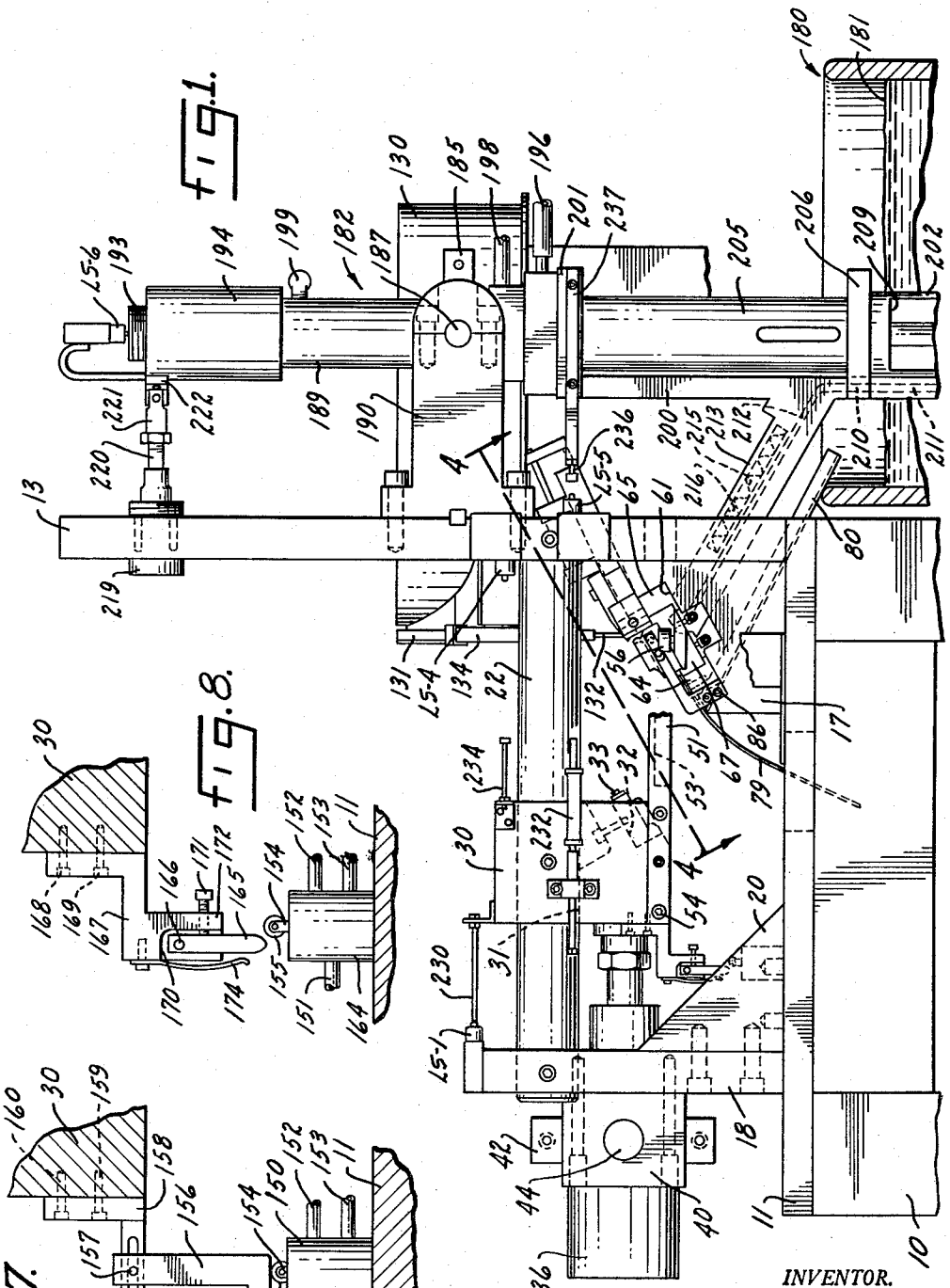


FIG. 1.

FIG. 8.

FIG. 7.

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MACHINE AND METHOD FOR AUTOMATICALLY MOLDING WHEEL WEIGHTS AND THE LIKE

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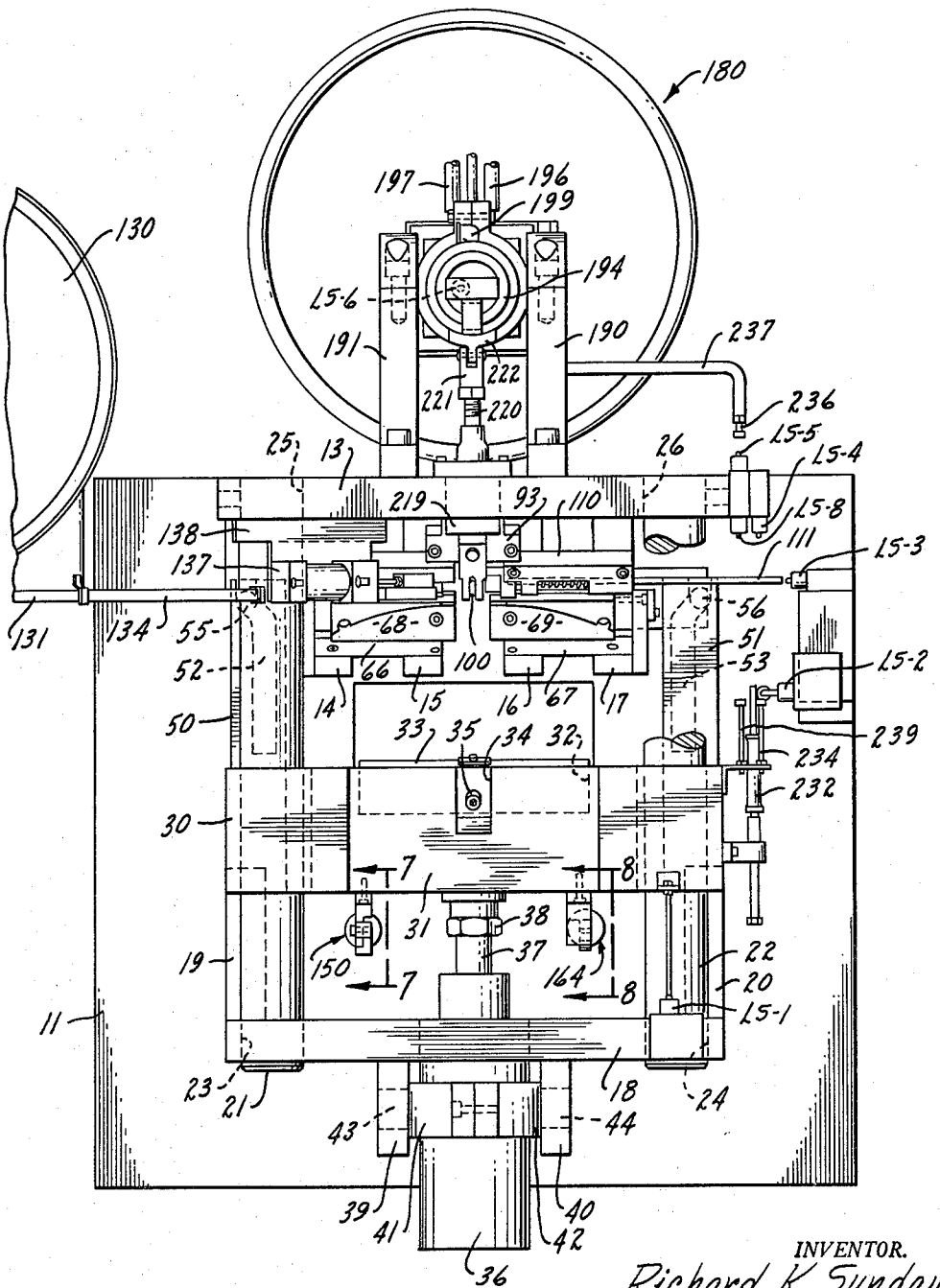


Fig. 2.

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MACHINE AND METHOD FOR AUTOMATICALLY MOLDING WHEEL WEIGHTS AND THE LIKE

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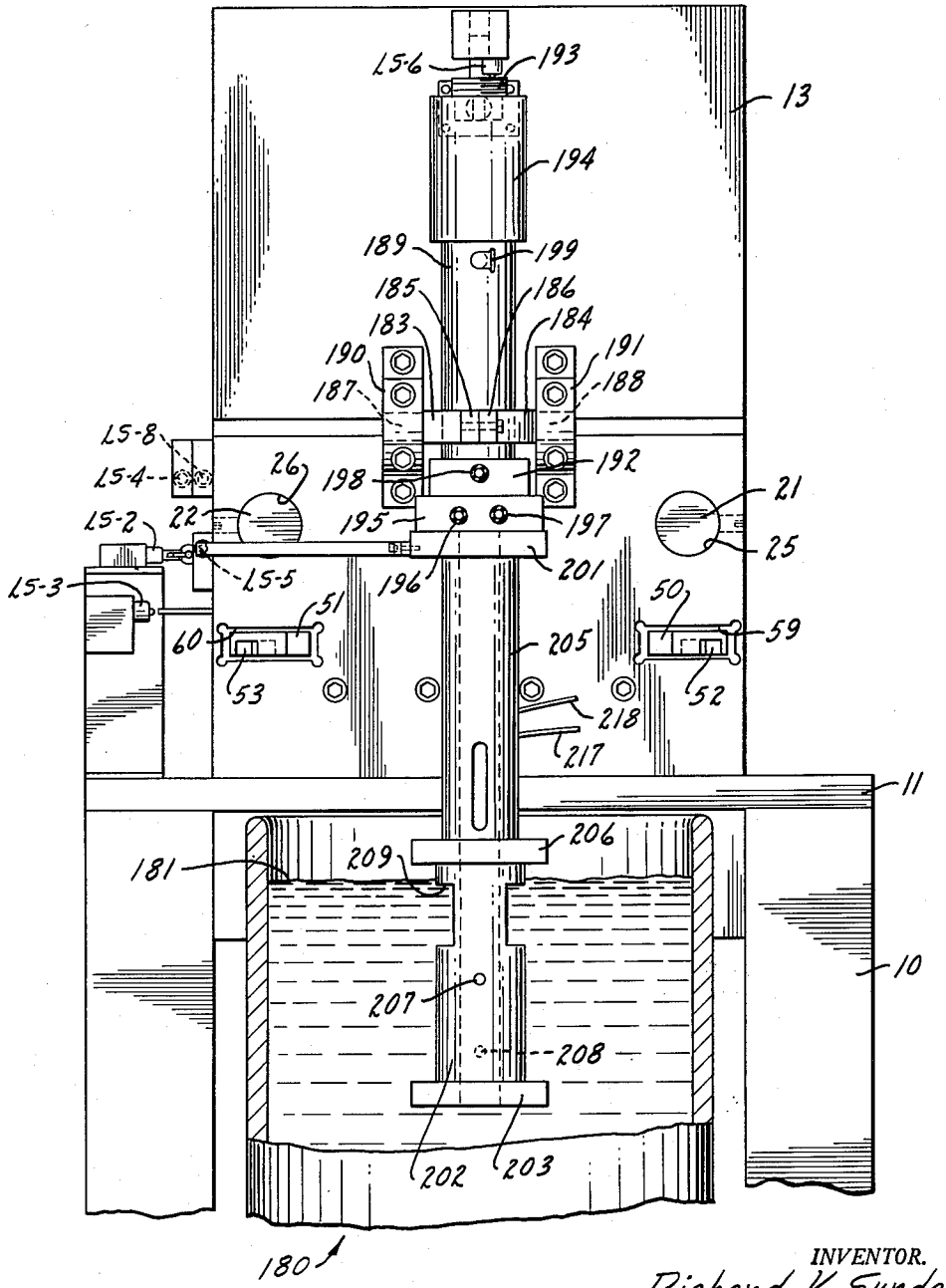


FIG. 3.

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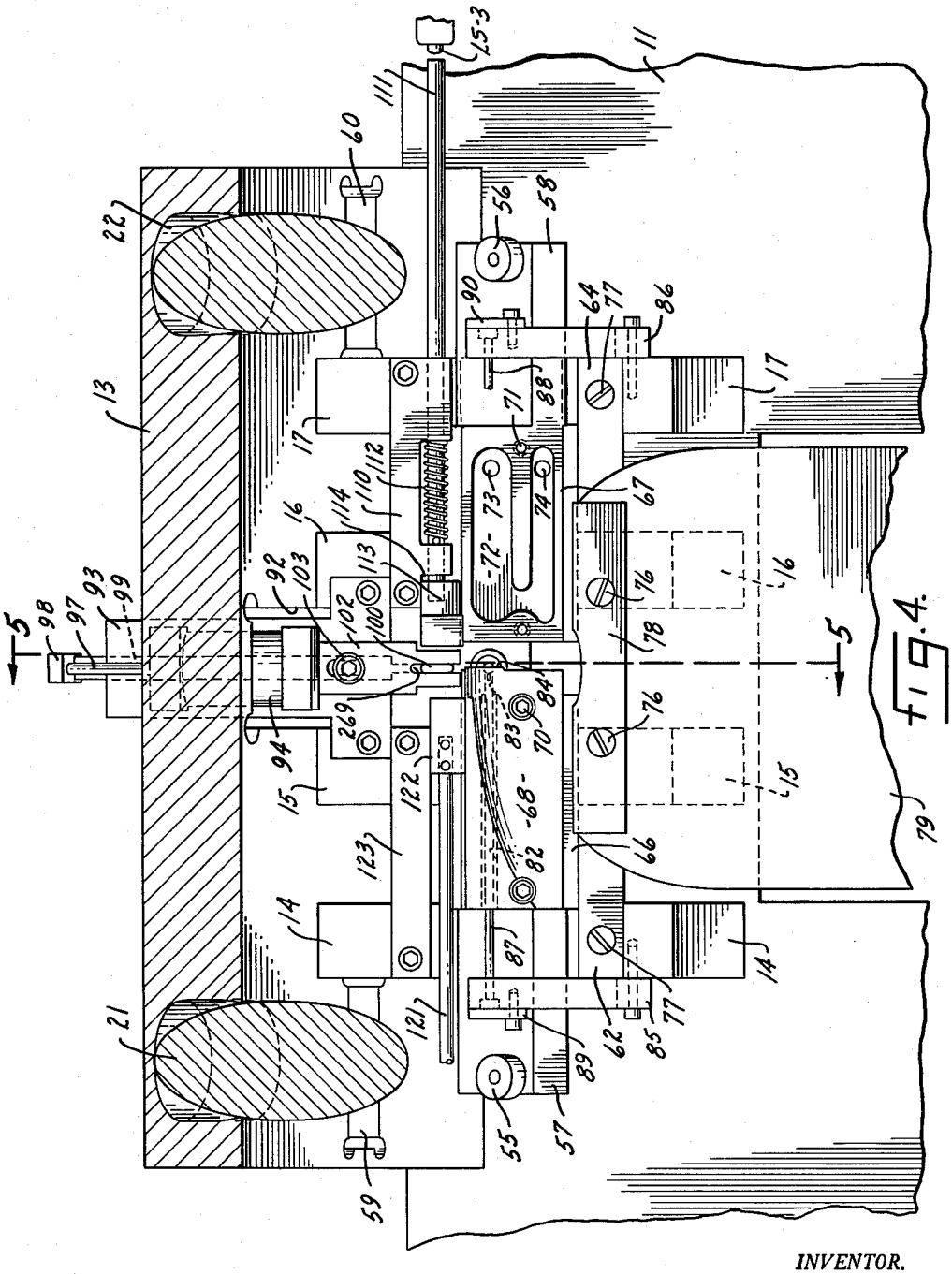


FIG. 4.

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MACHINE AND METHOD FOR AUTOMATICALLY MOLDING WHEEL WEIGHTS AND THE LIKE

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Fig. 5.

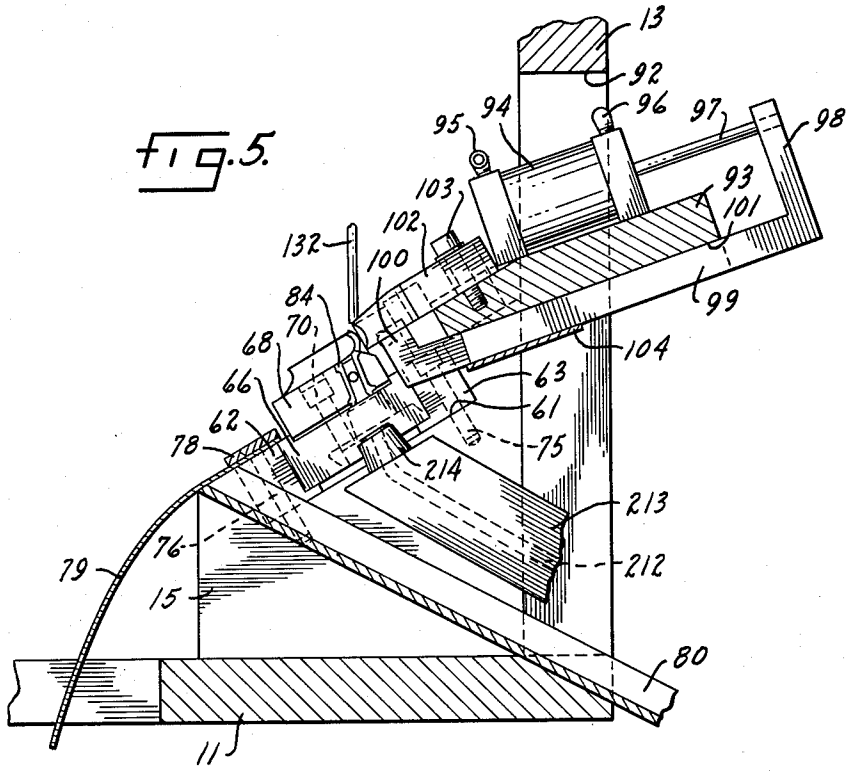
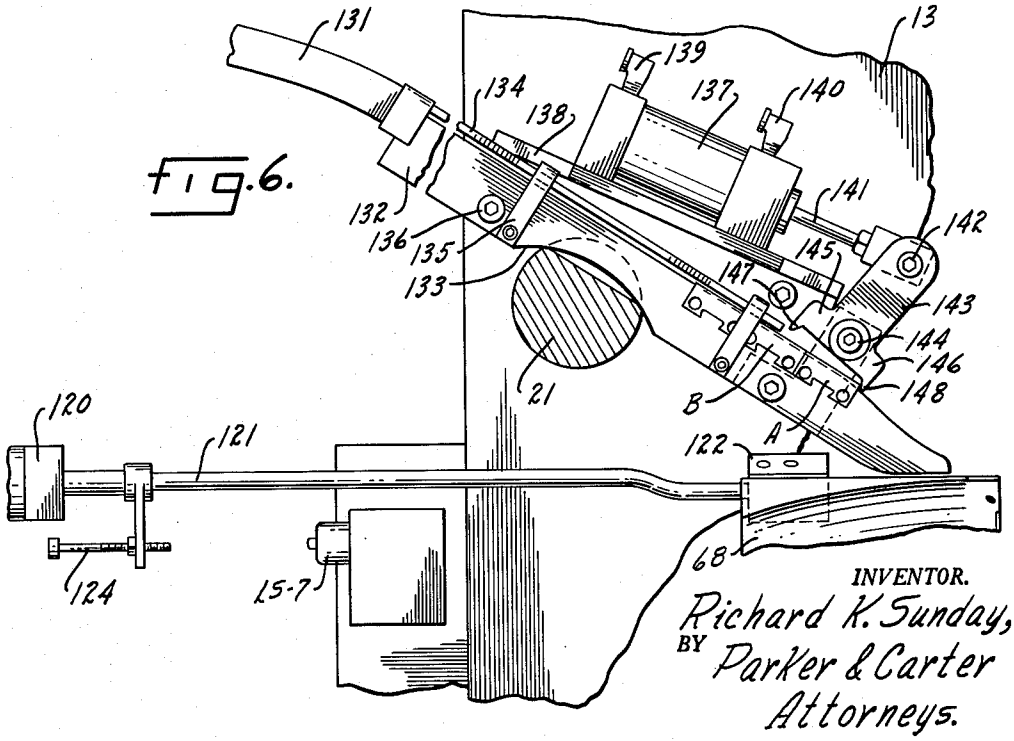


Fig. 6.



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MACHINE AND METHOD FOR AUTOMATICALLY MOLDING WHEEL WEIGHTS AND THE LIKE

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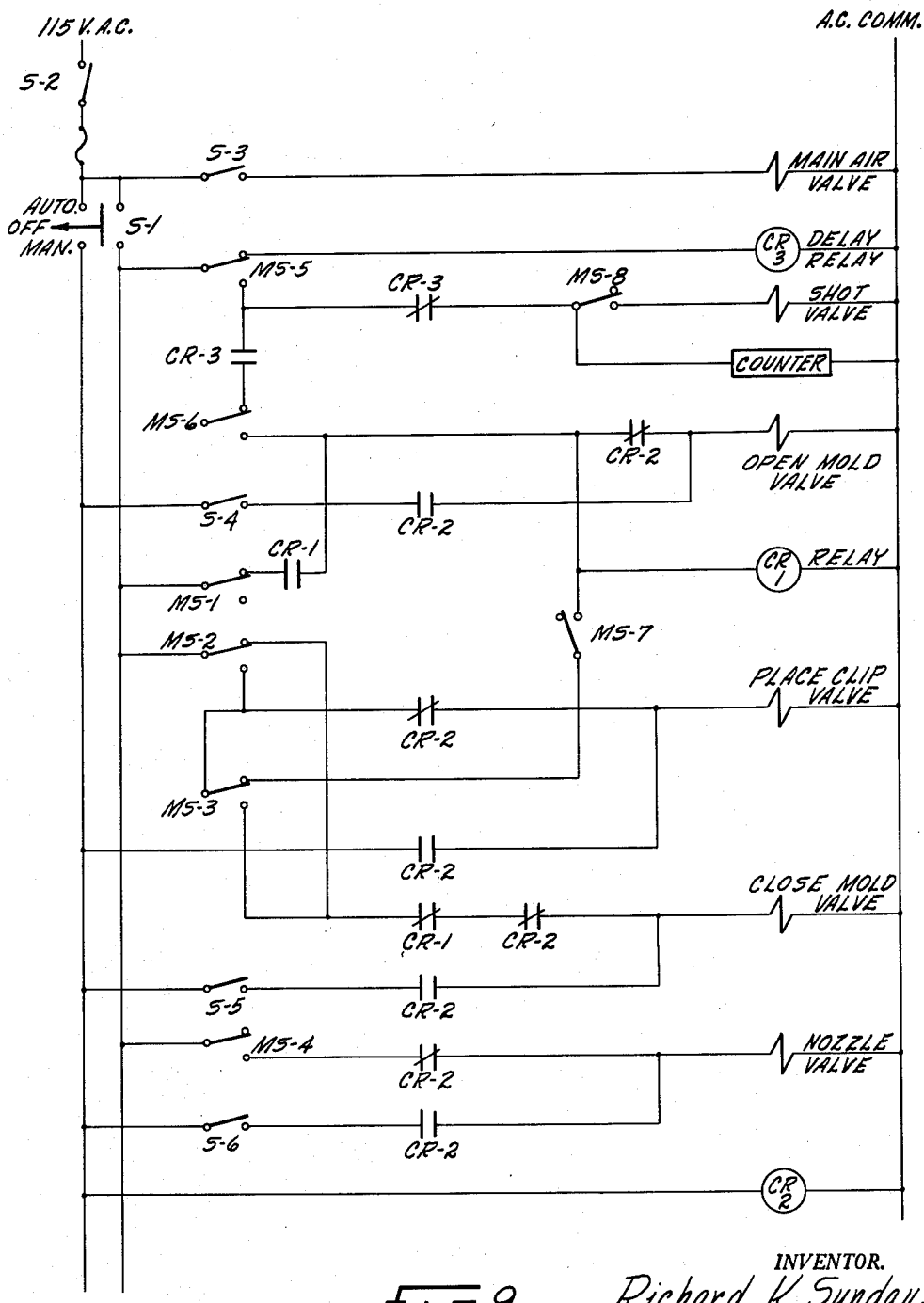


Fig. 9.

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MACHINE AND METHOD FOR AUTOMATICALLY MOLDING WHEEL WEIGHTS AND THE LIKE

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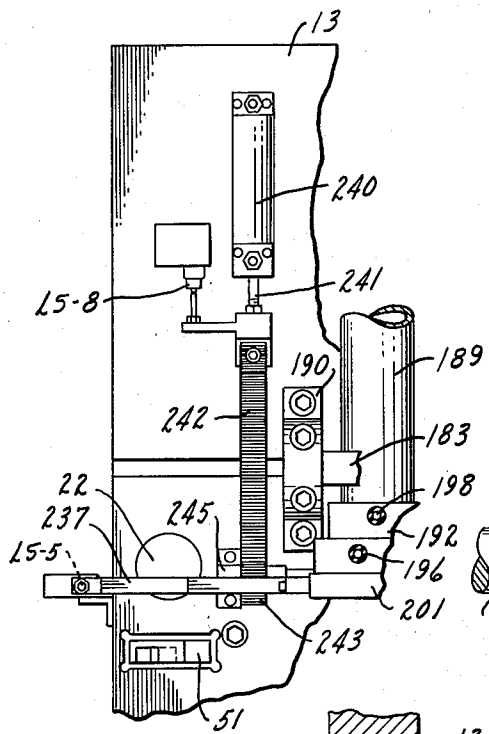


Fig. 10.

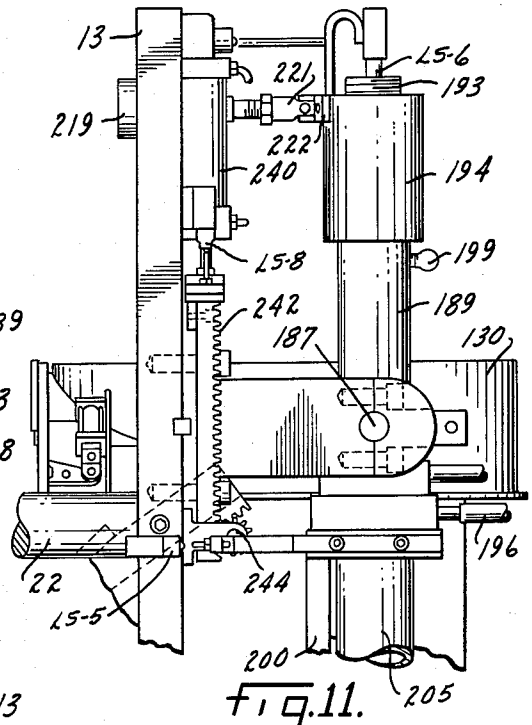


Fig. 11.

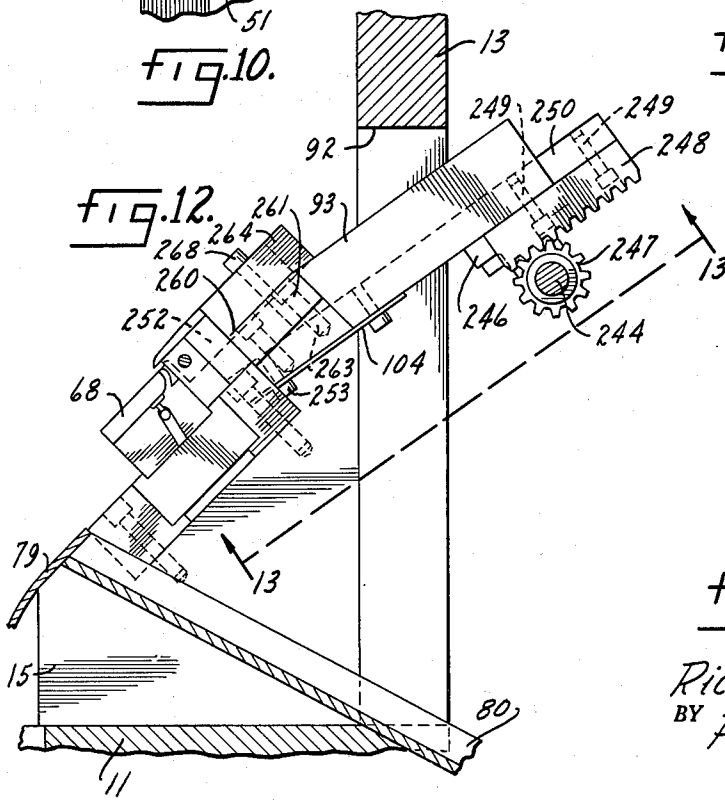


Fig. 12.

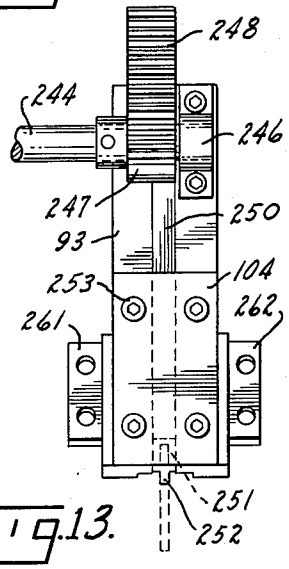


Fig. 13.

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MACHINE AND METHOD FOR AUTOMATICALLY MOLDING WHEEL WEIGHTS AND THE LIKE

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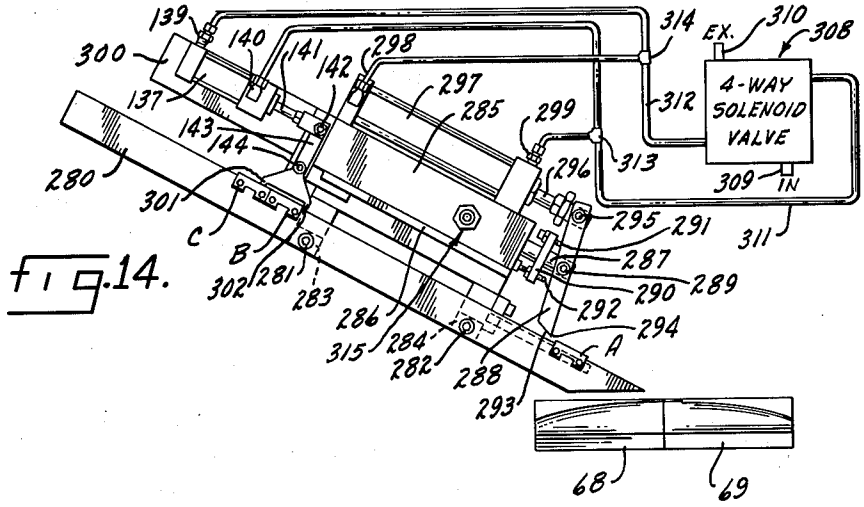


Fig. 14.

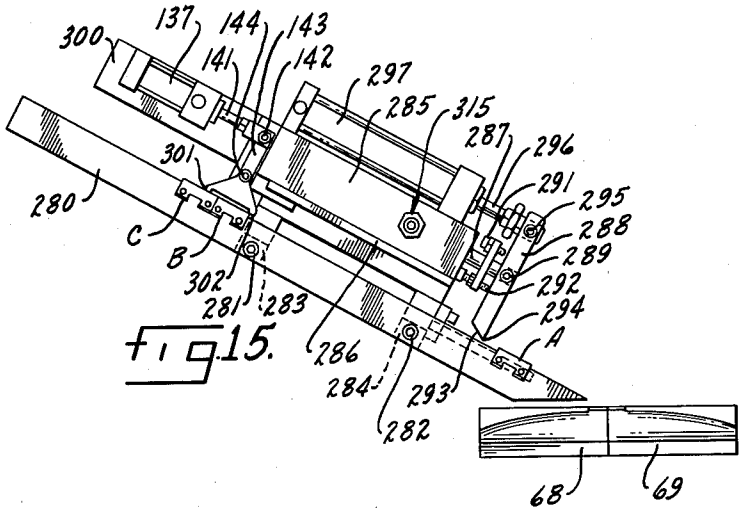


Fig. 15.

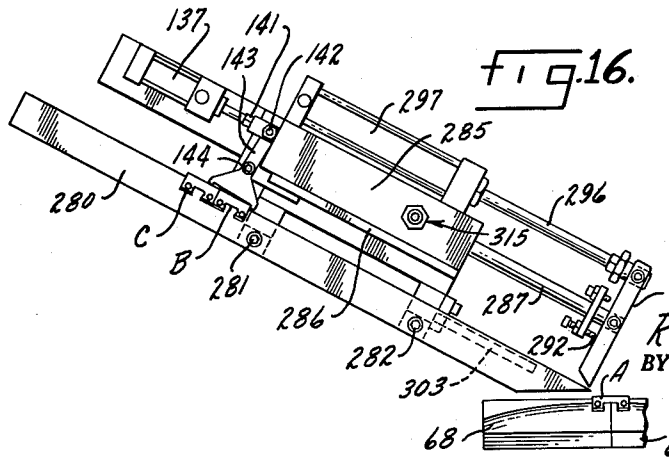


Fig. 16.

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MACHINE AND METHOD FOR AUTOMATICALLY MOLDING WHEEL WEIGHTS AND THE LIKE

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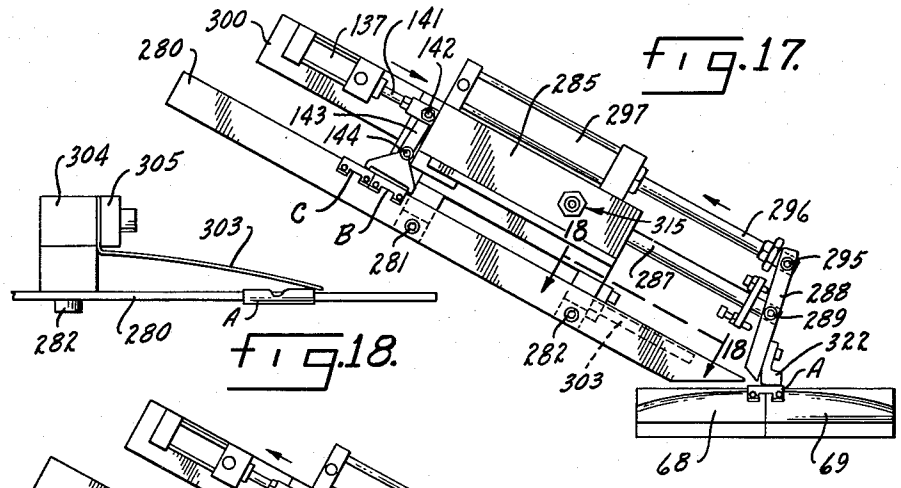


Fig. 17.

Fig. 18.

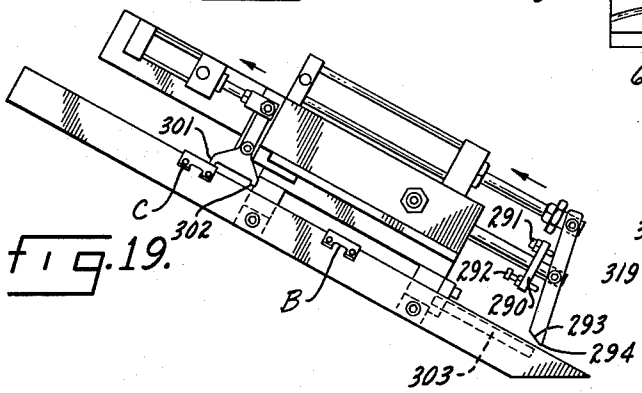


Fig. 19.

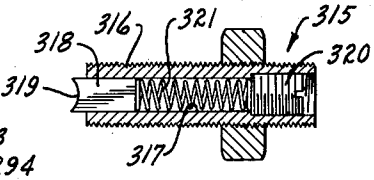


Fig. 22.

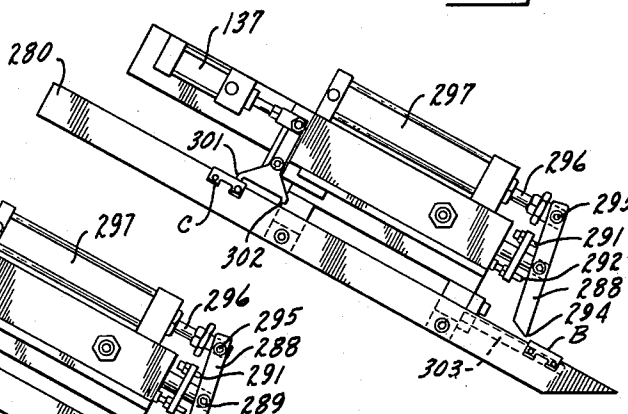


Fig. 20.

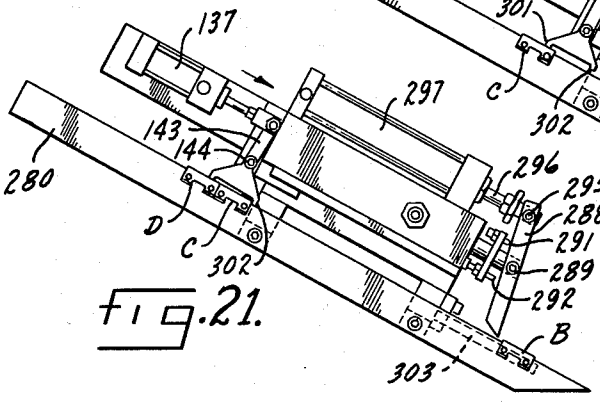


Fig. 21.

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United States Patent Office 3,137,045 Patented June 16, 1964

3,137,045

MACHINE AND METHOD FOR AUTOMATICALLY MOLDING WHEEL WEIGHTS AND THE LIKE

Richard K. Sunday, Kokomo, Ind., assignor to Perfect Equipment Corp., Kokomo, Ind., a corporation of Indiana

Filed Nov. 21, 1960, Ser. No. 70,521
15 Claims. (Cl. 22—150)

This invention relates in general to the art of molding, and specifically to a machine and method for automatically molding small objects such as lead wheel weights and the like.

Throughout the following specification and claims the term "molding" will be used to refer to the process of forming an object from molten metal because in the lead wheel weight art that terminology has become known and accepted. Actually a pair of metal dies are brought into engagement and a charge of molten metal is injected thereinto, which, of course, is generally termed a "casting" operation. For the same reason, the object-forming elements or dies will be referred to as "molds."

Accordingly, a primary object of the invention is to provide a molding machine which may be operated automatically at high rates of production to produce accurate moldings.

Yet another object is to provide a molding machine in which the nozzle mechanism is moved into engagement with the mold at a predetermined time in the molding cycle and is maintained in place only long enough to inject a shot of molten metal into the mold to thereby prevent overheating of the mold.

Another object is to provide a molding machine having means for positioning an insert in the mold cavity and safety means for preventing injection until the insert is properly oriented.

Another object is to provide a molding machine having a movable carriage block which hesitates and then recedes if an insert is not present in the mold cavity, so that no injection can occur unless the mold cavity is completely closed.

Yet another object is to provide a molding machine in which mold-opening is held off until pressure on the molten metal is removed.

Yet another object is to provide a molding machine having a plurality of mold members slidable along stationary ejector pins which comprise a portion of the sprue forming area of the mold cavity, so that upon movement of the mold members along the pins the sprue will be maintained in its as-cast position preparatory to ejection.

Still a further object is to provide a molding machine in which one of the molds forms a track along which an insert is slid into place preparatory to injection.

Yet another object is to provide a molding machine having a final positioning means for moving an insert which has been delivered to the track into position in the mold cavity.

Another object is to provide a molding machine having a sorting mechanism which will automatically direct the moldings into a receiving bin and return the sprues to the pot for remelting or to an overflow bin.

Yet a further object is to provide a molding machine in which the sprue knockout and insert delivery means are mechanically-pneumatically actuated automatically upon retraction of the movable mold carriage block.

Yet a further object is to provide a molding machine in which the molds are inclined at such an angle that an insert such as a wheel clip will always settle into molding position so that dry runs due to popping out of an insert are practically eliminated.

Yet a further object is to provide a molding machine having an air cylinder knockout which is inexpensive, easy to assemble and simple and positive in action.

Yet a further object is to provide a molding machine which can be either automatically or manually operated.

Another object is to provide a method of molding in which operation of the injection mechanism is held off until an insert is properly positioned within the mold cavity.

Yet another object is to provide a method of molding wherein the sprue is severed upon retraction of the mold members and then retained in its as-cast position preparatory to its return to the melting pot.

Still a further object is to provide a method of molding in which overheating of the mold members is prevented by movement of the injecting assembly away from the members at the completion of each shot.

Other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawings wherein by way of illustration and example certain embodiments of the invention are set forth.

The invention is illustrated more or less diagrammatically in the accompanying drawings wherein:

FIGURE 1 is a side view with parts omitted and other parts in section;

FIGURE 2 is a plan view with parts broken away;

FIGURE 3 is a rear view with parts broken away and others omitted;

FIGURE 4 is a view taken substantially along the line 4—4 of FIGURE 1 with parts omitted for clarity;

FIGURE 5 is a view taken substantially along the line 5—5 of FIGURE 4;

FIGURE 6 is an elevational view of a portion of the insert delivering mechanism;

FIGURE 7 is a detail view taken substantially along the line 7—7 of FIGURE 2 illustrating a portion of the escapement mechanism;

FIGURE 8 is a detail view taken substantially along the line 8—8 of FIGURE 2 illustrating a portion of the knockout mechanism;

FIGURE 9 is a wiring diagram illustrating automatic and manual operation of the embodiment of FIGURES 1 through 8;

FIGURE 10 is a rear view with parts broken away and others omitted illustrating another form of knockout mechanism;

FIGURE 11 is a side view with parts in section showing the details of the knockout mechanism illustrated in FIGURE 10;

FIGURE 12 is a view substantially similar to FIGURE 5;

FIGURE 13 is a view taken substantially along the line 13—13 of FIGURE 12;

FIGURES 14 through 21 are a series of views illustrating the operation of an alternate clip feed assembly; and

FIGURE 22 is a sectional view of a drag block assembly used in the clip feed assembly of FIGURES 14 through 21.

This application is a continuation-in-part of application Serial No. 780,718, filed December 16, 1958, now abandoned, for "Machine and Method of Die Casting."

Like reference numerals will be used to indicate like parts throughout the following description.

Referring to FIGURES 1, 2 and 3, the molding machine is there illustrated as mounted on a main frame **10** which supports a base plate **11**. Back plate **13** is located to the rear of the base plate, that is—to the right as viewed in of rear plate support brackets **14**, **15**, **16** and **17** shown best in FIGURES 2 and 4. A front plate **18** is secured near the forward end of the base plate by front plate support brackets **19** and **20**. The plates are connected at any suitable distance by a pair of leader pins **21** and **22** which are received within suitable leader pin holes **23**, **24** and

25, 26 in the front and back plates. The pins are secured to the plates by bolts or other suitable means.

A mold carrying movable carriage block 30 is supported by the leader pins 21 and 22. The carriage block 30 reciprocates between the rearward mold open position of FIGURE 1 to a forward mold closed or molding position. The carriage block is offset as at 31 (FIGURE 2). The lower forward portion of the carriage block is recessed at 32 to receive mold half 33 which is inclined 30 degrees to the horizontal. A recess 34 in the top forward area of offset 31 provides clearance for a bolt 35 which secures mold half 33 to the carriage block.

The carriage block is reciprocated along the leader pins by a cylinder and piston assembly including cylinder 36 having a piston rod 37 threadably connected to the rear face of the carriage block as at 38. A pair of cylinder brackets 39 and 40 secured to the front plate 18 support cylinder 36 by any suitable means, such as the yoke arms 41, 42 having stub shafts 43, 44, respectively, journaled in the brackets. Cylinder 36 is of the type that always has air on one side of the piston.

A pair of cams 50 and 51 having cam tracks or slides 52 and 53, respectively, in their lower surfaces are secured to the carriage block as at 54. The cams move with the carriage block and engage cam guide pins 55 and 56 projecting upwardly from the extensions 57 and 58 of the left and right slides, respectively. The cam slides may be designed to cause the rear die halves (to be described in detail hereinafter) to open and close at any predetermined time and at any predetermined speed. In the construction shown the cam slides will close the dies a substantial time before the front die engages the rear dies. Cams 50 and 51 are received within suitable cam openings 59 and 60 in the back plate 13.

The rear plate support brackets 14, 15, 16 and 17 are recessed at 61 to receive anchor blocks 62, 63, 64 and 65 which form a slideway for slides 66, 67. A pair of molds or back jaws 68 and 69 are secured to the slides, as shown best in FIGURES 4 and 5.

Both back jaws have been shown in FIGURE 2 but right back jaw 69 has been omitted from FIGURE 4. The back jaws are secured to the slides by bolts 70 received in aligned aperture 71 in the jaws and slides.

Each slide also serves as a cooling block for its associated back jaw. A cooling cavity 72 having inlet and outlet ports 73, 74, which in turn are connected to suitable piping shown best in FIGURE 1, cause circulation of cooling fluid through the dies at all times. The tortuous water pathway insures good heat transference between the rear face of the back jaws and the water in the slides.

Anchor blocks 63, 65 are secured to the back plate support brackets by screws 75 and anchor blocks 62, 64 are secured to the back plate support brackets by screws 76, 77. Screws 76 pass through a rectangular clamping plate 78 which clamps an apron 79 to the top forward portion of brackets 15 and 16. As can best be seen in FIGURE 5, the upper edge of clamping plate 78 and apron 79 overlie the bottom edge of slide 66 to prevent vertical displacement of the slide. A return chute 80 is suitably secured to back plate support brackets 15 and 16 and rest in snug engagement against the underside of apron 79.

Each of the back jaws 68 and 69 are formed with a longitudinal passage extending its length near its upper edge. The passage consists of a longer, large diameter portion 82 which terminates in a smaller diameter portion 83 opening into the surface 84 which abuts a corresponding surface on the other jaw when the jaws are in molding engagement. A pair of L-shaped screw pin holding arms 85, 86 are bolted to the outside surfaces of brackets 14 and 17. Each arm is apertured at its upper terminal end to receive a sprue pin 87, 88 which passes through the longitudinal passage 82, 83 in each of the back jaws. Sprue pin retainer plates 89, 90 are bolted to the arms 85, 86 and hold the sprue pins in a fixed position at all times. It will thus be apparent that when back jaws 68, 69 slide toward and way from one another, they will slide along sprue pins 87, 88 which will remain fixed with respect to the remainder of the machine. Thus when the back jaws move outwardly from the closed molding position of FIGURE 4 to the open ejecting position of FIGURE 2, the sprue pins will support the severed sprue preparatory to its knockout by suitable mechanism to be described hereinafter.

The inner surfaces of each of back plate support brackets 15 and 16 are aligned with a rectangular opening 92 cut in the midportion of the back plate 13. An inverted T-shaped plate 93 is bolted or otherwise suitably secured to the outer ends of the brackets 15 and 16. The plate supports an ejector or knockout mechanism illustrated best in FIGURES 4 and 5.

The ejector mechanism consists essentially of a small air cylinder 94 having air connections 95, 96. A reciprocal piston rod 97 extends outwardly, upwardly beyond the rear of back plate 13 and is secured to the upwardly extending portion 98 of a knockout arm 99. The lower end of the arm 99 terminates in another upwardly projecting portion 100 which can, for convenience, be termed a knockout hammer. Knockout arm 99 slides along a slideway 101 formed in the bottom of the T-shaped block knockout slide piece 93. The knockout hammer 100 is received in a slot formed at the lower end of clip placement guide 102. The placement guide is suitably secured to the upper surface of the T-shaped base plate 93 by any suitable securing means, such as bolt 103. An ejector cover plate 104 is fastened to the bottom of the block knockout slide piece 93 by bolts. The cover plate forms a support for the knockout arm 99 as it slides back and forth in response to actuation of the knockout cylinder 94. As can be seen best in FIGURE 5, the lower ends of the parallel arms forming the slot within which the knockout hammer 100 reciprocates are curved to conform to the curved contour of a mold insert, such as a clip.

Referring to FIGURE 4, push rod anchor block 110 is secured to the upper surfaces of brackets 16 and 17 in abutting engagement with the lower edge of T-shaped base plate 93. The anchor block is apertured to receive a limit switch push rod 111 which projects beyond the edge of base plate 11 and is aligned with a limit switch LS–3. A portion of the interior of block 110 has been cut away to form a bed for a spring 112, whose left end is attached to the push rod. The spring is biased to return the rod to the extended position shown in FIGURE 4 prior to the reception of a clip or other insert in the molding cavity. The left end of push rod 111 is received in a push head 113 which, when biased to the extended position of FIGURE 4, is separated from the abutting surface of the guide block 110 by a clearance 114. The clearance between push head 113 and anchor block 110 is such that when the push head is forced to the right and the spring depressed, the right end of push rod 111 will contact limit switch LS–3.

A clip placement rod cylinder 120, having an outwardly extending clip placement rod 121 terminating in a push head 122, is located to the left and above base plate 11. Rod 121 is so positioned as to slide along the top of the left back jaw 68 and engage a clip or other insert which has been deposited on the top of the jaw from the clip escapement mechanism, which will be described in detail hereinafter. The force exerted by the clip placement rod 121 against the insert is transmitted to the push head 113 and overcomes the retaining force of spring 112 to position the insert in the mold cavity. Placement of the insert in the mold cavity simultaneously moves push rod 111 to the right and into contact with limit switch LS–3. Push head 122 is guided in a straight path by a guide block 123 secured to the upper side of brackets 14 and 15.

As best seen in FIGURE 6, movements of the clip placement rod 121 to the right carries limit switch actuator 124 toward engagement with limit switch LS–7.

One mechanism for feeding clips or inserts down to the molding cavity is shown best in FIGURES 1, 2 and 6. For purposes of illustration it will be assumed that the machine is set up to produce lead wheel weights which have a clip on their upper side for securement to a wheel rim.

A source of clips is indicated at 130. In this instance a syntron elevator arrangement has been outlined, but it will be understood that any suitable mechanism which lines up properly positioned clips preparatory to final placement in the mold cavity may be utilized. A clip slide 131 extends from the clip source 130 down to a point adjacent the upper left edge or back jaw 68 when it is in a closed molding position. The slide is open for the first portion of its length and then terminates in a delivery portion 132, whose underside has been cut away as at 133 to provide clearance for the leader pin 21. A retaining piece 134 overlies the lower portion 132 of the clip slide and is secured thereto by any suitable means, such as hangers 135. In this instance the lower portion 132 of the clip slide has been bolted to the back plate 13, as at 136, but it will be understood that the support for the clip slide may be placed in any convenient location.

An escapement mechanism for feeding one clip at a time to the molding cavity is illustrated best in FIGURE 6. The mechanism consists of air cylinder 137 bolted to a supporting plate 138, which in turn is secured to back plate 13. Suitable air inlet and outlet connections 139, 140 reciprocate rod 141, which is pivotally connected as at 142 to an escapement arm 143. The escapement arm in turn is pivotally connected as at 144 to back plate 13. Escapement arm 143 terminates in radial arm portions 145, 146. The radial arm portions extend outwardly from pivot point 144 and carry a pair of restraining teeth 147, 148. The stroke of piston rod 141 and the size of teeth 147 and 148 are so correlated that when the rod is in the extended position of FIGURE 6, right tooth 148 will just make engagement with the upper edge of clip slide piece 132, and left tooth 147 will be elevated a substantial distance above the clip slide piece.

Mechanism for actuating the escapement arm 143 and knockout hammer 100 is illustrated in FIGURES 7 and 8.

In FIGURE 7 the escapement control valve is indicated at 150. Essentially it is a three-way valve having an air intake 151 and air outlets 152, 153 connected by suitable lines to the ends of the escapement air cylinder 137. The valve includes a reciprocating plunger 154 to which a roller 155 is rotatably secured at its upper end. The plunger is depressed by J-cam 156 rigidly bolted as at 157 to an L-shaped mounting bracket 158 which in turn is bolted to the carriage block 30 at 159, 160. The horizontal section of the mounting bracket is slotted as at 161 to provide position adjustment for the J-cam. In the mold open position of FIGURE 7 the plunger 155 has been depressed by the roller contacting surface 162 of the J-cam and hydraulic fluid has been diverted from air intake 151 through valve 150 to connect 140 of escapement air cylinder 137. In this condition the plunger 141 and escapement arm 143 will be in a position opposite to that shown in FIGURE 6.

In FIGURE 8 the knockout cylinder control valve is indicated at 164. The control valve is similar to escapement control valve 150 and includes air inlet 151 and outlets 152, 153. Plunger 154 alternately connects ports 152 and 153 with the air connections 95, 96 of the knockout cylinder 94.

The mechanism includes a swinging arm 165 which is pivotally connected, as at 166, to a mounting bracket 167 which in turn is secured to the rear of carriage block 30 by mounting screws 168, 169. Actuating arm 165 is set within a recess 170 formed in the lower end of bracket 167 and is free to swing clockwise. A set screw 171 threaded through offset portion 172 of the lower end of the mounting bracket is aligned with the swinging arm and forms an abutment which prevents clockwise movement of the arm past the position shown in the figure.

When the carriage block moves to the left, or in a mold-opening direction, arm 165 strikes roller 155 on the top of plunger 154 and depresses the plunger to a position in which air momentarily passes through valve 164 from inlet 151 to air connection 96 of knockout cylinder 94. Set screw 171 prevents the swinging arm from riding up and over roller 155.

When the carriage block moves to the right, or in a mold-closing direction, arm 165 rides up and over the plunger without depressing it because it is urged in a counterclockwise direction only by a light spring 174. The purpose of spring 174 is merely to return the swinging arm to a roughly vertical position so that it will strike roller 155 on the next mold-opening movement of the carriage block. It is too light to cause plunger 154 to be depressed on the mold-closing movement of the carriage block.

A pot and pump injection apparatus is positioned to the rear of the back plate 13 as best shown in FIGURES 1, 2 and 3.

The pot is indicated generally at 180 and contains a quantity of lead or other casting material whose level is indicated at 181. It will be understood that the pot may be electrically or gas heated in order to maintain the casting material at a predetermined temperature. Since the details of the pot are conventional they have not been further illustrated. In some instances, it may be advantageous to position a coarse screen near the top of the body of molten casting material.

An injection pump, indicated generally at 182, is rotatably secured to the back plate by a pair of yoke arms 183 and 184 (FIGURE 3) having ears 185, 186 and trunnion shafts 187 and 188 which are connected to and encircle cylinder 189 of the pump. The trunnion shafts are received within the apertures in trunnion brackets 190 and 191 to permit the pump to rotate about the trunnion shafts as a pivot. The amount of swing of the pump need be only a fraction of an inch and in fact movement on the order of 5/8" to 1/2" is quite adequate.

The pump consists of injection air cylinder 189 mounted on a suitable spacer base 192. An injection plunger 193 (only the upper end of which is shown in the drawings) is received in a switch mounting sleeve 194 which in turn is secured to the air cylinder 189. The spacer base is mounted on a water jacket 195 which cools the upper portion of the pump structure, and suitable water lines 196, 197 circulate cooling fluid through the water jacket.

Air lines 198 and 199 actuate the pump piston to inject a charge of molten metal into the mold cavity.

A support post or any other suitable structural member 200 (see FIGURE 1) extends downwardly from the pump switch lever mounting block 201 secured to the water jacket. At the bottom of the post is a pump housing 202 which is closed by a bottom plate 203, best seen in FIGURE 3. The pump plunger 193 extends through a spacer sleeve 205 and a spacer block 206 positioned between the sleeve and the top of the pump housing. An inlet hole 207 disposed well below the level of the lead in the pot and an outlet hole 208 near the bottom of the pump housing serve as an inlet and outlet for the molten metal. The pump housing may be recessed as at 209 for ease in handling.

An injection channel 210 is formed in the spacer block 206 and mates with a similar channel 211 in the support post which is aligned with delivery passage 212 in the nozzle 213. The nozzle terminates in a nozzle tip 214, shown best in FIGURE 5, which may be formed integrally with the nozzle or separately. It will be understood that during operation jets of flame may be directed at the nozzle, or the nozzle may be electrically heated to prevent freezing of the fluid metal in the delivery pas-

sage. In FIGURE 1, a resistance heater 215 is shown in a bore 216 which extends a substantial distance along the delivery passage. Suitable electrical connections 217 and 218 are shown in FIGURE 3.

Air cylinder assembly 219 rotates the pump around trunnion shafts 187 and 188. A piston rod 220 is connected to a clevis 221 which in turn is pivotally connected to a connector clevis 222 secured to the stop of the switch mounting sleeve 194.

Any suitable pneumatic, electrical or mechanical operating means may be utilized to run the machine through a cycle or a plurality of cycles. In the specific embodiment described, a plurality of limit switches operated by push rods carried by moving parts of the machine initiate subsequent operations of the cycle in response to movement of the machine elements in a predetermined sequence. Although any combination of electrically and mechanically operated switches may be used, the machine may be made completely automatic with as few as seven electrically and two mechanically operated switches.

Limit switch LS–1 is mounted on the top right-hand side of front plate 18, as shown best in FIGURE 1. It is actuated by a push rod 230 mounted by means of a suitable supporting bracket on the top right-hand rear edge of carriage block 30. This switch controls a valve which admits air to one end or the other of carriage block cylinder 36 which moves the carriage block 30 and front mold member 33 into and out of molding engagement with the back jaws 68, 69. Push rod 230 is so adjusted as to actuate LS–1 at the end of the return stroke of carriage block 30 so that the operation is continuous so long as everything is proceeding normally.

Limit switch LS–2 is mounted on the right side of base plate 11, as shown best in FIGURE 2, and is operated by a push rod 232 which is mounted by a suitable bracket to the right side of carriage block 30. LS–2 is a hesitation switch. It shuts off air to the mold-closing cylinder 36 so that if an insert is not properly positioned in the mold, the cycle of operation will be interrupted and air admitted to the forward end of cylinder 36 after a predetermined time. Admission of air to the forward end of cylinder 36 causes the carriage block to return to the position of FIGURE 1. This switch also actuates the clip place arm 121 by operating an air valve which admits air to the left end of cylinder 120.

Limit switch LS–3 is also located on the right side of the base plate 11, as best shown in FIGURES 2 and 3. This switch through its associate air valve, when actuated by push rod 111, readmits air to the left end of mold-closing cylinder 36 to cause the carriage block and mold member 33 to come into molding engagement with the back jaws 68 and 69. LS–3 is only actuated if an insert such as a clip for a lead wheel weight is properly positioned in the molding cavity.

Limit switch LS–4 is mounted on the right edge of back plate 13, as best seen in FIGURES 2 and 3. This limit switch, which is activated at the end of the movement of the carriage block toward the molding position, swivels the pump and nozzle assembly into place preparatory to delivering a shot of molten metal into the mold cavity. The switch is actuated by a push rod 234 mounted by means of a suitable bracket to the carriage block, as best seen in FIGURES 1 and 2, and is operated when the mold members are in engagement. Actuation of this switch operates an air valve which admits air to the left end of cylinder 219, which causes the pump 182 to rotate about trunnions 187 and 188 until the nozzle tip 214 comes into molding engagement with the back edge of the back jaws.

Limit switch LS–5 is located on the right edge of back plate 13 just below limit switch 4, as best seen in FIGURE 3. LS–5 is actuated by a push rod 236 carried by a pump switch lever 237 which in turn is secured to the pump switch lever mounting block 201 and moves with it. Actuation of this switch admits air through its associated valve and to the upper end of injection cylinder 189, through inlet connection 199. As the plunger moves down a shot of molten metal is injected into the mold cavity. LS–5 also controls a timer which governs the time that the pump plunger stays down. When the timer times out, the pump plunger moves upwardly while the pump remains in a casting position.

The pump will not operate unless LS–5 is actuated so there is no danger that the plunger will inject molten metal into the molding area unless the molds are in engagement.

Limit switch LS–6 is mounted on the top of pump switch mounting sleeve 194 and is actuated by the "up" return of plunger 193. Actuation of LS–6 admits air to the forward end of mold-closing cylinder 36 which causes the carriage block to move to a mold-opening direction. At the end of movement of the carriage block LS–1 is actuated and the cycle begins again. Carriage block 30 will not move rearwardly, however, until LS–6 is actuated, so that there is no pump pressure on the lead in the pot when the nozzle breaks away from the mold. This switch also controls the return of the pump to the disengaged position of FIGURE 1.

Limit switch LS–7 is mounted on the left edge of back plate 13, as best seen in FIGURE 6. This switch is a safety switch and will never operate unless a clip is not properly positioned in the mold cavity. In other words, if a clip is properly located in the mold cavity, push rod 124 will never make contact with LS–7 because push head 122 can only advance to a position a slight distance to the right of the position of FIGURE 4. When in this position push rod 124 remains out of contact with LS–7. If no clip is in place, however, push rod 121 advances further to the right until push rod 124 comes into contact with LS–7. Actuation of LS–7 admits air by a suitable air valve to the front end of mold-closing cylinder 36 which causes the carriage block, which is in the hesitation position, to return to the position of FIGURE 1 without completing the cycle. Should the carriage block hesitate and then recede because a clip was not properly positioned in the mold cavity, limit switch LS–1 would again be actuated and the machine would start another cycle. The mere fact that a clip is not properly positioned, therefore, will not cause the machine to shut down; it will merely stop that particular cycle and start over again.

Limit switch LS–8 is mounted on the right edge of back plate 13, as shown in FIGURES 1 and 3. This switch is merely an electrical counter. It is actuated by push rod 239. Since it is only actuated when the molds are in molding engagement, it will make an accurate record of the number of shots. It will be understood, however, that this switch could be located at many other locations in the machine, and in fact it could be entirely replaced by a mechanical counter.

Although a mechanical counter has been illustrated, it will be understood that electric, pneumatic, or any other suitable type may be utilized. Likewise, it may be mounted on any suitable portion of the machine, including the pump and the relative positions of the push rod and counter may be reversed.

Although a plurality of limit switches actuated by various moving components of the machine has been shown, it will be understood that other limit switches located in different positions and actuated by different movements may be used to accomplish the same purpose.

A wiring diagram showing the relationship between the limit switches and air cylinders which actuate moving parts of the machine is illustrated in FIGURE 9. This figure is a simplified circuit utilizable in the embodiment of FIGURES 1 thru 8.

The wiring diagram illustrates a mode of manually and automatically operating the machine. There will be understood the fact that in normal production the automatic system will be used but it may be very advan-

tageous at times to operate the machine manually, particularly when repairing or inspecting the machine. In the diagram the symbols S followed by a reference numeral indicate manually depressible switches located in a control box at any suitable point on the machine. It will also be understood that a source of air must be available to the machine. In one embodiment, air under pressure is brought in adjacent the machine through a main header, and a series of bleeder valves which regulate the pressure to any given adjustable value, will supply air to the limit switch actuated by air valves located between the appropriate air cylinder and air source.

To operate the machine, manual-automatic switch S–1 is turned to the desired position, main power switch S–2 must be depressed to supply power to the machine and main air valve switch S–3 must be depressed to admit air to the main air header valve which in turn feeds it via the above described regulating valves to the various components of the machine. Switches S–4, S–5 and S–6 are used to open the mold, close the mold, and tilt the pump, respectively, during manual operation. During automatic operation, these last mentioned switches are not utilized.

The symbols MS followed by a reference numeral correspond to a similarly numbered limit switch; in effect these are micro-switches. The symbols CR followed by a reference number enclosed in a circle represent a control relay. The contacts controlled by each relay are indicated by the same symbol and number without the circle. The contacts are shown in a deenergized condition, or, in other words, as they come out of the box. The symbols along the right edge of the diagram represent the coils of solenoid-operated valves which control the operation of the air cylinders by air valves which in turn actuate movement of the various components of the machine.

Although an electrical system has been illustrated, it will be understood that a hydraulic or mechanical linkage actuating system could likewise be utilized to accomplish the same purposes described in this specification.

The operation of the electric circuit will not be further described in detail because its functioning will become apparent upon a reading of the use and operation of the machine in conjunction with a study of the diagram.

Another form of ejector mechanism is illustrated in FIGURES 10, 11, 12 and 13. In this embodiment the air cylinder 94 of the embodiment of FIGURES 1 thru 6 has been replaced in effect by a rack and pinion arrangement, as will become apparent from the following description of the mechanism.

The ejector mechanism is secured to the rear of the back plate 13. The mechanism includes an air cylinder 240 best shown in FIGURE 10, having a downwardly extending piston rod 241 secured to a long gear rack 242. The gear rack in turn is secured to a pinion gear 243 carried on one end of a gear drive shaft 244. The shaft 244 is rotatably journaled in a gear mounting bracket 245, 246 shown only in FIGURES 11 and 13. A second pinion gear 247 shown only in FIGURES 12 and 13 is secured to the other end of the gear drive shaft and cooperates with a stub rack 248 to operate the knockout hammer.

As best seen in FIGURES 12 and 13, the short stub gear rack 248 is suitably connected by bolts 249 to a knockout hammer 250 which is received in a slide way formed in the bottom of the block knockout slide piece 93. The hammer has a lower, vertically upstanding end portion 251 shown best in FIGURES 12 and 13 which terminates in an ejector knockout head 252. The end portion and knockout head extend upwardly in the slot formed in the end of the block knockout slide 93. The ejector cover plate 104 is fastened to the bottom of the block knockout slide piece 93 by bolts 253. The cover plate 104 and gear drive shaft 244 form a two point support for the knockout hammer 250.

The top of the knockout slide piece 93 is canted at 260 and has a pair of outwardly extending ears 261 and 262, seen best in FIGURE 13, which are apertured to receive bolts 263 which secure the knockout slide piece to rear plate support blocks 15 and 16. A clip guide 264 having a rear slot through which a hold down and adjusting bolt 268 fits positions the guide along the canted surface of the knockout slide. The bottom end of the clip guide is formed with a slot 269 (FIGURE 4) which receives the knockout head 252 of the knockout hammer 250.

Another form of clip feed assembly is illustrated in FIGURES 14 through 22. In this embodiment the air cylinder 137 of FIGURE 6 has been moved upwardly along the clip slide and a clip feed arm assembly added to positively push a clip into place, as will become apparent from the following description.

Referring first to FIGURE 14, a clip slide is indicated at 280. The lower end of the slide overlies a pair of back jaws 68, 69 which in FIGURES 14 through 17 are illustrated in the closed position. The clip slide is bolted to the back plate by bolts 281, 282 and supporting studs 283, 284.

A guide block 285 is bolted to a support plate 286 which in turn is bolted to the back plate by any suitable means. The guide block is bored to receive a stablizer rod 287 which slides back and forth therein. A feed arm 288 is pivotally connected to the lower end of the stabilizer rod at 289. A stop block 290 is welded or otherwise suitably secured to the stabilizer rod just to the left of pivot 289. A pair of adjusting screws 291, 292 are threaded through the stop block above and below the stabilizer rod to provide adjustable abutments for the feed arm. The lower end of feed arm 288 is cut away as at 293. The rod is so proportioned that when it is perpendicular to the upper surface of clip slide 280 its tip 294 will be very closely spaced to the top of the slide. This is best seen in FIGURES 15 and 16.

The upper end of feed arm 288 is pivotally connected as at 295 to a piston rod 296 which reciprocates in feed arm push cylinder 297. Piston rod 296 is a floating piston. Combination air inlets and outlets 298 and 299 open into the ends of the cylinder to alternately admit and exhaust air behind the floating piston.

Air cylinder 137 is located rearwardly of guide block 285. The cylinder is bolted or otherwise suitably secured to air cylinder support plate 300. It may be convenient to extend the air cylinder support plate downwardly until its lower end is flush with the lower end of guide block 285 but this is primarily a matter of choice.

Rod 141 which extends outwardly from a floating piston is reciprocated by air admitted through combination inlet and outlet connections 139 and 140. The outer end of rod 141 is pivotally connected as at 142 to an escapement arm 143. The escapement arm is pivoted as at 144 to an extension of plate 300. The lower end of the escapement or rocker arm terminates in a pair of downwardly extending teeth or dogs 301, 302 which are generally radially located with respect to pivot point 144.

Three clips are indicated at A, B, and C. In operation it will be understood that clips will be backed up behind clip C right up to a source of supply but for purposes of description three clips only are shown.

In FIGURE 14 clip A is held in its indicated position by a light leaf spring 303, shown in top plan view in FIGURE 18. The terminal end of the spring rests against the back side of the clip slide and the spring tension is just sufficient to prevent a clip from sliding past it. The rear end of spring 303 is clamped between a pair of blocks 304, 305 in any convenient manner.

Clip B is held in place by right tooth 302 of escapement arm 143. In FIGURES 14, 15, 16 and 17 piston rod 141 is extended outwardly which in turn rocks escapement arm 143 about pivot arm 144 so that dog

302 prevents movement of clip B down the slide. Dog 301 is just out of contact with clip C.

In FIGURE 14 a four-way solenoid valve which correlates the operation of air cylinder 137 and 297 is indicated generally at 308. An air inlet is indicated at 309 and an exhaust at 310. Suitable electric connections correlate the operation of the valve with the operation of the machine in much the same manner as was described in connection with the embodiment of FIGURE 7. It will be understood that when using this arrangement the J-cam of FIGURE 7 is eliminated. Valve 308 may be run for example off limit switches 2 and 7. Air lines 311 and 312 lead from the valve to T's 313 and 314 respectively which in turn admit air to inlet and outlet connections 139, 140, 298 and 299.

In operation, the parts start from the position shown in FIGURE 14. In this position the machine has completed a cycle and ejected the preceding wheel weight. In this instance the back jaws 68 and 69 are shown closed for purposes of illustration.

In the position of FIGURE 14 piston rod 296 is in its extreme retracted position. Stabilizer rod 287 is likewise in its extreme retracted position. The position of stabilizer rod 287 is determined by adjusting screw 292. As clearly seen in FIGURES 14 and 15 the head of the screw abuts the right end of guide block 285. Feed arm 288 is canted rearwardly with respect to a line perpendicular to the upper surface of clip slide 280. The amount of rearward cant of the feed arm and also the retracted position of piston rod 296 is governed by upper adjustment screw 291 as best seen in FIGURE 14.

When air is admitted to connection 298, rod 296 begins to move downwardly as seen in FIGURE 15. Stabilizer rod 287 however will not move until feed arm 288 contacts lower adjustment screw 292. Movement of stabilizer rod 287 is restrained by the drag block assembly indicated generally at 315 and illustrated in FIGURE 22. The drag block assembly consists of a shaft 316 which is threaded on its exterior. A tapped hole 317 extends the length of the shaft, and the outer or righthand end of the holes is tapped. A brass bearing block 318 whose outer bearing end 319 is contoured to engage the stabilizer rod 287 is positioned at the inner or left end of the assembly. A set screw 320 exerts pressure on spring 321 compressed between the bearing block and set screw. By threading the set screw in and out the pressure on bearing block 318 and consequently the resistance to sliding movement of stabilizer rod 287 can be adjusted.

Referring again to FIGURES 15 and 16 it will be apparent that the bearing pressure on block 318 is sufficient to prevent sliding movement of rod 287 until feed arm 288 strikes adjusting screw 292.

When piston rod 296 reaches the position of FIGURE 15 it "picks up" stabilizer rod 287 and both rods move downwardly simultaneously. Movement of feed arm 288 from the position of FIGURE 14 to FIGURE 15 drops the tip 294 below the shoulder of clip A. The feed arm moves the clip downwardly past the light resisting force of spring 303 and drops it on to the top of the back jaws 68 and 69. During this movement escapement arm 143 has remained stationary with the lower dog 302 preventing sliding movement of clips B and C down the slide.

In FIGURE 17 stabilizer rod 287 has remained stationary but piston rod 296 has begun its retracting movement. Due to the bearing pressure exerted by the drag block assembly on rod 287, the rod will not move upwardly until feed arm 288 has rocked backwardly into contact with adjustment screw 291. In this position feed arm 288 has "picked up" the stabilizer rod and carries it upwardly with it. As soon as rod 296 begins its upward movement air is admitted to the right end of cylinder 137 to rock escapement arm 143 counterclockwise about pivot 144. Upper dog 301 thereby presses clip C against the clip slide to prevent any downward movement. At the same time dog 302 has rocked upwardly out of engagement with clip B. Clip B slides by gravity down the slide until it is stopped by spring 303.

The function of the drag block assembly is illustrated by the relationship of the parts in FIGURE 20. By tilting feed arm 288 rearwardly its tip 294 lies upwardly sufficient to clear clip B so that feed arm 288 can pass over the clip to the position of FIGURE 14.

As soon as clip B has cleared dog 302, air is admitted to the left end of air cylinder 137 through rocking escapement arm 143 clockwise about pivot 144. The restraining pressure on clip C from dog 301 is released and the clip slides downwardly until it strikes dog 302. The next clip then moves into the position just vacated by clip C.

In FIGURE 17 a shoe 322 attached to the forward edge of arm 288 is illustrated. This shoe overlies the clip as it moves down the slide and positively prevents any popping of the clip off the slide or back jaws. The shoe may be metal or rubber. Rubber is preferable because if the carriage block moves forward too quickly it may strike the shoe before it has a chance to clear the molding area.

It will be understood that the size and tension of spring 303 may be varied to accommodate varying size of clips.

The use and operation of the invention are as follows:

Assume that the parts are in the position shown in FIGURE 1. An automatic cycle of the machine will be described since virtually all of the components of the manual as well as the automatic system will be brought into operation.

Switches S–1, S–2 and S–3 are punched on the control panel. Closure of switch S–1 regulates the automatic-manual operation of the machine, and in this instance it will be turned to the automatic position. S–3 furnishes power to the main air valve which energizes it so that air is supplied to the regulating valves connected downstream from it. The regulating valves in turn supply air to the operating cylinders of the machine. Closure of switch S–2 supplies power to the limit switches and the main air valve.

The cycle starts when limit switch LS–1 is actuated on the return or mold-opening movement of carriage 30. Actuation of LS–1 admits air, through its associated air valve, to the left end of mold-closing cylinder 36 which moves the carriage block 30 carrying front mold 33 in a mold-closing direction toward the back plate 13. As carriage block 30 moves forward the back jaws 68, 69 will be forced together in response to the coaction of cam rollers 55, 56 with the cam tracks 52, 53 in cams 50, 51. The back jaws will engage one another while the carriage is a considerable distance away, as will be apparent upon a study of the contour of the cam track in FIGURE 2. During this portion of the forward motion the pump is in the full-line position of FIGURE 1.

After block 30 has traveled a substantial distance in a mold-closing direction, push rod 232 will actuate LS–2. As soon as LS–2 is depressed the air supply to the left end of mold-closing cylinder 36 is cut off, which immediately stops the forward movement of the carriage in a position a short distance before engagement with the back jaws. Actuation of LS–2 also admits air to the left hand of cylinder 120, which causes push rod 121 to move to the right. Push rod 122 will engage a clip which has been deposited on the upper left edge of back jaw 68 by the escapement mechanism of FIGURE 6. It will be understood that the upper edge of back jaws 68 is so contoured as to form an unobstructed path for the movement of the clip along it. The operation of the escapement mechanism will be described in detail hereinafter as, during the portion of the cycle, the escapement arm 143 is in the solid line position of FIGURE 6.

As push rod 121 moves the clip to the right, push rod 111 is also moved to the right a distance substantially equal to clearance space 114. Push head 113 is, of course, maintained in the illustrated position of FIGURE 4 by the resistance of spring 112.

By the time push head 114 engages the abutment portion of block 110, push rod 111 will have actuated LS–3. Actuation of LS–3 turns off a timer which was actuated by LS–2. The purpose of the timer was to cause air to be admitted to the right end of mold-closing cylinder 36 if the carriage did not come into molding engagement with the back jaw before the timer timed out. At the same time, air is again admitted by means of the air valve associated with LS–3 to the left end of mold-closing cylinder 36 and the carriage moves on to final engagement with the back jaws.

It is at this point in the cycle that the safety feature regulated by LS–7 comes into operation. If a clip had not been properly located on the top of back jaw 68 and subsequently moved into molding position straddling the back jaws 68—69, push rod 121 would have advanced past the position it assumes when a clip is properly positioned. Movement of push rod 121 to this advanced position brings push rod 124 into engagement with LS–7. Actuation of LS–7 admits air to the forward end of carriage-closing cylinder 36 and causes it to retreat to the position of FIGURE 1 from the hesitation position.

Assuming, however, that a clip was properly positioned and carriage block 30 moves from the hesitation position into engagement with back jaws 68 and 69, substantially the following sequence of operations result.

Push rod 235 actuates LS–4. Due to the shorter length of travel of push rod 121 when a clip is in the proper position, LS–7 will not be actuated. This of course is due to the relationship between the length of push rod 121 and the location of LS–7. LS–7 and its mold closure preventing function is therefore effectively cut out of the cycle. LS–4 admits air through its associated air valve to the left end of tilting cylinder 219 which causes the nozzle to tilt from the solid line position of FIGURES 1 and 5 to the dotted line injecting position of FIGURE 5. The degree of tilt of the pump need not be great and a movement of ½ to ⅝ of an inch has proven to be quite adequate. It is really only necessary that a small air break be formed between the rear of the back jaws and the nozzle tip to prevent heat transference from the nozzle to the back jaws between shots.

When the pump tilts in under the control of LS–4 and tilting cylinder 219, the pump switch lever arm 237 causes push rod 236 to depress LS–5. LS–5 through its associated air valve admits air to pump plunger cylinder 189 through air connection 199, and a shot of molten metal is forced by the pump plunger by passageways 211, 210, 212 into the closed mold cavity. LS–5 also actuates a timer in the control panel which governs the time that the pump plunger stays down. As soon as the timer times out, air pressure to connection 199 is cut off and air is admitted to the bottom end of the cylinder which moves the pump plunger upwardly.

On the "up" return of plunger 193, LS–6 is actuated. Actuation of LS–6 admits air through its associated air valve to the forward end of carriage cylinder 36 which causes the carriage to move to the left, as viewed in FIGURE 1, in a mold-opening direction. In effect, opening movement of the molds is prevented until the pressure on the metal is removed.

As the carriage 30 moves to the left, push rod 235, which has kept LS–4 depressed, deenergizes the air valve controlled by LS–4 and air is admitted to the opposite or right end of tilting cylinder 219. This causes the pump to tilt back to the position of FIGURE 1.

As the carriage block 30 moves rearwardly, the wheel weight is exposed to ambient atmosphere which gives it sufficient time to harden preparatory to ejection. It will be understood, of course, that the back jaws 68, 69 are being constantly cooled by a circulation of water through the connections to the rear of slides 66 and 67 and shown in FIGURE 4. Toward the end of its rearward movement and after the wheel weight has hardened, back jaws 68 and 69 will separate due to the action of cam rollers 55 and 56 when they contact the jog in cam tracks 52 and 53. The back jaws will thereby move outwardly away from one another in a direction substantially transverse to the direction of movement of the carriage block and front mold 33. As the back jaws separate, the sprue will be sheared from the wheel weight, as fully described in copending application, Serial No. 780,718, filed December 16, 1958, Richard K. Sunday, Machine and Method of Die Casting, now abandoned, assigned to the assignee of this application. As soon as the sprue is severed from the wheel weight, the weight will fall forwardly along apron 79 and into a suitable receiving bin and the sprue will drop downwardly until it strikes return chute 80 which directs it back into the pot 180 for remelting.

The sprue pins 87, 88 are fixed, however, with respect to the main frame and base plate 11 of the machine, and consequently they will hold the severed sprue in its as-cast position while the back jaws move outwardly. In effect, the back jaws will slide along the passage 82, 83 therewithin. The facing ends of the sprue pins will generally be substantially flat so that by themselves they form no mechanical support or cradle for the sprue. As a result, in many instances the sprue will immediately drop downwardly into the return chute 80 and back to the pot. It may be, however, that the sprue does not drop down immediately, and accordingly the ejector mechanism of FIGURES 1 thru 6, or FIGURES 10 thru 13, will be brought into play. For convenience of description only the embodiment of FIGURES 1 thru 6 will be described.

During the majority of the cycle the knockout hammer 99 of FIGURE 5 will be in the position shown in that figure. Near the end of the return stroke of the mold carriage, however, air cylinder 94 will be actuated to move the knockout hammer 99 downwardly to the left, as viewed in FIGURE 5, to knock out a sprue which may be held between the exposed ends of the sprue pins.

Toward the end of the return stroke of the mold carriage, pivot arm 165 passes over and depresses plunger 154 of air valve 164. Setscrew 171 prevents clockwise movement of the swinging pivot arm 165 past the position indicated in FIGURE 8. In general it is convenient to so position air valve 164 that arm 165 passes beyond it to the left, as viewed in FIGURE 8, so that the plunger is only momentarily depressed. The momentary depression of the cylinder will cause air to enter cylinder 94 thru inlet 96, thus moving knockout hammer 99 and knockout head 100 aligned with the sprue downwardly. When the plunger 155, 154 pops upwardly after arm 165 passes over it, air will again be admitted to inlet 95 and piston 97 will return to the FIGURE 5 position. When the carriage block 30 moves to a mold-closing direction in the next cycle of operations, arm 165 will swing clockwise up and over plunger 154 without depressing it since it is relatively free to swing in this direction. Only light return spring 174 resists clockwise movement, and this spring is not sufficient to induce displacement of plunger 154.

The clip placement mechanism of FIGURE 6 acts at approximately the same time that pivot arm 165 actuates the knockout hammer, J-cam 156 depresses plunger 154 of air valve 150. Depression of the plunger diverts air through line 152 which is connected to air connection 140 of cylinder 137, which thereby causes piston 141 to move to the left, as viewed in FIGURE 6. As the piston moves to the left, the escapement arm 143 rotates about pivot 144 and right tooth 148 rises, thus enabling clip A to slide down the clip slide and into position on top of back jaw 68. At the same time left tooth 147 will move downwardly until it presses clip B against the top of the clip slide. Movement of escapement arm 143 is so fast that clip B does not move any appreciable distance downwardly past its FIGURE 6 position due to its iner-

tia. Escapement arm **143** will remain in this position so long as J-cam **156** keeps plunger **154** depressed.

As soon as mold carriage **30** begins its movement to the right for the next cycle, plunger **154** is released and air is again admitted to inlet **139** of cylinder **137**. This causes escapement arm **143** to swing back to the position of FIGURE 6 and clip B and all those behind it move downwardly one clip length until clip B occupies the position formerly occupied by clip A.

When mold carriage **30** returned to the starting position of FIGURE 1, push rod **230** actuated LS–1 which initiated a succeding cycle of operation. It should be understood that the operation of the knockout and escapement mechanisms is very rapid and consumes only a fraction of the time that the mold carriage is moving forward in a mold-closing direction.

The operation of the embodiment of FIGURES 10 thru 13 will not be described in detail since it will be obvious to one skilled in the art that actuation of the gear and rack mechanism there illustrated can be tied into the machines cycle by the use of conventional components.

Although a preferred and alternate embodiment of the invention have been illustrated and described, it will be understood that the particular structure is illustrative only and that many modifications may be made without departing from the essential spirit and scope of the invention. For example, it is not essential that a pair of back jaws be utilized. A mold structure having a total of three, four, five or more parts, including retractable or permanent cores may be utilized.

It may also be advantageous in some circumstances to incorporate a booster for urging the clips downwardly along the slide, such as a booster blast of air. In addition, any suitable means for presenting properly facing clips to the clip slide may be utilized.

In view of the illustrative nature of this description, the scope of the invention should only be defined by the scope of the following appended claims.

What is claimed is:

1. A casting machine for forming metal objects, such as lead wheel weights and the like, said casting machine including in combination,
   - a plurality of die members constructed and arranged, when in engagement, to form a die cavity for the reception of molten metal,
   - pump means for injecting molten metal into the die cavity,
   - means for moving the die members away from one another,
   - means for smoothly shearing the sprue from the formed object as the die members move away from one another, and
   - means for maintaining the sheared sprue in its as cast postion during at least the initial increment of movement of the die members away from one another.

2. The casting machine of claim 1 further including means for ejecting the sheared, stationary sprue.

3. The casting machine of claim 1 further characterized in that the means for maintaining the sheared sprue in its as cast position includes a plurality of pins, said pins being so arranged as to hold the sheared sprue against movement with the cast object.

4. The casting machine of claim 3 further characterized in that the holding surfaces of the plurality of sprue holding pins form a portion of the surface of the die cavity.

5. The casting machine of claim 3 further characterized in that the sprue holding pins are received within the die members, the die members being movable with respect to the sprue pins.

6. The casting machine of claim 3 further characterized in that each sprue holding pin is positioned parallel to the direction of movement of the die member with which it is associated.

7. The casting machine of claim 4 further characterized in that those portions of the sprue holding pins in contact with the sprue are so formed as to provide no mechanical support for the sheared sprue.

8. The casting machine of claim 1 further characterized in that the die members and sprue pins are so positioned as to locate the sheared sprue above a return path terminating at the pump means.

9. The casting machine of claim 2 further characterized in that the ejecting means for the sheared sprue is so located that upon actuation thereof the sheared sprue, if contacted, is urged along a path terminating at the pump means.

10. The casting machine of claim 1 further including means for preventing movement of the die members away from one another so long as the pump means exerts pressure on the metal in the die cavity.

11. The casting machine of claim 1 further including means for positioning an insert in the die cavity and means for preventing injection of molten metal until an insert has been properly positioned in the die cavity.

12. The casting machine of claim 1 further including means for preventing closure of the die members unless an insert is properly positioned in the die cavity, said die member closure preventing means being effective to move the die members away from one another and prevent further squential operations unless an insert is properly positioned in the die cavity.

13. The casting machine of claim 12 further including means operable to cut out operation of the die member closure preventing means when an insert is properly positioned in the die cavity.

14. In the method of pressure casting which includes the steps of moving a plurality of die members into casting engagement with one another to define a die cavity and thereafter injecting molten material into the die cavity, the improvement comprising
   - shearing the sprue from the cast object as the die members move out of engagement with one another,
   - exerting a holding force on the sprue during the shearing operation to thereby maintain the sheared sprue in its as cast position at least during the shearing operation, and
   - ejecting the sheared sprue from its as cast position.

15. The pressure casting method of claim 10 further characterized, firstly, in that the sheared sprue is held in its as cast position after the shearing operation and, secondly, in that the sheared sprue is positively ejected from its as cast position.

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