Oct. 4, 1938. R. F. JOHNSON 2,131,955

DIE CASTING MACHINE

Filed Nov. 21, 1935 9 Sheets-Sheet 1

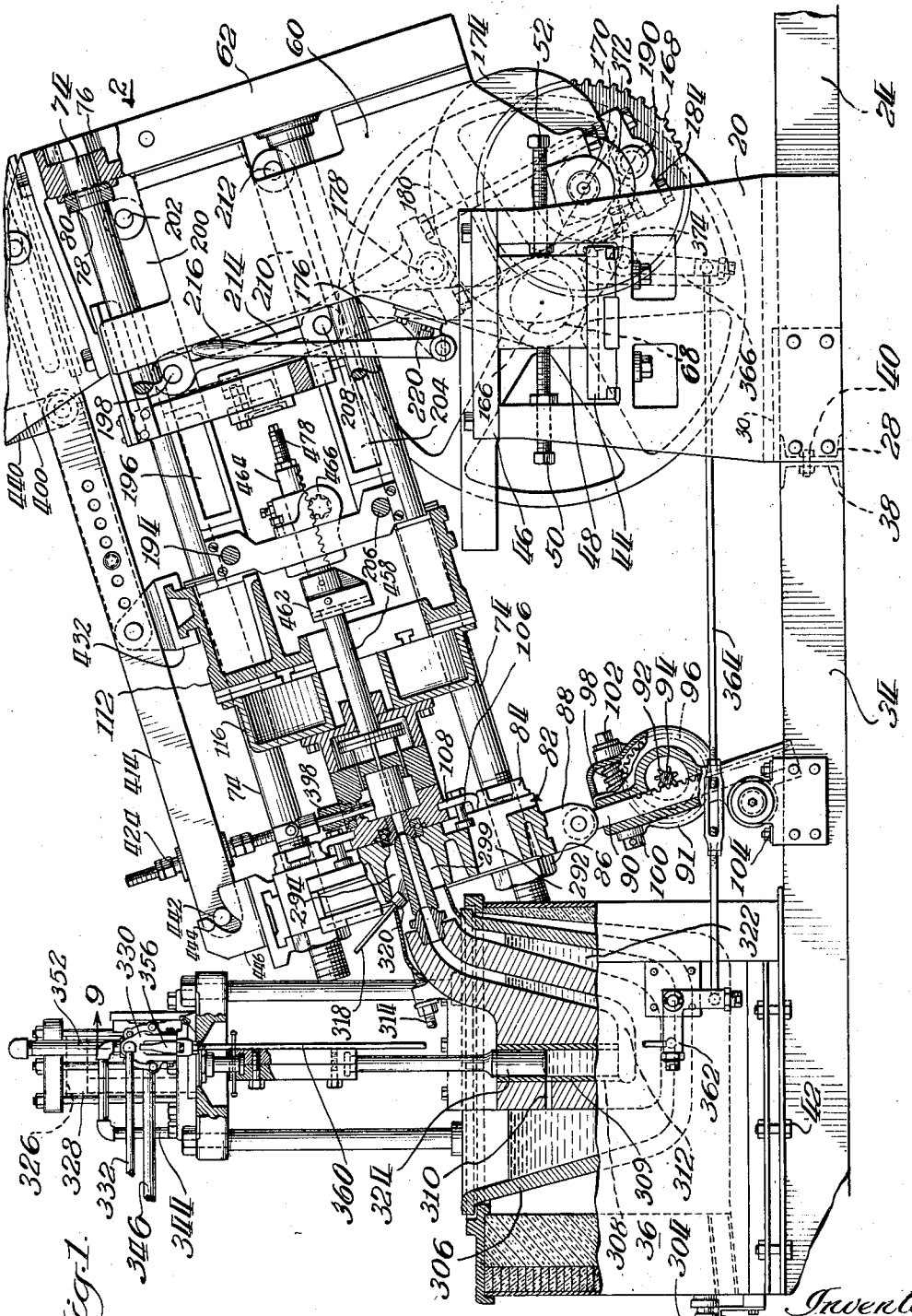


Fig. 1.

Inventor:
Roy F. Johnson
By Williams, Bradbury, McCabe & Hinkle.
Attys.

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DIE CASTING MACHINE

Filed Nov. 21, 1935 9 Sheets-Sheet 2

Fig. 3.

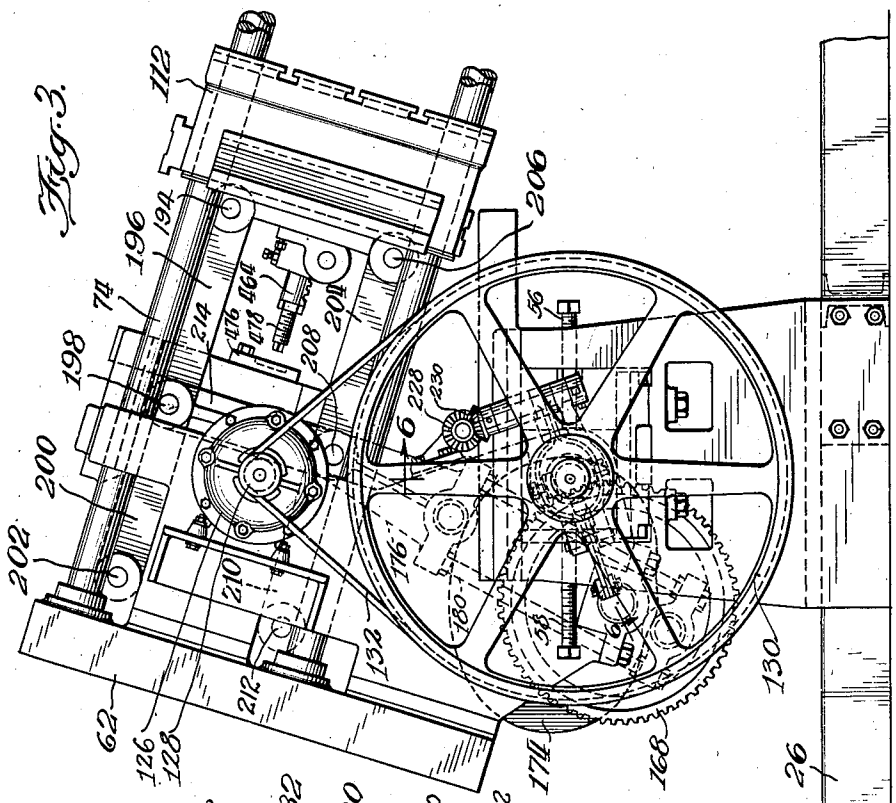
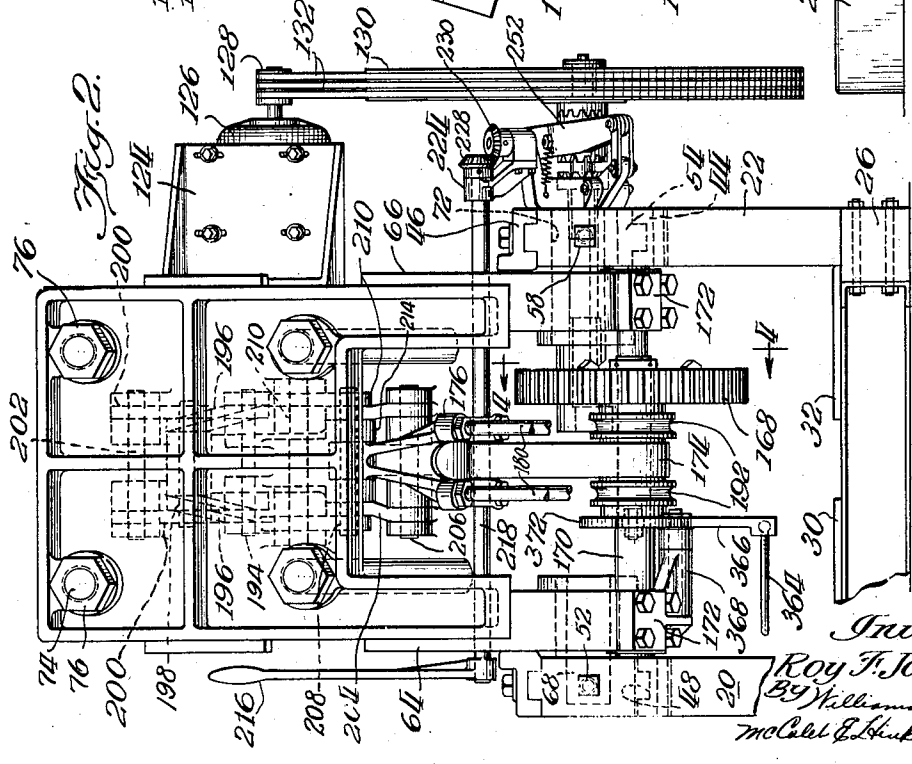


Fig. 2.



Inventor:
Roy F. Johnson
By Williamson, Bradbury
McCabe & Hinkle Attys.

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DIE CASTING MACHINE

Filed Nov. 21, 1935 9 Sheets-Sheet 3

Fig. 5.

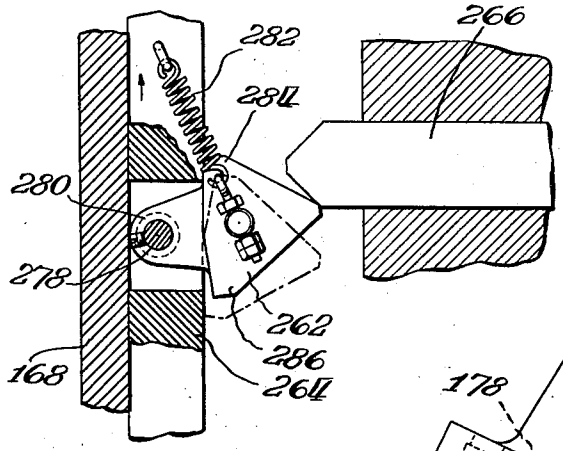


Fig. 4.

Inventor:
Roy F. Johnson
By Williams, Bradbury,
McCaleb & Hinkle, Attys.

Oct. 4, 1938. R. F. JOHNSON 2,131,955

DIE CASTING MACHINE

Filed Nov. 21, 1935 9 Sheets-Sheet 4

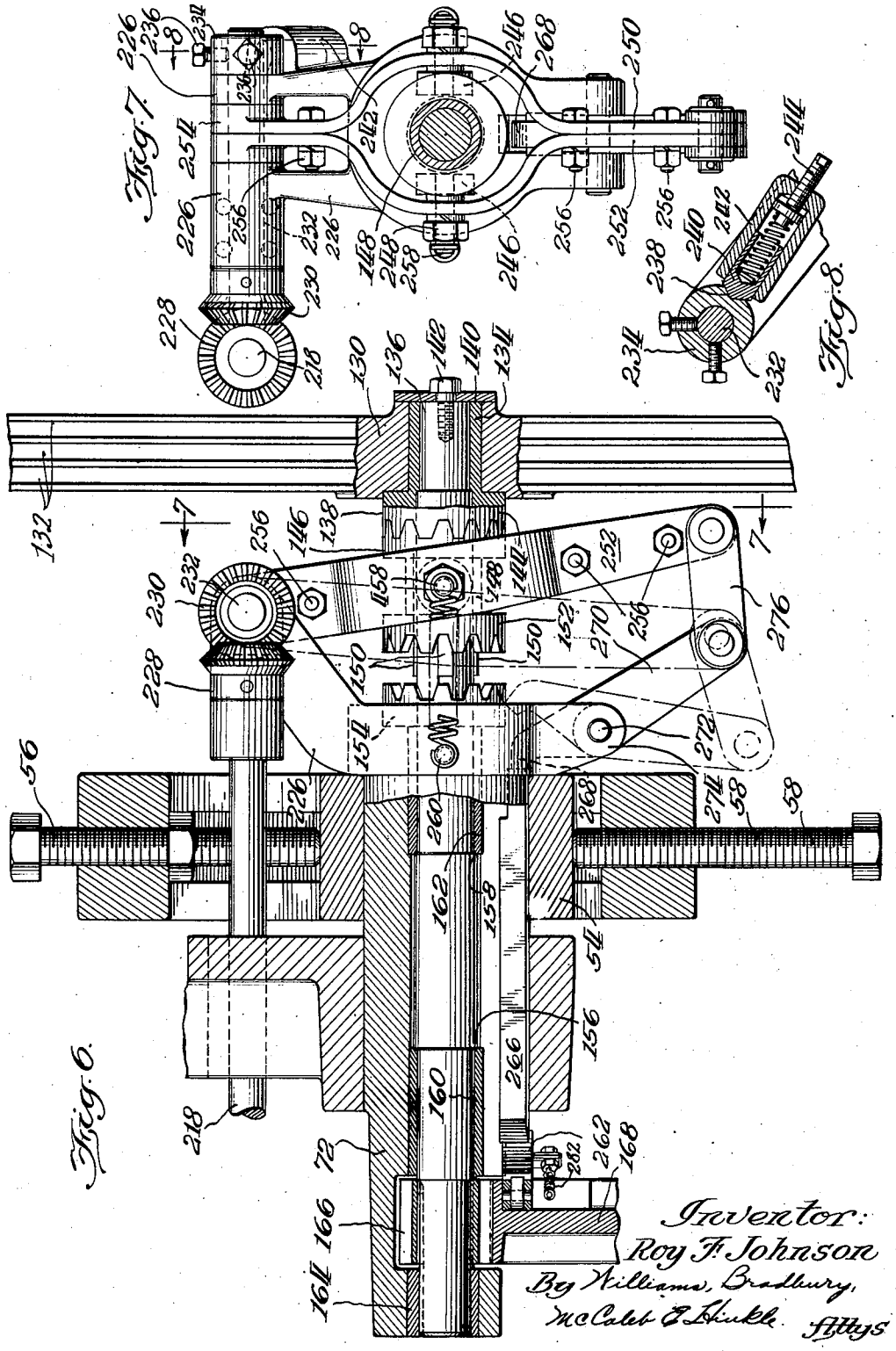


Fig. 6.

Inventor:
Roy F. Johnson
By Williams, Bradbury,
McCaleb & Hinkle
Attys

Oct. 4, 1938. R. F. JOHNSON 2,131,955

DIE CASTING MACHINE

Filed Nov. 21, 1935 9 Sheets-Sheet 5

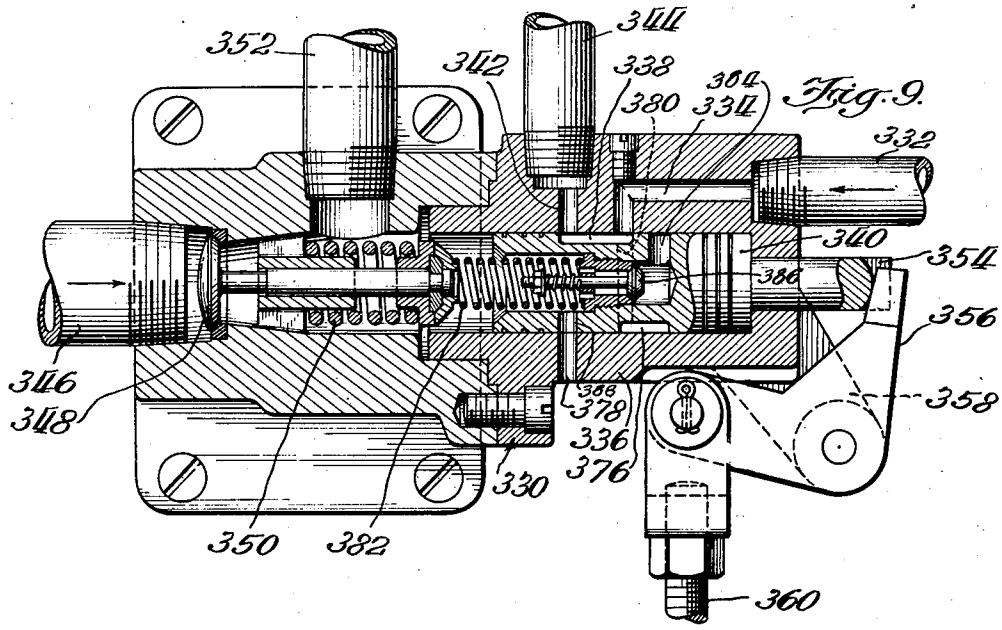


Fig. 9.

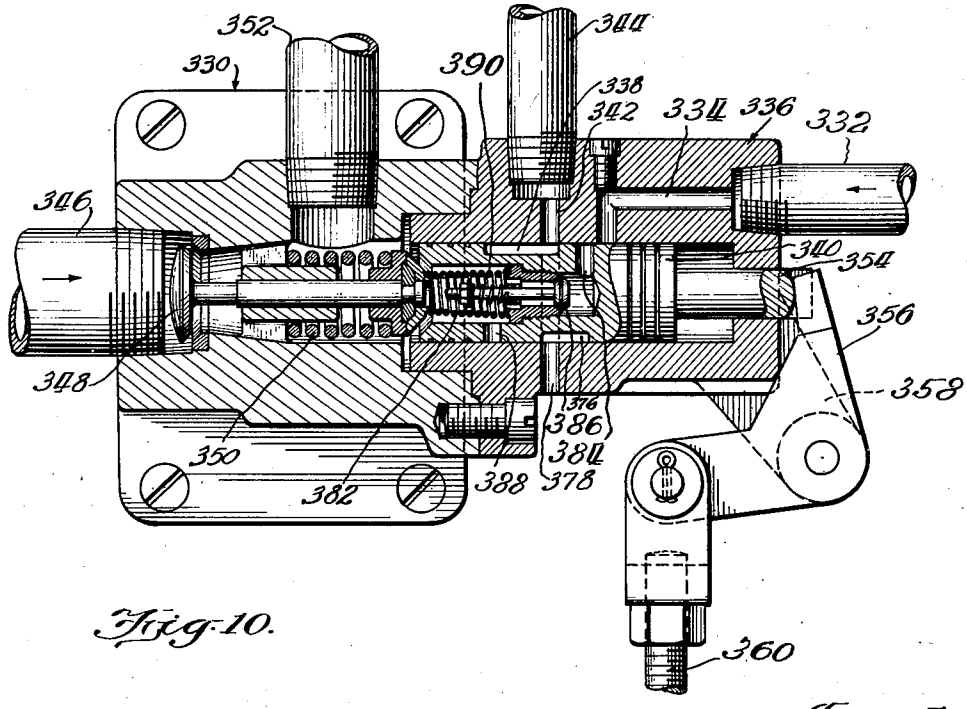


Fig. 10.

Inventor:
Roy F. Johnson
By
Williams, Bradbury, McCaleb & Hinkle
Attys.

Oct. 4, 1938. R. F. JOHNSON 2,131,955

DIE CASTING MACHINE

Filed Nov. 21, 1935 9 Sheets-Sheet 6

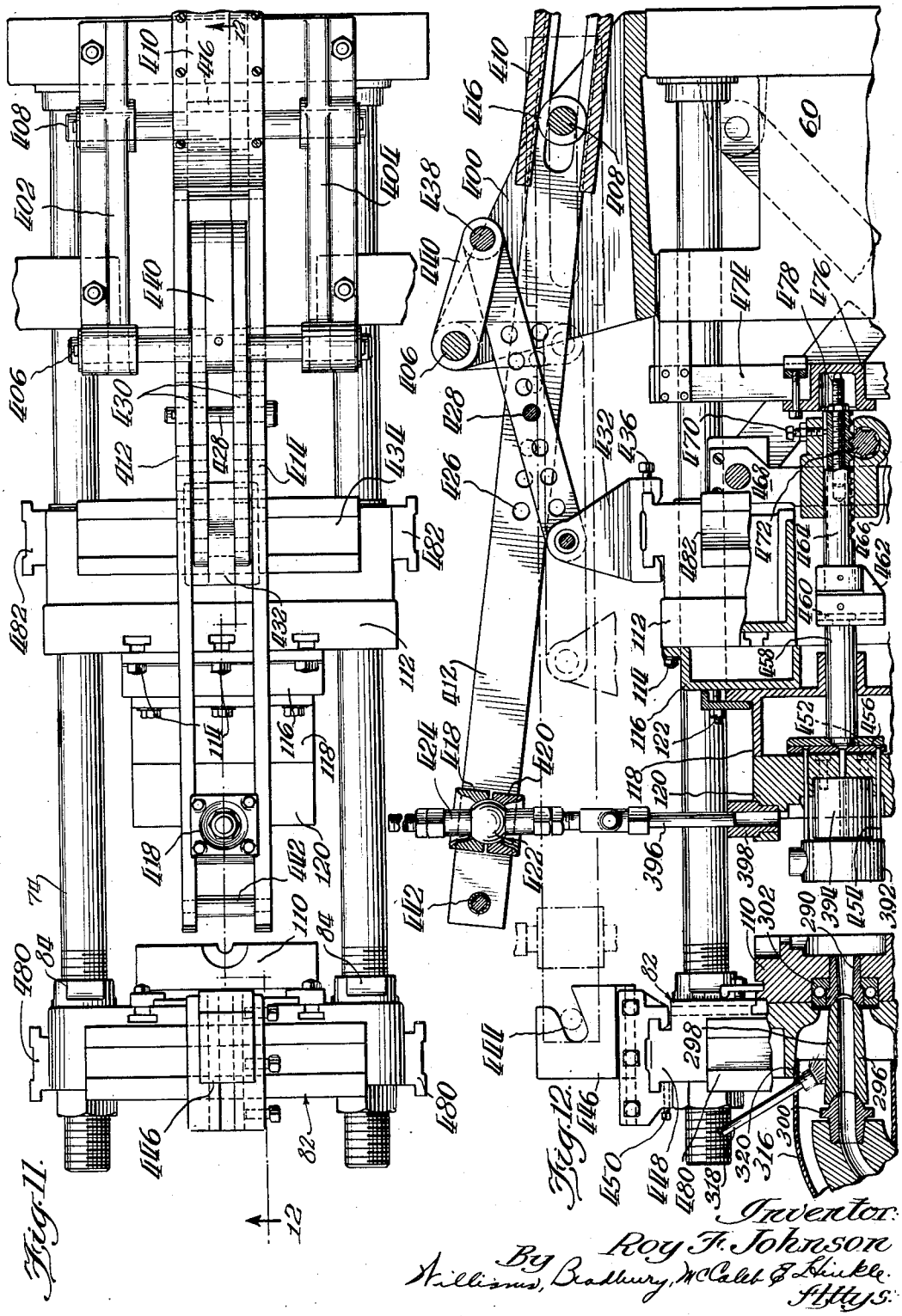


Fig. 11.

Fig. 12.

Inventor:
Roy F. Johnson
By Williams, Bradbury, McCaleb & Hinkle
Attys.

Oct. 4, 1938. R. F. JOHNSON 2,131,955

DIE CASTING MACHINE

Filed Nov. 21, 1935 9 Sheets-Sheet 7

Fig. 17

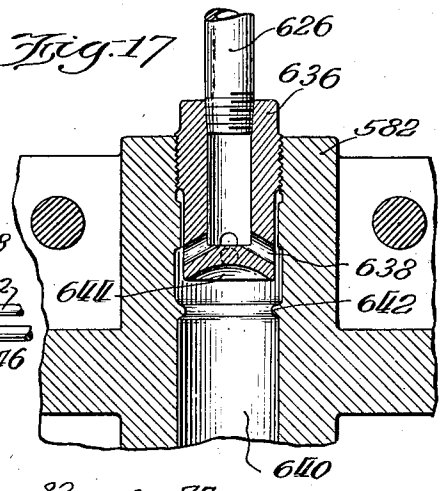


Fig. 13.

Inventor:
Roy F. Johnson
By Williams, Bradbury, McCaleb & Hinkle
Attys.

Oct. 4, 1938. R. F. JOHNSON 2,131,955

DIE CASTING MACHINE

Filed Nov. 21, 1935 9 Sheets-Sheet 8

Fig. 15.

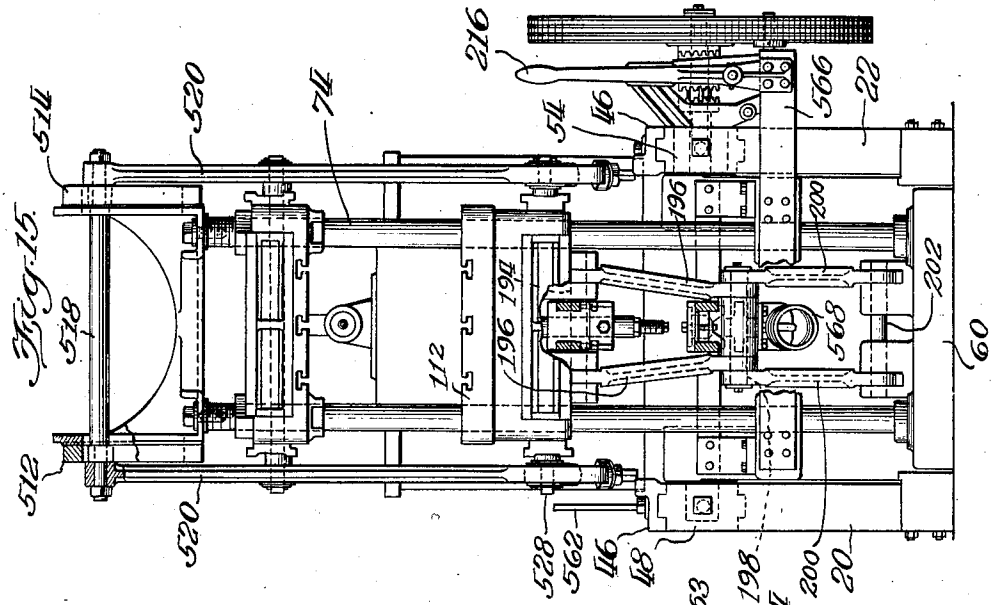
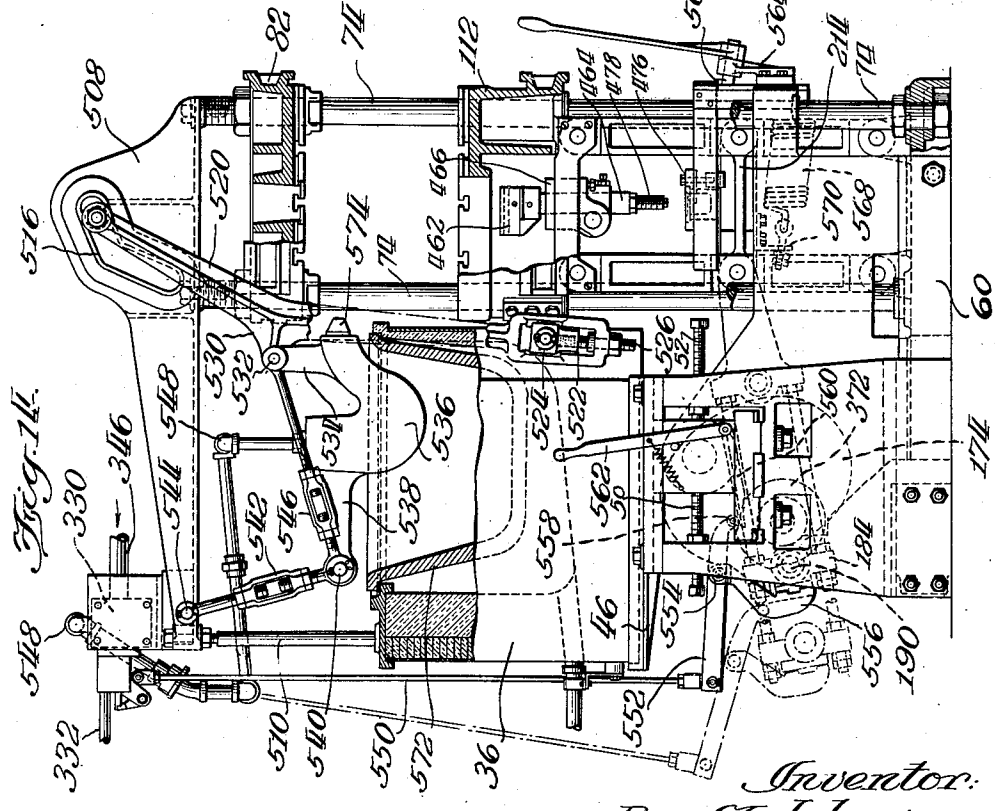


Fig. 14.



Inventor:
Roy F. Johnson
By Williams, Bradbury, McCaleb & Hinkle
Attys.

Oct. 4, 1938. R. F. JOHNSON 2,131,955

DIE CASTING MACHINE

Filed Nov. 21, 1935 9 Sheets-Sheet 9

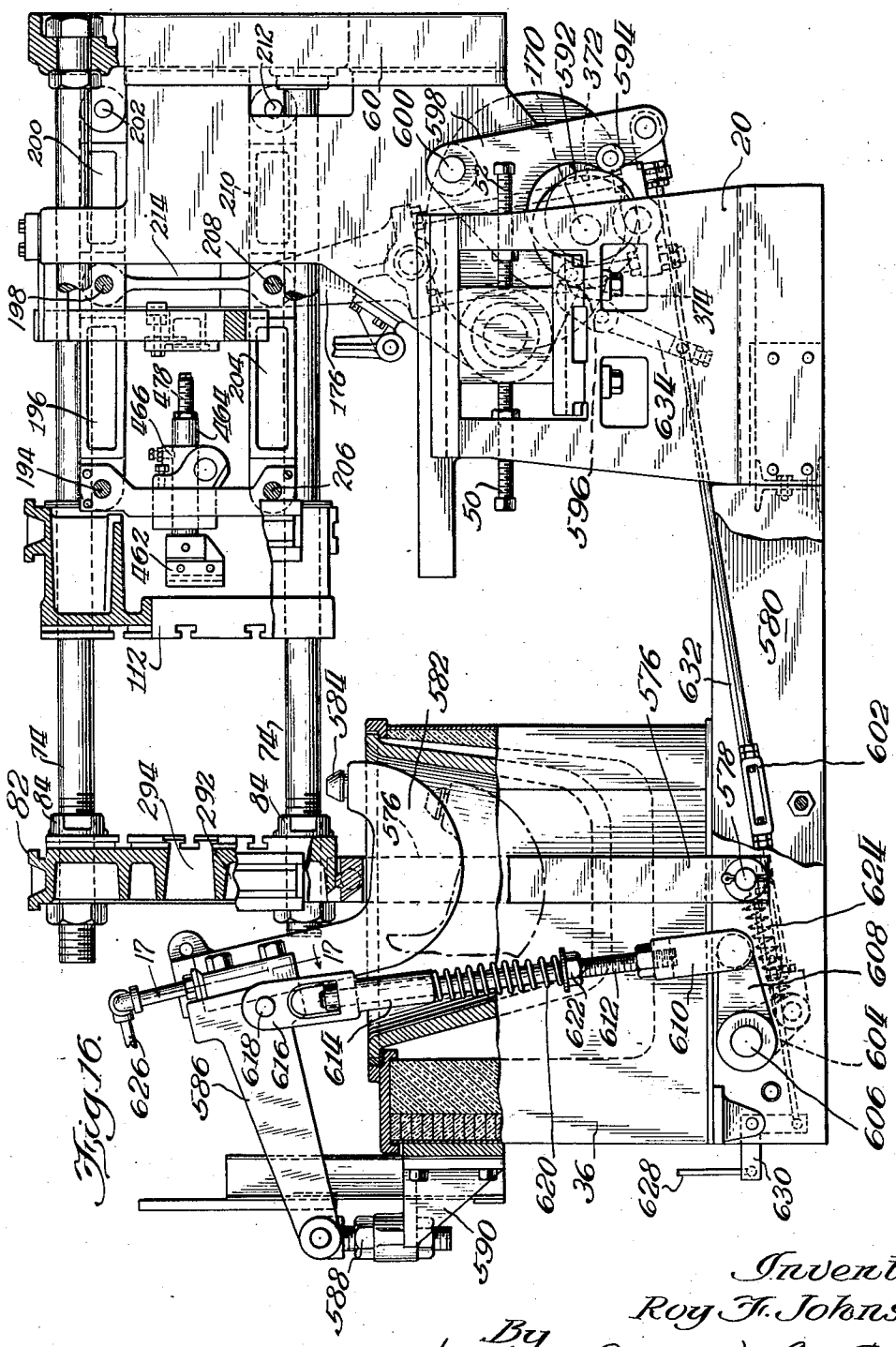


Fig. 16.

Inventor
Roy F. Johnson
By
Williams, Bradbury, McCaleb & Hinkle
Attys.

Patented Oct. 4, 1938 2,131,955

UNITED STATES PATENT OFFICE

2,131,955

DIE CASTING MACHINE

Roy F. Johnson, Oak Park, Ill., assignor to The Imperial Die Casting Company, Chicago, Ill., a corporation of Illinois

Application November 21, 1935, Serial No. 50,914

22 Claims. (Cl. 22—69)

My invention pertains to die casting machines.

An object of my invention is to provide a new and improved die casting machine which is adapted for a wider range of work than those now in use.

Another object of my invention is to provide an improved die casting machine which is adapted for making die castings of different metals.

Another object of my invention is to provide an improved die casting machine which is economical and efficient in operation.

Another object of my invention is to provide an improved die casting machine which can be used in either a horizontal or vertical or inclined position.

Another object of my invention is to provide an improved die casting machine which operates at higher pressures and makes better castings than those heretofore used.

Another object is to provide an improved die casting machine which can be operated as either a fully automatic machine or as a semi-automatic machine.

Another object is to provide an improved die casting machine which is safer to operate and easier to handle than the machines now in use.

Another object of my invention is to provide a die casting machine having improved driving mechanism.

Another object of my invention is to provide a die casting machine having improved clutch control mechanism.

Another object is to provide a die casting machine having improved casting ejecting means.

Another object is to provide a die casting machine having automatic core pulling means.

Another object is to provide a die casting machine having an improved valve for controlling the admission of air to inject molten metal into the die.

Another object of my invention is to provide improved means for preventing solidification of the molten metal in the injecting nozzle.

Another object of my invention is to provide improved means for preventing the die cast metal from interfering with the air supply.

Other objects and advantages will become apparent as the description proceeds.

In the drawings,

Figure 1 is a side elevation, partly in section, of one embodiment of my invention;

Figure 2 is an end elevation looking in the direction of the arrow 2 of Figure 1;

Figure 3 is a fragmentary view showing part of the mechanism shown in Figure 1 but viewing this mechanism from the opposite side of the machine;

Figure 4 is a sectional view showing the driving mechanism and is taken on the line 4—4 of Figure 2;

Figure 5 is a detail of the clutch throw-out dog;

Figure 6 is a sectional view of the clutch and associated mechanism and is taken on the line 6—6 of Figure 3;

Figure 7 is a sectional view showing the clutch mechanism and is taken on the line 7—7 of Figure 6;

Figure 8 is a sectional view of the clutch control detent and is taken on the line 8—8 of Figure 7;

Figure 9 is a section through the air valve showing the parts in normal position and is taken on the line 9—9 of Figure 1;

Figure 10 is a section of the air valve, identical with that of Figure 9 except that the parts are shown in opposing position;

Figure 11 is a top view showing the core pulling mechanism;

Figure 12 is a vertical section taken on the line 12—12 of Figure 11;

Figure 13 is an elevation, partly in section, showing a modified form of metal feeding or injecting mechanism for the machine shown in Figure 1;

Figure 14 is a side elevation, partly in section, showing a modified form of my invention;

Figure 15 is an end elevation of the machine shown in Figure 14;

Figure 16 is a side elevation, partly in section, showing a further modification; and

Figure 17 is a sectional view showing a detail of the baffle and is taken on the line 17—17 of Figure 16.

In Figures 1 through 13 of the drawings, I have shown an embodiment of my invention having a base comprising uprights 20 and 22 to which are secured rearward extensions 24 and 26, respectively. The left-hand ends of the uprights 20 and 22 and their associated extensions 24 and 26 are connected together as by means of a transverse channel iron 28. I also provide gussets 30 and 32 to reinforce the base.

A pair of side rails 34 extend forwardly and support a furnace 36 which may be of any suitable construction. The side rails 34 are connected by suitable transverse members 38, one of which is secured to the channel 28 by bolts 40. In the present instance the furnace 36 is shown as attached to the rails 34 by bolts 42 although any other suitable means may be used.

The upper ends of the uprights 20 and 22 are yoke-shaped and to each upright there is bolted a pair of guides 44 and 46. The guides 44 and 46 associated with the upright 20 slidably receive a supporting block 48 which may be adjusted by means of screws 50 and 52. The guides 44 and 46 secured to the upright 22 similarly

receive in slidable relation thereto a supporting block 54 which may be adjusted by means of screws 56 and 58. The blocks 48 and 54 pivotally support the main framework of the machine.

The framework of the machine includes a casting noted generally by the reference numeral 60, this casting having a base portion 62 and side portions 64 and 66. The side portion 64 of the casting is pivotally supported on a pin 68 secured in the supporting block 48. The side portion 66 of the casting is similarly mounted in pivotal relationship upon a pin 72 carried by the supporting block 54.

Four heavy rods 74 are shown as being attached to the base portion 62 of the casting 60 by means of nuts 76. Each rod 74 has a shoulder 78 which clamps a washer 80 against the base portion 62. The rods 74 are arranged in rectangular relationship and have secured to their other end a stationary head or platen 82. The head 82 is shown as clamped between a pair of nuts 84 and 86 threadedly engaging each of the rods 74. The nuts 84 are preferably calibrated as indicated, to facilitate accurate adjustment of the head 82. By means of this adjustment the machine can be made to accommodate different sizes of dies.

The platen 82 has a pair of ears 88, to each of which is pivotally connected a rack bar 90, whereby the platen 82 may be raised or lowered to adjust the inclination of the machine about its pivotal supports in the blocks 48 and 54. Each rack bar 90 slides in a housing 91 and is engaged by a pinion 92 carried on a shaft 94 having a worm-wheel 96 rotated by a worm 98 carried by a second shaft 100 having a square end 102 projecting from the housing so that it can be engaged and rotated by a suitable tool. Each housing 91 is pivotally supported on a bracket 104 attached to a rail 34.

The platen 82 is provided with suitable T-shaped grooves for receiving the heads of clamping bolts 106 passing through clamp members 108 which secure the stationary part 110 of a die to the platen 82.

The machine also has a movable head or platen 112 which slides on the rods 74. This movable head is also provided with suitable T-shaped slots for receiving the heads of bolts 114 which secure a spacing member 116 thereto. A die box 118, which includes the movable portion 120 of the die, is attached to the spacing member 116 as by means of clamps 122. In Figure 1 of the drawings the movable platen 112 is shown as being in its forward position, in which position the two parts of the die are firmly held against each other and the machine is closed. In Figure 12 of the drawings the movable head 112 is shown as being in its retracted or open position, and the two parts of the die are shown as separated to permit removal of the casting. The means for reciprocating the movable platen 112 will now be described.

Referring particularly to Figures 2 and 3, I have shown a bracket 124 attached to the side portion 66 of the casting 60. This bracket 124 supports an electric motor 126 which drives a small pulley 128 connected to a large pulley 130 by three belts 132. As shown most clearly in Figure 6, the pulley 130 is press-fitted on a hub 134 which is rotatably mounted on a shaft 136 journalled in the pin 72 and extending through the supporting block 54. The hub 134 is confined between a shoulder 138 formed on the shaft 136 and a plate 140 secured to the shaft by bolt 142.

The hub 134 has an enlarged collar 144 carrying suitable teeth and forming one element of a clutch member. The other element of the clutch member constitutes the enlarged collar 146 formed on a sleeve 148 which is non-rotatably but slidably connected with the shaft 136 by splines 150. The other end of the sleeve 148 carries a similar toothed collar 152 for engagement with a toothed brake member 154 pressed or otherwise secured to one end of the casting 72.

The shaft 136 is held against axial movement in the casting 72 by opposed shoulders 156 and 158 which abut bushings 160 and 162, respectively, which may be press-fitted or otherwise secured in the casting 72. A further bushing 164 carries the extreme inner end of the shaft 136. It will be understood that the bushings 160, 162 and 164 may be of any suitable bearing material.

The shaft 136 drives a pinion 166 which engages a large gear 168 keyed to a shaft 170 mounted in suitable bushings carried in the side portions 64 and 66 of the casting 60. The shaft 170 is removably secured in place by bearing caps 172. This shaft 170 is of such length that it does not extend outwardly beyond the side portions 64 and 66, thereby permitting swiveling of these side portions about their pivotal mountings in the bearing blocks 48 and 54.

The shaft 170 carries a main cam 174 shown most clearly in Figure 4. This cam is of the uniform diameter type and may be either solid or have openings therein to reduce its weight. The cam follower associated with the cam 174 comprises a casting 176 carrying a roller 178 which engages with the cam 174. Screwed into the casting 176 are four rods 180 which are locked in place by nuts 182. The other ends of these rods are secured to a cap 184 by nuts 186 and 188. The cap 184 carries a second cam roller 190 which engages the cam 174 at a point diametrically opposite from the roller 178. Mounted on the shaft 170 adjacent each side of the cam 174 is a guide pulley 192 for engaging and guiding two of the rods 180 whereby the cam follower is always accurately located with respect to its cam 174.

The movable head or platen 112 is advanced and retracted by toggle mechanism which I shall now describe with particular reference to Figures 1, 2 and 15 of the drawings. Pivotally attached to the upper part of the platen 112 and by means of a cross-shaft 194 is a pair of links 196 whose other ends are pivotally connected to a cross-shaft 198. Also connected to the cross-shaft 198 are the forward ends of a second pair of links 200 whose rearward ends are pivotally connected by a shaft 202 to ears formed on the base portion 62.

The second set of lower toggle links 204 have their forward ends pivotally connected to platen 112 by a shaft 206 and their rear ends pivotally connected by a shaft 208 to the forward ends of a second pair of links 210 whose rearward ends are pivoted to ears formed on the base portion 62 by a shaft 212. The central shafts 198 and 208 of the two sets of toggle links are connected by an inclined link 214, the lower end of the link 214 being notched out to receive the upper end of the casting 176 of the cam follower through which the shaft 208 passes.

As the cam 174 rotates and moves the cam follower to the position shown in Figures 1 to 4 of the drawings, the platen 112 is advanced to close

the two parts of the die. When the two parts of the die are firmly clamped together, the links 196 and 200 of the upper set of toggles and the links 204 and 210 of the lower set of toggles are in aligned position, so that all of the force exerted upon the movable platen 112 by the injection of the metal is transmitted directly to the base portion 62 of the casting 60 and does not react upon the cam 174 and its associated mechanism.

When it is desired to remove the casting from the die the toggles are positively broken by the cam 174 which positively moves the platen 112 to retracted position. It will be noted that as the cam follower is reciprocated by the cam 174, this follower oscillates slightly about the cam shaft 170, and that during this oscillation it is guided by the engagement of the rods 180 with the grooved pulleys 192.

The clutch for connecting the drive-shaft 136 with pulley 130 may be either manually or automatically controlled. I provide a handle 216 attached to a cross-shaft 218 mounted at one end in a bracket 220 attached to the side portion 64 of the casting 60 and mounted at its other end in a bracket 224 attached to arm 226 of casting 72. A beveled pinion 228 is pinned to the shaft 218 and engages a second beveled pinion 230 on a clutch control shaft 232 carried in the yoke-shaped arm 226 of the casting 72. The shaft 232 carries a collar 234 secured thereto by bolts 236, this collar having a notch 238 best shown in Figure 8.

When the clutch is in driving relation the notch 238 is engaged by a spring-pressed detent 240 which holds the clutch in driving position. The detent 240 is located in a boss 242 on yoke-shaped arm 226. The spring tension of the detent member is adjusted by screw 244.

The reduced portion of the clutch collar 148 is engaged by a pair of rollers 246 mounted on bolts 248 carried by the two strips 250 and 252 of a clutch control arm indicated generally by the reference numeral 254. The two strips 250 and 252 are secured together by suitable bolts 256 and function as a single member.

One end of the clutch control arm 254 is keyed or pinned to the shaft 232 to rotate therewith. The arm 254 and clutch member associated therewith are urged to brake engaging position by a pair of springs 258 which connect bolts 248 with pins 260 secured to casting 72. The springs 258 are not strong enough to rotate the clutch arm 254 and shaft 232 against the resistance of the detent 240 and, in order to release the movable clutch collar 148 from engagement with the driving collar 144, it is necessary to exert some additional force on the detent 240. This additional force can be supplied either by manual actuation of the handle 216 or by automatic means presently to be described. As soon as this additional force is applied and breaks the grip of the detent 240, the springs 258 pull the clutch collar 148 over into engagement with the brake 154 whereupon the machine is stopped and locked in stopped position by the engagement of the teeth of the brake 154 with the cooperating teeth on the clutch collar.

The clutch may be automatically disengaged from driving position by stops 262 which are pivotally mounted on segmental strips 264 bolted to the side of the drive gear 168. As shown, the driving gear 168 is provided with a plurality of holes adjacent its periphery whereby the segmental strips 264 may be bolted thereto in different positions to accommodate different operating conditions. Stops 262 engage one end of a slide 266 mounted in a channel formed in the casting 72 (Figure 6). The other end of this slide engages the nose 268 of a lever 270 which is pivoted at 272 to an arm 274 of the casting 72. The other end of the lever 270 is connected to one end of the clutch control arm 254 by a link 276.

It is to be noted that the stops 262 need give the slide 266 only a slight movement in order to break the grip of the detent 240, and that thereafter the springs 258 complete the disengagement of the movable clutch element with the driving pulley and shift this movable clutch element to engage the brake. As soon as the movable clutch element engages the brake, the machine is brought to a stop. If the machine stopped with one of the stops 262 engaging the slide 266, it would be impossible to restart the machine since the clutch could not be reengaged with the driving pulley. I therefore provide novel means to prevent this from happening.

Referring particularly to Figure 5, it will be seen that each stop 262 is secured to a shaft 278 pivoted in bushings 280 located in the arcuate segments 264. A spring 282 biases the stop 262 in the direction of rotation of the gear 168 so that the forward shoulder 284 of the stop engages the segment 264. When a stop first engages the end of slide 266, the stop is rotated about its pivot against the tension of the spring 282 until the other shoulder 286 engages the segment 264. Thereafter further movement of gear 168 and stop 262 reciprocates slide 266. As soon as the top or right-hand portion of stop 262 has engaged the extreme left-hand end of slide 266, thereby moving this slide to its extreme limit, the spring 282 pulls the stop 262 past the end of the slide 266 and returns the stop to the forward position. The stop 262 would then be in the same position shown in Figure 5 but above the end of the slide 266 which is thereafter free to return when the handle 216 is actuated to reengage the clutch with the driving pulley. It will be noted that the contacting ends of the stop 262 and slide 266 are tapered to facilitate the return of the stop by its spring 282.

The particular embodiment shown in Figures 1 to 12, inclusive, is set up for making die castings of zinc and its alloys, and the die cast metal is injected into the die under high pressures. The stationary part 110 of the die is provided with the usual gate 290 through which the molten metal is injected into the die. The stationary head or platen 82 is illustrated as being provided with two openings 292 and 294, either of which may be placed in registry with the gate 290. In the particular instance shown, the stationary part of the die is so located on the platen 82 that the gate 290 registers with the upper opening 294.

The platen 82 is vertically adjusted by means of the rack bars 90 and attendant mechanism, and also adjusted longitudinally of the rod 74 by nuts 82 and 86 so that the gate 290 is firmly pressed against the nozzle 296. This nozzle comprises two parts 298 and 300 which have a ball and socket connection whereby the part 298 may seat itself accurately with respect to the gate 290. The usual ring 302 surrounds the inlet end of the gate 290 and this ring 302 may be water cooled, if desired.

The furnace 36 may be fired by gas, oil or any other fuel indicated as being supplied through a pipe 304. The particular structure of the furnace forms no part of my invention, and any

desired type of furnace may be used. In the furnace is located a pot 306 containing the molten metal to be used in making the die castings. In this pot is a cylinder 308 which may have a lining sleeve 309 of Nitraloy or other especially suitable material. This cylinder 308 has an inlet port 310 which is normally in open communication with the interior of the pot 306. The lower or discharge end of the cylinder 308 communicates with the nozzle 296 through a passage 312.

In the form of the invention shown in Figure 1, bolts 314 extend between the furnace pot and the platen 82 to hold the gate 290 firmly clamped against the nozzle 296 to prevent leakage of metal therebetween.

I preferably provide means to maintain the nozzle 296 at such temperature that the molten metal will not solidify therein. This means includes a cover 316 which extends into the opening 294 in the platen 82 and generally surrounds the nozzle 296 in spaced relation thereto. A burner pipe 318 extends through an opening in the cover 316 to a point adjacent the nozzle 296 and carries a suitable burner 320 on its inner end which, in the present instance, is indicated as a gas burner of conventional type. The products of combustion flow around the nozzle 296 and serve to maintain it at the desired temperature, these products of combustion eventually escaping between the left-hand end of the cover 316 and the cylinder casting. The cover 316 may be formed of two semi-cylindrical castings, and it is to be understood that these castings do not form a tight fit with the casting in which the cylinder 308 is located. Any metal which may escape between the nozzle 296 and gate 290 returns to the pot 306 by way of passage 322.

The molten metal is injected into the die by a plunger 324 operated by a piston 326 in a cylinder 328 supported above the furnace 36. The piston 326 is operated in both directions by compressed air controlled by a novel air valve 330 and control mechanism which I shall now describe.

Figure 9 shows the air valve in the position it assumes when the plunger 324 is in the upper position shown in Figure 1 of the drawings. In this position the air from a low-pressure source, which is preferably under approximately fifty pounds pressure to the square inch, flows to the air valve 330 through a low-pressure supply pipe 332 communicating with a duct 334 located in the casting 336 of the air valve. As shown in Figure 9, the duct 334 is in communication with a passage 338 formed in a piston 340 which, in the position shown, establishes communication between the duct 334 and the port 342 leading to pipe 344 connected to the lower end of the cylinder 328. In the position of the parts shown, the lower side of the piston 326 is exposed to the pressure of the low-pressure air and is held in elevated position thereby.

A source of high-pressure air, which is maintained under approximately five hundred pounds pressure to the square inch, is connected to the air valve 330 through a supply pipe 346. In the position of the parts shown in Figure 9, this supply of high-pressure air is cut off by the poppet valve 348 which is held closed by its spring 350. A pipe 352 leads to the upper or high-pressure end of the cylinder 328.

The valve mechanism is controlled by a stem 354 projecting from the casting 336. This stem is shown as contacting with one arm of a bell crank lever 356 pivoted on ears 358 formed on the casting 336. The other end of the bell crank lever 356 is pivoted to a pull rod 360 whose other end is pivoted to a second bell crank lever 362 pivoted on a suitable bracket attached to the side of the furnace 36. The other arm of the lever 362 is connected to a second pull rod 364 which extends to a point adjacent the base of the die casting machine.

The pull rod 364 may be either manually or automatically operated to control the actuation of the valve. In the embodiment shown in Figure 1, the pull rod 364 is connected to one end of a lever 366 pivoted on a boss 368 formed on the bearing cap 172. The lever 366 carries at its opposite end a cam roller 370 which engages cam 372 which is mounted on and rotates with the main cam shaft 170.

When the enlargement 374 on the cam 372 engages roller 370, the piston 340 is moved inwardly, thereby cutting off communication between the low-pressure air supply and the lower end of the cylinder 328. Further inward movement of the piston 340 causes longitudinal groove 376 to register with port 378, whereupon the lower end of the cylinder 328 exhausts through pipe 344, longitudinal passages 338 and 376 which merge with and are connected by annular groove 380, and thence to atmosphere through port 378.

Further inward movement of the piston 340 opens the valve 348. It will be noted that this valve 348 is moved from its seat through a spring 382 which is confined between the base of the valve and the piston 340. This spring 382 constitutes a lost motion connection which permits a predetermined movement of the piston 340 before the high-pressure valve 348 is opened. Furthermore, as soon as this high-pressure valve is once opened, it is pushed to wide-open position, permitting free flow of air into the top of the cylinder 328. This position of the valve mechanism is shown in Figure 10.

The area of the piston 326 is approximately five times that of the plunger 324, whereby an air pressure of five hundred pounds per square inch on the piston 326 will inject the metal into the die under a pressure of twenty-five hundred pounds to the square inch. This pressure is far greater than that heretofore generally used in making die castings, and I have found that this increased pressure produces more perfect castings.

The enlargement 374 on the air valve control cam 372 extends through only a short arc so that the high pressure is maintained on the metal for only a brief period of time, and thereafter springs 350 and 382 return the parts of the air valve mechanism to their original position. During the return movement of these parts, the high-pressure valve 348 first closes and thereafter port 384 in the piston 340 registers with the low-pressure air inlet 334. When this occurs high-pressure air from the upper end of the cylinder 328 opens poppet valve 386 and flows into the source of low-pressure air, thus conserving an appreciable part of the energy present in the volume of high-pressure air utilized in the injection stroke of the plunger 324. Further movement of the piston 340 to the right moves the port 384 out of registry with the low-pressure air inlet 334 and brings a port 388 into registry with the outlet port 378, whereupon the remainder of the air in the upper end of the cylinder 328 is discharged to atmosphere. The poppet valve 386 is returned to its seat by its spring 390 and communication is again estab-

lished between the source of low-pressure air and the lower end of the cylinder 328 to raise the piston 326 and plunger 324 to the position shown in Figure 1. The poppet valve 386 prevents the flow of low-pressure air into the upper end of the cylinder 326.

The injection of molten metal into the die has been completed and in the embodiment shown in Figures 1 to 12, inclusive, one of the stops 362 is so positioned as to stop the machine at this point to permit cooling of the casting before its removal from the machine. It will be appreciated by those skilled in the art that where the casting is of such a nature that no prolonged cooling period is required, the machine need not be stopped at this point and may operate in a continuous cycle. After a suitable period of time the machine is restarted by movement of the handle 316 which controls the clutch.

As shown most clearly in Figure 12 of the drawings, the machine is set up to make the casting indicated at 392. This casting has a horizontal core 394 and a vertical core 396. The vertical core 396 is slidable in a guide 398 attached to the movable part 120 of the die. Before the casting 392 can be removed from the die, the core 396 must be withdrawn from the casting. An important feature of my invention lies in the particular means for automatically withdrawing the core 396.

Referring particularly to Figures 11 and 12, it will be seen that I have bolted a bracket 400 to the upper edges of the casting 60. The bracket 400 has upstanding arms 402 and 404 carrying cross-pins 406 and 408. A frame 410 having spaced arms 412 and 414 is pivotally mounted on the pin 408, a roller 416 being interposed between the pin and the frame 410 to carry the force exerted therebetween. On the forward ends of the arms 412 and 414 are the socket members 418 and 420 of a ball and socket joint, the ball portion 422 being carried by a post 424 which is adjustably and removably attached to the core 396.

The arms 412 and 414 are provided with a series of holes 426, in one of which is located a pin 428 forming a pivotal connection between the arms and a pair of links 430. One end of each of the links 430 is pivoted to a bracket 432 mounted on the T-shaped track 434 provided on the upper side of the movable head or platen 112. The bracket 432 is held in laterally-adjusted position by a bolt 436. The other ends of the links 430 are pivotally connected by a pin 438 to one end of a link 440 whose other end is pivoted on the cross-pin 406.

The full lines in Figure 12 indicate the position of the parts when the platen 112 is in its rearward position. As the platen is moved forward the frame 410, with its arms 412 and 414, are swung downwardly into the dotted line position indicated in this figure. As they swing downwardly the core 396 is moved into the die. As the movable platen 112 approaches the forward limit of its movement a pin 442 connecting the forward ends of the arms 412 and 414 engages in the inclined slot 444 of a bracket 446 mounted on the T-shaped track 448 carried by the upper edge of the stationary platen 82. The bracket 446 is held in any laterally-adjusted position by bolt 450.

During the injection of the metal into the die the slot 444 assists in holding the core 396 in place against the force exerted thereon by the injected metal. When the movable platen 112 starts its rearward movement, the pin 442 is first drawn out of the inclined slot 444. The inclination of this slot causes an outward movement of the core 396 and materially assists in breaking any bond which may have been formed between this core and the die casting. As the movable platen 112 continues its rearward movement, the various parts of this core pulling mechanism assume the position shown in full lines in Figure 12 and the core 396 is completely withdrawn from the casting 392.

The horizontal core 394 is secured to the movable part 120 of the die, as, for example, by bolts 452, so that this core is removed from the casting by ejecting the casting from the movable part 120 of the die. The dies are so designed that when the two parts of the die are separated the casting adheres to the movable part of the die and some means must be provided for ejecting the casting therefrom. This means is another feature of my invention.

The casting 392 is ejected from the part 120 of the die by pins 454 extending through suitable openings provided in this part of the die. The pins are attached to a head 456 mounted on one end of a rod 458. The rod 458 is guided by the die box and has a T-shaped end which engages in a vertical T-shaped slot 460 formed in a coupling member 462. The coupling 462 is mounted on one end of a rack bar 464 slidably carried in a housing 466 vertically adjustable on a frame 468 secured to and movable with the platen 112.

The rack bar is held against rotation by a stud 470 engaging in a longitudinal groove formed in the upper surface of the rack bar. The rack bar may be reciprocated by a pinion 472 mounted on a shaft having a squared end for engagement by a hand crank. I prefer, however, to eject the casting automatically where the nature of the casting makes this feasible. For this purpose I attach a frame 474 to the forward edges of the side portions of the casting 60 and on this frame 474 I adjustably mount a stop plate 476 adapted to be engaged by a screw 478 adjustably secured in the adjacent end of the rack bar 464.

When the machine is originally set up for making any particular casting, the screw 478 will be adjusted to project the proper length from the rear end of the rack bar 464 so that, as the platen 112 moves backwardly to separate the two parts of the die, this screw 478 will engage the stop 476 and eject the casting from the movable part 120 of the die. It will, of course, be understood that the particular casting shown cannot be ejected from the die until after the core 396 has been withdrawn therefrom, and the adjustment of the screw 478 must take into account this necessary timed relationship. In some instances I prefer to complete the ejection of the casting by hand. In such instances the screw 478 is so adjusted that, as the platen 112 completes its rearward movement, the casting will only be partially ejected by the engagement of this screw with the stop 476 and thereafter the ejection of the casting can be completed by manual rotation of the pinion 472.

In setting up the machine the parts of the die are clamped to the platens 82 and 112 and the platen 82 is then adjusted both vertically and longitudinally so as to bring the gate of the die against the nozzle of the metal injecting mechanism. The bolts 314 are then secured in place to hold the gate firmly clamped against this nozzle. While no water circulating means for

cooling the two parts of the die has been shown, it will be understood that the usual water attachments are provided to circulate water through the parts of the die.

The core pulling mechanism is attached to the core **396** and properly adjusted so that the automatic operation of the machine completely withdraws this core. The particular casting shown as being made by the machine as set up in Figures 1 to 12 of the drawings has only a single core to be laterally withdrawn, and I have accordingly shown only a single core puller attached to the top of the machine. The stationary platen **82** has a pair of side tracks **480**, and the movable platen **112** has a similar pair of side tracks **482**, whereby additional core pullers may be attached to either or both sides of these platens whenever desirable. The screw **478** of the casting ejecting mechanism is also adjusted to produce the desired ejecting action.

When the metal in the pot **306** has been brought to the appropriate temperature, the burner **320** is lighted and the machine is ready to operate. The motor **126** is started and the clutch control handle **216** is moved to engage the clutch collar with the driving pulley **130**, whereupon the cam shaft **170** commences to rotate and the cam **174** moves the platen **112** to close the two parts of the die. As the platen **112** moves forwardly, the casting ejecting pins **454** are retracted until they lie flush with the forward face of the depression in the movable part **120** of the die. Also during the forward movement of the platen **112** the core puller is moved downwardly to move the core **396** into the die and the pin **442** on the forward end of the core puller is locked in the slot **444**.

As soon as the die has been closed the air control cam **372** operates the air valve **330** to admit high pressure air to the upper side of the piston **326**, thereby moving this piston and its associated plunger **324** downwardly and injecting metal into the die under approximately 2500 pounds pressure. As soon as the air control cam **372** has moved far enough to release the air valve **330**, one of the stops **262** engages the clutch shifting rod **266** and disengages the clutch from the driving pulley. The clutch springs **258** draw the clutch collar over into engagement with the brake **154** which stops the machine and locks it in stopped position, but before the machine has been stopped the stop dog **262** has moved past the end of the rod **266**, thereby permitting restarting of the machine by the clutch control lever **216**. As soon as the air valve **330** has been released it returns to normal position, thereby admitting low pressure air to the cylinder **328** and returning the piston **326** and plunger **324** to their upper positions. This relieves the pressure on the metal in the cylinder **308** and the metal in the nozzle flows back into this cylinder.

After a brief wait to permit sufficient cooling of the casting, the operator again moves the clutch control lever **216** to reengage the clutch with the driving pulley, whereupon the cam **174** retracts the movable platen **112**. The initial part of this retractile movement causes the pin **442** in the forward end of the core puller to move upwardly in the inclined slot **444** and break any bond which may have been formed between the core **396** and the casting. Continued movement of the platen **112** swings the core puller to the full line position shown in Figure 12, thereby completely withdrawing the core **396** from the casting.

After the core **396** has been withdrawn from the casting, the screw **478** on the casting ejecting mechanism engages the plate **476**, whereupon the ejecting pins **454** are prevented from moving backwardly with the part **120** of the die and as this die moves backwardly with the platen **112** the casting is ejected therefrom and falls either into a suitable receptacle located therebeneath or into the hands of the operator. As soon as the platen **112** has reached the limit of its rearward movement, the other stop **262** disengages the clutch from the driving pulley and again stops the machine, thus completing the cycle of operation. In this position of the machine the exposed surfaces of the dies may be cleaned by the operator before the next casting is made.

Where the machine is being used to make light castings which require no appreciable time to cool, and where it is not necessary to clean the surfaces of the die between successive castings, the stops **262** may be eliminated and the machine may be operated continuously to make any desired number of castings without stopping. On the other hand, where the nature of the casting so requires, additional stops may be provided to further break up the automatic periods of operation of the machine.

In Figure 13 I have shown a modified type of high-pressure injecting mechanism. In this form of injecting mechanism there is bolted to the top of the furnace **36** a casting **484** having a hollow cylindrical portion **486** constituting a hollow piston. To the upper end of this hallow piston **486** is threaded a nozzle **488** comprising a single element having a rounded nose which contacts with the gate **290** of the die. The nozzle has an external shoulder **490** which is engaged by a plate **492** bolted or otherwise secured to the platen **82** whereby the end of the nozzle is maintained firmly clamped against the gate **290**. The nozzle **490** may be surrounded by a cover **494** provided with an opening **496** through which a suitable burner pipe may be inserted to maintain the nozzle at a high temperature as described more fully in connection with the previous embodiment of my invention.

The structures of the hollow piston **486** and cylinder **498** are particularly advantageous where it is desired to make these parts of especially hard material, such as Nitraloy, which I have found to be a desirable material for making these parts as well as for making nozzles, sleeves, rollers and bearing parts.

Located in the bottom of the pot **306** is a reciprocable cylinder **498** having a port **500** which is normally open. The cylinder is carried by rods **502** secured to a head **504** pivotally attached to the lower end of the piston rod **506** connected to the piston **326** in the cylinder **328**. The air valve **330** for controlling the admission and exhaust of air to the opposite ends of the cylinder **328** is identical with the air valve described in connection with the previous embodiment. In this modification, however, the high pressure air is admitted to the lower end of the cylinder **328** and the low pressure air is admitted to the upper end of this cylinder. In this modification the piston **326** is normally located in the lower end of the cylinder.

When the air valve **330** is operated by its control mechanism in the manner previously described, high pressure air is admitted to the lower end of the cylinder **328** and the upper end of the cylinder is connected to atmosphere. The piston **326** is moved upwardly and carries with it the cylinder **498**, thereby injecting metal under high pressure into the die. The relative areas of the

cylinder 328 and the cylinder 498 may be selected to give the desired pressure on the metal injected into the die. I have found that where a 500 pounds air pressure is used in the cylinder 328 excellent results are obtained where the area of the cylinder 498 is one-fifth of that of the cylinder 328, although it will be understood that other pressures and ratios of area may be used when desired.

In Figures 14 and 15 I have shown my die casting machine arranged in vertical position and utilized in connection with metal injecting mechanism of the gooseneck type. In these figures I have shown the casting 60 pivoted about its support on the blocks 48 and 54 so that the base portion of the casting 60 rests upon the floor of the shop. The stationary platen 82, movable platen 112, and their cooperating mechanism, are the same as that previously described. In this form of my invention the rails 34 of the previous embodiment have been dispensed with, and the furnace 36 is mounted directly upon the guides 46 carried on the upper ends of the uprights 20 and 22.

A frame 508 is bolted to the upper ends of the rods 74, the other end of this frame being supported on a post 510 resting upon the furnace 36. The frame 508 has upstanding sides 512 and 514, each of which contains a cam slot 516 forming guides for a transverse rod 518, to the ends of which are attached arms 520. The lower end of each arm 520 has an opening 522 in which a collar 524 is adjustably secured by a screw 526. Each collar 524 pivots upon a pin 528 attached to one side of the movable platen 112.

The arms 520 have lateral extensions 530 carrying a transverse pin 532 to which is pivoted the ear 534 of a gooseneck 536. This gooseneck includes a second ear 538 pivoted to a pin 540 supported by a pair of adjustable links 542 pivoted on a rod 544 mounted in the frame 508. A second pair of adjustable links 546 connect the pins 540 and 532 and relieve the gooseneck 536 of any strain.

The gooseneck 536 is supplied with air under high pressure through a swivelly jointed pipe 548 leading from the valve 330 which is identical with the valve shown in Figures 9 and 10. In this embodiment the high-pressure air under approximately 500 pounds pressure to the square inch, is supplied through the pipe 346, and its admission to the gooseneck through the jointed pipe 548 is controlled in the manner previously described, through the actuation of the valve control rod 550. In this embodiment of my invention there is no need for a low pressure air supply. However, I prefer to connect the valve 330 with a container of low pressure air by means of a pipe 332, as in the previous embodiment of my invention, so that some of the air exhausted from the gooseneck 536 may be conserved and utilized for other purposes about the shop. The valve outlet which in Figures 9 and 10 is shown as being connected with a pipe 344, is plugged up when the valve is used in connection with the embodiment shown in Figures 14 and 15 of the drawings.

A feature of this form of my invention lies in the means provided to prevent accidental operation of the air valve when the machine is in open position. To this end I attach the lower end of the valve control rod 550 to one end of a lever 552 pivoted at 554 on a pin carried by a bracket 556 carried by the cap 184 of the main cam follower. The other end of the lever 552 is provided with a removable cam follower roller 558 which engages the air controlled cam 372. The forward end of the lever 552 is also adapted to be engaged and moved to valve actuating position by a link 560 controlled by a handle 562, whereby the admission of air to the gooseneck 536 may be manually controlled. When manual control of the air is to be used, the automatic control is eliminated by removing the cam follower roller 558.

When the machine is in the closed position shown in Figures 14 and 15 of the drawings, the roller 558 is in position to be engaged by the air control cam 372. Also the end of the lever 552 overlies the link 560 whereby the air valve may be manually controlled by the handle 562. However, when the machine is in open position, the end of the lever 552 carrying the roller 558 is moved away from the control cam 372 and also from the link 560, as indicated by dotted lines in Figure 14, whereby the air valve cannot be opened either by the cam or by the handle when the machine is in open position. This safety feature prevents accidental operation of the air valve by the machine operator when the two parts of the die are separated. It also prevents untimely operation of the air valve by an air control cam which may have slipped on its shaft or which may have been incorrectly timed when the machine was assembled.

In Figures 14 and 15 the clutch control handle 216 is attached to a control shaft 563 which is pivoted in a bracket 564 carried by a bar 566 bolted to the side portions of the casting 60. Also attached to this bar is one end of a heavy spring 568 whose other end is attached to an angle iron 570 secured to the link 214 of the toggle mechanism, whereby the roller 190 is pressed against the main cam 174. This spring 568 cushions the downward movement of the platen 112.

The operation of the mechanism shown in Figures 14 and 15 of the drawings is essentially the same as the operation of the embodiment shown in Figures 1 to 12, inclusive. When the movable platen 112 is moved downwardly, the gooseneck 536 is moved to the left, as viewed in Figure 14, and drops down into the pot 572 containing the molten metal which may be either aluminum or zinc. As the gooseneck 536 reaches the lower end of its movement, a fresh supply of metal enters the gooseneck through its nozzle 574. Upon the following upward stroke of the platen 112 the gooseneck is raised to the position shown in Figures 14 and 15, in which position the nozzle 574 is firmly held against the gate in the die. The air valve 330 is then tripped to admit high pressure air directly upon the top of the metal in the gooseneck 536, whereupon this metal is forced into the die. The pressure is then relieved, completing the cycle of operation.

In Figure 16 of the drawings I have shown my machine arranged with the movable frame in a substantially horizontal position. In this figure I also use a movable gooseneck for feeding the metal into the die. The machine, as arranged in this figure, is particularly adapted for the making of die castings of aluminum and its alloys.

In the form shown in Figure 16, the stationary platen 82 is carried by a pair of supports 576 pivoted upon the projecting ends of a rod 578 mounted in the side rails 580 which support the furnace 36. The gooseneck 582 is of a different type from that shown in Figures 14 and 15 and has a nozzle 584 which engages a gate located in

the lower surface of the die. The gooseneck 582 is bolted to a frame 586 pivoted on a post 588 attached to a bracket 590 secured to the rear of the furnace 36.

The actuating mechanism for raising and lowering the gooseneck 582 comprises a cam 592 mounted on the main cam shaft 170 adjacent the air control cam 372. The cam 592 is of the uniform diameter type and is contacted by opposed rollers 594 and 596 carried by cam follower 598 pivoted at 600 on the casting 60. The cam follower 598 is connected to one end of an adjustable link 602 whose other end is connected to an arm 604 keyed to a shaft 606 extending through the furnace supporting rails 580.

A second arm 608 is keyed or otherwise non-rotatably attached to each end of the shaft 606, each arm 608 being pivoted to a yoke 610. Each yoke carries a screw 612 extending through the sleeve portion 614 of a link 616 pivoted at 618 to the gooseneck supporting frame 586.

An exceedingly heavy spring 620 surrounds each screw 612 and is adjustably confined between the sleeve portion 614 of a link 616 and a nut 622. In the ordinary operation of the machine the springs 620 do not yield or yield only to a very slight extent to prevent breakage of the machine in case a drop of solidified metal or other obstruction becomes interposed between the nozzle 584 of the gooseneck and the gate of the die.

In order to relieve wear on the cam shaft 170 and its supporting bearings, I preferably provide means for balancing the weight of the gooseneck 582. In Figure 16 this balanced means is shown as a tension spring 624 connecting the arm 604 with the cross-pin 578.

The air is admitted into the upper end of the gooseneck 582 through a swiveled pipe 626 which connects with a source of high pressure air supply through an air valve which may be of any desired type but which is preferably the air valve shown in detail in Figures 9 and 10 of the drawings. This air valve is controlled through the rod 628 connected to one end of a bell crank lever 630 pivoted on a side rail 580 and actuated through a pull rod 632 connected to one end of a lever 634 pivoted on the upright 20 and having its other end engaging the air control cam 372.

I have found that aluminum is particularly apt to splash into the air supply pipe of the gooseneck and that such splashing will in time eventually seal the air supply line to the gooseneck. In order to avoid this I provide the structure shown in Figure 17 of the drawings. The air supply line 626 is attached to a fitting 636 threaded into the upper end of the gooseneck 582. The lower end of the fitting 636 is of reduced diameter and is provided with diagonal passages 638 which connect the pipe 626 with the passage 640 formed in the upper end of the gooseneck.

This passage 640 is provided with an internal rib or shoulder 642 located a short distance below the lower end of the fitting 636, and this rib prevents the molten metal from splashing up into the space between the reduced lower end of the fitting 636 and the adjacent wall of the passage 640. The downwardly directed lower end of the fitting 636 is hemispherically concave, as indicated at 644, to direct away from the diagonal passages 638 any metal which may splash up against this surface. This particular arrangement of baffles for preventing clogging of the air inlet pipe, due to splashing of the molten metal, has proved to be exceedingly effective in use.

The mode of operation of the embodiment shown in Figure 16 is essentially the same as the mode of operation of the embodiment shown in Figures 14 and 15. It will therefore be unnecessary to describe in detail the operation of the mechanism shown in Figure 16.

An important feature of my die casting machine lies in its adaptability for making various types of castings using different metals having different melting points and injected under different pressures. The design of my machine is such that any of the desired adjustments may be made without disturbing the fundamental relationships of the mechanism. Furthermore, the machine may be operated continuously or any desired combination of automatic operation and hand control can be obtained by the utilization of a few simple stops which can be easily attached and detached or rearranged at will.

While I have shown several arrangements of my invention, it is to be understood that my invention is not limited to the specific arrangements shown and, furthermore, that my invention is not limited to the specific details of construction shown in the drawings and described in the specification. My invention may assume various forms and the scope of my invention is to be limited solely by the following claims.

I claim:

1. In a die casting machine of the class described, the combination of a frame, a stationary platen provided thereby, a second platen movably mounted on said frame, said platens adapted for attachment of die parts thereto, means for reciprocating said movable platen, and a core puller mounted on said frame, said core puller including a core-carrying member pivoted on said frame, a link pivotally connected to said member and said movable platen whereby movement of said platen causes said core puller to insert and withdraw a core.

2. In a die casting machine of the class described, the combination of a frame providing a stationary platen, a second platen movable on said frame, means for reciprocating said last-named platen, said platens adapted to have die parts attached thereto, a core puller mounted on said frame, said core puller including a member pivoted on said frame, a link pivotally connected to said member and said movable platen for moving said member, and means associated with said stationary platen for rigidly clamping said core puller to resist the force exerted when metal is injected into a die attached to said platens.

3. In a die casting machine of the class described, the combination of a frame, a movable platen carried thereby, means for reciprocating said platen including a source of power, a cam shaft, a jaw clutch for connecting said shaft with and disconnecting it from said source of power, a stop rotatable with said shaft for initiating disengagement of said clutch, and spring means for completing the disengaging movement of said clutch.

4. In a die casting machine, the combination of a frame, a movable platen mounted thereon, a cam for reciprocating said platen, a cam follower for said cam, said cam follower being connected to said platen, said cam follower including spaced rods, a cam shaft passing between said rods, and a guide pulley carried by said shaft and having flanges engaging said rods to prevent axial displacement of said cam follower.

5. In a die casting machine, the combination of a pair of relatively movable platens, means for

reciprocating one of said platens including a cam, a cam shaft, and a cam follower, said platens being adapted for the attachment of a die thereto, air operated means for injecting metal into said die, an air valve for controlling said means, a second cam on said shaft for operating said air valve, and an air valve cam follower mounted on said first-mentioned cam follower so that said air valve cam follower is out of contact with its cam when the dies are open.

6. In a die casting machine having a pair of platens adapted to have a die secured thereto and air operated means for injecting metal into said die, the combination of an air valve controlling said means comprising a first port connected with a source of high pressure air, a second port through which high pressure air is supplied to said metal injecting means, a third port connected to a vessel containing low pressure air, a valve controlling said first-mentioned port, means for opening said valve, a piston including a second valve for cutting off communication between said first and third ports while said valve is open, said second valve permitting flow of air from said second port into said third port, and means for operating said valve.

7. In a die casting machine including a pair of platens adapted to have a die secured thereto, and metal injecting means comprising a cylinder adapted to be filled with metal, a plunger for forcing the metal from the cylinder into the die, a second cylinder, an air operated piston in said second cylinder, and means connecting said two pistons, the combination of an air valve, pipes connecting said air valve with sources of high and low pressure air, a pipe connecting said air valve with each end of said cylinder, a valve member for cutting off communication between said air valve and said source of high pressure air, a piston in said air valve movable to open said valve member to admit high pressure air to one end of said cylinder, means provided by said piston for simultaneously venting the other end of said cylinder, means for establishing communication between said end of the cylinder and the source of low pressure air during a part only of the return stroke of said piston, and means including a passage in said piston for maintaining the other end of said cylinder normally in communication with said source of low pressure air.

8. In a die casting machine having a pair of platens adapted to have a die secured thereto, metal injecting means including a nozzle, means for clamping said nozzle against a part of said die, a cylinder from which said nozzle is supplied with molten metal, a plunger in said cylinder, an air cylinder having a cross-section approximately five times that of said first-mentioned cylinder, a piston in said air cylinder, and a rod connecting said piston and plunger, the combination of an air valve connected to a source of low pressure air and also connected to a source of high pressure air, a connection from said air valve to each end of said cylinder, means normally closing communication between said source of high pressure air and said air valve, means normally maintaining communication between said source of low pressure air and one end of said cylinder, a piston movable in said cylinder to cut off said last-mentioned communication and to open communication between said source of high pressure air and the other end of said cylinder, means for venting the first-mentioned end of said air cylinder during the admission of high pressure air to the other end thereof, said valve piston movable upon its return stroke to permit cutting off of the supply of high pressure air to said valve and to vent a part of the high pressure air supplied to said air cylinder into said source of low pressure air, and means for reciprocating said air valve piston.

9. In a die casting machine including a pair of platens adapted to have a die attached thereto, means for feeding metal to said die comprising a cylinder adapted to be filled with molten metal and a plunger for expelling the metal therefrom, and means for reciprocating said plunger including an air cylinder having a piston therein connected to said plunger, the combination of air valve means including a body having a chamber therein, a first port connecting said chamber with a source of high pressure air, a valve for closing said port, a second port leading to one end of said cylinder, a third port leading to the opposite end of said cylinder, a fourth port leading to a source of low pressure air and a fifth port leading to atmosphere, a piston reciprocable in said chamber, said piston having a passage normally maintaining said third and fourth ports in open communication, said piston being movable first to cut off communication between said third and fourth ports and thereafter to open said valve to admit high pressure air to said chamber and simultaneously to connect said third and fifth ports, said piston forming a barrier across said chamber between said second and third ports, and a one-way valve carried by said piston for permitting discharge of air through said second port into said fourth port and thence to the source of low pressure air.

10. In a die casting machine, the combination of a stationary platen, a movable platen, said platens being adapted to have a die attached thereto, a cam shaft, a cam thereon, a cam follower for said cam connected to said movable platen, driving means for said cam shaft including a clutch and means for shifting said clutch including a pivoted stop rotatable with said cam shaft, said stop having a pair of opposed inclined surfaces for engaging a cooperating element, a spring for rotating said stop about its pivot in the direction of rotation of said cam shaft, and shoulders limiting rotation of said stop under the influence of said spring and also under the influence of a cooperative element engaged thereby.

11. In a die casting machine, the combination of a base including a pair of uprights, an adjustable block slidably supported by each upright, a frame pivotally mounted on said blocks, said pivotal mounting including a casting in which a driving shaft is journalled, a driven shaft carried by said frame, gears connecting said driving and driven shafts, a pair of platens on said frame, a cam on said driven shaft for reciprocating one of said platens, a motor on said frame, a clutch for connecting said motor with said driving shaft, a clutch control rod slidably mounted in said casting, a plate adjustably attached to one of said gears, a stop member pivoted on said plate, said stop member having a pair of tapered ends for engaging a tapered end of said clutch control rod, means for limiting pivotal movement of said stop member, and a spring for biasing said stop member in the direction of rotation of the gear by which it is carried.

12. A die casting machine comprising a pair of platens adapted to have a die secured thereto, said die including a gate, metal feeding means including a horizontally extending nozzle, means for clamping said nozzle against said gate, means

for supplying metal under pressure to said nozzle and die, and means for maintaining said nozzle hot including a removable cover, a burner located between said cover and said nozzle, and means extending through said cover for supplying fuel to said burner, said cover causing the products of combustion from said burner to flow along said nozzle in a generally horizontal direction but permitting said products to escape adjacent a furnace containing said supply means, said cover providing a return for any metal escaping from said nozzle.

13. In a die casting machine of the class described, the combination of a frame including a stationary platen, a movable platen, means for moving said movable platen vertically, said means including a cam, a cam follower having a roller on each side of said cam, sets of toggles controlled by said cam follower, a link connecting said sets of toggles, driving means for said cam, and a balancing spring connecting to said link with said frame for offsetting the weight of said movable platen.

14. In a die casting machine having die carrying means, a gooseneck for supplying metal to said die, and a pipe through which air is supplied to said gooseneck, a fitting interposed between said pipe and said gooseneck, said fitting including a reduced lower end adapted to extend in spaced relation into a straight bore in said gooseneck, said reduced lower end having diagonal passages establishing communication between the interior of said gooseneck and said pipe, and an annular internal rib in said bore protecting said diagonal passages against splashing metal.

15. A die casting machine of the class described, comprising a base, a frame pivoted thereon, said frame including a stationary platen, a movable platen slidable on said frame, said platens adapted to have secured thereto the parts of a die, a cam shaft carried by said movable frame, a cam on said shaft for reciprocating said movable platen, driving means for said cam shaft extending through the pivotal mounting of said frame, and means for shifting said frame about its pivotal mounting.

16. A die casting machine of the class described, comprising a base, a frame pivoted thereon, said frame including a stationary platen, a movable platen slidable on said frame, said platens adapted to have secured thereto parts of a die, operating means for said movable platen carried by said pivoted frame, driving means for said operating means extending through the pivotal mounting of said frame, and means for shifting said frame about its pivotal mounting.

17. In a die casting machine of the class described, the combination of a frame, a stationary platen provided thereby, a second platen movably mounted on said frame, said platens adapted for attachment of die parts thereto, means for reciprocating said movable platen, and a core puller mounted on said frame, said core puller including a pair of spaced rods pivoted at one end to said frame, core carrying means universally connected to the other end of said rods, and an adjustable link connecting said rods with said movable platen whereby movement of said platen causes said core puller to insert and withdraw a core.

18. In a die casting machine of the class described, the combination of a frame, a movable platen carried thereby, means for reciprocating said platen including a source of power, a cam shaft, a clutch for connecting said shaft with and disconnecting it from a source of power, said clutch including a sleeve having teeth at both ends thereof, said source of power including a rotating member having teeth for engagement with the teeth of said clutch, a stop rotatable with said shaft for initiating disengagement of said clutch, a brake having teeth adapted to be engaged by said clutch, and resilient means for completing disengagement of said clutch from said source of power and moving said clutch into engagement with said brake.

19. In a die casting machine, the combination of a frame, a pair of platens adapted to have a die attached thereto, means for moving one of said platens, a core puller comprising a rod pivoted at one end on said frame, a pair of pivoted links having one end pivoted to said frame and the other end pivoted to said movable platen, a pivotal connection between said links and said rod, and means for attaching a core to the free end of said rod.

20. A die casting machine of the class described, comprising a base, a frame pivoted thereon, a pivotal mounting for said frame, permitting movement of said frame through an arc of greater than 90 degrees, said frame including a casting having a portion adapted to rest upon the floor when said frame is in a pre-determined position, and sides extending from said portion and connected to said pivotal mounting, said frame also including four rods attached to said casting and a stationary platen, a movable platen slidable on said rods, said platens adapted to have secured thereto the parts of a die, a cam shaft mounted in said sides, a cam on said shaft for reciprocating said movable platen, and driving means for said cam shaft, including a driving shaft supported by said base and passing through said pivotal mounting.

21. In a die casting machine of the class described, the combination of a frame providing a fixed platen, a movable platen mounted on said frame, a cam for reciprocating said movable platen, a cam follower for said cam, said cam follower being connected to said platen and having an oscillatory motion induced by said cam, said cam follower including four spaced rods, a pair of said rods being located on each side of said cam, and a guide pulley on each side of said cam engaging a pair of said rods to guide said cam follower in its oscillatory movement and prevent axial displacement of said follower from said cam.

22. A die casting machine comprising a pair of platens adapted to have a die secured thereto, said die including a gate, metal feeding means including a nozzle means for clamping said nozzle against said gate, means for supplying metal under pressure to said nozzle and die, and a two-part cover enclosing said nozzle, a heating element located between said nozzle and said cover, and means including said cover providing a passage for return to said supply means of metal escaping from said nozzle.

ROY F. JOHNSON.