Jan. 3, 1933. O. B. NORGREN 1,893,301

DIE CASTING MACHINE

Filed Oct. 29, 1930 4 Sheets-Sheet 1

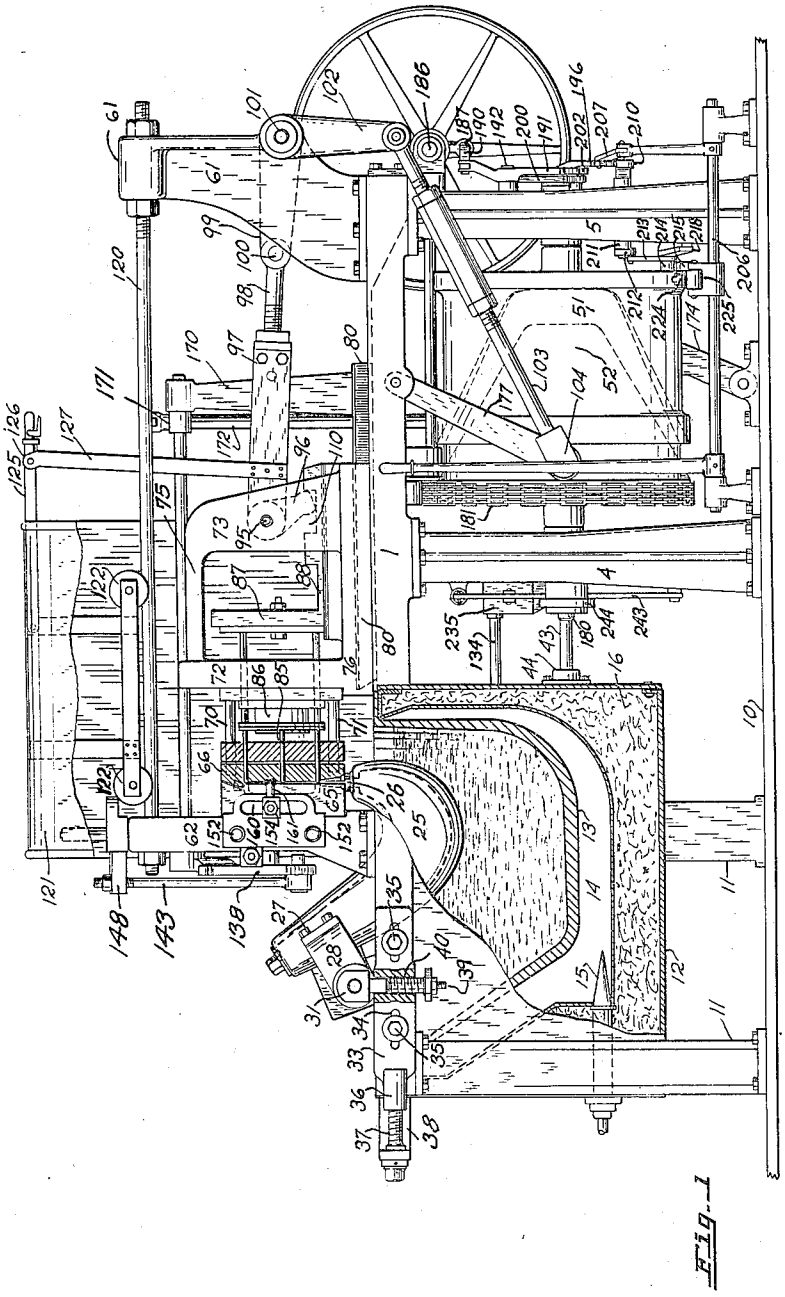


Fig. 1

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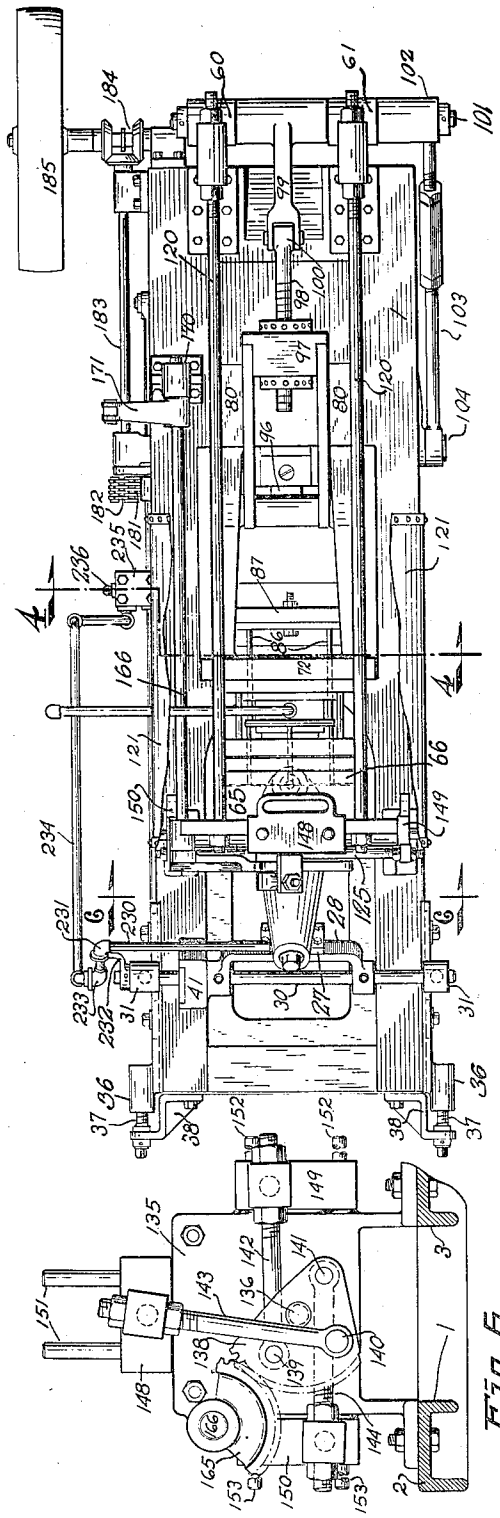


Fig. 2

Fig. 6

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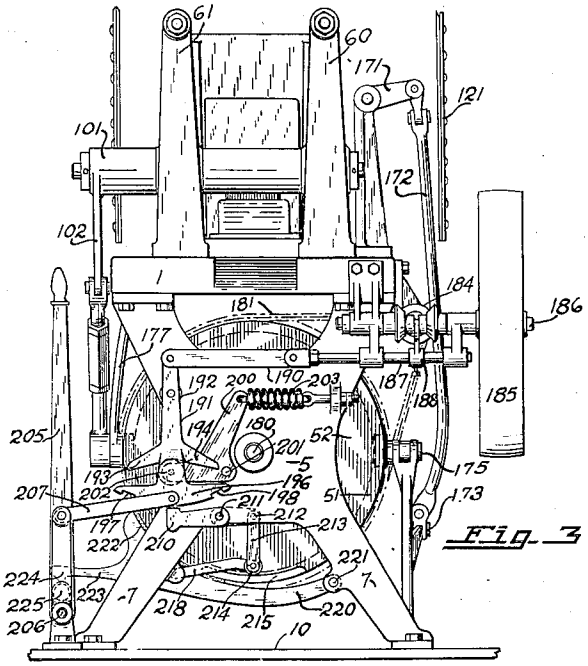


Fig. 3

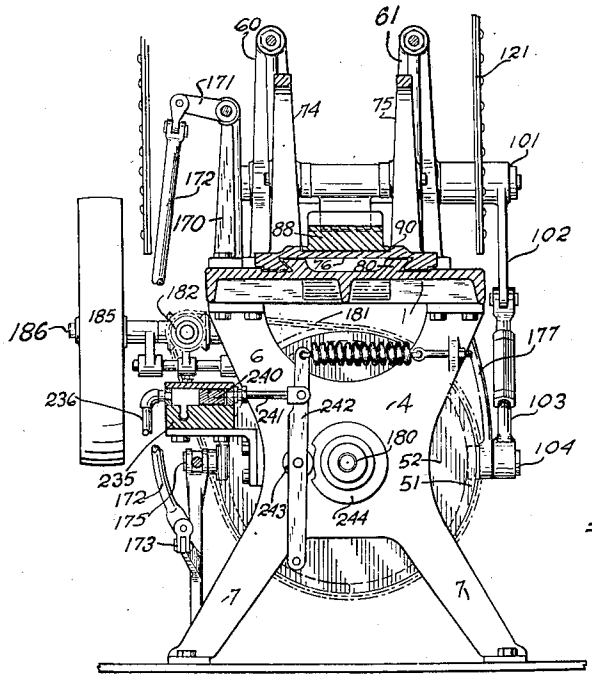


Fig. 4

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DIE CASTING MACHINE

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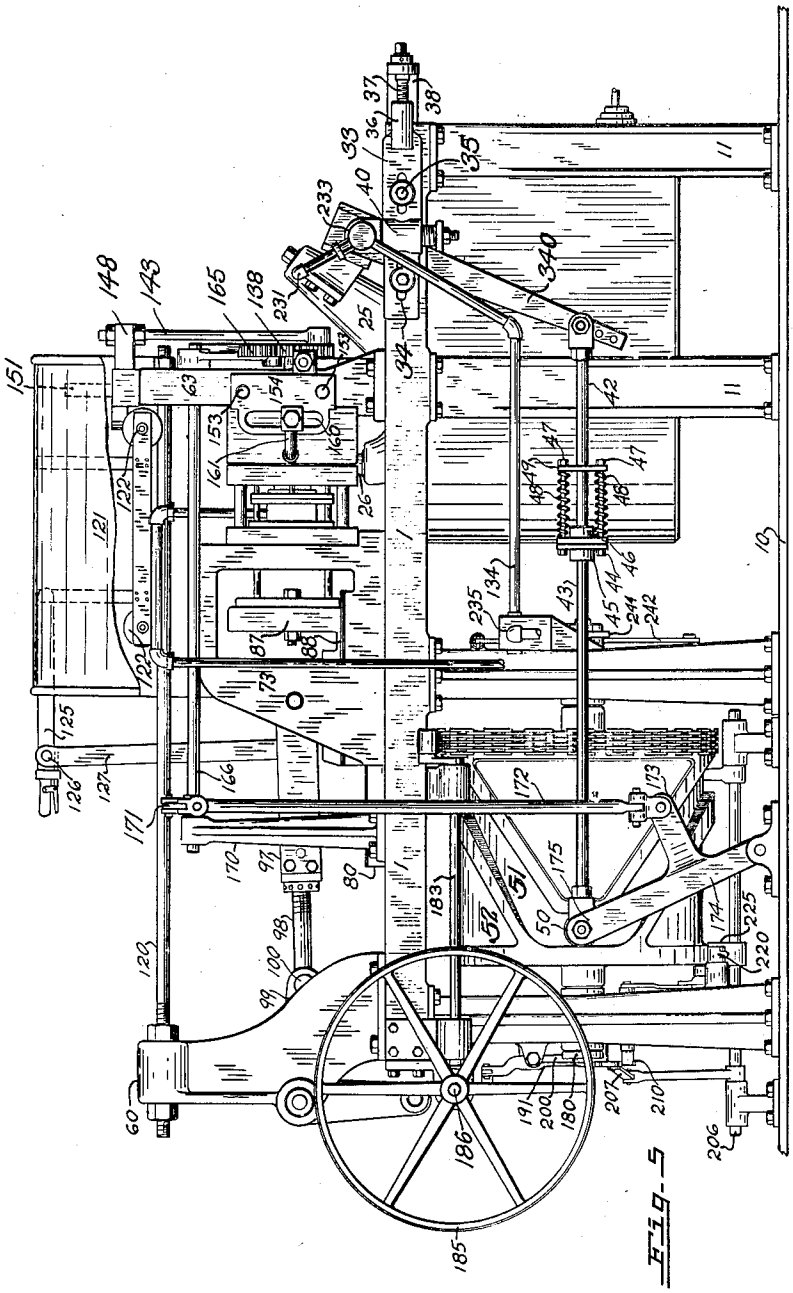


FIG. 5

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UNITED STATES PATENT OFFICE

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DIE CASTING MACHINE

Application filed October 29, 1930. Serial No. 491,882.

This invention relates to die casting machines, and particularly to the type of machine wherein a movable container travels from a stationary furnace to dies for injection of liquid metal therein. As is well known, such a machine is customarily provided with two or more relatively movable dies, which when closed form a mold. The customary gate is provided through which liquid metal is injected under pressure to fill the mold and solidify therein. Upon separation of the dies the casting may be removed with or without the aid of auxiliary instrumentalities, such as knock-out pins, all of which will later be described.

It is evident that a machine of this character has many of its parts exposed to high temperatures and high pressures and strains. Furthermore, the elevated temperature of the machine—which is invariably made of iron, steel or similar metal—is conducive to the interaction of such metal with the casting metals employed, such as aluminum and similar low melting alloys. The tendency for thermo-electric currents to cause corrosion is sufficient at such high temperatures to result in rapid wear of the machine. For the above reasons it is evident that a die casting machine should be simple, strong, have few parts and be easily adjustable.

In prior machines of the above type, it has been customary to have a multiplicity of levers, links and cams for operating the various portions of the machines. This invention is primarily concerned with a die casting machine, the number of whose parts has been reduced to a minimum.

In general this machine comprises a frame, from which is supported a stationary furnace adapted to contain a quantity of molten metal. Suitable heating means may be associated with said furnace to maintain said metal at a desired temperature. Above said furnace is mounted a mold consisting of a plurality of relatively movable dies. In order to transfer liquid metal from said furnace into said mold, a movable container, having a curved shape of well known design and hereinafter referred to as a goose neck, is provided. This goose neck is mounted in a simple, yet effective manner, so that it may oscillate between its two extreme positions. At one extreme position, a considerable portion of the goose neck is well below the surface of the molten metal, so that it may be filled through its nozzle with clean metal. Its other extreme position is with its nozzle abutting firmly against the gate of the mold, preparatory to injection of the metal from said goose neck into said mold.

For the ready removal of the casting, knock out pins, carried by a suitable plate, are provided. As is well known such pins project through one or more walls of the dies and form a portion of the mold surface at their tips. When the dies open such pins are moved inwardly against the casting relatively to the die walls, and tend to force the casting away from the die walls. In certain instances, core pins may be necessary during the casting operation. Such pins must be withdrawn from the casting, prior to the removal of the casting from the mold.

A principal feature of this invention, lies in the operation of the several instrumentalities by a single main cam. Obviously, an additional cam surface may be provided for any one, or more of these instrumentalities, where peculiar conditions exist without departing in any way from the spirit of this invention. The single cam is preferably provided with a pair of cam followers, each of which is angularly displaced with respect to the other. Each of said followers operates certain of said instrumentalities, as will be hereinafter described.

An additional feature involves the use of a hood inclosing the dies during the casting operation. This hood is automatically moved, so that at the completion of the casting operation, access to the casting may be readily had. This hood is also actuated by said cam during the die casting cycles. A separate cam is provided for controlling a high pressure air supply line to the goose neck. By virtue of the two cams every movement of various portions of the machine necessary for die casting is controlled.

Additional features of this invention are the operating means connecting the main

cam and the various instrumentalities operated thereby, as well as the goose neck mounting. Other features will be pointed out later as the description proceeds, and in the claims.

Referring to the drawings:

Figure 1 is a side view of the die casting machine, with certain portions shown in section.

Figure 2 is a top view looking down upon the machine.

Figure 3 is an end view looking at the power drive.

Figure 4 is a section taken along 4—4 of Figure 2.

Figure 5 is a side view similar to Figure 1, but from the other side.

Figure 6 is a detailed section on 6—6 of Figure 2 showing the core pin removing mechanism.

The machine comprises a frame, consisting of a bed 1, formed for a portion of its length into channel members 2 and 3 (Figure 6). Bolted to bed 1 are a plurality of legs 11 and spider-like castings 4 and 5 having a central solid body portion and radiating arms 6 and legs 7, as shown in Figures 3 and 4. Arms 6 are bolted to bed 1, while legs 7, together with legs 11, support the entire machine. The frame may be completed by a base 10, upon which the entire machine is supported.

Supported from the frame, preferably at one end thereof, between channels 2 and 3, is a furnace generally designated by numeral 12. This furnace consists of an iron, or similar pot 13, having a space 14 around the outside of it, and into which any suitable heating means, such as gas flames 15, may be disposed. Inclosing space 14 is a wall 16 of suitable heat insulating material inclosed by sheet metal.

Mounted above the furnace, and adapted to cooperate therewith, is an oscillatory container, or goose neck 25. This goose neck has the curved shape shown in the drawing, and is provided with an interior chamber terminating in a tapered nozzle 26. The goose neck itself is provided with bosses 27, cast to the rear portion thereof, to which is bolted a yoke 28, having suitably apertured journals. A rock shaft 30 passes through these journals, and serves as a center, about which goose neck 25 is adapted to swing.

Rock shaft 30 is supported at each end in journals 31, both of which are adjustably secured to channel members 2 and 3 of the frame. The adjustment is obtained by the provision of blocks 33, provided with elongated slots 34, through which suitable bolts 35 project. Bolts 35 are attached to channel members 2 and 3 and when loose permit blocks 33 to be adjusted in a horizontal direction.

As an aid to adjusting blocks 33, bosses 36 are provided at the rear ends of blocks 33. These bosses have threaded openings therein, into which bolts 37 project. These bolts are mounted in brackets 38, secured to the frame and permit bolts 37 to turn but not move lengthwise. It is clear that with bolts 35 loose, bolts 37 may be turned to adjust blocks to the desired position. By this provision the entire goose neck structure may be adjusted, both lengthwise and transversely of the machine in a horizontal plane. For vertical adjustment of goose neck 25, blocks 33 carry vertical bosses 40, into which journals 31 are adjustably mounted, by means of bolts 39. It is clear that by this mounting goose neck 25 may be universally adjusted to dispose nozzle 26 in desired position.

In order to impart oscillatory movements to the goose neck, a crank arm 340 is rigidly attached to one of the yoke journals, by means of block 41. Crank arm 340 is actuated by means of a link 42, suitably attached to the free end of crank 340.

Link 42 is preferably connected to another link 43, through a flexible shock absorbing coupling 44, of any suitable type and here shown as consisting of flat members 45 and 46, bolted to links 43 and 42 respectively. Member 45 carries two bolts 47 surrounded by coil springs 48. A yoke 49 joins the free end of the bolts. Member 46 is suitably apertured so that bolts 47 may slide therethrough. Obviously, springs 48 will tend to maintain members 45 and 46 in contact and will yield to permit members 45 and 46 to separate. Link 43 bears at its free end a cam roller 50 riding in a cam track 51 of a cylindrical cam 52.

Mounted on bed 1 is a super-structure consisting of standards 60, 61, 62 and 63, and forming a part of the frame of the machine. Between standards 62 and 63 there is rigidly mounted a supporting plate 135 (Figure 2) carrying a stationary die 65 having a suitable concave interior. Cooperating with stationary die 65 is a movable die 66, (Figure 1) which when disposed in abutting relationship to die 65 is adapted to form a mold for casting. The two dies are provided at the bottom, with corresponding halves of a tapering opening forming a gate and connected to the mold inside by suitable channels, all of which are well known. When dies 65 and 66 are closed, nozzle 26 of goose-neck 25, is adapted to make a snug fit with the gate.

In order to open the dies, movable die 66 is carried by bolts 70 and 71, rigidly mounted in a yoke 72. Yoke 72 is rigidly mounted on a carriage 73, comprising arched members 75 and 75 (Figure 4) joined by a bed member 76. Bed member 76 is adapted to slide on suitable tracks 80, provided in bed 1 of the frame. In this way carriage 73 may be moved back and forth horizontally along tracks 80, carrying movable die 66 therewith to open and close the mold chamber.

In order to expedite the removal of the

castings from the dies, expelling means in the shape of knock-out pins are provided in conjunction with die 66. These knock-out pins, shown as rods 85, (Figure 1) extend through suitable apertures in die 66, and are adapted to lie flush with the interior mold surface of die 66. Pins 85 are carried by a yoke 86, adjustably bolted to a second carriage 87. Carriage 87 is provided with a base 88, which is adapted to slide in suitable grooves 90 (Figure 4) of carriage 73. By this construction, carriage 87 slides on carriage 73, which itself may slide along the frame of the machine.

In order to move carriage 73, the rear portion thereof is provided with a transverse pin 95 (Figure 1). Pivotally mounted on this pin is a bell crank lever, having arms 96 and 97. Arm 97 is preferably provided with an adjustable extension 98 pivotally engaging arm 99 of a second bell crank lever. Extensions 98 and arm 99 are joined in toggle formation, by means of a pin 100. Arm 99 is pivotally mounted between standards 60 and 61, by means of a pivot pin 101, and terminates in another arm 102, which together with arm 99 forms a second bell crank lever. The free end of arm 102 is pivotally joined to an adjustable link 103 bearing a cam roller 104 at its free end. Cam roller 104 is adapted to cooperate with track 51 of drum 52.

It is evident that horizontal motion of cam roller 104 will tend to move carriage 73 and movable die 66 horizontally along the machine. In order to provide desired relative motion between the knock-out pins and die 66, the second carriage 87 has its base 88 provided with a transverse channel 110. Arm 96 of the first bell crank is adapted to operate in channel 110, and by pressure on the opposing side walls of the channel, moves second carriage 87 relatively to the main carriage. It is clear that at the very beginning of the travel of main carriage 73 in either direction, secondary carriage 87 is moved relatively to the main carriage in the opposite direction for a short distance. When secondary carriage 87 has reached its extreme position of movement, with respect to the main carriage, both carriages are then moved together. In this way when the dies are first opened, the knock-out pins are maintained against the casting while the movable die is traveling away.

In order to take up tensile strains induced in the frame of the machine, standards 60 to 63 inclusive, are connected by a pair of parallel tie rods 120. Along these rods is adapted to slide a projecting hood 121 on suitable rollers 122. A hood of this character is essential to a die casting machine, for the reason that there is always a small amount of metal blown out into the air, through nozzle 26. During the casting operation hood 121 is adapted to inclose the space around dies 65 and 66. In order to provide ready access to the casting, after the cycle has been completed, the hood is provided with a lever 125 adapted to engage pin 126 of a vertical rod 127. Rod 127 is suitably fastened to arm 97 of the bell crank lever, so that when arm 97 is displaced horizontally because of the bending of the toggle at pin 100, hood 121 is moved on its rollers along tie rods 120. In case it is desired to move the hood independently of the machine, arm 125 may be raised clear from pin 126.

As is well known, in some types of castings, it is necessary to have cores. In the case of die castings, it is essential that the cores be inserted into and removed from the dies during proper periods of each cycle. For this purpose the following mechanism has been provided.

Mounted on channel members 2 and 3, between standards 62 and 63, is the flat supporting plate 135, to which is bolted the stationary die 65. Rotatively mounted on plate 135, (Figure 6) by means of a pin 136, is a segmental gear 138. At eccentric points on gear 138, here shown as three in number, there are provided pins 139, 140 and 141. It will be noticed that pins 139 and 141 are on one side of gear 138, while pin 140 is on the other side for clearance purposes. Each of these three pins is provided with a suitable crank 142, 143 and 144. Each of these three cranks bears, at its end, cross heads 148, 149 and 150. These cross heads are adapted to slide on pins 151, 152 and 153, projecting outwardly from plate 135 and aligned in substantially one plane. Each of the three cross heads has a shoulder portion 154, (Figures 1 and 5) provided with an elongated slot 160. Core pins 161 may be adjustably bolted in these slots.

It is clear that upon oscillation of segmental gear 138, the various pins and cross heads will be suitably operated, so that any core pins attached thereto will be moved in to and out from the dies. The oscillation of gear 138 is effected through a segmental gear 165 meshing with gear 138, and mounted upon a rock shaft 166. Rock shaft 166 is suitably journaled in standard 63 and a standard 170 resting upon the frame of the machine. Rock shaft 166 is provided with a rocker arm 171, to which is pivoted a vertical link 172. Link 172 is pivotally mounted at its bottom end to arm 173 (Figure 5) of a lever 174. This latter lever is pivotally mounted at its free end to base 10 of the frame, and at its other end 175 it is provided with cam follower 50.

As cam follower 50 is moved in a generally horizontal direction, pivoted lever 174 will be turned, resulting in a vertical motion of link 172. This vertical motion of link 172

is translated into rotary motion of rocker shaft 166, and operates the core pins.

It is evident that all the motions of the various mechanical elements, heretofore described, are obtained from rollers 50 and 104. As is clearly evident these two cam rollers are disposed on opposite sides of the machine and cooperate with one cam track 51 on outer surface of drum 52. In order to steady cam follower 104, lever 177 pivotally mounted to the frame of the machine, is provided with its free end connected to the cam follower.

Cam drum 52 is mounted to rotate on a shaft 180, suitably journaled between spiders 4 and 5. It will be noted that the cam is mounted on a portion of the frame remote from the furnace and is therefore not exposed to high temperatures. Drum 52 has gear teeth at one end thereof and is adapted to be driven by a chain 181 driven from a sprocket 182. This sprocket is mounted on a stub shaft 183, suitably journaled in the frame and driven from any suitable two way clutch 184.

Clutch 184 is adapted to control the power applied to a pulley 185 mounted upon a jack shaft 186. In order to control the power, a rod 187 suitably journaled for sliding motion is adapted to operate clutch 184 through clutch lever 188. Rod 187 is joined at its free end to a lever 190, which is joined to another lever 191. This lever 191 is pivotally mounted at 192 to the machine and at its lower portion extends transversely of the lever to form two forked arms 193 and 194 having a concave cam surface.

Lever 191 also has an extension beyond these two arms in the form of a sector 196 having slots 197 and 198 disposed at each end of said sector.

A bell crank lever 200 pivoted to the frame of the machine at 201 carries a roller 202 at its free end adapted to co-act with the concave cam surface formed by the transverse arms 193 and 194. The other end of bell crank 200 is so biased by spring 203, suitably anchored to the frame of the machine, that roller 202 is tightly pressed against the cam surface. It is clear that because of the spring bias of bell crank 200, lever 191 will normally tend to maintain the position shown in Figure 3 so that roller 202 is at its highest vertical position.

In order to manually operate clutch 184 through the above described means, a hand lever 205 pivotally mounted at 206 to the base of the machine carries a link 207 which connects the hand lever and sector 196 together. By pushing or pulling handle 205 from its neutral position, lever 191 will be turned on its pivot 192 to change the position of clutch 184.

Associated with this power control is an automatic stop brake. The automatic stop comprises a lever 210 whose end is adapted to engage slots 197 or 198 in sector 196. Lever 210 is pivotally mounted at 211 on the frame of the machine and has rigidly joined thereto another lever 212 carrying a link 213. This link bears at its free lower end a lever 218 which is pivotally joined to a brake member 220. Member 220 is pivotally mounted to leg 7 of the frame at 221 and at its free end is provided with a friction surface 222. Brake member 220 also bears an extension 223 having a claw 224 which is adapted to co-act with a pin 225 on the handle 205.

Thus, when handle 205 is moved from its neutral position, lever 191 is turned on its pivot 192, moving rod 190 horizontally to operate clutch 184. When this occurs, drum 52 will begin to turn on its axle 180 by virtue of the sprocket connections between the cam drum and the clutch, previously described. When cam drum 52 has turned a few degrees, cam surface 215 on the edge of the drum will permit roller 214 to drop, thus permitting arm 210 to lock into one of the slots in sector 196. At the same time, brake member 220, which had previously been bearing against an outer surface of the cam drum, is permitted to clear said surface because of the movement of pin 225 on the handle 205 away from under claw 224.

The power control is thus locked in the running position until the machine has gone through a predetermined series of operations, at which cam drum 52 will bring cam surface 215 under roller 214 and force the latter upwardly. This will release arm 210 from one of the slots in sector 196 and permit spring 203 to pull roller 202, which had been depressed to its low position while the machine was running, to assume its normal position and force levers 191 and 190 to release clutch 184. At the same time brake member 220 will be pulled upwardly by lever 218 as well as by pin 225 on handle 205, which is also automatically caused to assume its neutral position.

In order to control the air supply to gooseneck 25, a pipe 230 (Figure 2) is tapped into the end of the gooseneck and disposed parallel to rock shaft 30. Pipe 230 is provided with an elbow 231 supported by bracket 232 mounted adjacent one of the journals 31. In order to permit pipe 230 and its elbow to oscillate back and forth with the gooseneck, a sliding connection 233 is provided. This connection leads to a length of stationary pipe 234 which goes to a suitable valve 235 mounted on the frame of the machine. A pipe 236 joins valve 235 with a high-pressure air supply (not shown).

In order to control valve 235 so that a blast of high-pressure air is released into the gooseneck at proper times, sliding block 240 of valve 235 is provided with an arm 241 joined to a pivoted lever 242. Pivoted

lever 242 carries a cam roller 243 adapted to co-operate with cam 244 mounted co-axial with drum 52 on axle 180 to rotate therewith.

The operation of the machine is as follows: Assuming that pulley 185 is suitably driven, handle 205 is pulled outwardly from the position shown in Figure 3. As previously pointed out, as soon as cam drum 52 begins to rotate, the power control, including the clutch, brake and leverage system controlling them is locked in the running position. Ordinarily, when at rest as shown in Figure 3, gooseneck 25 is in its lower position below the level of the liquid metal, while dies 65 and 66 are open. In this position hood 121 is clear of the space around stationary die 65, while the core pulling mechanism is in such a position that the cross heads and core pins are furthest away from stationary die 65.

In this normal position of rest, cam drum 52 is turned 180 degrees from the position shown in Figures 1 and 2. In this position, cam roller 104 controlling the movement of the dies, knock-out pins and hood is in the extreme right-hand position with reference to Figure 1 and is in the small straight portion of cam groove 51 disposed at the right-hand side of the drum. As soon as the drum begins to rotate, roller 104 begins to go down the inclined portion of cam groove 51, with the result that the roller is forced to travel in a generally horizontal direction to the left of the machine toward the furnace. Arm 102 of the second bell crank is turned in a clock-wise direction by means of link 103 and results in the toggle formed by arms 97 and 99 being straightened out from the bent position to the position shown in Figure 1.

As previously pointed out, this straightening of the toggle operates the various carriages to close the dies and knock-out pins and place the dies in position for receiving a charge of liquid metal.

In the meantime, roller 50 on the other side of the machine, which controls the movements of the gooseneck and core pins, begins to move from its extreme right-hand position, as viewed in Figure 5, toward the left. In its extreme right-hand position, assumed when the machine is in its normal idle position, roller 50 is in the straight vertical portion of cam groove 51. As roller 50 begins to move along the inclined portion of the cam groove, the gooseneck and core pins are suitably operated, as previously described. In the position shown in Figure 5 the gooseneck is disposed tightly against the gate of the dies, while the core pins are inserted within the die space. In this position of the machine, shown in Figures 1 and 4 to 6 inclusive, it will be noted in Figure 4 that cam 244 is so disposed as to permit lever 242 to be pulled to the right by the spring. In this position, valve block 240 permits high-pressure air to go to gooseneck 25.

It will be noted that in the position of the drum shown in Figures 1 and 5, a comparatively small range of angular motion of the drum 52 suffices for the actual casting operation. After this short period of time, in which the machine is in the position shown in Figures 1, 4, 5 and 6, as cam drum 52 continues to rotate, roller 50 begins to go down to the other inclined portion of cam groove 51, serving to reverse the motions of the gooseneck and core pin mechanism. The air supply at valve 235 has also been shut off at the end of this short interval. With continued rotation of drum 52, roller 104 begins to bear against the inclined portion of cam groove 51 and reverses the movement of the dies, knock-out pins and hood.

Due to the symmetrical nature of cam groove 51, it is evident that whether the machine is run forward or backward is of no consequence as far as the operating cycle of the machine is concerned. When the cam drum has made a complete revolution the power release mechanism and brake are automatically operated in the manner previously pointed out.

Thus, it will be seen that I have devised a die casting machine of relatively simple construction, having but few parts, of sturdy construction and capable of operating at a relatively high speed. It is clear that certain changes in construction are permissible without departing from the scope of this invention. Thus, the shape of any of the cams, particularly cam groove 51, may be varied to suit peculiar conditions. If desired, one or more additional cams may be provided to operate certain of the instrumentalities where conditions warrant. However, the machine illustrated in these drawings is my preferred embodiment and represents the most desirable structure from a commercial point of view.

Having described my invention in accordance with patent statutes, I claim:

1. In a die casting machine comprising a framework, a furnace supported thereon and adapted to contain a quantity of molten metal, a plurality of relatively movable dies, a gooseneck adapted to travel from said furnace to said dies and back again, knock-out pins associated with said dies and movable relatively thereto, a hood adapted to move back and forth and adapted to inclose the space around the dies during the casting operation, a cam having a single track, and means mechanically associated with and operated from said single track for moving said gooseneck, dies, knock-out pins and hood in desired sequence and relationship during a die casting cycle.

2. In a die casting machine comprising a framework, a furnace supported thereby and adapted to contain a quantity of molten metal, relatively movable dies, adapted to

open and close, knock-out pins associated with one of said dies, a hood adapted to inclose the space around said dies when in die casting position, a gooseneck adapted to travel from said furnace to said dies and back again, a cam having a single track thereon, means mechanically associated with said track for operating said gooseneck, additional means mechanically associated with said track for operating said dies, knock-out pins and hood, said additional means including a pair of bell crank levers arranged in toggle formation, one of said bell crank levers having a connection between one of its arms and said hood for moving it back and forth, said same bell crank lever having a lost motion connection for imparting motion to said knock-out pins relative to said dies.

3. In a die casting machine comprising a frame, a furnace supported by said frame, a plurality of relatively movable dies, a gooseneck adapted to travel from said furnace to said dies and back again, knock-out pins associated with one of said dies, core pins associated with said dies, a cam, and means mechanically associated with and operated by said cam for operating said gooseneck, opening and closing said dies, moving said knock-out pins relative to said dies and suitably withdrawing and inserting core pins within said dies during a die casting cycle.

4. In a die casting machine comprising a frame, a furnace carried thereby, relatively movable dies, knock-out pins associated with one of said dies, core pins associated with said dies, a gooseneck adapted to travel from said furnace to said dies and back again, a hood adapted to inclose the space around said dies during the casting operation and movable during the completion of the die casting cycle to permit access to said casting, a cam, and means mechanically associated with and operated by said cam for operating said gooseneck, dies, knock-out pins, core pins and hood during a die casting cycle.

5. In a die casting machine comprising a frame, a furnace carried thereby, relatively movable dies, knock-out pins associated with one of said dies, core pins associated with said dies, a gooseneck, a cam having a single track thereon, means including a cam roller cooperating with said track for operating said gooseneck and said core pins in desired sequence, means including an additional cam roller cooperating with said track for operating said dies, and a lost motion connection between said die operating means and said knock-out pins for moving the latter relative to said dies during the die casting cycle.

6. In a die casting machine comprising a frame, a furnace supported thereby, a plurality of relatively movable dies, knock-out pins associated with said dies and movable relatively thereto, a gooseneck adapted to travel from said furnace to said dies and back again, said gooseneck being adapted to be periodically connected to an air supply source for injection of metal into said dies, a movable hood adapted to inclose the space around said dies during the casting operation, a pair of cam tracks, and linkage means mechanically associated with and energized by said cam tracks for operating said dies, said knock-out pins, said hood, said gooseneck and controlling the air supply to said gooseneck.

7. In a die casting machine comprising a frame, a furnace supported thereby, a plurality of relatively movable dies, knock-out pins associated therewith and movable relatively thereto, a gooseneck adapted to travel from said furnace to said dies and back again, said gooseneck being adapted to be periodically connected to a high pressure air supply for injection of metal into said dies, core pins adapted to be inserted into and removed from said dies, a pair of cam tracks and linkage means mechanically associated with and energized from both of said tracks for operating all of said instrumentalities during a die casting cycle.

8. In a die casting machine comprising a frame, a furnace suported thereby, a plurality of relatively movable dies, knock-out pins associated therewith and movable relatively thereto, a gooseneck adapted to travel from said furnace to said dies and back again, said gooseneck being adapted to be periodically connected to a high pressure air supply line for injection of metal into said dies, core pins adapted to be inserted into and removed from said dies, a pair of cam tracks, means mechanically associated with and operated by one of said tracks for controlling the gas pressure to said gooseneck and means mechanically associated with and energized from the other of said tracks for operating the remaining instrumentalities during a die casting cycle.

9. In a die casting machine comprising a frame, a furnace supported thereby, relatively movable dies, knock-out pins associated therewith and movable relatively thereto, core pins insertable into and removable from said dies, a gooseneck adapted to travel from said furnace to said dies and back again, said gooseneck being adapted to be connected to a high pressure air supply for injection of metal into said dies, a pair of cams each provided with a single cam track, means associated with one of said cams for controlling said air supply, a pair of cam rollers cooperating with said other cam track, means associated with one of said cam rollers for operating said gooseneck and core pins and means associated with the other of said cam rollers for operating said dies and knock-out pins.

10. In a die casting machine comprising a frame, a furnace supported thereby, relatively movable dies, knockout pins associated

therewith and movable relatively thereto, core pins insertable into and removable from said dies, a gooseneck adapted to travel from said furnace to said dies and back again, said gooseneck being adapted to be periodically connected to a high-pressure air supply for injection of metal into said dies, a hood adapted to travel with one of said dies and inclose the space around said dies during the casting operation, a pair of cam tracks, means associated with one of said tracks for controlling said air supply, a pair of cam rollers cooperating with said other track and angularly disposed with respect to each other, means associated with one of said rollers for operating said gooseneck and core-pins and means associated with the other roller for operating said dies, knock-out pins and hood.

11. In a die casting machine, a frame, dies supported thereon, a segmental gear rotatively mounted upon said frame adjacent said die, a plurality of arms radiating from said frame in a plane parallel to said segmental gear, cross-heads mounted on said arms for sliding motion thereon, cranks connecting said cross-heads, with eccentric portions of said segmental gear, whereby said cross-heads move on said arms when said gear is turned, and means for mounting core pins on said cross-heads for cooperation with said dies.

12. In a die casting machine comprising a frame, a cam mounted on said frame for rotation, said cam having a single track thereon, a pair of cam rollers adapted to cooperate with said track and angularly displaced with respect to each other, a furnace mounted on said frame, a gooseneck pivotally mounted above said furnace, means operatively associating one of said cam rollers with said gooseneck, said means being disposed on one side of said machine, a pair of relatively movable dies mounted on said frame and adapted to cooperate with said gooseneck, a carriage mounted on said frame, and adapted to carry one of said dies, another carriage mounted on said first carriage, knock-out pins associated with said second carriage and cooperating with one of said dies, a bell crank lever pivoted on said first carriage and having one free arm adapted to operate said second carriage, a second bell crank lever pivoted on said frame, the free end of one of said arms being pivotally joined to the free end of said first bell crank lever, and means operatively associating the free end of said last named bell crank lever with said second cam roller, whereby said single cam track operates the gooseneck, dies, and knock-out pins.

13. The structure of claim 12 including means mounted on the frame adjacent said dies for inserting and removing core pins from said dies, and means for operating said core pins from said first named roller.

14. In a die casting machine, a frame, a furnace supported thereby and adapted to contain a quantity of molten metal, relatively movable dies mounted above said furnace and adapted to open and close, a gooseneck adapted to travel from said furnace to said dies and back again and to be connected to a high-pressure air supply for injection of metal into said dies, knock-out pins associated with said dies and movable relatively thereto, a drum rotatably mounted in said frame, said drum having a single cam surface along its outer surface, means associated with said cam surface for operating said gooseneck, dies and knock-out pins, a second cam coaxial with said drum and adapted to rotate therewith, means associated with said second cam for controlling the air supply to said gooseneck, a third cam disposed along the edge of said drum, power controlling means including a clutch having forward and reverse positions, a brake adapted to cooperate with an edge of said drum as a brake surface, manually controlled means for operating said clutch, said means being spring biased to neutral position and adapted to be locked in either one of two running positions, means associated with said third cam for releasing said locking means after a predetermined series of operations of the machine whereby said control means assumes its neutral position, and means whereby said brake is applied when said locking means is released.

In testimony whereof he affixes his signature.

OSCAR B. NORGREN.