

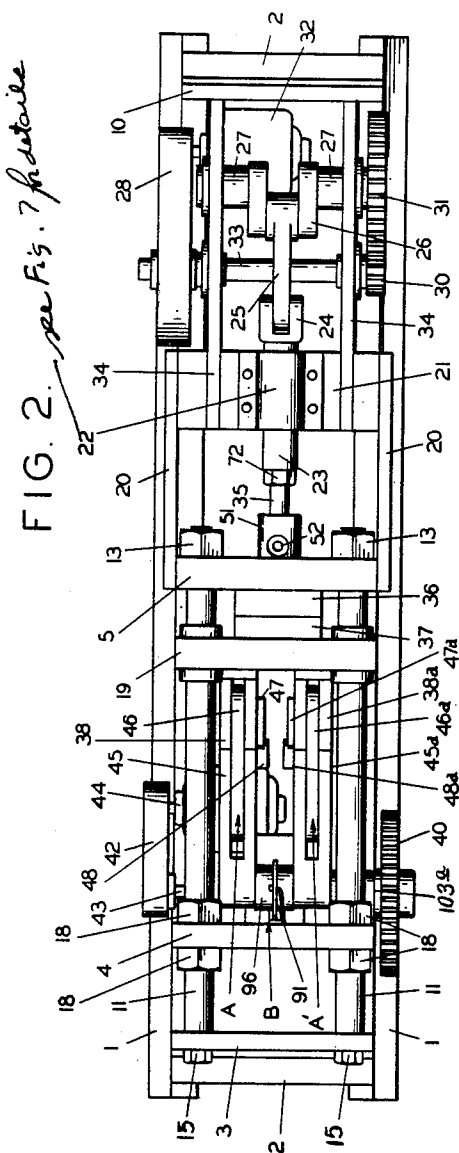
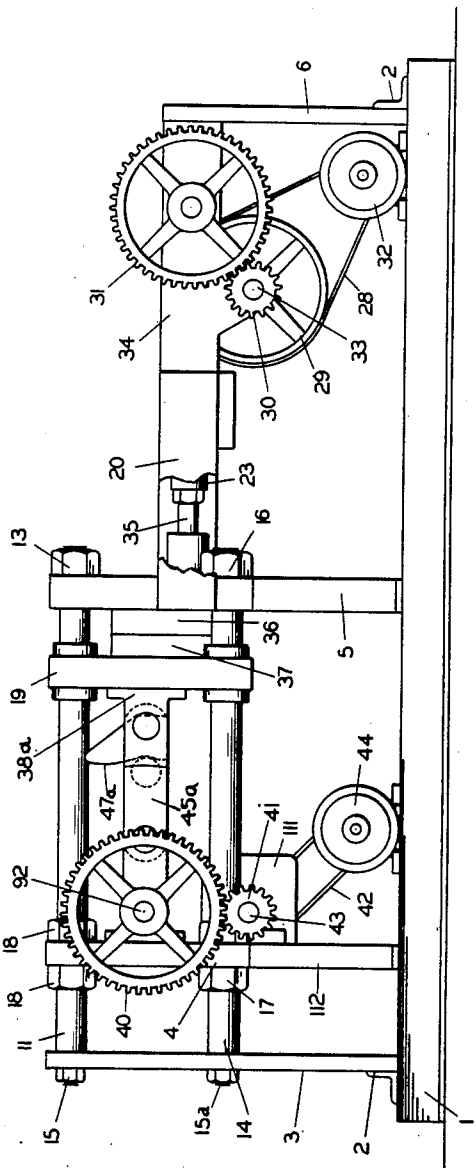
June 14, 1949.

J. GALLIANO
DIE CASTING MACHINE

2,473,366 ✓

Filed April 9, 1945

3 Sheets-Sheet 1



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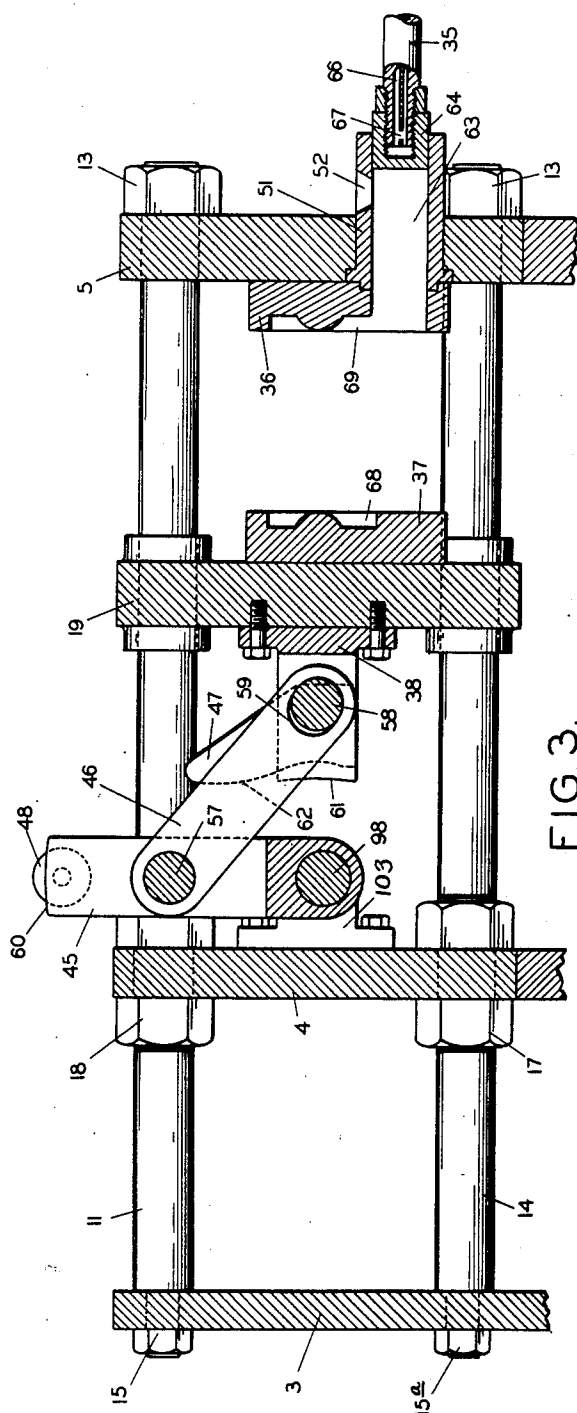
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DIE CASTING MACHINE

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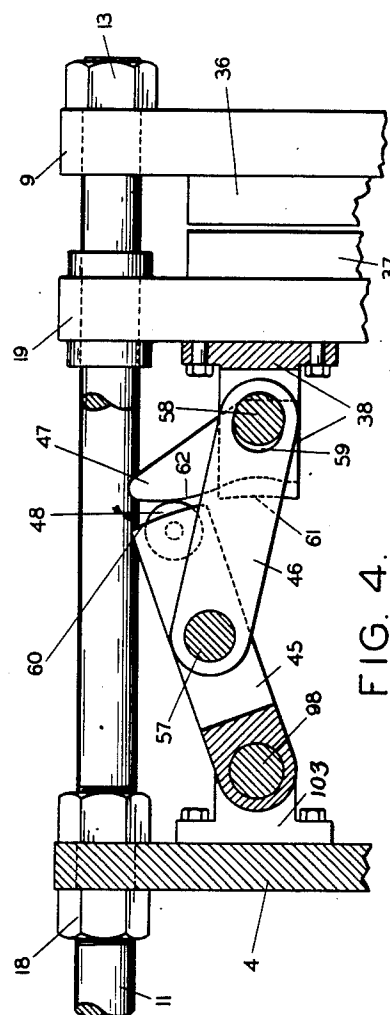


FIG. 4.

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3 Sheets-Sheet 3

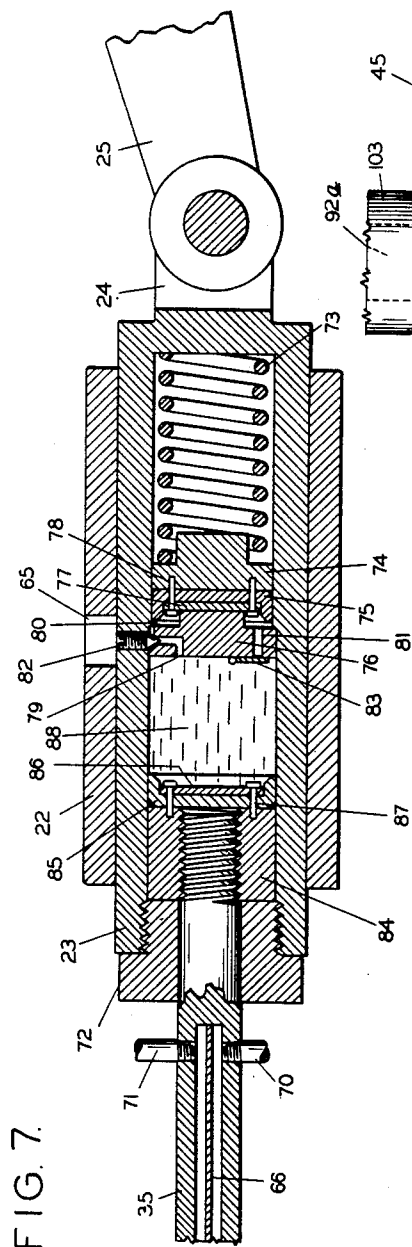


FIG. 7.

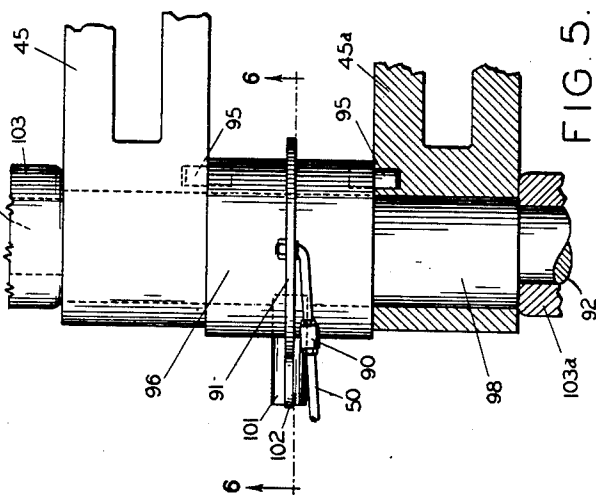


FIG. 5.

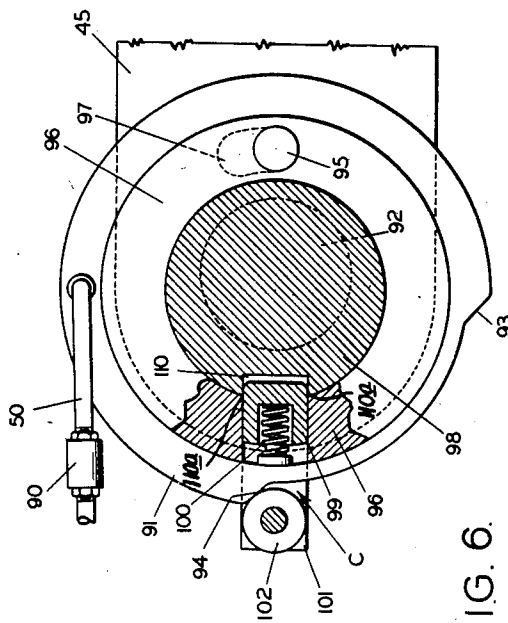


FIG. 6.

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UNITED STATES PATENT OFFICE

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DIE CASTING MACHINE

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Application April 9, 1945, Serial No. 587,285

5 Claims. (Cl. 22-92)

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The present invention relates to die casting machines, and more particularly to improved locking and pressure application mechanisms for die casting machines.

In the past few years it has become common practice to form metal articles by compression of the metal in powdered or liquid state in a die at extremely high pressures. The articles thus formed generally have structural strengths in excess of forged or cast articles formed of the same metal and may be produced at a much greater speed. Furthermore, if threads or similar machine work are required on the finished articles, they may be formed during the die casting operation and are equivalent in all respects to threads, or the like, formed on a lathe or other machining equipment.

One of the major problems in the die casting art lies in the provision of a suitable mechanism for closing the two halves of the split molds which are commonly employed. In order to expedite production it is necessary that the die halves close and open rapidly and at the same time it is necessary to insure positive locking during the casting operation, as the high pressures employed cause the metal to spray out, in the event that the die is not tightly closed, with consequent great danger to the operator of the machine and imperfections in the casting. Another problem in the die casting of metal articles resides in the step of opening the die blocks after pressure has been applied by the compression ram. In conventional mechanisms it is often found that the gates of the casting were broken off in removing the casting from the die.

It is an object of the present invention to provide an improved die casting machine of the type described above. A further object is to provide an improved die locking mechanism for die casting machines. Another object is to provide an improved pressure ram mechanism for die casting machines, whereby damage to the casting in removing the same from the die is obviated. Still further, it is an object of the present invention to provide a die casting machine which will produce any pressure normally utilized in die casting operations and which is entirely mechanical in operation; i. e. the utilization of hydraulic systems with consequent pressure pump and conduit maintenance is entirely eliminated.

Other objects, together with some of the advantages residing in the presently disclosed die casting machine, will become apparent from the following detailed description thereof, taken to-

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gether with the accompanying drawings forming a part of the specification and wherein:

Figure 1 is a side elevation of a die casting machine constructed in accordance with the present invention.

Figure 2 is a plan view of the die casting machine shown in Figure 1.

Figure 3 is a enlarged side elevation, partly in section, of the die block closing and locking mechanism, with the die blocks in open position.

Figure 4 is a fragmentary elevation of the mechanism shown in Figure 3, with the die blocks in nearly closed position.

Figure 5 is an enlarged scale plan view, partly in section, of the actuating mechanism for the die block closing toggles.

Figure 6 is a sectional elevation through line 6-6 of Figure 5.

Figure 7 is a sectional elevation of the pressure relief mechanism for the compression ram.

The die casting machine comprises two independently actuated mechanisms, a compound toggle-eccentric movement for closing and locking the die blocks and a compression ram driven by a crank movement for forcing the metal into the die and compressing the same therein.

Referring to Figures 1, 2 and 3, longitudinal members 1-1 and cross members 2-2 form the base of the die casting machine. An upright member 5, in the form of a plate, is rigidly attached to longitudinal members 1-1 near the center thereof. An upright member 3, in the form of a plate, is rigidly attached to longitudinal members 1-1 adjacent to one end thereof.

A pair of support bars 11-11 extend through upright members 3 and 5, being threaded on opposite end thereof and secured by means of nuts, as at 13 and 15. A second pair of support bars, as at 14, are disposed beneath support bars 11 and secured to upright members 3 and 5 by means of nuts, as at 15 and 16. Upright member 4, which is also in the form of a plate, is slidably mounted on support bars 11-11 and 14-14. Lock nuts, as at 18, threadably engage support bars 11-11 on opposite sides of upright member 4. In like manner, lock nuts, as at 17, threadably engage support bars 14-14 on opposite sides of member 4.

Yoke member 19 is slidably mounted on support bars 11-11 and 14-14 between uprights 4 and 5. Die block 37 is rigidly and detachably mounted on the face of yoke member 19 adjacent to upright member 5. Die block 36 is rigidly and detachably mounted on upright member 5 in coaxial alignment with die block 37.

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Referring particularly to Figures 3, 4 and 5, the die closing mechanism comprises a slotted locking element 38, which is rigidly attached to yoke member 18 and is provided with slightly arcuate faces at 61. Yoke member 45 is rotatably mounted on shaft 98. Link element 46 is pivotally attached to yoke member 45, between the arms thereof, at 57. The opposite end of link element 46 is pivotally attached to slotted element 38, between the arms thereof, at 58. The hole in link element 46, through which pivotal mounting shaft 58 passes, is somewhat elliptical, as indicated at 59. Cam element 47 is provided with a cam face at 62 and is rigidly mounted on slotted member 38. A roller 48 is rotatably mounted in the end of one of the arms of yoke member 45.

The above described compound toggle-eccentric arrangement is generally indicated at A in Figure 2. This assembly is duplicated, as generally indicated at A' in Figure 2. Between the compound toggle-eccentric assemblies a clutch mechanism is provided, as generally indicated at B in Figure 2. The details of the clutch mechanism are shown in detail in Figures 5 and 6. Annular element 96 is rotatably mounted on shaft 98 between yoke members 45 and 45^a. Cam collar 91 is, in turn, rotatably mounted on annular element 96 and is secured in position by tie rod 50 which is rigidly attached to cam collar 91 and to a stationary base (not shown). A turnbuckle 90, or other suitable means, is provided in tie rod 50 for adjusting the rotational disposition of cam collar 91 with respect to annular element 96. Cam collar 91 is provided with cam faces at 93 and 94.

A clutching pin, as indicated generally at C in Figure 6, comprises a bifurcated portion 101 which is carried by annular element 96 and in which is mounted roller element 102, cam collar 91 passing through bifurcated portion 101 and bearing against roller element 102. Head 99 at the end of body portion 101 is slidable within annular element 96 and is adapted to engage a suitable slot provided in shaft 98 at 110 when in alignment therewith. Spring 100 urges head 99 into normal engagement with slot 110. Pin elements 95 are mounted on opposite sides of annular element 96 and pass through arcuate slots 97 in yoke elements 45 and 45^a.

Drive shaft 92 is rigidly attached to shaft 98 and eccentrically disposed with respect thereto. Bearing shaft 92^a is similarly attached to the opposite end of shaft 98. Shaft 92 is keyed to and driven by gear 40 (referring to Figures 1 and 2), shaft housings 103 and 103^a being mounted on upright member 4. Motor 44 is mounted on longitudinal members 1—1 and drives shaft 43 through a gear reduction unit 111 which is mounted on stationary upright member 112. Gear 41 is keyed on shaft 43 and meshes with gear 40. Motor 44 is of the reversible type.

The operation of the die closing mechanism is as follows: With the die blocks open, as shown in Figure 3, motor 44 is operated to drive gear 40 in a clockwise direction with respect to Figure 1. This brings about rotation of shaft 92 and shaft 98. At this point plunger pin 99 is engaging shaft 98 and consequently causes rotation of annular element 96 with shaft 98. Rotation of annular element 96, through pin 95, causes yoke members 45 and 45^a to move downwardly from the position shown in Figure 3 to that shown in Figure 4. This movement of yoke members 45 and 45^a, through link elements 46, causes yoke

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member 19 and die block 37 to move towards die block 36, sliding on support bars 11—11 and 14—14. Referring particularly to Figure 4, when yoke member 45 reaches the position shown, roller 48 contacts the cam face 62 of cam element 47, thereby longitudinally displacing yoke member 45 with respect to slotted member 38 in order to guide arcuate locking faces 60 and 61 into juxtaposition with each other. This longitudinal displacement is permitted by the elliptical opening 59 in link member 46 at its mounting on shaft 58.

The downward movement of yoke member 45 then continues until the arcuate faces 60 thereof engage the arcuate faces 61 of member 38. At this point (referring particularly to Figure 6), clutching pin C will have been rotated by shaft 98 and annular element 96 to a position, moving in a clockwise direction, slightly beyond that shown. As a result cam face 94 will have acted against roller 102 to almost entirely disengage plunger pin 99 from shaft 98. Complete disengagement of clutch pin C from slot 110 is effected in the following manner: Shaft 98 carrying slot 110 continues to rotate and by so doing causes the outer lip 110^a of slot 110 to bear against the rounded end of head 99, thereby camming head 99 outwardly and entirely out of engagement with slot 110. Thus, the action of roller 102 in passing over cam faces 93 and 94 will disengage the clutch pin C from slot 110 only enough to allow the camming action of lip 110^a acting against the rounded head 99 to take place in order to complete the clutch disengagement; and thus head 99 of clutch pin C will remain spring biased against shaft 98 which will continue to rotate independently of annular element 96 and yoke members 45 and 45^a. No further rotational force is exerted on yoke members 45 and 45^a since the rotational force exerted thereon is applied entirely through pins 95 and annular element 96 when the same is engaged to shaft 98 through clutching pin C.

Although no further rotational force is exerted on yoke members 45 and 45^a when annular element 96 is disengaged from shaft 98, it will be seen that, due to the eccentric mounting of shafts 92 and 92^a with respect to shaft 98, continued rotation of shaft 92 will act to bring pressure to bear on yoke members 45 and 45^a and urge the same against members 38 and 38^a respectively. In this manner die block 37 is urged firmly against die block 36. Owing to the supplemental arcuate faces 60 and 61 of yoke member 45 and member 38, it will be seen that a locking action occurs which will prevent slipping at the contact surfaces or rotation of the yoke member about the axis of shaft 98 regardless of the pressure exerted on the yoke member by the eccentric motion of shaft 98.

When maximum pressure, as a result of the eccentric motion of shaft 98, is attained, the motor is turned off either manually or by means of suitable conventional limit switches. Maximum pressure which is to be applied may be varied by adjusting the spacing between upright members 4 and 5. This is accomplished by loosening nuts 17 and 18, moving upright 4 to desired position and locking the same in place again by means of nuts 17 and 18.

When it is desired to open the die blocks, motor 44 is reversed, causing counterclockwise rotation of shafts 92 and 98. When slot 110 in shaft 98 comes into alignment with plunger pin 99, spring 100 urges plunger pin 99 into sufficient

partial engagement with shaft 98 to bring about rotation of annular element 96 and clutching pin C with shaft 98. As rotation continues, roller 102 passes cam face 94 and brings about complete engagement of plunger pin 99 with shaft 98. I have found that unless provision is made to temporarily take the load off of shaft 96 by relieving it from the weight of arms 45 and 45^a during the period when roller 102 is passing over cam face 94 or 93 that the clutch pin is very likely to only partially engage slot 110 during engagement operations. Thus, in order to allow a certain amount of free play to annular element 96 during clutch engagement or disengagement operations, I provide, as a preferred means of accomplishing this end, the annular slot 97 which is of a sufficient length to allow the roller 102 to pass over cam faces 93 or 94 without the load from yoke members 45 and 45^a being transmitted to annular element 96 through pins 95. When yoke members 45 and 45^a have been returned to the position shown in Figure 3, cam face 93 acts to disengage clutching pin C and permit free rotation of shaft 98 without driving force being exerted on yokes 45 and 45^a through pin 95.

The ram actuating mechanism is shown particularly in Figures 1, 2 and 7. Variable speed motor 32 is mounted on longitudinal members 1—1 and drives flywheel 29 through belt 28. Longitudinal support elements 20 are rigidly attached to and supported by upright member 5. At their opposite ends these elements are rigidly attached to longitudinal members 34 through cross head 21. The opposite ends of longitudinal members 34 are, in turn, supported by an upright member 6. Shaft 33 is bearingly supported by longitudinal members 34, is driven by flywheel 29 and drives gear 30. Crankshaft 27 is bearingly supported by longitudinal members 34 and is driven by gear 31 which meshes with gear 30. Connecting rod 25 is pivotally attached to crank 27, at 26, and at the opposite end is pivotally attached to yoke 24. Guide 32 is mounted on and supported by crosshead 21. Ram 35 passes into sleeve 51 which is in flow communication with the interior 69 of die block 36.

Filling port 52 is provided in the top of sleeve 51 in flow communication with the interior of sleeve 51. Yoke 24 is rigidly attached to, or formed as a part of, cylinder body 23 which is reciprocable within sleeve 22. The end of cylinder body 23, opposite yoke 24, is closed by means of a threadedly engaged plug 72. Ram 35 extends through plug 72 and is slidable with respect thereto. Piston element 84 threadedly engages the end of ram 35 extending within cylinder body 23 and is, in turn, attached to head plate 86 by means of a plurality of bolts, as at 87. A disk of sealing material 85, such as leather, soft metal, or the like, is secured between head plate 86 and piston element 84 and serves as a piston ring or seal. Spring element 73 is disposed in the opposite end of cylinder body 23 and urges against a second piston element 74, to which is attached head plate 77 by means of a plurality of bolts, as at 78, sealing element 75 being disposed between head plate 77 and piston element 74.

By-pass element 76 is rigidly mounted within cylinder body 23 near the center thereof and divides the interior of cylinder body 23 into two fluid-tight chambers. Conduit 81 leads in flow communication between the two fluid tight chambers. Check valve 83 is mounted on by-pass element 76, permitting fluid flow through conduit 81

when the pressure on the ram side of by-pass element 76 is less than the pressure on the opposite side thereof, preventing flow through conduit 81 when the pressure on the ram side of by-pass element 76 is greater than on the opposite side thereof. Conduit 79 also provides flow communication between the ram side of by-pass element 76 and the opposite side thereof. Set screw 82 threadedly engages cylinder body 23 and serves to control the rate of flow through conduit 79. Access to set screw 82 is gained through an appropriate opening 65 provided in sleeve 22.

Ram 35 is provided with a cylindrical bore which is divided into two chambers by partition 66, flow communication between the two chambers being provided by port 67 in partition 66. Cooling fluid is admitted to one of these chambers through conduit 70 and passes out of the other chamber through conduit 71. A conventional piston head 64 is threadedly mounted on the end of ram 35 and is closely fitted in sleeve 51.

In the operation of the die casting machine, the die blocks are first closed and locked as hereinbefore described. With the ram retracted, a suitable amount of powdered or molten metal or other material which is to be used in forming the casting is introduced to sleeve 51 through port 52. Motor 32 is then operated to drive gear 31 and crank 27, thereby forcing ram 35 into sleeve 51 and, in turn, forcing material placed in sleeve 51 into the die blocks and compressing the same. When ram 35 has been moved forwardly into sleeve 51 as far as is possible by rotation of crank 27, it will be appreciated that maximum pressure in the die blocks is attained. With further rotation of crank 27, ram 35 is withdrawn, in this manner obviating the difficulty commonly encountered with conventional screw or hydraulically driven rams, wherein it is often found that the end of the ram is heated excessively by prolonged contact with the material in the die at maximum pressure. In the present die casting machine, the ram may be forced into the die blocks and withdrawn again as slowly or rapidly as desired by control of the speed of rotation of flywheel 29 through variable speed motor 32 or through any desired conventional speed control, such as a transmission, or the like. In the event that the above reciprocating action of the ram is not desired, a conventional clutch mechanism (not shown) may be incorporated in shaft 33, whereby the driving force exerted on ram 35 is stopped when maximum forward motion and maximum pressure have been attained, flywheel 29 continuing to rotate freely.

Referring again to Figure 7, as the pressure exerted against cylinder body 23 by connecting rod 25 increases, it will be seen that this pressure is transmitted and applied against head plate 86 by the hydraulic liquid 88 which fills the space between head plate 86 and by-pass element 76. The pressure exerted against head plate 86 is, of course, in turn, transmitted directly to ram 35. Set screw 82 is adjusted to permit slight flow of fluid through conduit 79 under high pressure. As a result, as the pressure increases on hydraulic fluid 88, part of the hydraulic fluid is by-passed through conduit 79 and acts to move piston element 74 in a direction to compress spring 73 by exerting pressure on head plate 77. Flow through conduit 81 under these conditions is prevented by check valve 83.

The die blocks are then opened in the manner previously described and the casting removed.

In conventional die casting machines it is often found that the gates of the casting are broken off as the die blocks open. This difficulty is avoided in the present die casting machine by means of the hydraulic cylinder arrangement previously described and shown in Figure 7. As soon as the die begins to open, pressure on the ram is relieved and pressure in the hydraulic cylinder is accordingly simultaneously relieved, check valve 83 opening to permit flow of fluid through conduit 81 and return of piston element 74 to the position shown in Figure 7 by spring 73. The ram is thus freed for limited travel as soon as the pressure on piston 64 is relieved by the opening of the die blocks. In this manner the casting is readily freed from die block 36 without damage thereto. The described hydraulic cylinder mechanism also makes possible the use of a reciprocating motion of the pressure ram in forming die castings, serving as a form of shock absorber as the end of the ram repeatedly strikes the material being compressed in the die blocks.

Particular advantages ascribed to the die casting machine of the present invention include the following: Exceedingly high pressures may be obtained without the utilization of hydraulic conduits and pumps or cumbersome screw mechanisms. For example, castings have been made in a die casting machine constructed in accordance with the principles hereinbefore set forth at pressures of the order of eighty thousand pounds per square inch. It will be appreciated, of course, that higher or lower pressures may be attained as required by the conditions at hand by adjusting the length of stroke of the pressure ram or the relative disposition of the die blocks with respect to the pressure ram. The employment of a crank action drive for the pressure ram has the additional advantages of eliminating any possibility of the ram striking and damaging the die blocks and, further, insures uniform pressure application during each casting cycle.

The cycle of operations employed in producing castings with the presently described machine may be carried out at a rate far in excess of that possible with conventional hydraulic or screw operated machines of the same general type and the time required for each cycle may be varied as desired. The die locking mechanism has been found to obviate all danger of molten metal leaking or spraying from the die blocks during the casting operation.

Numerous other advantages will be apparent to those skilled in the present art and various modifications in mechanical detail may be embodied without departing from the spirit and scope of the principles set forth in the above specifications and appended claims.

I claim:

1. In a die casting machine having a stationary die block mounted thereon, the combination comprising a slidable die block supported by a carrier in coacting alignment with said stationary die block, a drive shaft mounted on said machine, a second shaft rigidly mounted on said drive shaft and arranged eccentrically to the axis of rotation of said drive shaft, a slidable die block actuating member pivotally mounted on said second shaft and having its longitudinal axis perpendicular to the axes of rotation of said drive shaft and said second shaft, a clutch connecting said actuating member and said second shaft, a link member having pivotal connections at each of its ends to connect said actuating member with said slidable die block, means to impart a

rotary motion to said drive shaft, said second shaft and said actuating member to move said slidable die block into juxtaposition with said stationary die block, means including said clutch to rotate said second shaft independently of rotation of said actuating member to urge eccentrically said actuating member and said slidable die block in a direction toward said stationary die block so that said slidable die block is pressed firmly against said stationary die block, and means to prevent further rotational movement of said actuating member when said actuating member is disengaged from said second shaft by said clutch.

2. In a die casting machine having a stationary die block mounted thereon, the combination comprising a slidable die block supported by a carrier in coacting alignment with said stationary die block, an arcuate locking face provided on the rear of said slidable die block, a drive shaft mounted on said machine, a second shaft rigidly mounted on said drive shaft and arranged eccentrically to the axis of rotation of said drive shaft, a slidable die block actuating member pivotally mounted on said second shaft and having its longitudinal axis perpendicular to the axes of rotation of said drive shaft and said second shaft, a clutch connecting said second shaft and said actuating member, an arcuate locking element complementary to said arcuate locking face mounted on the free end of said actuating member, a link member having pivotal connections at each of its ends to connect said actuating member with said slidable die block, means to impart a rotary motion to said drive shaft said second shaft and said actuating member to move said slidable die block into juxtaposition with said stationary die block, and to move said locking element on said actuating member into complementary locking engagement with said arcuate locking face on said slidable die block, and means including said clutch to rotate said second shaft independently of rotation of said actuating member to urge eccentrically the said actuating member and said slidable die block in a direction toward said stationary die block so that said slidable die block is pressed firmly against said stationary die block.

3. In a clutch for die casting machines of the type characterized as having a drive shaft with a second shaft rigidly mounted upon the said drive shaft and eccentric to the axis of rotation of said drive shaft, a slidable die block, and a die block actuating member rotatably mounted on said second shaft, the combination comprising an annular element rotatably mounted on said second shaft, a drive pin engaging said actuating member and said annular element, a clutch pin slidably mounted in said annular element and normally engaging said second shaft, a cam collar mounted in rotatable relationship with respect to said annular element, and means including means carried by said cam collar to disengage said clutch pin from said second shaft when said annular element is rotated to predetermined positions by said second shaft, so that said drive shaft and said second shaft may be rotated independently of rotation of said cam collar, said annular element, and said actuating member.

4. In a die casting machine having a stationary die block mounted thereon, the combination comprising a slidable die block supported by a carrier in coacting alignment with said stationary die block, an arcuate locking face provided on the rear of said slidable die block, a drive shaft

mounted on said machine, a second shaft rigidly mounted on said drive shaft and arranged eccentrically to the axis of rotation of said drive shaft, a slidable die block actuating member pivotally mounted on said second shaft and having its longitudinal axis perpendicular to the axes of rotation of said drive shaft and said second shaft, a clutch connecting said second shaft and said actuating member an arcuate locking element complementary to said arcuate locking face mounted on the free end of said actuating element, a link member having pivotal connections at each of its ends to connect said actuating member with said slidable die block, means to impart a rotary motion to said drive shaft, said second shaft, and said actuating elements to move said slidable die block into juxtaposition with said stationary die block and to move said locking element on said actuating member into complementary locking engagement with said arcuate locking face on said slidable die block, means including said clutch to rotate said second shaft independently of rotation of said actuating member to urge eccentrically the said actuating member and said slidable die block in a direction toward said stationary die block so that said slidable die block is pressed firmly against said stationary die block, and means to reverse the rotation of said drive shaft and said second shaft to urge eccentrically said slidable die block actuating member and said slidable die block away from said stationary die block.

5. In a die casting machine, the combination comprising a stationary die block, a movable die block, means to support the movable die block for movement toward and away from the stationary die block, a drive shaft, a second shaft rigidly

mounted on said drive shaft and arranged eccentrically to the axis of rotation of said drive shaft, an actuating member mounted on said second shaft, a clutch connecting the actuating member to one of said shafts during rotation of the drive shaft over one portion of its angular movement, said second shaft laterally moving the actuating member during rotation of the drive shaft over another portion of its angular movement, link means connecting the actuating member and the movable die block to move the movable die block during swinging movement of the actuating member, means effective to limit swinging movement of the actuating member, and a face on the actuating member contacting the movable die block to move the movable die block during lateral movement of the actuating member.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
945,551	Knoell	Jan. 4, 1910
1,249,919	Doehler	Dec. 11, 1917
1,268,909	Yingling	June 11, 1918
1,569,420	Clisson	Jan. 12, 1926
1,948,992	Morin	Feb. 27, 1934
1,950,568	Richards	Mar. 13, 1934
2,079,936	Gastrow	May 11, 1937
2,173,377	Schultz et al.	Sept. 19, 1939
2,233,354	Thilenius	Feb. 25, 1941
2,268,949	Lehmann	Jan. 6, 1942
2,289,928	Parker	July 14, 1942
2,293,087	Tann	Aug. 18, 1942