May 14, 1929. W. O. WILL ET AL 1,713,312

DIE CASTING MACHINE

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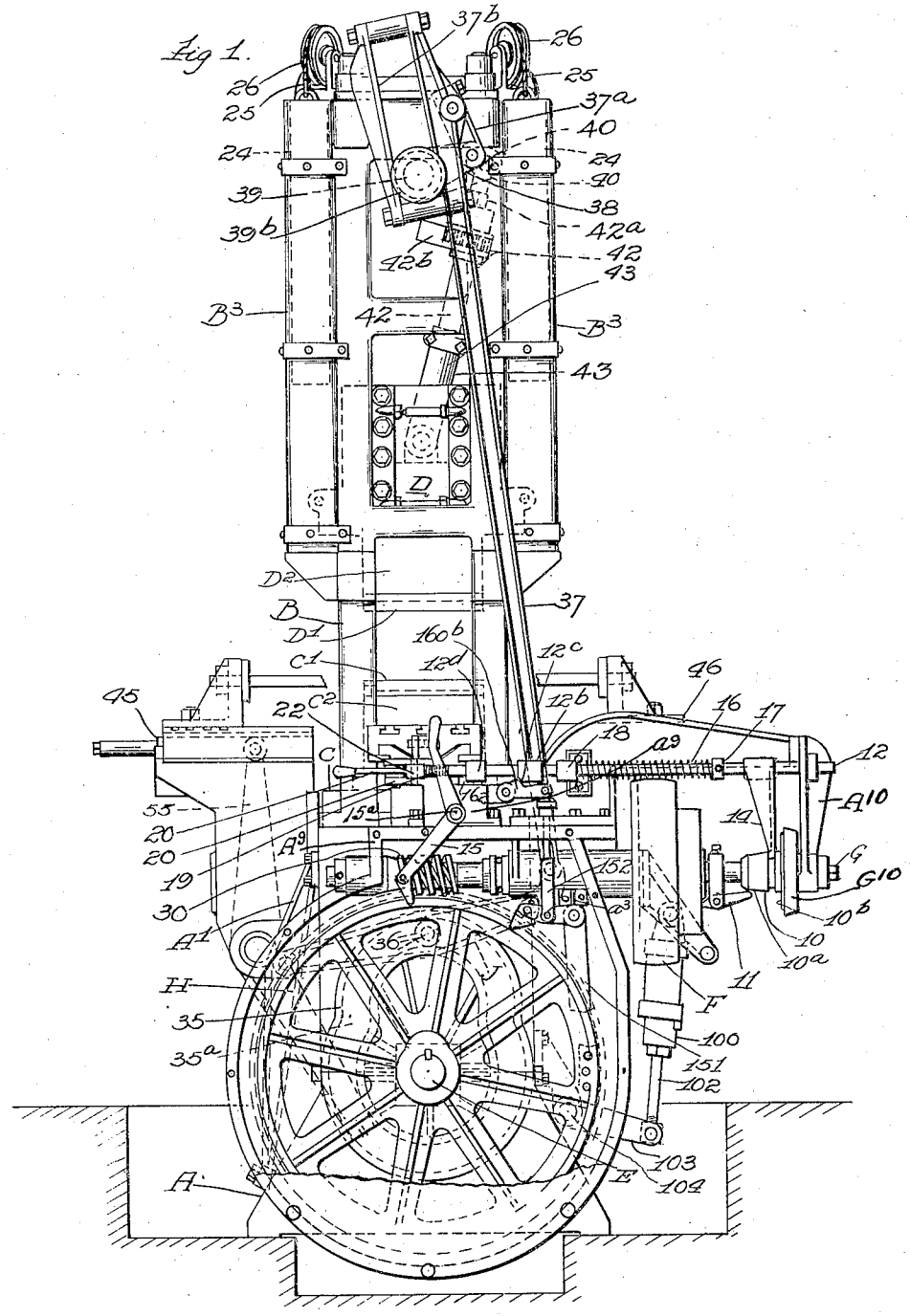
Fig 1.



Witness.
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by Burton & Burton
his Attorneys.

May 14, 1929. W. O. WILL ET AL 1,713,312

DIE CASTING MACHINE

Filed Feb. 1, 1926 11 Sheets-Sheet 2

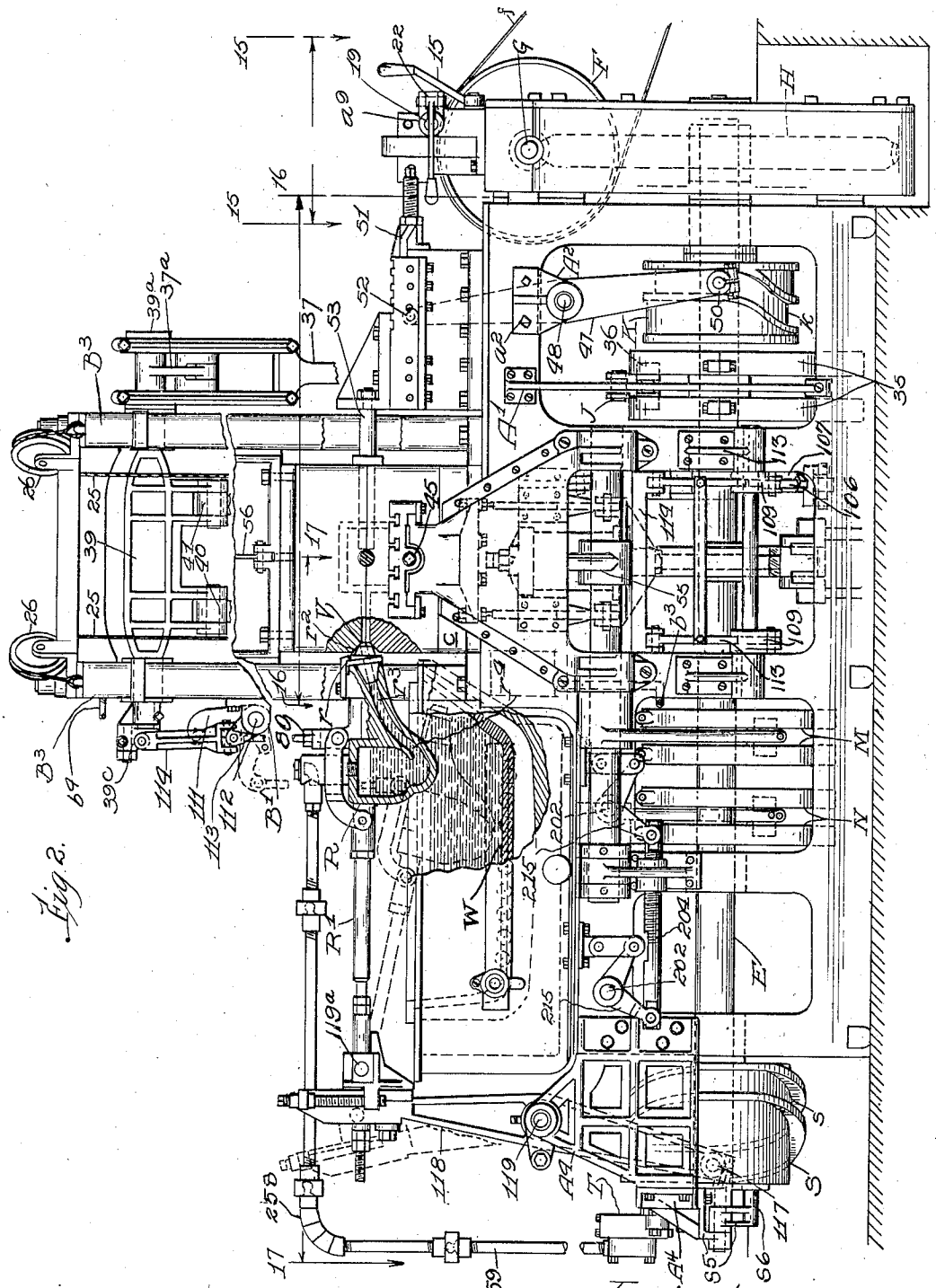

Fig 2.

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May 14, 1929. W. O. WILL ET AL 1,713,312

DIE CASTING MACHINE

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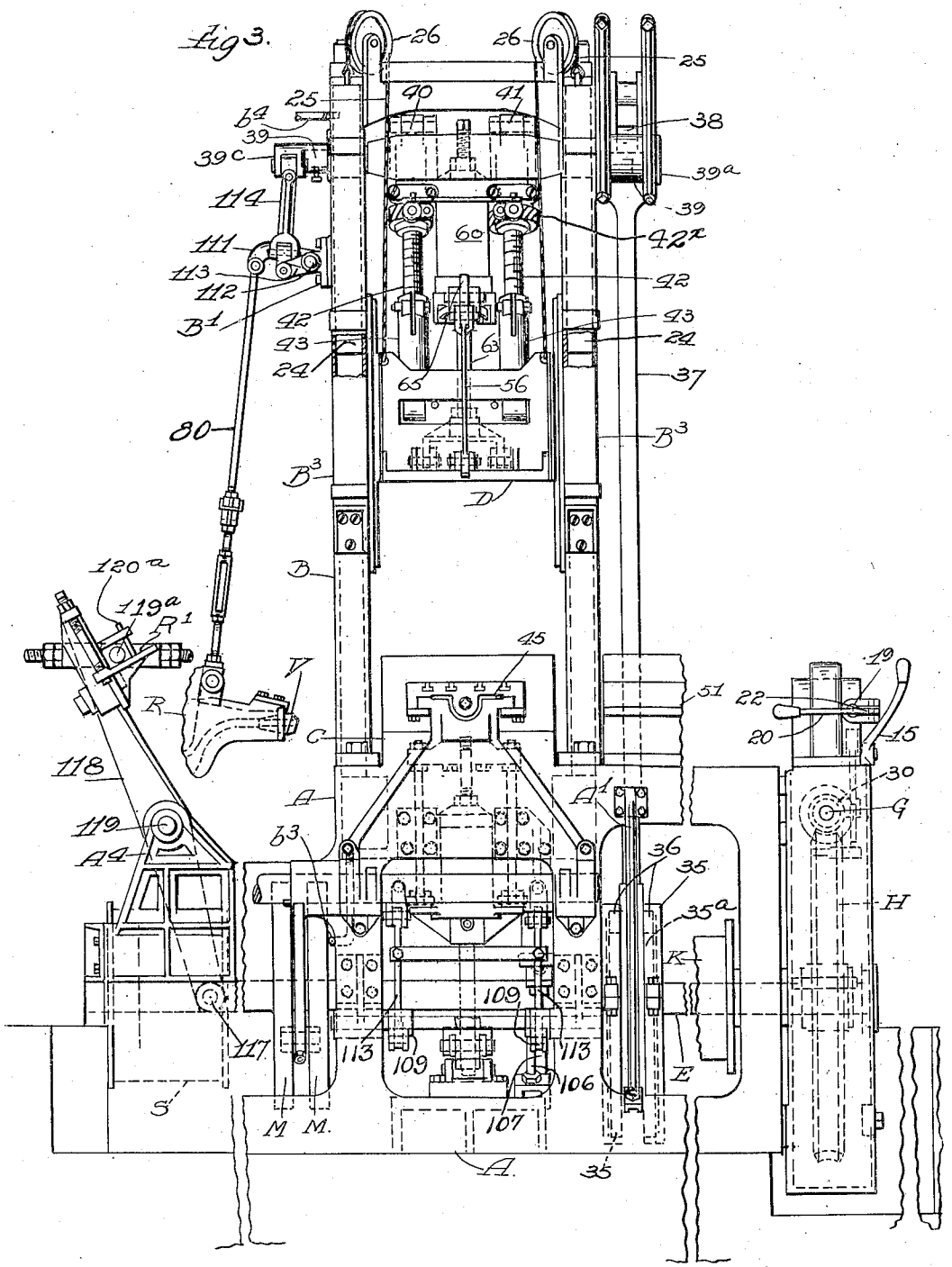
Fig 3.



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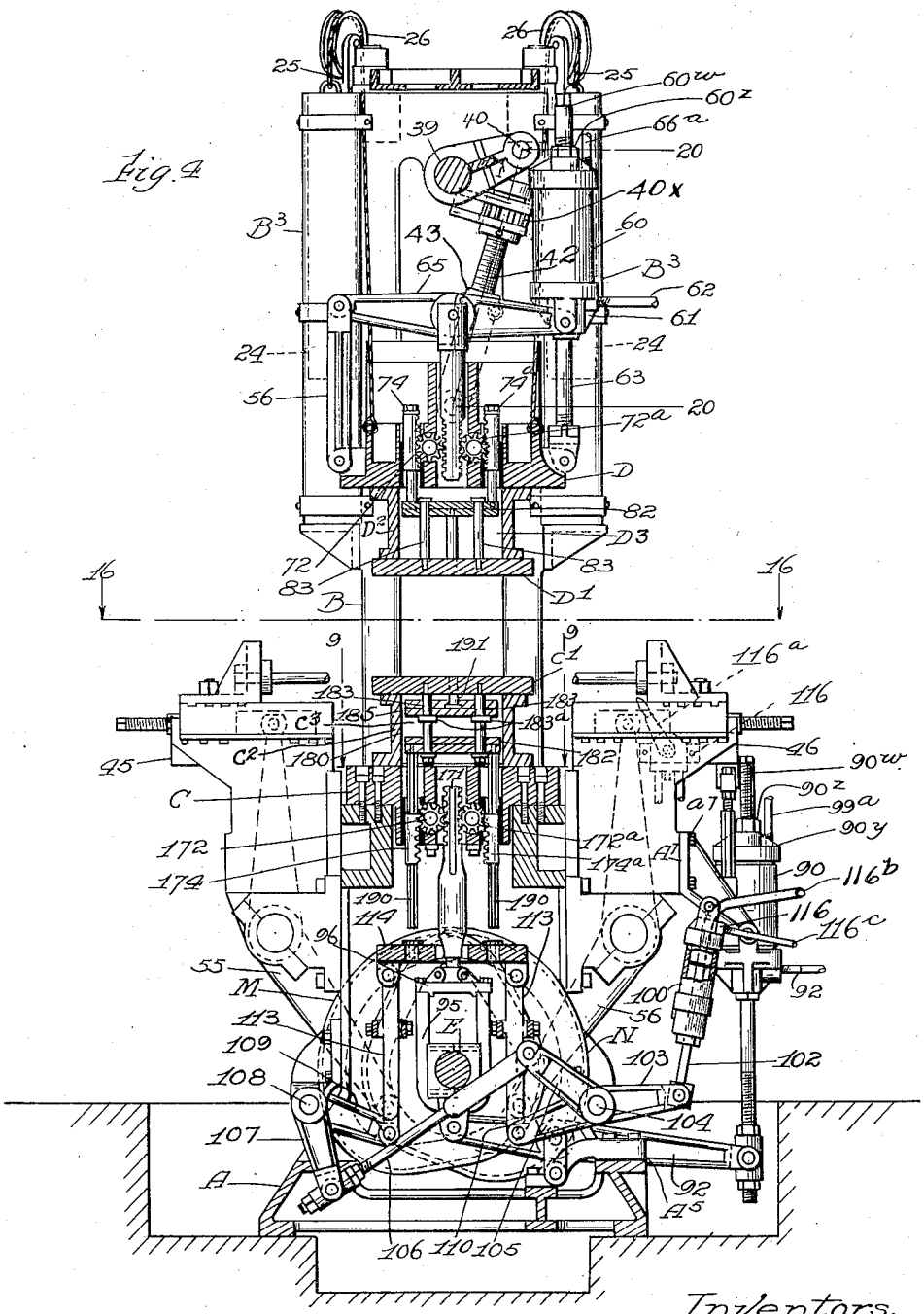
May 14, 1929. W. O. WILL ET AL 1,713,312

DIE CASTING MACHINE

Filed Feb. 1, 1926 11 Sheets-Sheet 4

Fig. 4



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May 14, 1929. W. O. WILL ET AL 1,713,312

DIE CASTING MACHINE

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Fig. 5.

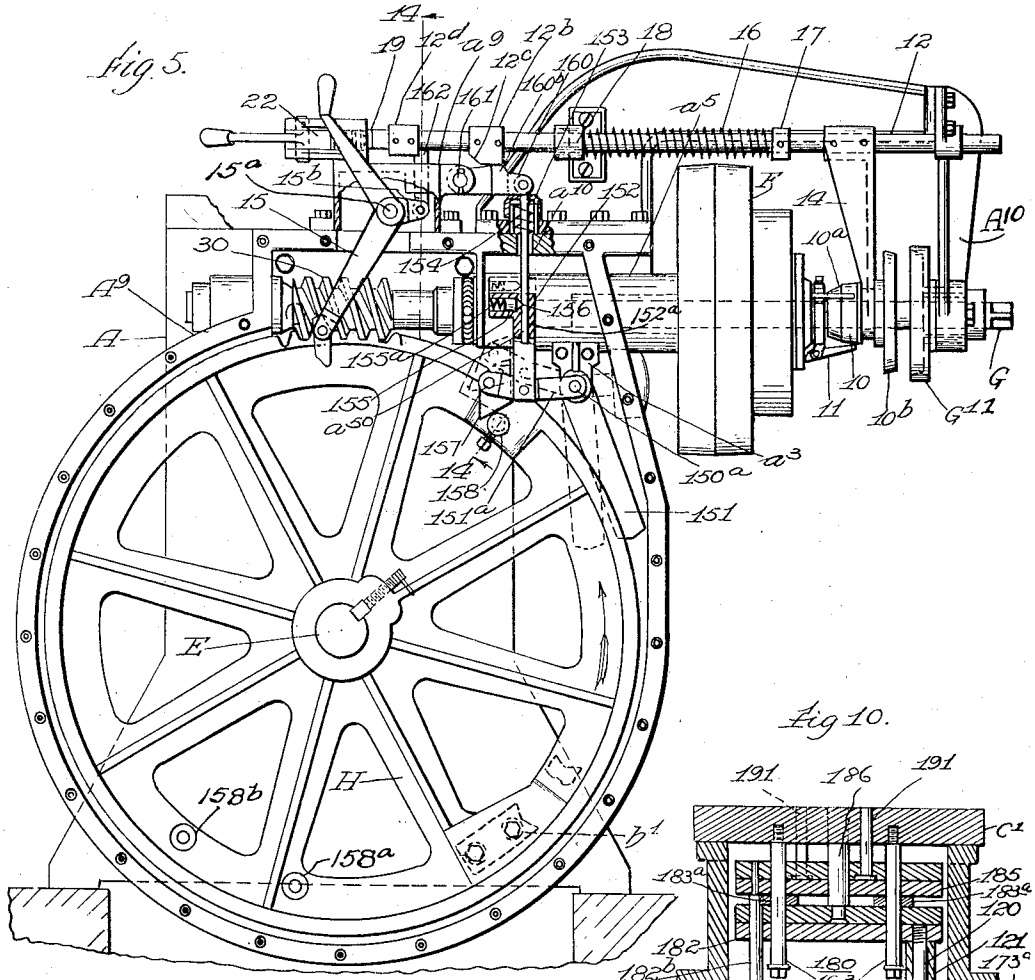
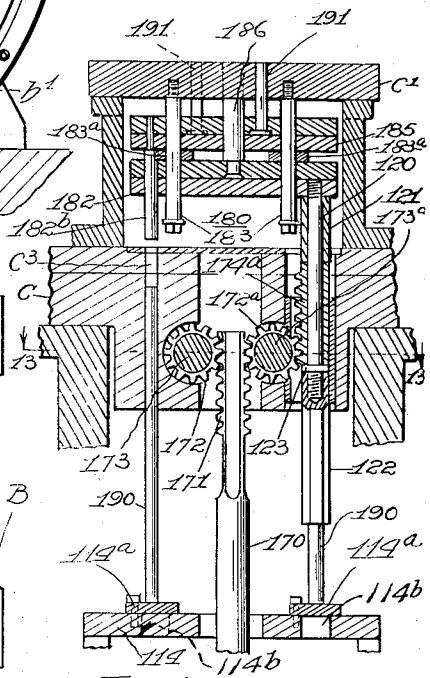


Fig 10.



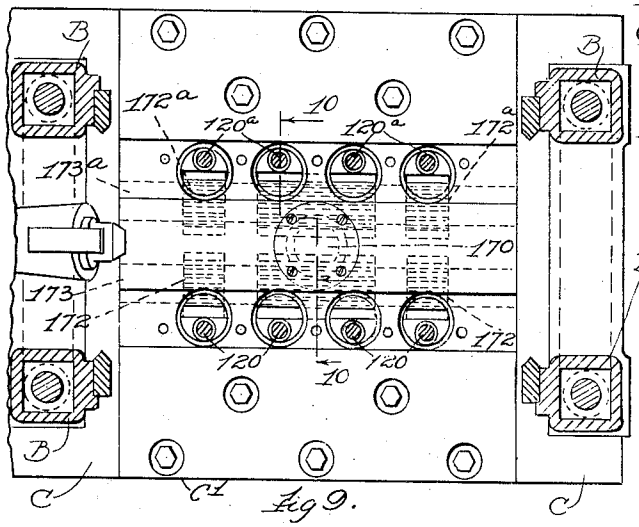


Fig 9.

Witness
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DIE CASTING MACHINE

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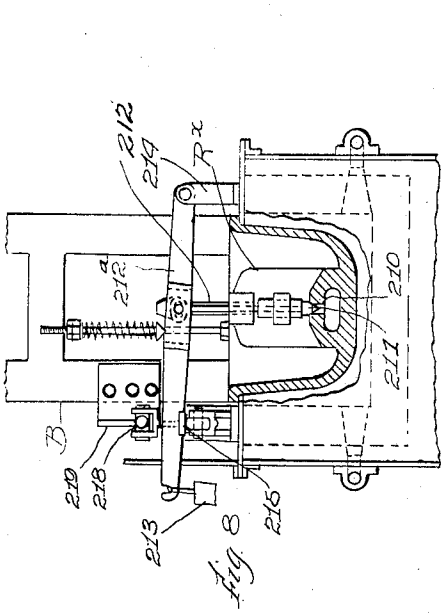

Fig. 8

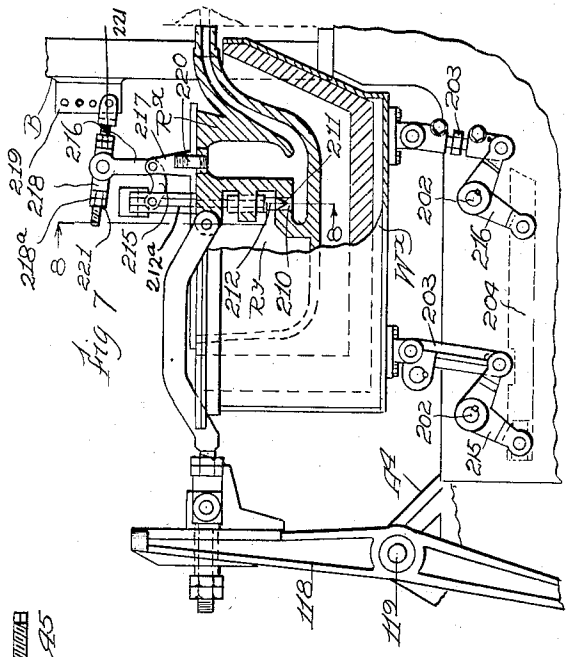

Fig 7

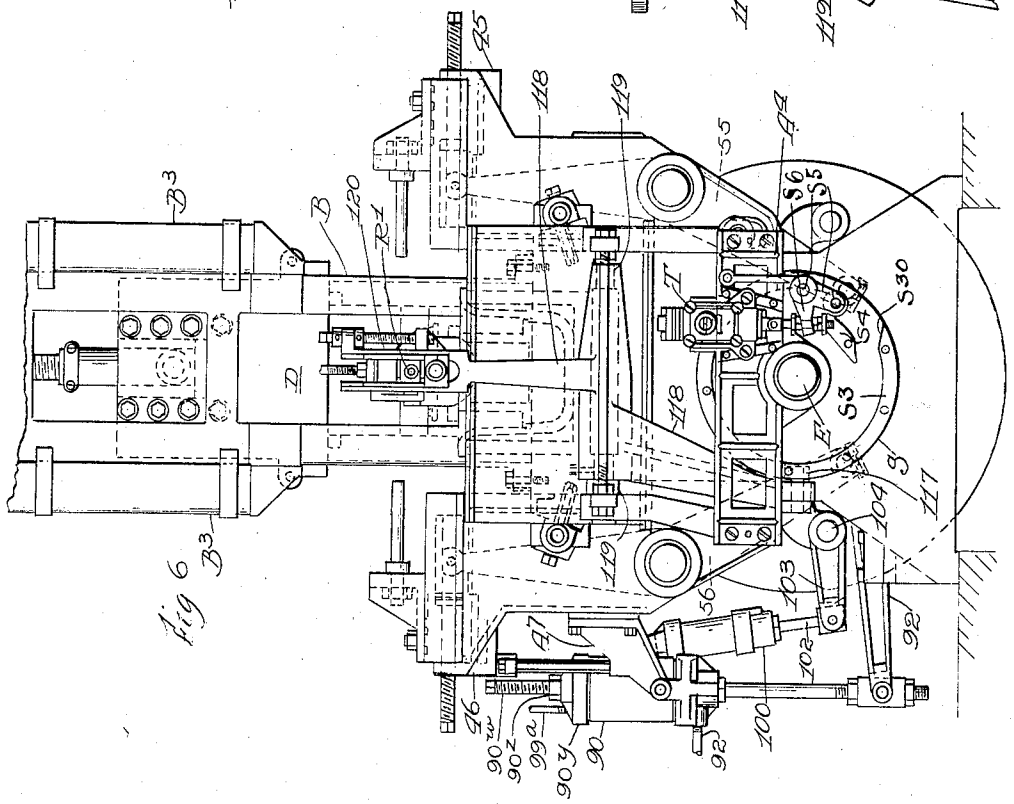

Fig 6

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May 14, 1929. W. O. WILL ET AL 1,713,312

DIE CASTING MACHINE

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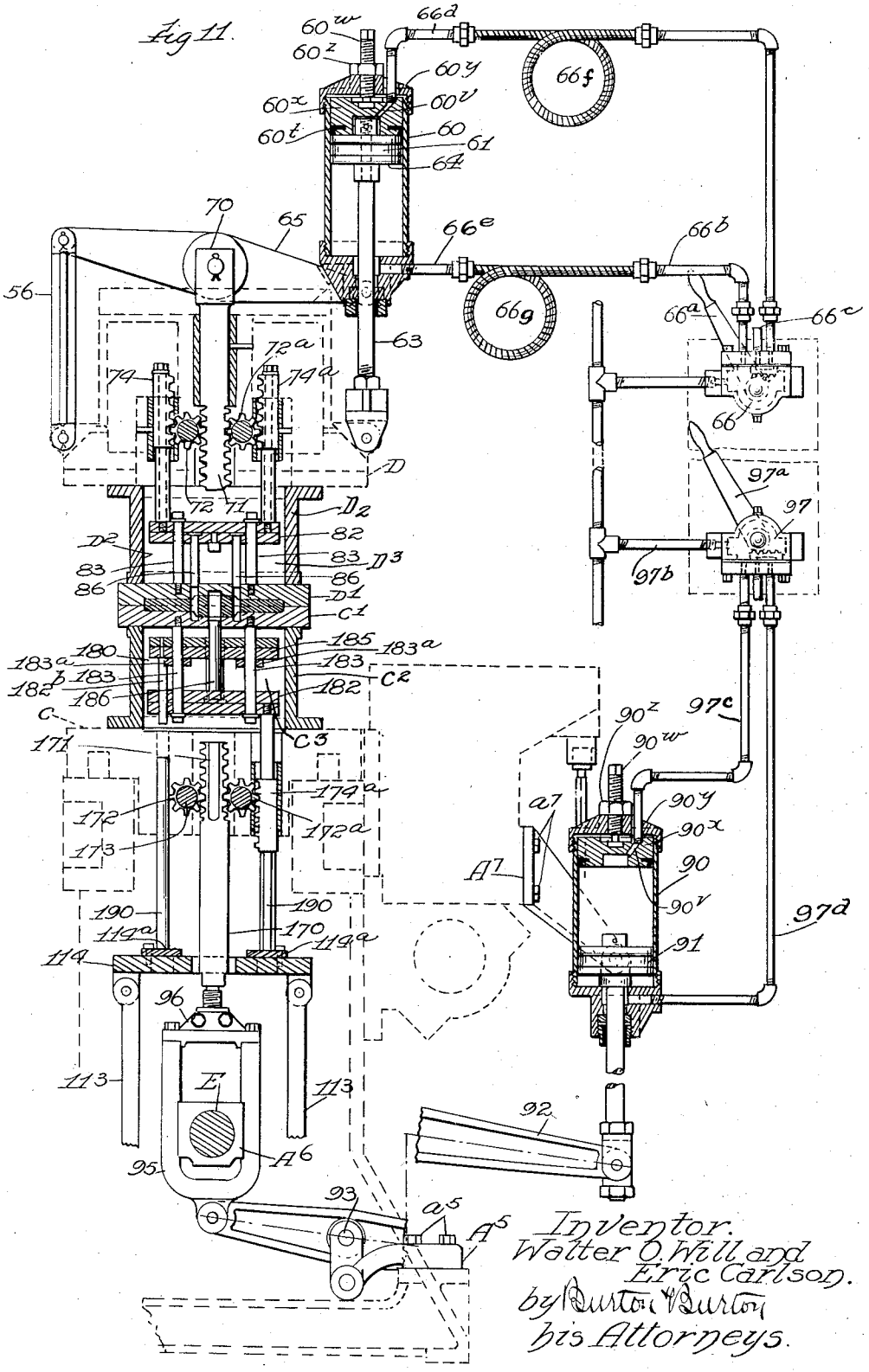
Fig 11.



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May 14, 1929. W. O. WILL ET AL 1,713,312

DIE CASTING MACHINE

Filed Feb. 1, 1926 11 Sheets-Sheet 8

Fig 12

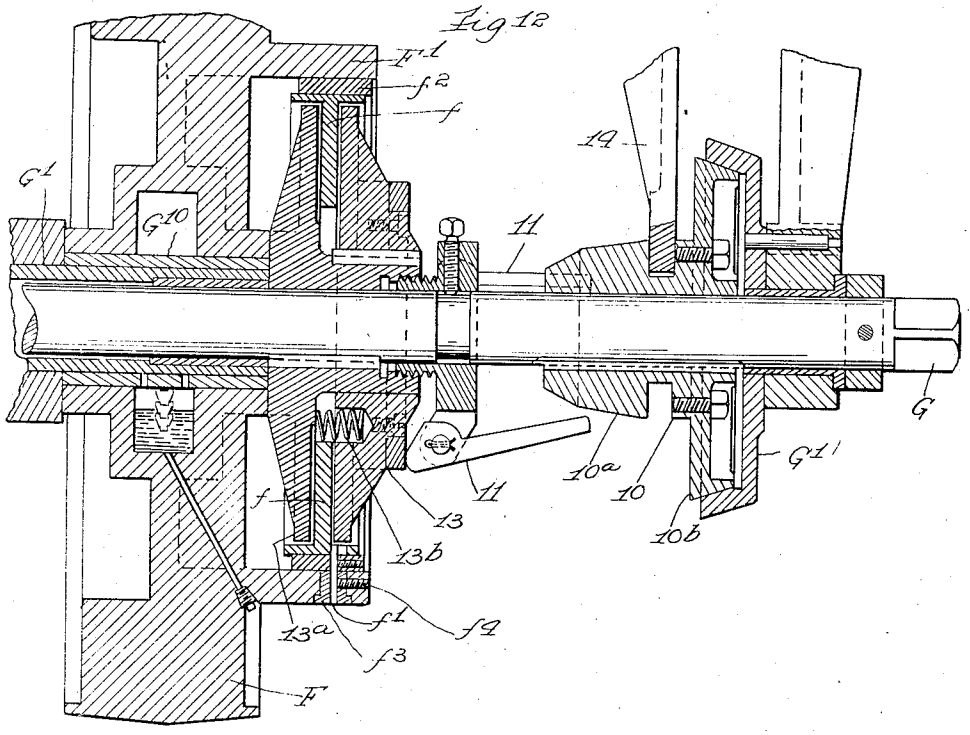


Fig 13

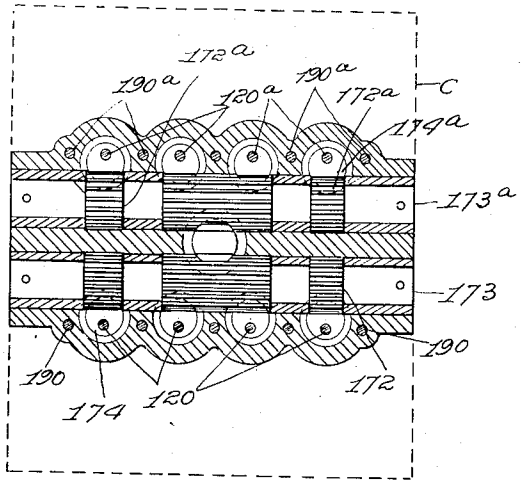
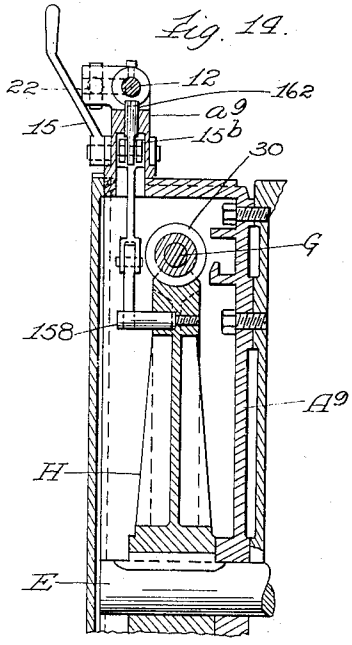


Fig. 19.



Witness
W. O. McKinley.

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May 14, 1929. W. O. WILL ET AL 1,713,312

DIE CASTING MACHINE

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Fig 15.

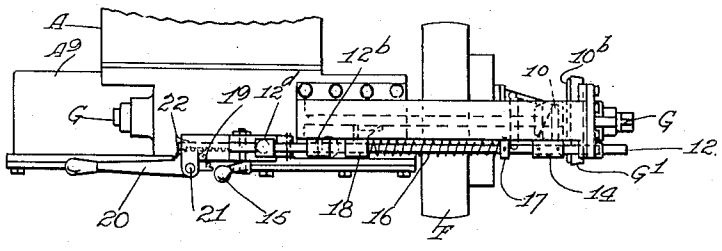
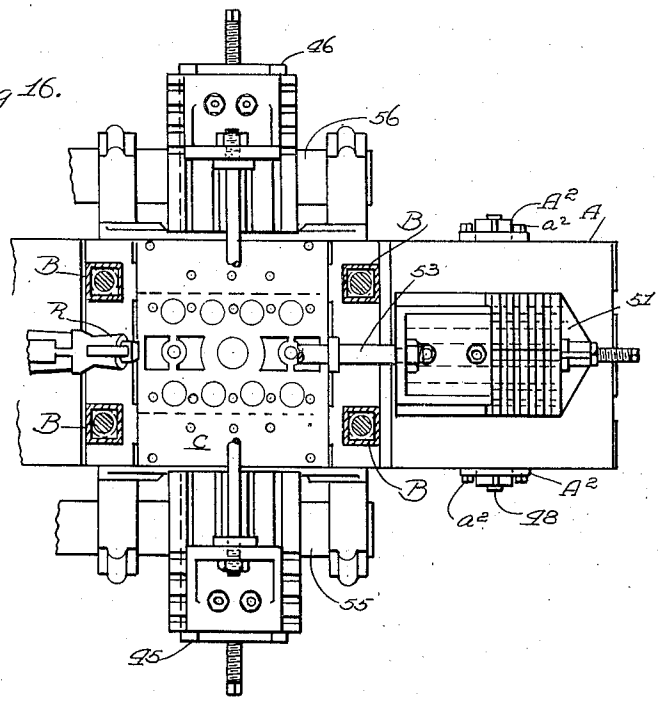


Fig 16.



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May 14, 1929. W. O. WILL ET AL 1,713,312

DIE CASTING MACHINE

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Fig. 17.

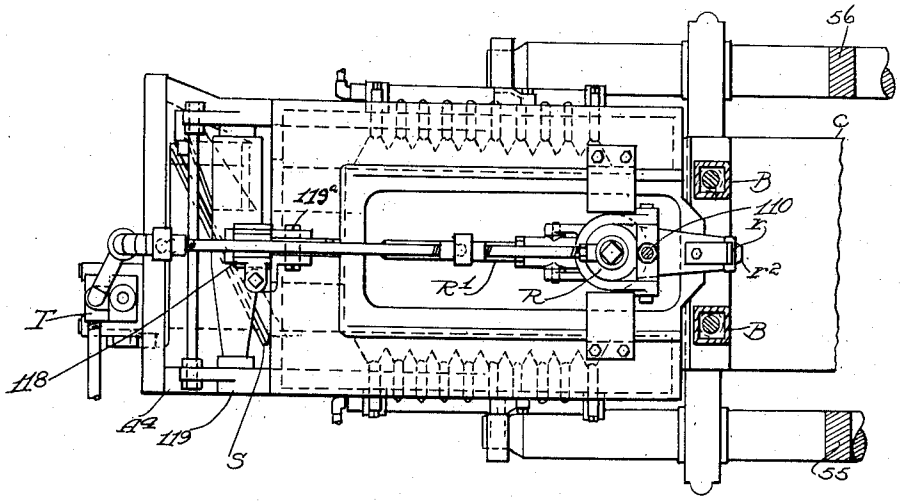


Fig. 18.

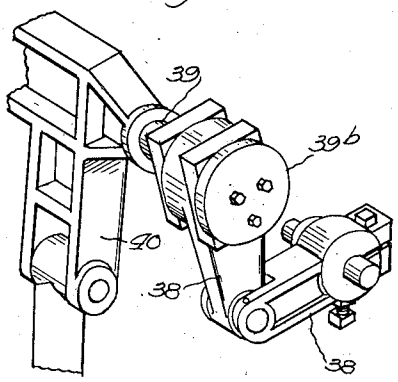


Fig. 20

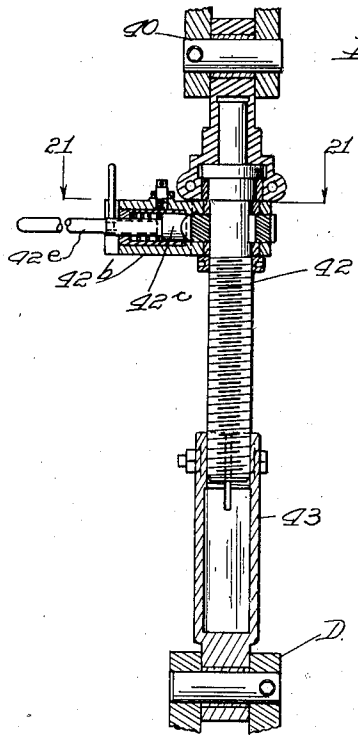
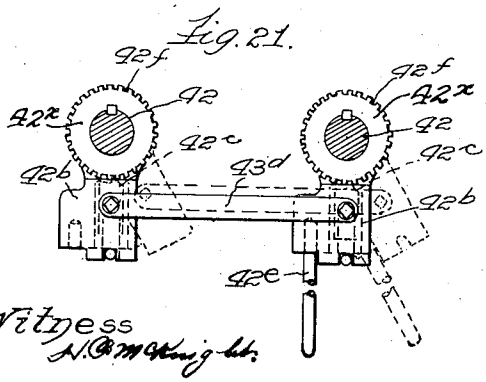


Fig. 21.



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May 14, 1929. W. O. WILL ET AL 1,713,312

DIE CASTING MACHINE

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Fig. 19.

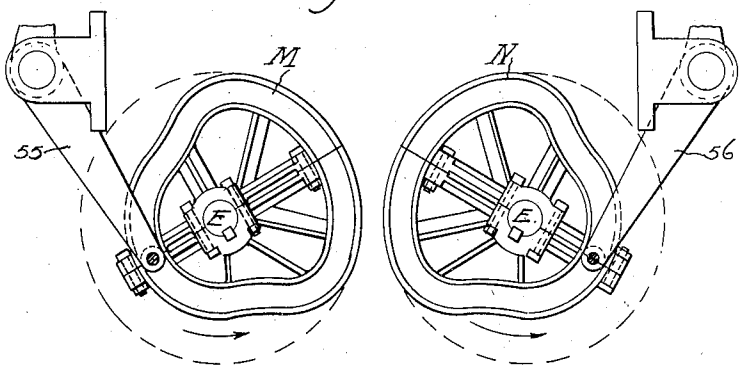


Fig 22.

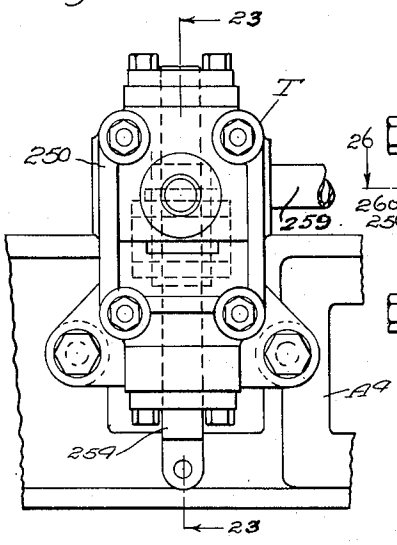


Fig 23

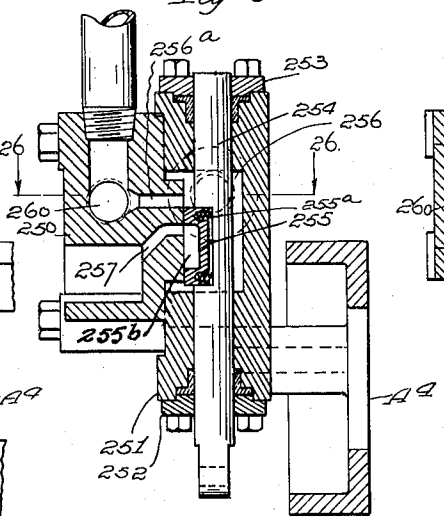


Fig 26

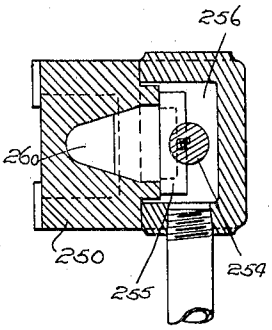


Fig 24

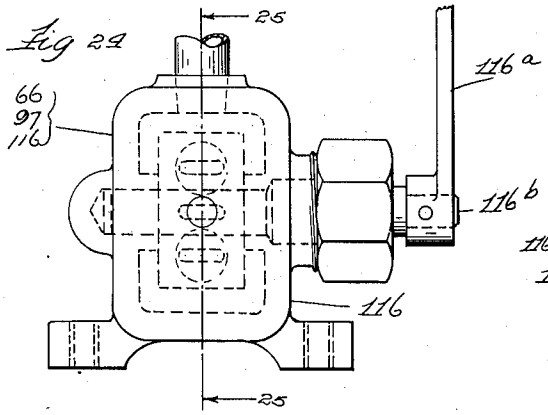
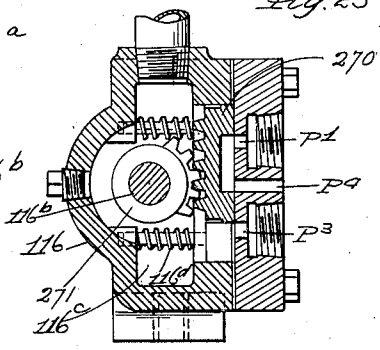


Fig. 25



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Patented May 14, 1929. 1,713,312

UNITED STATES PATENT OFFICE.

WALTER O. WILL AND ERIC CARLSON, OF CHICAGO, ILLINOIS, ASSIGNORS TO STEWART MANUFACTURING CORPORATION, OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

DIE-CASTING MACHINE.

Application filed February 1, 1926. Serial No. 85,165.

The purpose of this invention is to provide an improved machine for die casting. It consists in the elements and features of construction shown and described as indicated in the claims.

In the drawings:

Figure 1 is a front end elevation with the casing of a main power-transmitting wheel partly broken away.

Figure 2 is a left hand side elevation partly sectional as to the melting pot and injector for delivering molten metal to the mold or die, and broken away as to an intermediate portion of the upright frame structure and part contained for condensing the view vertically.

Figure 3 is a side elevation for showing principally the upright frame structure and portion of the base structure underneath said upright frame portions intermediate the latter and the front and rear ends respectively, being broken away to condense the view.

Figure 4 is a transverse vertical section at a plane about midway the length of the upper and lower die-member-carrying and operating heads.

Figure 5 is a front end elevation on a larger scale than Figure 1, showing a main power-transmitting wheel with a driving shaft and clutch and starting and stopping devices.

Figure 6 is a partial or detail rear end elevation the upper part of the machine being broken away.

Figure 7 is a sectional detail view of a modified form of the melting pot metal injecter and operating connections, section being made in the plane of the metal injector throat.

Figure 8 is a section at the line 8—8 on Figure 7.

Figure 9 is a section at the line 9—9 on Figure 4.

Figure 10 is a section at the line 10—10 on Figure 9.

Figure 11 is a section at substantially the same plane as Figure 4 and in part at the planes of Figure 10, showing diagrammatically, that is, without identity as to the plane of section, certain compressed air operating devices for controlling certain of the movements of the mechanism.

Figure 12 is a detail section on a larger scale than Figure 5, axial with respect to the power shaft, fly wheel and pulley and clutch mechanism.

Figure 13 is a section at the line 13—13 on Figure 10.

Figure 14 is a section at the line 14—14 on Figure 5.

Figure 15 is a top plan view of so much of the structure as lies between the two lines 15—15 on Fig. 2.

Figure 16 is a horizontal section at the line 16—16 on Figs. 2 and 4.

Figure 17 is a horizontal section and top plan view at the plane indicated by the line, 17—17 on Fig. 2.

Figure 18 is a perspective view of a link in the connections for operating the upper reciprocating die-member-carrying head.

Figure 19 is a side elevation of two cams for operating symmetrically the transverse slide heads for carrying transversely thrust cores and the like.

Figure 20 is a detail section at the line, 20—20, on Fig. 4.

Figure 21 is a section at the line, 21—21, on Fig. 20.

Figure 22 is an elevation of the valve device for controlling compressed air for injecting metal into the die.

Figure 23 is a section at the line, 23—23, on Figure 22.

Figure 24 is an edge elevation of one of several identically constructed valves operated at will for controlling compressed air for operating certain parts of the mechanism.

Figure 25 is a section at the line, 25—25, on Fig. 24.

Figure 26 is a section at the line, 26—26, on Fig. 23.

The machine shown in the drawings comprises elements which will be hereinafter described in detail with respect to their operation and co-operation, but which will be first enumerated in general for affording an outline understanding of the organization, as follows:

1. A main base frame, A, in which there is journalled extending longitudinally thereof a main operating shaft hereinafter identified;

2. An upright frame structure, B, in which the top and bottom die-member-car-

rying heads, D and C, are mounted for the movement of one of said heads for opening and closing the mold; said heads each comprising a main body and a spacer rigidly spacing a die member from the main body forming an interspace for a purpose hereinafter explained; said die members being designated respectively, C^1 and D^1, the spacers respectively, C^2 and D^2, and the interspaces, C^3 and D^3 respectively.

3. The main operating shaft, E, journalled in and extending longitudinally of the main base frame, A;

4. Power communicating means comprising a pulley, F, to be driven by a belt, from any convenient power shaft, said pulley being journaled on a fixed sleeve G^1, within which the shaft, G, extends transversely of the main operating shaft, E; a friction clutch device comprising a member, 10, slidable on the transverse shaft, G; a clutch-operating slide shaft, 12, parallel with said transverse shaft, G, and having a clutch shifting fork, 14, operating the slidable member, 10, for engaging and disengaging the clutch; a spring, 16, coiled about the transverse shaft, 12, and stopped between a stop collar, 17, thereon, and the slide bearing, 18, of said shaft for yieldingly holding the transverse shaft, 12, thrust in the direction for causing the clutch shifting fork, 14, to hold the clutch member, 10, at clutch disengaging position; a rack, 19, on the transverse shaft, 12, and a starting lever, 20, fulcrumed on the slide bearing, 21, of said shaft, the lever having a gear segment, 22, engaging the rack, 19, for actuating the slide shaft, 12, longitudinally for engaging and disengaging the clutch members; and a locking dog, 162, carried by a short arm, 15^b, of the lever, 15, hereinafter further described, said locking dog engaging a stop collar, 12^d, on the shaft, 12, for locking the shaft at engaged position of the clutch.

5. A worm, 30, on the transverse shaft, G, engaging a worm wheel, H, fast on the main operating shaft, E, whereby the latter shaft is rotated slowly by a relatively rapid rotation of the transverse shaft, G, when the clutch members are engaged and the drive pulley, F, is being driven by the belt, *f*, which is connected to the source of power;

6. Means by which the main operating shaft, E, actuates the top die-member-carrying head, C, for closing and opening the mold, comprising pair of facing cams, 35, fast on the shaft, E, whose facing grooves 35^a, are engaged each by a stud-and-roll, 36, on a lever, J, which is fulcrumed at one end on a bracket, A^1, depending from the main base frame, A, and at the other end is pivotally connected with the lower end of a link, 37, which extends upward to the top of the machine for actuating a lever arm, 38, of a rock shaft, 39, which is journalled in the upper end of the upright frame, B; a pair of crank arms, 40; and two-membered pitman, 42, 43, therefrom, connected with and actuating said top die-member-carrying head;

7. Two pairs of face cams, M, M, and N, N, fast on the main operating shaft, E, and for operating by means of levers, 55 and 56, respectively right and left hand horizontally reciprocable slide heads, 45 and 46, for carrying laterally related cores or other die members into and out of co-operate relation with the remainder of the die;

8. A peripheral cam, K, fast on the main operating shaft, E, co-operating with an up and down extending lever, 47, fulcrumed at 48 on a bracket, A^2, secured to the main base frame at a^2, said lever having a cam roll, 50, at the lower end engaging the peripheral groove, *k*, of the cam for oscillating the lever in a longitudinally vertical plane to actuate a longitudinally reciprocable slide head, 51, which is engaged by the upper end of said lever, as seen at 52, for carrying a core, or other die member, indicated at 53, horizontally at right angles to the direction of movement of the core-carrying slide heads, 45 and 46, into and out of co-operative relation to the parts of the die which are positioned by the bottom and the top die-member-carrying heads, C and D;

9. A metal injector, R, mounted for submerging its intake,—which is also the injection nozzle, *r*,—in the molten metal in the metal pot, W, for taking in through said nozzle a quantity of the molten metal sufficient for the capacity of the most capacious die for which the machine is designed;

10. Operating means for lifting and advancing the injector, R, and registering its nozzle, *r*, with the mold nipple indicated at V, and retracting and depressing the injector in respect to its intake nozzle into the molten metal for filling the injector, said operating means comprising means for the two movements, viz: (*a*) for lifting and lowering the nozzle end of the metal injector into and out of alignment with the filling port of the die, and (*b*) for advancing and retracting the injector for seating and unseating the nozzle at said port. For the first mentioned of these movements the injector is connected near the nozzle end to the lower end of a link, 80, which depends from a lever arm, 111, of a short rock shaft, 112, which is journalled on a bracket, B^1, mounted on the rear side of the upright frame, B, and having a second arm, 113, which is connected by a link, 114, to a short lever arm, 39^c of the rock shaft, 39, which operates the top die-member-carrying head, D, so that the nozzle end of the injector is lifted and lowered in time with the rocking of the shaft, 39, by which the head, D, is

lowered and lifted for closing and opening the mold. The second mentioned means for advancing and retracting the injector with respect to the mold consists of a peripheral cam, S, fast on the rear end of the main operating shaft, E, having its peripheral cam groove, *s*, engaged with a stud-and-roll, 117, at the lower end of an up and down extending lever, 118, fulcrumed at 119 upon a bracket member, A^4, of the main base frame, the upper end of said lever being pivotally connected at 119^a with the rear end of the stem, R^1, with which the injector, R, is provided extending rigidly rearwardly from the body of the injector. It will be seen that the cam, 35, by which the reciprocation of the top die-member-carrying head is controlled, and the cam, S, by which the advancing and contracting movement of the injector, R, is controlled, will be relatively formed as to their camming portions to cause the two movements of the injector to co-operate properly for registering the nozzle with the die and disengaging it therefrom in proper correlation to all the movements of the different parts of the die which are derived from the main operating shaft, E. The nozzle, *r*, of the injector is preferably made detachable from the spout, as may be understood from Figure 2, for the reason that it is liable to require somewhat frequent replacement because of deterioration from the severe service to which it is subjected in the frequent flow of molten metal and the necessity of seating hard at the die inlet. For making sure liquid-tight seating at the die inlet it is tapered at a less angle than the seat at the die inlet with which it registers, and its angle edge is sharply defined as distinguished from being blunted or beveled, so that the seating area is reduced as nearly as possible to a mere circumferential line of contact.

The form of the throat or metal flow passage of the injector is of the form shown in Figure 2, viz, comprising a final or delivery part, r^2, very nearly straight and sloping,—when the injector is in position registered with the die,—at such angle that when the injector is in submerged position for being filled by the inflow through the spout, this part of the passage is substantially horizontal, and the remainder indicated at r^3 of the passage leading back into the bottom of the metal reservoir cavity slopes more steeply than the part, r^2, making a distinct bend downward as seen at r^4. The purpose of this form of the passage is first, to ensure that the metal shall flow into the injector cavity through the passage, without possibility of trapping air at any point therein; and second, to ensure that the spout passage shall be full to the top of the nozzle when the nozzle is lifted and advanced into registration with the die inlet.

The construction of the valve which controls the admission of air to the metal injector for forcing the molten metal into the die requires particular description. This valve is a slide valve, 255, (see Fig. 23) carried by stem, 254, which has guide bearings in the part, 251, of a valve casing, T, which is mounted on the bracket, A^4, said stem extending through stuffing boxes, 252 and 253, at the lower and upper ends of said part, 251, which is integral with the bracket, A^4, and supports the remainder of the valve casing to which the letter, T, is applied (see Figs. 22 and 23). The valve, 255, has in its seating face a rectangular cavity, 255^b, dimensioned for spanning two ports, 256^a and 257, in the valve seat toward which said valve is pressed by springs, 255^a, reacting against the stem, 254.

Compressed air from a source not shown enters the valve casing through a pipe, 259, and is admitted through port, 256^a, at the open position of the valve, 255, seen in Fig. 23, and by the pipe, 259, flexible elbow, 258 and horizontal pipe, 259^b, is led to the injector, R, at proper times in the cycle of the machine for injecting the molten metal into the mold. Upon the retraction of the slide valve from the position shown in Fig. 23,—the cam, S^3, being formed for such retraction at the proper stage in the die casting operation,—the air pressure is vented through the port, 257. The flexible elbow, 258, it will be understood, accommodates the movement of the pipe, 259^a, which is necessary for the movement of the injector, R, in advancing to and withdrawing from the mold as above described.

In addition to the foregoing positively operated machine elements deriving their movements from the belt driven pulley on the power shaft, the machine comprises parts operated by compressed air and whose operation is controlled at will by the operator as follows:

11. A compressed air cylinder, 60, and piston, 61, therein, operating upon the admission of compressed air through pipe, 62, controlled by a valve hereinafter described for operating certain parts of the machine. The piston stem, 63, is pivotally stepped upon the top die-member-carrying head, D; and the cylinder, 60, suitably guided for reciprocation on the piston head, 64, within said cylinder, is connected at its lower end with one end of a lever, 65, fulcrumed at its opposite end upon the upper end of an upstanding link, 56, pivoted at its foot on said head, D, and connected intermediate its ends with a plunger, 70, whose lower end portion constitutes a double faced rack bar, 71, which engages at its opposite sides pinions, 72 and 72^a, mounted at opposite sides of said double faced rack bar, and which at their opposite sides are engaged with and operate verti-

cally reciprocating rack bars, 74 and 74^a, which are slidingly mounted for vertical reciprocation in the top head, D, and which carry at their ends below the main body of said head, D, in the interspace, D^2, a plate, 82, which is slidably mounted on headed guide studs; 83, upstanding from the upper die member, D^1, said plate, 82, having downwardly projecting studs, 86, which protrude through apertures in the upper die member, D^1, for carrying and withdrawing cores pertaining to the upper part of the die.

For convenience of assembling and making the compressed air connections to the cylinder, 60, and providing for the adjustment hereinafter mentioned, its upper head is formed by an inserted fitting, 60^x, piston-fitted into the body of the cylinder; and a screwed-on cap, 60^y, has a central threaded aperture for a screw-threaded stem, 60^w, of said member, 60^x, which serves for adjusting the latter in the cylinder to limit the effective length of the cylinder, and thereby the length of the possible stroke which the cylinder can make for operating the connected parts. A jam nut, 60^z, on the stem, 60^w, serves for securing the piston head, 60^x, at adjusted position. Said head, 60^x, has a port, 60^v, extending through it for admitting the compressed air to the moving piston head, 64.

12. A compressed air cylinder, 90, mounted on a bracket, A^7, bolted as seen at a^7 to the main base frame, having its piston stem, 91, connected to one end of a lever, 92, which is fulcrumed between its ends at 93 on a bracket, A^5, bolted to the main base frame, as seen at a^5, and connected at the other end with a vertically reciprocable member, 95, which is in the form of a yoke for embracing and obtaining slide bearing and vertical guidance upon the journal bearing, A^6, in the main base frame of the operating shaft, E, (said bearing being appropriated for this purpose as a matter of convenience in view of the necessity of positioning the part, 95, substantially in the vertical longitudinal plane in which the operating shaft is located), said yoke member, 95, being operatively connected, as hereinafter particularly described, with a plate, 96, equipped with means, also hereinafter described, for retracting the cores from the casting in the lower member of the die carried upon the head, C. The cylinder, 90, has the construction comprising parts indicated by the reference characters 90^v, 90^w, 90^x, 90^y, 90^z, corresponding to the parts of the cylinder, 60, denoted by 60^v, 60^w, 60^x, 60^y, 60^z, respectively.

13. A cylinder, 100, having connection for compressed air for operating its piston, 101, which has a stem, 102, projecting through the lower end of the cylinder and connected to a lever arm, 103, of a rock shaft, 104, which has a second lever arm, 105, connected by a link, 106, to a lever arm, 107, of a rock shaft, 108, positioned oppositely to the first mentioned rock shaft in relation to the vertical plane of the main operating shaft, E, said second rock shaft 108 having two parallel lever arms, 109, projecting inwardly toward said vertical plane of the shaft, E, the first mentioned rock shaft having two corresponding lever arms, 110, projecting inwardly toward the arms, 109, respectively, said lever arms, 109 and 110, having their inner ends connected respectively to the lower ends of four similar upstanding links, 113, said four links carrying at their upper ends a plate, 114, which is provided with means hereinafter more particularly described for loosening from the lower die member, by upward thrust into, the casting formed in said die member which is carried on the bottom head.

14. A valve for controlling the admission of compressed air to the metal injector for forcing the molten metal into the die; and a face cam, S^3, on the shaft, E, having cam members s^3 and s^4 for operating the valve 255 in valve casing member, T, to time the admission and cut-off of the compressed air suitably in relation to all the other movements dependent upon the rotation of the shaft, E.

Certain of the parts or elements above listed comprise details requiring specific description as follows:

The clutch device on the power shaft, G, comprises the fork-engaged member, 10, which is a sleeve feathered on the shaft, and comprises a conical cam, 10^a, and a friction brake disk, 10^b cooperating with a disk G^{11} rigid with the frame member, A^{10}. The cam co-operates with three levers, 11, fulcrumed on the sleeve at equal angular intervals around its axis and bearing at their inner ends at an oblique angle against the outer surface of a friction clutch member, 13, which is feathered on the hub of a co-operating friction clutch member, 13^a, which is keyed on the shaft, G, said friction disks facing each other for engaging between them a friction annulus, *f*, which is located within the flange which constitutes the pulley, F^1, and held fixedly to the pulley by means of the key pin, f^1, a machined steel bushing sleeve, f^2, being drive fitted within the pulley flange for seating said friction annulus, *f*, and a steel plug, f^3, being set into the pulley flange F^1 for receiving the key pin which is held in position by said screw, f^4, all as seen in Figure 12. Springs, 13^b, interposed and reacting between the disks, 13 and 13^a, tend to hold them normally out of frictional engagement with the friction annulus, *f*. The disk, 13^a, is stopped longitudinally on the shaft by the bushing and bearing sleeve, G^1, which is fixed in the horizontal bearing member, G^{10}, for journaling

the wheel, F, of which the pulley, F^1, constitutes a lateral flange, as may be understood from Figure 12.

The worm wheel, H, and the clutch-operating slide shaft, 12, co-operate with each other and with an emergency stopping and starting lever, 15, for automatically arresting the operation of the power driven mechanism operated through the main operating shaft, E, upon the completion of a cycle of the operation (which it will be understood is performed within a single revolution of said operating shaft, E, and worm wheel, H,) and automatically releasing the main operating shaft, E, from the arresting means upon the occurrence of the driving engagement of the clutch, and for giving the operator control for arresting the action at any time upon emergency requiring such control.

For these purposes the wheel, H, has mounted upon its inner side an abutment, h^1, and there is fulcrumed at 150^a on a bracket, a^3, bolted to the main base frame, A, a latch, 151, which depends adjacent the inner side of the wheel, H, and is adapted to swing into position to be encountered by the abutment, h^1, as the wheel, H, revolves. This latch has a lever arm, 151^a, extending at the outer side of the wheel, H, from which lever arm a thrust link, 152, extends upwardly alongside the journal bearing, a^5, of the shaft, G, and thence through an aperture, seen at a^{10}, in the casing, A^9, which encloses the wheel, H, and the cooperating worm, 30; and above said casing said thrust link extends up through a stop head, 153, which houses and stops a spring, 154, coiled around the thrust link, 152, and stopped at its lower end on the casing, whereby it reacts for upholding the thrust link and the lever, 151^a, of the latch, 151, at the position of said latch out of the path of the abutment, h^1. The thrust link comprises a lower part, 152^a, constituting a sleeve with which the upper part telescopes and which carries a locking pin, 155, seated transversely of the telescopic engagement of the two parts and engaging frictionally in the side of the upper member of the thrust link, being provided with a spring, 155^a, for enforcing such engagement. The two parts of the thrust link operate as a unit for upward thrust of the link at its upper end against the end portion of a short latch lever, 160, which is pivoted at 161 on a bracket, a^9 which is mounted on the casing, A^9, for carrying the slide bearing of the rack 19. The latch has at its upper edge a cam slope or shoulder, 160^b, and there is mounted upon the slide shaft, 12, a collar, 12^b, constituting or affording an abutment which has a cam slope, 12^c, which co-operates with the cam slope, 160^b, or the latch, 160, in the slide movement of said shaft, 12, for engaging the power shaft clutch. It will be understood from this description that upon the clutch-engaging sliding movement of the shaft, 12, the latch, 160, is crowded downward at its free end thrusting downward the thrust link, 152, causing it to rock the latch, 151, about its pivot and carry it to the full line position shown in Figure 5 out of the path of the abutment, h^1, whereas before that action said latch, 151, is normally held by the spring, 154, through the connection of the thrust link, in the position shown in dotted line in Figure 5 in the path of said abutment, b^1. The lever arm, 151^a, of the latch, 151, has at the end beyond the connection of the thrust link thereto, a cam terminal, 157, projecting its cam edge downward from the lower side of said lever arm. The purpose of this detail construction is that a stud-and-roll abutment, 158, mounted upon and projecting from the outer side of the wheel, H, is positioned with its path of rotation with the wheel, H, for encounter with said cam edge, 157, as the wheel, H, revolves in the closing quarter or third of its revolution, and crowds the thrust link upwardly with the effect of disengaging the lower part, 152^a, from the upper part and permitting said lower part to slide up along the upper part instead of forcing the upper part upwardly, such upward movement of the upper part being at that stage prevented by the latch, 160, which is locked against upward swinging movement. The upward swinging movement of the part, 151^a, caused by the encounter of the abutment, 158, with the cam edge, 157, operates for swinging the latch, 151, about its pivot away from the full line position shown in Figure 5 to the dotted line position shown in said figure for encountering the abutment, h^1, if for any reason the wheel, H, fails to come to rest upon the disengagement of the driving clutch which should occur by means hereinafter described.

The frictional engagement of the pin, 156, against the upper member of the thrust link, 152, is sufficient to hold the the lower member, 152^a, of the link, and the arm, 151^a, of the latch, 151, at the position to which these parts are forced by the abutment, 158; and the latch, 151, will therefore remain in dotted line position to which it has been moved until the lower part of the link is forcibly slid down along the upper part to make the link operative to its full length; and this re-extension of the link occurs at proper time as hereinafter described.

The lever, 15, hereinafter referred to as the tripping lever fulcrumed at 15^a upon the bracket member, a^9 has a short lever arm, 15^b, which is connected with the sliding detent latch, 162, positioned and guided for vertical movement in the bracket, a^9, for en-

gaging the collar, 12^d, which is positioned on said shaft to be engaged at its right hand end, as heretofore described, by the detent latch, 162, at the retracted position of the slide shaft, 12, at which the power shaft clutch is engaged for driving the shaft, G; and the lever, 15, is provided with a spring, 15^c, reacting for thrusting the detent latch to its shaft-locking position shown in Figure 5. At the lower end of the lever, 15, it projects adjacent the outer side of the wheel, H, terminating in position to be encountered by the abutment, 158, after that abutment has passed the cam edge, 157, of the latch, 151. This encounter it will be seen rocks the lever, 15, in the direction to withdraw the slide-latch, 162, out of engagement with the collar, 12^d, on the shaft, 12, thereby releasing said shaft leaving it subject to the action of the spring, 16, for thrusting it in the direction for disengagement of the power shaft clutch and engagement of the friction brake members, 10^b and G^{11}; and the power being thus disconnected, and the brake becoming simultaneously operative, the wheel, H, and the operating shaft, E, and the entire power driven mechanism tend to come to rest; and if for any reason it fails to do so, the movement is positively arrested by the encounter of the abutment, h^1, with the end of the latch, 151, upon the wheel revolving a few degrees further after the disengagement of the clutch and encounter of the brake disks, 10^b, and G^{11}. And this positive stoppage of the mechanism will either cause disengagement of the clutch,—whatever may have delayed such disengagement,—or will cause the belt to slip and to be fed off the pulley. There is, however, provided an additional means which operates in the emergency which would result from the failure of disengagement of the clutch, or failure of the brake to arrest the rotation of the power shaft as described. This means consists in that the flange which constitutes the belt pulley, f^1, is held to the friction annulus f of the clutch, for deriving rotation therefrom only by the key pin, f^1, which will be sheared off in case the stop of the wheel, H, by the encounter of the abutment, b^1, with the lever, arm, 151, should not cause the belt to slip on the pulley and eventually leave it.

The construction by which the sliding yoke member, 95, operates for retracting the cores from the casting in the lower member of the die which is carried by the head, C, requires specific description. Referring to Figures 4 and 11 it will be understood that the said reciprocable member, 95, has projecting from its upper end, formed by a cross head plate, 96, connecting the side bars of its yoke form, a stem, 170, which carries at its upper end a double-faced rack bar, 171, whose opposite racks engage similar pinions, 172, 172^a, at the opposite sides of said rack bar, said pinions being journalled in the lower or main plate or body of the bottom head, C, and at their opposite sides meshing with racks, 174, 174^a, which are slidably mounted in said lower body of the head, C, for sliding oppositely to the sliding movement of the stem, 170; that is, so that the upward movement of said stem with the yoke slide member, 95, causes downward sliding movement of the rack bars, 174, 174^a. Said rack bars extend up through the said body member of the head, C, and in the interspace, 180, between said body member and the bottom die member, C^1, said rack bars carry a plate, 182, which is slidably mounted upon downwardly headed guide rods, 183, which are secured to and project downward from said die member, C^1. On said guide rods above said plate, 182, there is positioned and guided for short up and down sliding movement between the die member, C^1, and stops, 183^a, on said rods, 183, a plate, 185, serving a purpose hereinafter described in detail, said plate having apertures through which core-carriers, 186, which are carried rigidly by the plate, 182, extend for protruding also through apertures in the die member, C^1, to carry the die cores in and out with respect to said die member.

The detail construction by which the plate, 114, operates for dislodging the casting from the lower member of the die mounted on the bottom head, C, requires specific description. This means comprises thrust rods, 190, carried in the head, C, as best seen in Figure 10, and stepped on said plate, 114, through the medium of removable covers, 114^a, for apertures, 114^b, in said plate, 114, for a purpose hereinafter explained, said thrust rods extending parallel to each other upwardly in apertures, c^3, provided in said head, C; said apertures extending through the head and registering with stems, 182^b, which extend down from the plate, 185, above mentioned, through registering apertures in the plate, 182, which has the core-operating function above described. Said plate, 185, has mounted in it and projecting from it through suitable apertures provided in the die member, C^1, knock-out pins, 191, to any desired number, and distributed as may be suitable for the particular casting to be produced in any particular die which may be mounted in the machine; and it will be understood that the plates, 182 and 185, have provision, by means of registered holes distributed over their respective areas, for a variable number of variably arranged core-carriers, 186, to extend from the plate, 182, and casting-loosening or "knock-out" pins, 191, to extend from the plate, 185.

The foregoing description of the construction and operation of the core-withdrawing

means associated with the lower head, C, will apply to the construction and operation of the identically operated and operating core-withdrawing means in the upper head, D, the parts 70, 71, 72, 72ª, 74, 74ª and 82 in the upper construction corresponding in form and function and operation to the parts 170, 171, 172, 172ª, 174, 174ª and 182 of the construction associated with the lower head, C.

It may be understood from Figures 9 and 10 that the construction of the core-withdrawing means may comprise a plurality of each of the parts, 170, 172, 172ª, 174, 174ª, in the lower head and the corresponding parts, 70, 72, 72ª, 74, 74ª in the upper head, the multiples of the several parts being arranged in rows lengthwise of the heads, C and D, respectively as shown in Figures 9 and 10, and that in the lower head like plurality of the thrust rods, 190, for carrying the plate, 114, in the lower head, and of the knock-out pins, 191, carried by said plate, 114, may be provided as seen in Figure 10. And it will be understood that for this purpose the multiple pinions, 172, 172ª, and 72, 72ª, are carried on shafts in common for each group of pinions, said shafts designated 173, 173ª and 73, 73ª, being journalled at their ends and also between the several pinions in the body of the respective heads, C and D, as seen in said Figures 4 and 13.

The detail construction of the rack bars, 74, 74ª, and 174, 174ª, as seen in Figures 4 and 10 which shows one of the rack bars, 174, for convenience of assembling the structure consists in that each of said rack members comprises a central rod, 120, screwed into the plate which the rack bars carry, on which rod the rack proper is mounted being for this purpose in the form of a sleeve, and being positioned along the length of the rod by a spacing sleeve, 121, at the end toward the plate, and a nut, 122, screwed on to the rod at the other end of the sleeve rack proper, with an interposed washer, 123, between the end of the sleeve and said nut. The nut, 122, is much elongated as shown, merely for rendering it conveniently accessible at all positions, and the plate, 96, has apertures, 97, to accommodate these nuts on the rack bars, 174, 174ª, in the reciprocating movements of the racks and said plate.

The operating connection from the link, 37, to the lever arm, 38, of the rock shaft, 39, comprises a link, 37ª, pivotally connected with said lever arm at one end, and at the other end pivotally connected to the link, 37, at one side thereof, the link 37 having at the other side a slideway, 37ᵇ, for sliding on the rock shaft, 39, which for that purpose protrudes from its bearing on the upright frame, B, into said slideway which is retained on said protruding end of the shaft by a narrow applied collar, 39ᵇ.

The uprights constituting the frame, B, are tubular, as seen in Figure 9, and on the side toward the metal pot where the heat from the pot is intense, these tubular uprights are connected for circulation of water to cool the same, as indicated by the pipe nipples shown at b^3 at the lower part of these uprights, which may be understood as designed for connection with a source of water supply, and the pipe nipple, b^4, at the upper ends of these pipes, which may be understood as connection with a waste pipe to which the water will flow after circulating through the standards for cooling them.

Upon the outer sides of the tubular standards there are mounted sheet metal sheathings, B^3, forming inclosures for accommodating counterweights, 24, which are connected by cables, 25, running over pulleys, 26, mounted with their peripheries overhanging the cavities of said sheet metal casing, with the head, D, whereby the movement of the head upward and downward is performed with substantially equal stress upon the cams, 35, and the operating connection from the lever, J, to the crank arm.

The controls and details of connection of the several compressed air cylinders referred to will now be described.

For controlling the operation of the cylinder, 60, by which the upper core-operating rack and pinion devices are actuated, a valve, 66, is mounted on the frame in any position convenient for locating its operating lever handle, 66ª, within convenient reach of the operator, standing at the forward end of the machine for operating the clutch-shifting lever. The body of the valve, 66, is connected by a pipe, 66ᶜ, with a source of compressed air, not shown, and by pipes, 66ᵈ and 66ᵉ respectively, with the upper and lower ends of the cylinder, 60, the two latter connections comprising a flexible pipe portion, 66ᶠ and 66ᵍ, for accommodating the movement of the cylinder, 60, as above described.

For controlling the cylinder, 90, whose piston operates the connections for actuating the core-withdrawing rack and pinion devices described, the valve, 97, is mounted upon the frame as seen in Figure 11 with its operating handle, 97ª, extending within convenient reach of the operator, the valve body being connected by the pipe, 97ᵇ, with a source of compressed air, and by pipes, 97ᶜ and 97ᵈ respectively, with the upper and lower ends of the cylinder, 90.

For controlling the cylinder, 100, a valve, 116, is mounted on the frame as seen in Figure 4 with its operating handle, 116ª, extending within convenient reach of the operator, the valve body being connected by a pipe, 116ᵇ, with a source of compressed air,

and by pipe, 116^c, with the upper end of said cylinder.

All of these manually operated valves for controlling the compressed air operated devices are three-way valves adapted at one position to close all the pipe connections, at another position to open the connection with the source of compressed air and the connection to the upper end of the cylinder, and at a third position to close the connection with a source of compressed air and open the connection with the lower end of the cylinder and the vent port. The detail construction of the valves as described may be understood from Figure 15 which may be understood as representing any one of the three valves, 66, 97 or 116, the compressed air inlet being indicated at p, the port for connection with the upper end of the cylinder at p^1, the port for connection at the lower end of the cylinder, and the vent port at p^3.

From the foregoing description it will be understood that for operating the cylinder, 110, which has no air connection to the lower end, the third position of the valve will not be used.

The several cams on the shaft, E, are relatively adjusted about the shaft with respect to the clutch-releasing parts carried by the wheel, H, for causing the mechanism to come to rest with the upper head, D, and the lateral sliding heads, 45 and 46 withdrawn and the core-carrying parts associated with the upper and lower heads withdrawn with respect to said heads respectively.

With the machine in this condition the order and manner of operating the machine in casting may be understood as follows:

The several members of the die comprising usually a bottom or body member, and a top member or cover, and lateral members or cores to be inserted and withdrawn laterally, are mounted respectively on the lower head plate, C^1, and the upper head plate, D^1, on the lateral sliding heads, 45 and 46, and the cores, if any, to be entered and withdrawn vertically, are secured to the proper core-carrying pins in the lower and upper heads respectively.

The die parts being now in condition for closing, but still in what may be called the rest position of the mechanism, the operator moves the starting lever, 20, causing the gear segment thereon to actuate the slide-shaft, 12, for engaging the clutch and bring the machine into operation under power.

In the first stage of the resulting movement the die-members are closed by the descent of the upper head and the movement toward each other of the lateral heads, and at the same time the core-operating parts in the upper and lower heads operate for thrusting the cores into place in both die-members.

In the next stage the metal injector is advanced in registration of its nozzle with the mold intake, and immediately following the registration of the nozzle with the intake the cam protrusion, s^{30}, of the cam member, s^3, operates for admitting compressed air to the injector chamber, and the metal is injected into the mold. The wheel, H, in addition to the abutment, 158, described for tripping the clutch-shifting locking means to disengage the driving means and bring the mechanism to rest, has two similar abutments, 158^a and 158^b, at positions on the wheel, H, for similarly tripping the clutch-shifting locking means and stopping the machine at earlier stages in the cycle of its operation. The first of these stages occurs immediately after the injection of the molten metal into the die. The purpose of this stoppage is to allow time for the metal to reach the remote and lesser cavities of the die and be fully forced thereinto before the air pressure is withdrawn. The operator governs the duration of this halting by operating the starting lever 20, at the proper limit of the halt; and the rotation of the shaft, E, being resumed, carries the several cams through their respective cycles to the point at which the lateral and forward end die members or core-carrying sliding heads, 45, 46 and 51 are withdrawn; and at this second stage the abutment, 158^b, encounters the tripping lever, 15, and causes the disengagement of the driving means, causing the machine to make a second halt, during which the operator operates the valve for admitting compressed air to the cylinders, 60 and 90, for withdrawing the vertically withdrawable cores. When this operation is completed, the operator again operates the starting lever, 20, for starting the machine, which thereupon completes its cycle, opening the die by drawing upwardly the upper die member, D^1, and coming to rest by the disengagement of the clutch and operation of the brake as first above described.

The operator then brings into action the compressed air cylinder, 100, for actuating the knock-out pins for loosening and disengaging the casting from the lower die member, C^1. In this action it is to be noted that the rods, 190, are of such length as to protrude up in the lower head, C, only so far that at normal position of rest of the parts as seen in Figure 10, they terminate short of the lower ends of the stems, 185^b, a sufficient distance so that the actuating parts comprising the plate, 114, acquire considerable momentum in their upward thrust caused by the piston of the cylinder, 100, before the rods, 190, collide with the stems, 182^b; so that the plate, 185, carrying the knock-out pins causes said pins to deliver a blow rather than a push against the casting in the die for loosening and dislodging it.

In practice, especially in the case of castings of considerable weight, the operator will usually repeat the operation of the compressed air valve-controlling cylinder, 100, opening and closing it more than once so as to cause the knock-out pins to deliver repeated blows at very short intervals upon the casting to first jar it loose, and afterward thrust it up from its position in the die.

In Figures 7 and 8 there is shown a modified form of metal pot and injector. In this form the metal container and injector constitute a unit indicated at R^x R^y, mounted fixedly in the heater element, W^x, and the entire structure,—hereinafter referred to as the metal pot,—is operated for movement bodily to carry the injector nozzle into and out of registration with the die inlet. The mounting for this purpose consists of a pair of bell cranks, 215 and 216, each fulcrumed at its angles indicated at 202, 202, with supporting legs, 203, of the metal pot pivotally connected to the corresponding upper arms of the bell cranks, the lower arms being connected by link, 204. From the upper end portion of the lever, 118, an operating link extends to the upper part of the metal pot to which pivotal connection is made at 205. The rocking of the lever, 118, on its fulcrum, it will be seen, will move the metal pot in an upwardly convexly curved path in withdrawing from and advancing toward the die, and the weight of the metal pot and connections operates for holding the metal pot nozzle firmly against the die at the inlet, tending thereby to take up all lost motion in the driving cam and connections.

In this construction the injector proper, R^x, is partitioned from the metal reservoir, R^y, and receives metal from the reservoir through a port, 210, near the bottom pole of the reservoir and the injector. This port is controlled by a valve, 211, whose stem, 212, extends up above the pot and is connected for operation by the lever, 212^a, which is fulcrumed at one end on a bracket, 214, upstanding from the pot, the opposite end carrying a weight 213, operating to hold the valve, 211, normally seated, excluding flow of metal from the reservoir into the injector. The lever, 212^a, is engaged near the weighted end with the horizontal arm, 215, of the bell crank lever, 215, 216, which is fulcrumed at its angle on a bracket, 217, upstanding from the metal pot; and the upper end of the arm, 216, of the bell crank is connected by a link, 218, to a bracket, 219, mounted on the frame. Upon considering this construction it will be understood that the withdrawal of the metal pot from the die automatically opens the valve, 211; and the movement in the opposite direction automatically closes it. The link, 218, is adjustable to vary its effective length by means of a sleeve, 218^a, which is pivoted to the lever arm, 217, and through which the link proper extends with adjustable stop screws, 221, on the link at the opposite ends of the sleeve. By this adjustment the accurate and certain seating of the nozzle at the die inlet may be secured. At 220 there is shown a pipe nipple at which connection is made with the source of compressed air controlled by the valve, 254, as described in connection with the preceding figures. It will be observed that the opening of the valve, 211, at the beginning of movement of withdrawal of the nipple from the die insures that the metal will not continue to be ejected from the nozzle by any remnant of air pressure in the injector after the nozzle leaves the die, because the vent opened through the port, 210, affords relief for the pressure, which is freer than that which it obtains through the nozzle and is opposed by less head of liquid than that contained in the nozzle.

For adjusting the pitman links, 42, 43, to vary their effective length, as is necessary for accommodating the position of the head, D, at closed position of the die members, D^1 and C^1, said pitman links are each made in two parts, 42 and 43, which are respectively exteriorly and interiorly threaded for screwing longitudinally one into the other. The part, 42, is swiveled to the pivot block, 42^a, by means of which it is pivoted to the crank wrist, 40; and adjacent to that pivot block, said part, 42, has an encompassing circular transversely projecting boss or flange which is peripherally notched forming a ratchet disk 42^x; and a forked pawl carrier, 42^b, pivoted on the link member, 42, strides this ratchet disk carrying a pawl, 42^c, for engaging notches of the ratchet disk. A link, 43^d, connects the two pawl carriers, and a handle, 42^e, extending from one of the pawl carriers serves for operating in an obvious manner to adjust both pitman members, 42, equally by screwing it into or out of the member, 43, for increasing or reducing the effective length of the pitman links.

The ratchet notches, 42^f of the ratchet disks, 42^x, are parallel-sided to adapt them for being engaged by the pawl for rotating the pitman members, 42, in either direction; and the pawl which has one shoulder abrupt and the other sloping is adapted to be swung over the pivot at which it is connected to the pawl carrier to trend for its feeding stroke either way—for screwing the member, 42, into or out of the member, 43, to shorten or lengthen the pitman.

We claim:

1. In a machine for the purpose indicated having a die-member-carrying head, a core-carrying plate mounted for reciprocation with respect to said head; secondary rack bars constituting carrying stems for said plate mounted for guidance in said head; gear pinions journalled in the head for co-

operating with said rack bars for reciprocating the latter and said plate; a primary rack bar mounted for reciprocation in the head, engaging said pinions for actuating the same; and actuating means for said primary rack bar for reciprocating the same relatively to the head.

2. In the construction defined in claim 1, means for actuating the primary thrust bar; operating means comprising a cylinder mounted on the frame of the machine, having connections with a source of compressed air; a piston in said cylinder; means normally holding the piston withdrawn in the cylinder and connections from the piston to the primary rack bar, and operating means for thrusting the rack bar in the direction for withdrawing the cores upon the movement of the piston caused by the admission of compressed air to the cylinder.

3. In a machine for the purpose indicated, means for opening and closing a die comprising a cylinder and piston, a reciprocating part, the piston being longitudinally fixed and the cylinder being free for longitudinal movement with respect to the piston, the piston stem and the cylinder being pivoted at the end toward which the piston moves in the cylinder under the operating fluid pressure, the piston stem being pivoted to the support which carries both the cylinder and piston, and the cylinder being pivoted to said reciprocated part; whereby both piston and cylinder are accommodated to the movement of the actuated part.

4. In a die casting machine in combination with means for carrying and operating the several members of the die for assembling to receive the metal and withdrawing from their assembled positions for removing the casting, means operable at will for loosening the casting from the die comprising pins arranged to be thrust into a die member for that purpose and withdrawn therefrom, thrust rods mounted in the die-member-carrying means for thrusting against the cast-loosening pins, and means independent of the die member operating mechanism for actuating said thrust rods at will for causing repeated blows to be given to the pins by the rods with any desired rapidity of succession.

5. In a die casting machine in combination with means for carrying and operating the several members of the die for assembling for receiving the molten metal and withdrawing from such assembled position for removing the casting; means operable at will for loosening the casting from the die comprising parts adapted to be thrust into the die for that purpose and withdrawn therefrom, means operated independently of the mechanism which operates the movable parts of the die for opening and closing, mounted for blow-delivering thrust against the cast-loosening parts and normally positioned spaced back from the latter and thereby adapted to acquire momentum before encountering said cast-loosening parts to communicate the cast-loosening blows, and means controllable at will for actuating said blow-delivering parts.

6. In a die casting machine in combination with means for carrying and operating the several members of the die for assembling the same for receiving molten metal and withdrawing from such assembled position for removing the casting; means operable at will for loosening the casting from the die comprising parts adapted to be thrust into the die for that purpose and withdrawn therefrom; and means operative independently of the mechanism which operates the movable parts of the die for opening and closing, mounted for blow-delivering thrust against the casting-loosening parts; compressed-air-operating means for actuating said blow-delivering parts, and means controllable at will for admitting and venting compressed air to said means; whereby successive casting-loosening blows may be delivered with any desired rapidity of succession.

7. In a machine of the character indicated in combination with a fixed die-mounting member and an opposed reciprocating die-carrying member for carrying respectively die members to be closed together and opened by said reciprocation, means for reciprocating the reciprocable die-carrying member comprising a rock shaft having a pair of crank arms, pitman links connecting said crank arms with the reciprocable die-carrying member, said pitman links being adjustable longitudinally with respect to their engagement with said reciprocated member for varying their effective lengths between the crank arms and said die-carrying member.

8. In a machine of the character indicated, in combination with a fixed die mounting member and an opposed reciprocating die-carrying member for carrying respectively die members to be closed together and opened in said reciprocation; means for reciprocating the reciprocable member comprising a rock shaft having a pair of crank arms; pitman links connecting said crank arms with the reciprocable die-carrying member, said pitman links comprising two parts one of which has swiveled connection with the crank wrist of the crank arm and threaded connection with the other part, said other part being pivotally connected to the reciprocable die-carrying member, and means for rotating simultaneously and equally the first mentioned parts of said pitmen for screwing said parts into and out of the other

parts of said pitmen respectively for adjusting equally and simultaneously the effective length of said pitman links.

9. In the construction defined in claim 8 the means for rotating the pitman link parts for adjusting the pitman links consisting of a transverse circular flange upon each of said rotated parts peripherally notched to constitute a ratchet disk, forked pawl carriers striding said flanges respectively, and pivoted on the respective link parts for rotating about the latter over said flanges, pawls carried by said pawl carriers for engaging said ratchet disks, and a link connecting said pawl carriers.

10. In the construction indicated in claim 7 the pitman for operating the moving die-carrying head comprising each two members longitudinally screwed one into the other for varying their effective lengths, means for so adjusting them equally and simultaneously, consisting of a ratchet disk on each of corresponding members of the two pitman, pawls mounted for rocking about said members respectively for engaging the ratchet disks, and a link connecting the pawls for simultaneous movement.

11. In the construction indicated in claim 7 the pitman for operating the moving die-carrying head comprising two members longitudinally screwed one into the other for varying the effective lengths of the pitman, means for so adjusting the pitman equally and simultaneously, consisting of a ratchet disk on each of corresponding members of the two pitman, pawls mounted for rocking about said pitman members respectively for engaging the ratchet disks, and a link connecting the pawls for simultaneous movement; the ratchet notches in said disks being abrupt-shouldered at both sides for actuating engagement by the pawls in either direction, and the pawls having their ratchet-engaging teeth adapted for driving engagement in one direction only, and sloped for idling over the ratchet disk in the reverse stroke, said pawls being reversible on the pawl carriers for trending in either direction over the ratchet disks.

In testimony whereof, we have hereunto set our hands at Chicago, Illinois, this 30th day of January, 1926.

WALTER O. WILL.
ERIC CARLSON.