Feb. 18, 1930. A. W. MORRIS ET AL 1,747,728

CASTING MACHINE

Filed Jan. 31, 1929 6 Sheets-Sheet 1

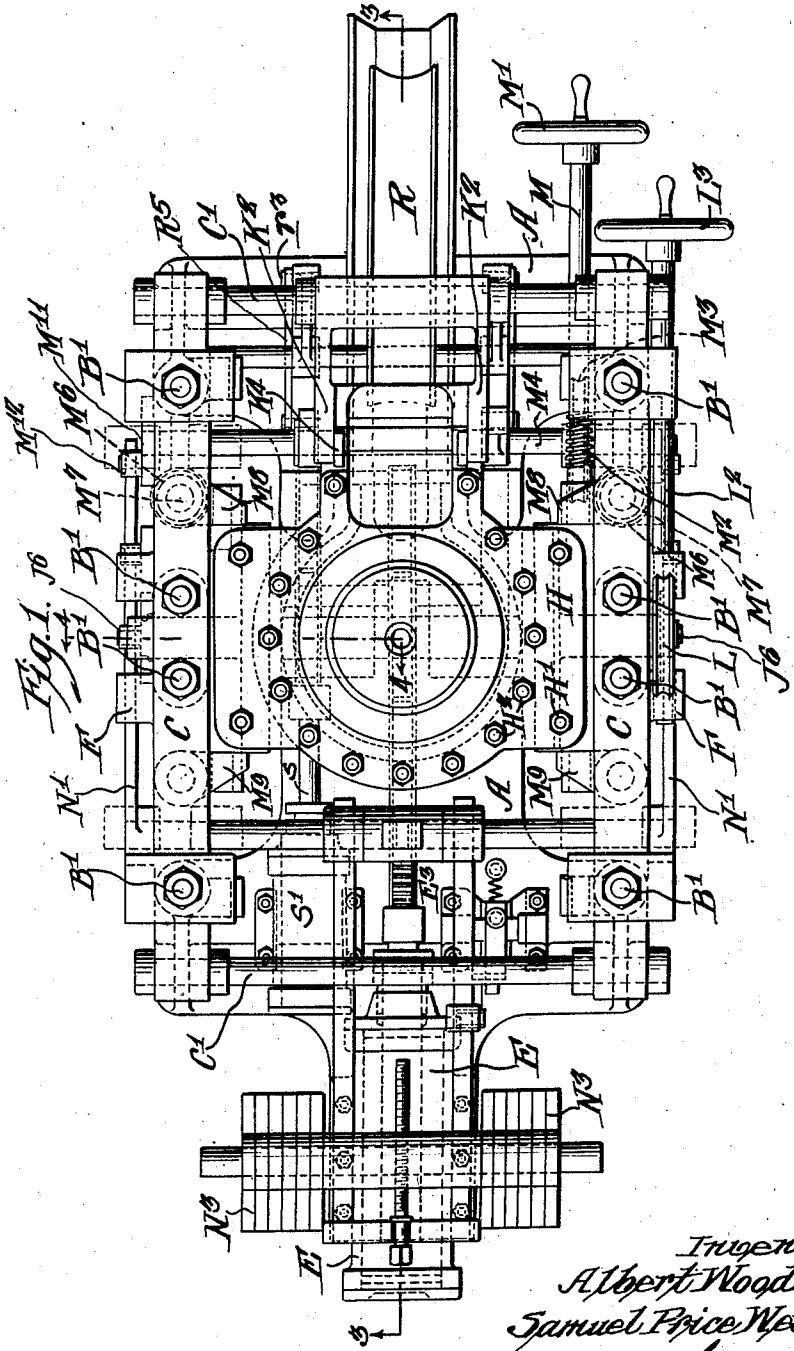


Fig. 1.

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CASTING MACHINE

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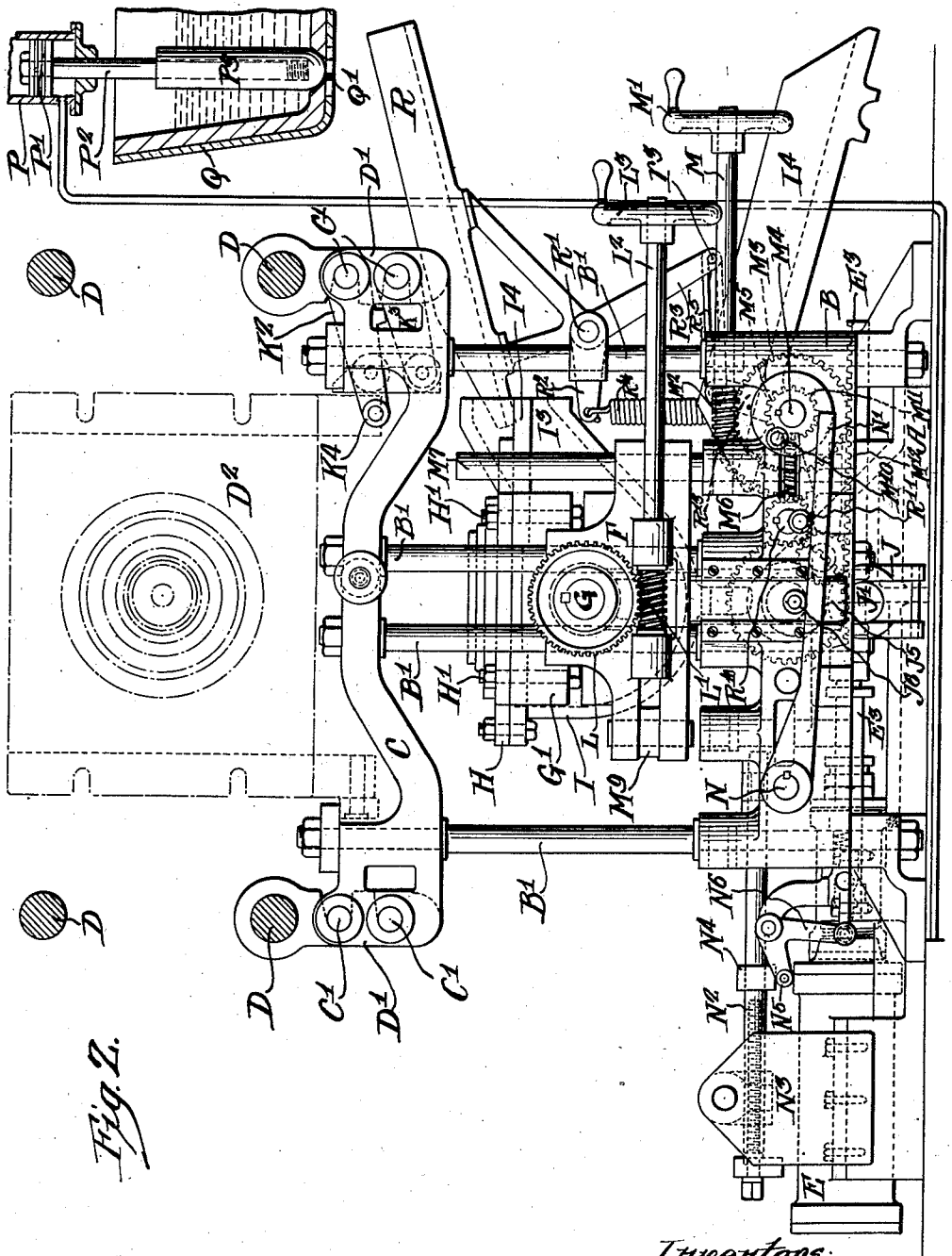


Fig. 2.

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CASTING MACHINE

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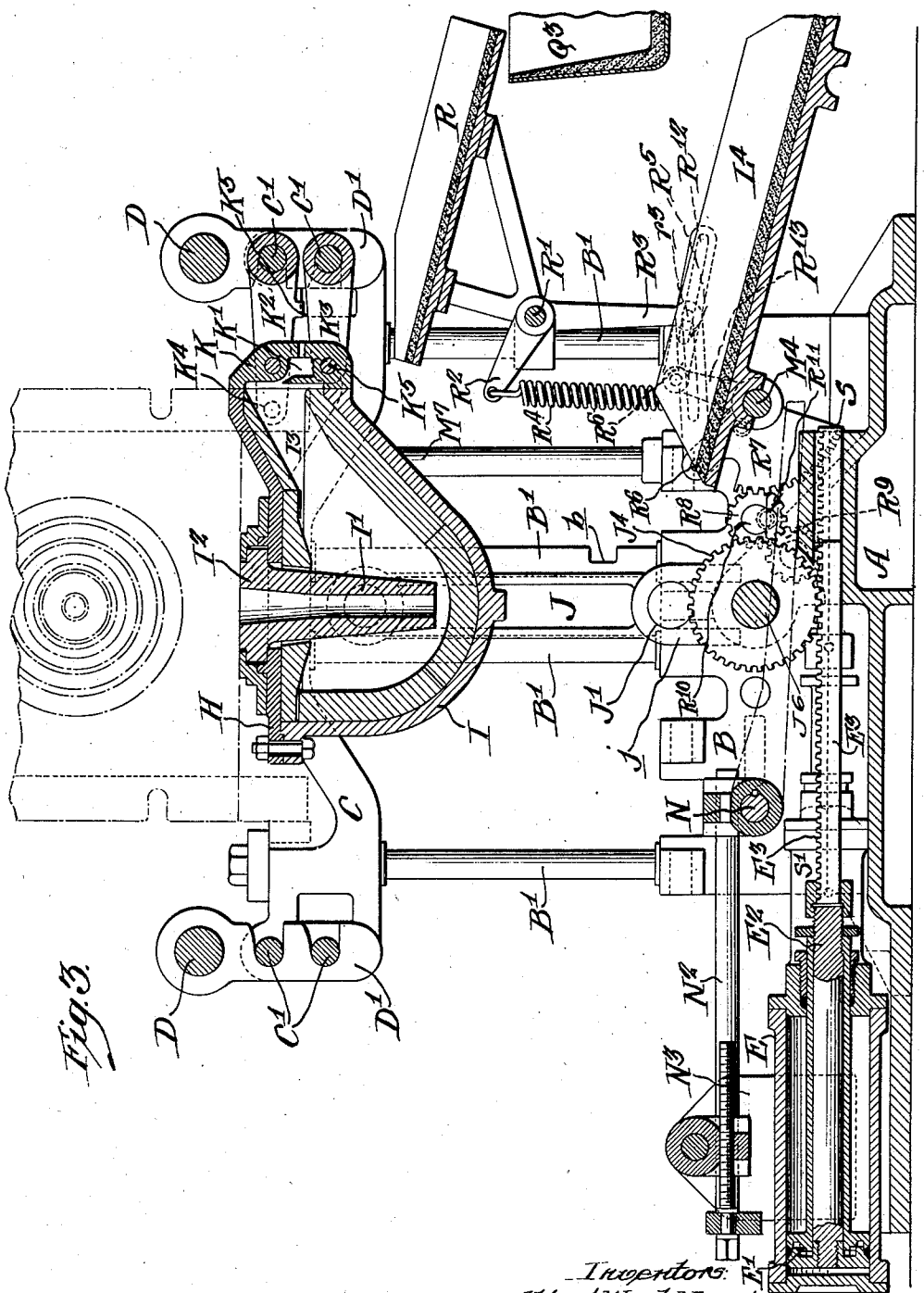


Fig. 3.

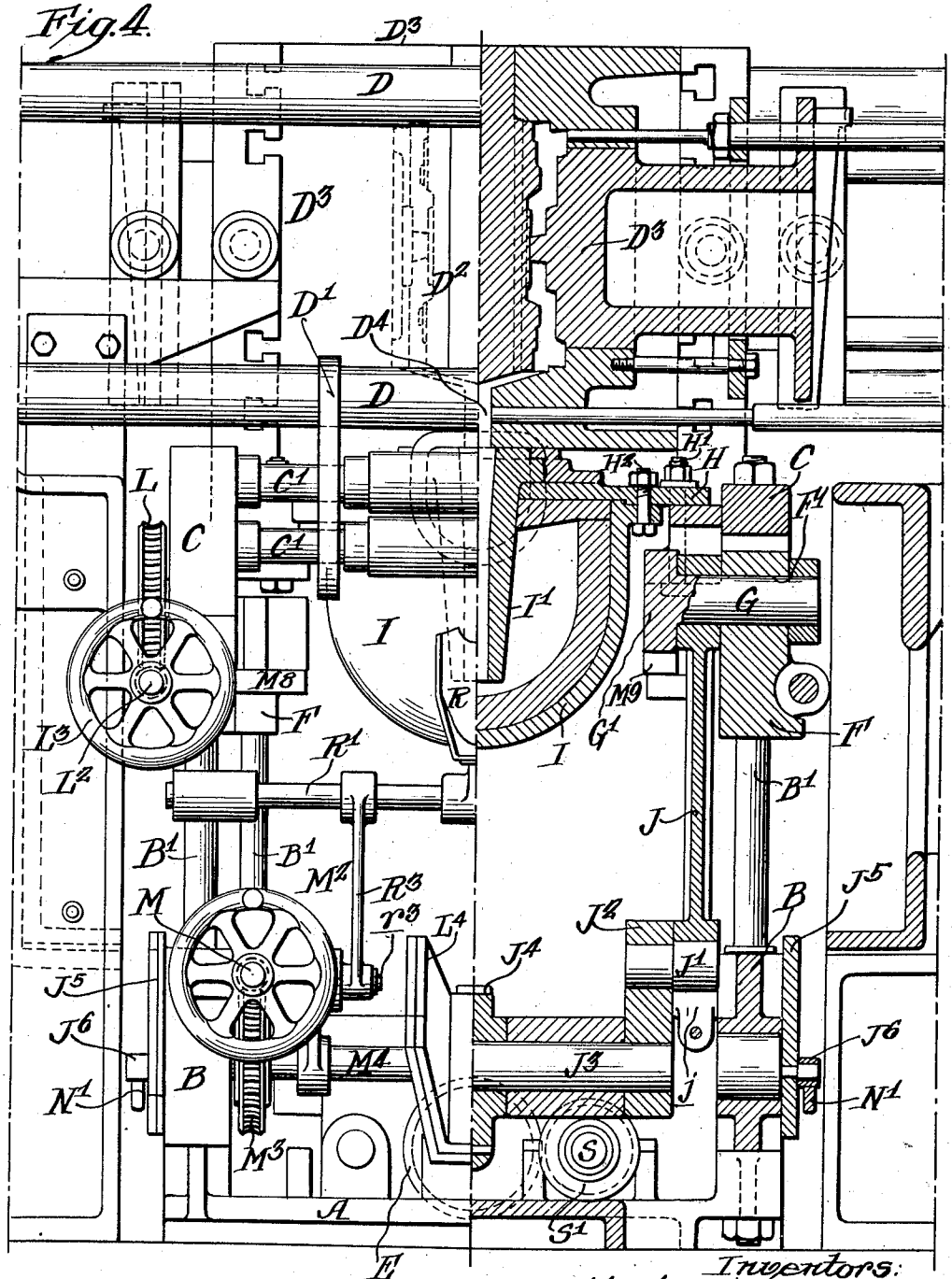
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Feb. 18, 1930. A. W. MORRIS ET AL 1,747,728

CASTING MACHINE

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Fig. 4.



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CASTING MACHINE

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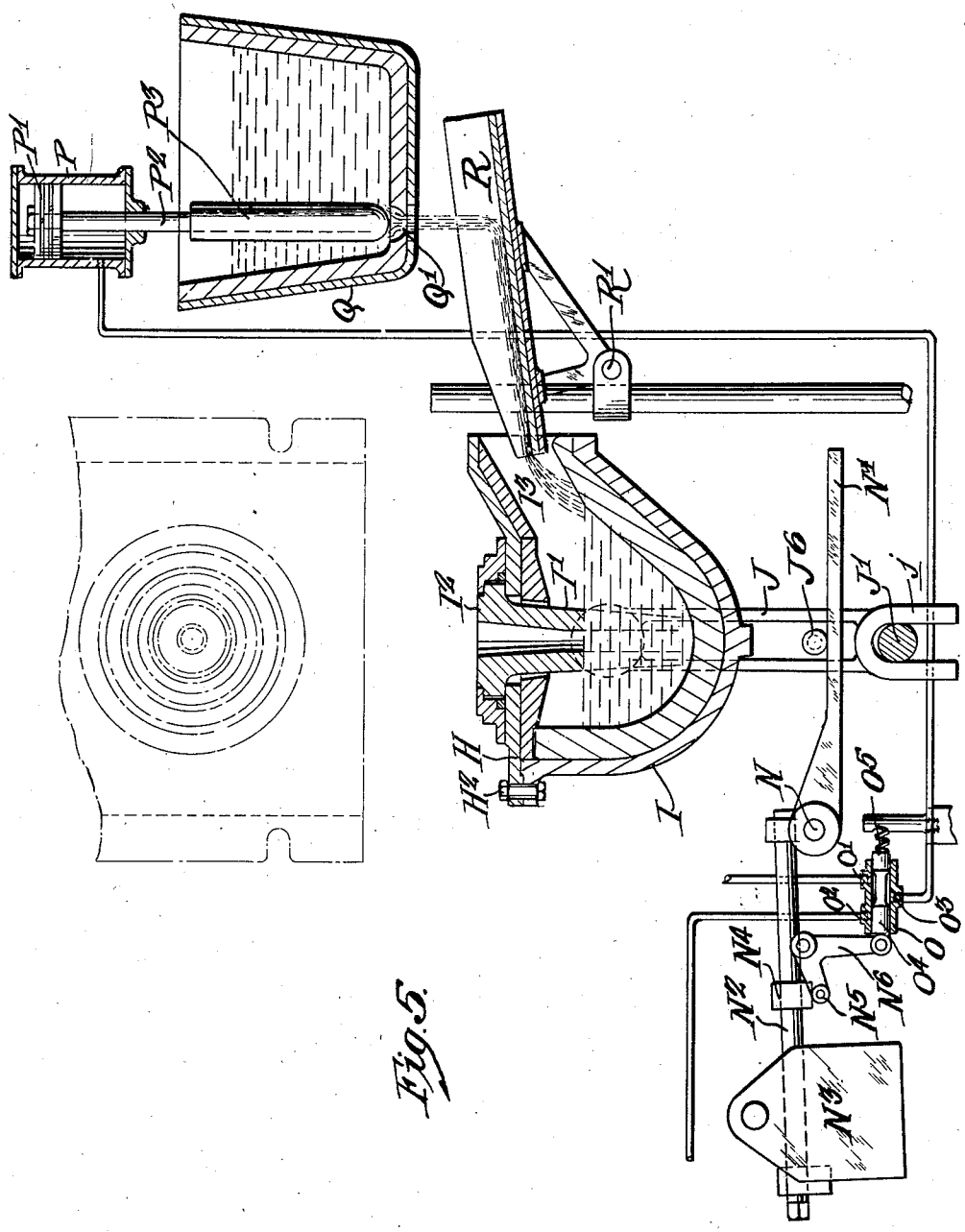


Fig. 5.

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CASTING MACHINE

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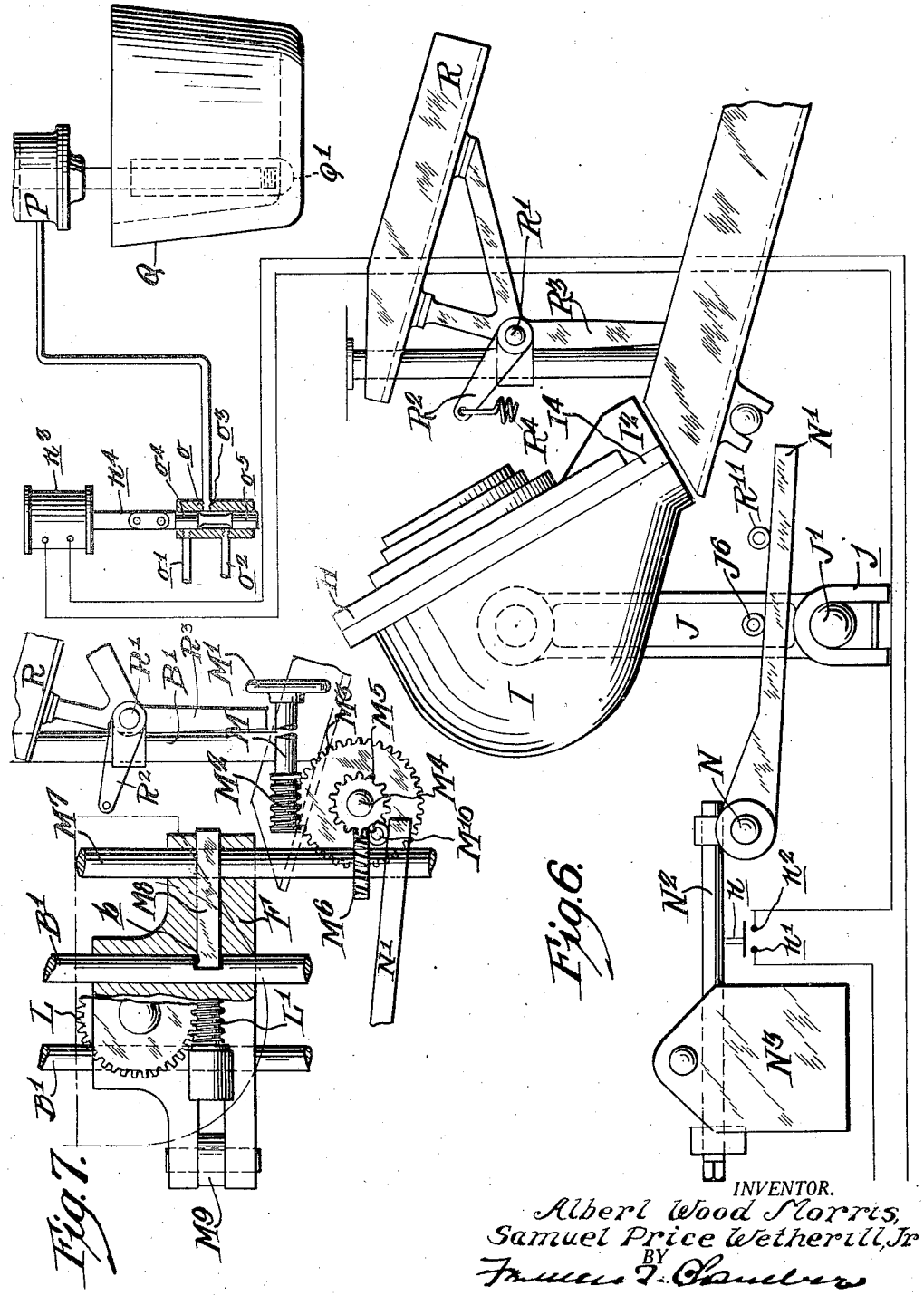


Fig. 6.

Fig. 7.

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Patented Feb. 18, 1930 1,747,728

UNITED STATES PATENT OFFICE

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CASTING MACHINE

Application filed January 31, 1929. Serial No. 336,556.

Our invention relates to a casting machine and more particularly to the mechanism for handling and charging casting ladles. Our machine is specially designed for handling cast iron or other metals of a high melting point and the prime object of our invention is to maintain the molten metal in the casting ladle at a constant high temperature by means of rapid replenishment of the metal in the ladle from a reservoir containing metal at high temperature. With this object in view, we provide automatic means by which metal is drawn from the reservoir and charged into the ladle whenever the bulk of metal contained in the ladle falls below a determined point. Other objects which we have in view are to provide against flow of metal from the reservoir except at times when the charging ladle is retracted from the mold and moved to a position in which it will register with the reservoir and receive metal from it; to provide for the shifting of the charging ladle between a point where it registers with the mold and a point where it registers with the reservoir in regular sequence; to combine means whereby, when the charging ladle is in retracted position, the bulk of the metal contained therein will, under proper conditions, actuate means for permitting and regulating the discharge of metal from the reservoir to the ladle and, generally speaking, to organize the casting machine for rapid and efficient operation.

The nature of our improvements will be best understood as described in connection with the drawings in which they are illustrated and the novel features will be particularly pointed out in the claims. In the drawings

Figure 1 is a plan view of an apparatus embodying our improvements.

Figure 2 is a side elevation.

Figure 3 is an elevation on the section line 3—3 of Fig. 1.

Figure 4 is an end elevation, one-half shown in section on the line 4—4 of Fig. 1.

Figure 5 is a sectional elevation on the same plane as Fig. 3, showing certain of the parts in changed position.

Figure 6 is an elevation showing certain changes in position of the parts shown in Figs. 4 and 5 and showing also a modification of part of the mechanism shown in Figs. 4 and 5.

Figure 7 is a partial sectional view showing certain details of construction.

A is the base plate of the machine supporting side frames indicated at B, B from which extend eight columns, indicated at B^1 B^1, etc. These columns support the upper side frames, indicated at C, C, which are connected together by the four ribs, two at each end, indicated at C^1 C^1, etc. D, D indicate tie rods, forming a part of the mold support and actuating mechanism, which is firmly anchored to the ladle actuating mechanism by means of swinging clamps, indicated at D^1, which engage the rods C^1 as best shown in Fig. 3. D^2 indicates the mold, shown partly in section in Fig. 4, as is also the movable mold portion indicated at D^3. D^4 indicates the sprue of the mold. These parts forming no portion of our present invention, need no further description.

E is a horizontal cylinder supported on the frame A; E^1 the piston working therein and connected with a piston rod E^2, which in turn is connected to a rack E^3. F, F are sliding cross heads moving vertically on the rods B^1 and forming bearings, indicated at F^1, for the trunnions G, which, by means of the brackets G^1 from which they extend, are firmly attached to the cover plate H of the casting ladle by means of the bolts H^1, H^2 indicating bolts by means of which the ladle, indicated at I, is attached to the cover plate. Also attached to the cover plate and extending down into the ladle is the nozzle I^1, the upper end I^2 of which is intended to be brought in contact with the under side of the mold.

I^8 indicates the metal receiving lateral passage of the ladle and I^4 is a ledge or extension of the ladle or of its cover, the function of which will be hereafter described. J, J are connecting rods which are journalled on the trunnions G and which at their bottoms are forked, as indicated at *j*, and extend over a crank pin J^1 secured to crank arms J^2, secured in turn to a shaft J^3, to which shaft is attached the gear wheel J^4, which is engaged by the rack E^3, as best shown in Fig. 3. J^5 indicates a slide, one at each end of the machine, moving in vertical guideways and supporting pins on which are rollers, as indicated at J^6. The upper ends of the slides are so located as to be contacted with by the cross heads F as they move toward their lowermost positions and the rollers J^6 are so located as to contact with the scale beams N^1 and press them down and hold them down as long as the ladle and its directly connected appliances are in their lowermost positions.

K is a plate, the purpose of which is to close the opening through which metal is delivered to the ladle when the ladle is in position to deliver metal to the mold. It is provided, as shown, with a compressed air passage K^1 through which compressed air is admitted to the ladle and is supported on arms K^2 K^3 pivoted on the rods C^1 C^1. K^5 is a stop finger on the arm K^2, which limits the drop of the plate K by coming in contact with the arm K^3 and K^4 is a pin connected with an extension of the arm K^2, which is engaged by a laterally extending rib I^4 of the ladle structure when the ladle moves up to register with the mold.

L is a worm wheel secured to one of the trunnions G, which is actuated by the worm L^1 on the shaft L^2 by means of the hand wheel indicated at L^3.

M is a shaft actuated by the hand wheel, indicated at M^1, having secured to it a worm, indicated at M^2, which engages a worm wheel, indicated at M^3, on a shaft indicated at M^4. This shaft M^4 has spiral gears indicated at M^5 near each end, which engage with spiral gears M^6 on vertical shafts indicated at M^7, to each of which shafts is fastened a locking arm indicated at M^8. M^9 M^9 indicate stationary lugs or stops against which the cover of the ladle rests when in horizontal position. As shown in Fig. 7, the locking bars M^8 move in slots formed in the cross heads F and in one position engage with detents *b* in columns B^1.

N is a pivotal support for the scale beams indicated at N^1 and having a counterbalance arm N^2 on which is adjustable a counterweight N^3. Also adjustable on the arm N^2 is a lug N^4 which engages a roller on one arm of the bell crank lever indicated at N^5, the other end of which bell crank lever is connected to a valve indicated at O^4. This valve moves in a casing O to which are connected, as shown in Fig. 5, inlet and exhaust conduits O^1 O^2 and a delivery conduit connected at O^3 shown in Fig. 5. This conduit O^3 communicates with a vertical cylinder P, as shown in Figs. 5 and 6, the piston P^1 of which acts through its rod P^2 with a stopper P^3, the function of which is to open and close the outlet passage Q^1 of the reservoir ladle indicated at Q.

R is a filling trough for the ladle which is pivoted at R^1 and provided with arms R^2 and R^3 extending from it, R^4 (Fig. 3) indicating a strong spring, the action of which is normally to keep the trough in the position shown in Fig. 5. r^3 is a pin at the end of the arm R^3 which is engaged in the slot of a link indicated at R^5, which link is pivoted on a pin R^6 secured to the sector R^7, best shown in Fig. 3. This sector is pivoted on the shaft M^4 and is engaged by a gear wheel R^8 driven by a gear R^9, (see Fig. 3) which is engaged by a rack indicated at S. Secured to the shaft to which the gear R^8 is secured are the discs R^{10} on which are mounted locking rolls R^{11}, which press down the scale beams N^1. S^1 indicates a cylinder and piston actuating the rack bar indicated at S. The pin r^3 is also engaged in the slotted link R^{12} which is actuated by a lever arm R^{13} secured to the shaft M^4.

It will be understood of course that the machine illustrated is one adapted for use in connection with a timing controller by which the various motions involved in the regular operation of the casting machine agree in time sequence; any timing controller can be used for this purpose, none being shown.

In operation, the locking bars, indicated at M^8, normally lie beneath the ledges of the ladle cover H, as, for instance, the ledge indicated at I^4, and ledges on the opposite side of the ladle cover rest on the stationary stops indicated at M^9, these lugs and stops holding the ladle in horizontal position and preventing tipping. When it is desired to tip the ladle the lock bars M^8 can be rotated from beneath the ledge of the ladle cover when the ladle is in depressed position and the locking bar registering with a locking detent *b* in one of the columns B^1, as shown in Fig. 7 and when engaged in this detent the locking bar prevents the elevation of the ladle so that the ladle can only be tipped when in lowered position and cannot be raised from this position until the ladle is again locked as against tipping. The actuation of the locking bar is, by means best shown in Fig. 7, the hand wheel M^1 rotating the shaft M, which by means of a worm wheel M^2 actuates a worm wheel M^3 on the shaft M^4 to which is secured a spiral gear M^5 engaged with a spiral gear M^6 on the shaft M^7, on which shaft is keyed the locking bar M^8; also secured to and rotating with the shaft M^4 is

the roller frame indicated at M^{10}, best shown in Figs. 2 and 7, which when the lugs are withdrawn, dispose the scale beam indicated at N^1, as shown in Fig. 7. Also secured to the shaft M^4 is a lever arm R^{13}, to which is pivotally attached a slotted link R^5 engaged with a pin r^3 on the end of the lever arm R^3. This part of the structure will be hereafter described as will also be the mechanism provided for tilting the ladle to empty it out after it is unlocked as against tilting.

In operation the ladle I is reciprocated vertically to an upper position in which its delivery nozzle I^2 registers with the metal receiving gate in the mold and a lower position in which it rests upon the scale beam indicated at N^1 which is directly engaged by roller pins J^6 secured to vertically movable slides J^5 upon the upper ends of which, as is best indicated in Fig. 4, the cross heads F supporting the trunnions of the ladle rest. When the ladle is lowered the scale beam N^1, normally locked in depressed position by a roller R^{11}, secured to discs secured in turn to the shaft to which the gear R^8 is secured; the gear R^8 is engaged and driven by a gear R^9, which in turn is actuated by the rack S, reciprocated through a cylinder and piston indicated at S^1. The gear wheel R^8 is engaged with the segmental rack indicated at R^7, which is journalled on the shaft M^4 and has attached to it a pivot pin R^6 to which is connected the slotted link R^5 which engages with the pin r^3 at the end of the lever arm R^3. Through this mechanism the charging trough R is retracted to the position shown, for instance, in Fig. 3, after the ladle is charged and before it is elevated to register with the mold, and, on the other hand, the same mechanism, after the depression of the ladle, restores the filling trough R to the position shown in Fig. 5, where it receives the metal from the reservoir ladle Q and delivers it into the lateral opening I^3 of the ladle I.

When it is desired to tilt the ladle the filling trough R is retracted, as shown in Fig. 6, by the action of the link R^5 actuated as already described when the locking bars which prevent the ladle from tilting are withdrawn.

It is an essential feature of our machine that when the ladle is retracted from operative contact with the mold it should be replenished at proper times by metal drawn from the reservoir indicated at Q and that the controlling flow from the reservoir should be by mechanism brought into operation to cause or prevent flow from the reservoir by the amount of the residual metal left in the casting ladle. This may be accomplished in many ways but by preference we control the flow from the reservoir ladle through the residual weight of the metal left in the casting ladle and, in the mechanism shown, the ladle is lowered until its weight rests upon the scale beams N^1 which are then, by the described mechanism, unlocked so as to be capable of moving upward, carrying the ladle with them, when the weight of the ladle and its contents does not counterbalance the weight of the counterweight N^3. When the scale beam moves up the connected arm N^2, rising, permits the bell crank lever N^6 to rotate to such an extent as to shift the valve portion to a position in which pressure fluid will be conducted through the cylinder P through the piston working in which the controlling stopper P^3 is drawn upward, permitting flow from the reservoir through its port, indicated at Q^1, the flow being into the trough R and through it to the casting ladle, as shown in Fig. 5. When the weight of the metal delivered to the casting ladle is sufficient to depress the scale beam N^1, the valve O is shifted to cut off the pressure fluid and permit exhaust from the cylinder P, which in turn permits the stopper P^3 to close the port Q^1. In connection with Fig. 6 of the drawings we have indicated an alternative arrangement for controlling the flow of metal from the reservoir ladle in which, instead of using a valve controlling the in and out flow of a fluid, we have indicated an electrical contrivance in which the circuit is opened and closed by the movement of the arm M^2 connected with the scale beam, which in turn actuates the solenoid indicated at n^3, which through the illustrated connections controls a valve in turn controlling the in and out flow of a pressure fluid through the cylinder P. It will be obvious that, by the described mechanism or its equivalent, the ladle is constantly replenished with hot metal from the reservoir with the effect, not only of supplying sufficient metal for the casting operation, but of constantly renewing the heat of the metal in the ladle, which is thus kept at proper working temperature without requiring any heating devices to be connected with the ladle.

In the construction illustrated by us metal is forced from the casting ladle through its nozzle I^1 into the mold by means of compressed air, which, as shown, is delivered to the ladle through a conduit indicated at K^1 in the closure K. This closure is supported, as described, on the pivoted arms K^2 and K^3, which arms are moved upward by contact of a ledge on the ladle cover with the pin K^4 on the arm K^2. The upward movement brings the closure K into proper registry with the opening I^3 and clamps the cover plate tightly over this opening. When the ladle moves upward the reverse action occurs, the arms K^2 and K^3 swinging downward to a sufficient degree to retract the cover plate from the opening I^3 and permit the upward movement of the ladle.

We have already described the mechanism

by which the ladle is locked against tilting and by means of which antitilting locks can be withdrawn. When so withdrawn the ladle is tilted by the action of the hand wheel L^3 actuating the shaft L^2, having secured to it a worm L^1 which is engaged with the worm wheel L secured to the trunnion G of the ladle.

It will be understood of course that the mold parts best indicated in Fig. 4 are actuated in sequence with the movements of the casting ladle so as to be in position to receive metal when the casting ladle registers with the mold gate and to discharge the casting immediately after the recession of the casting ladle and return to position to again receive metal and make a further casting. Any proper mechanism may be used for this mold actuating purpose which, except in a broad sense, does not form a part of our present invention.

Having now described our invention, what we claim as new and desire to secure by Letters Patent is:

1. In a casting machine the combination with a mold of a charging ladle, means for moving said charging ladle from a position in which it registers with the mold to a retracted position, a reservoir for melted metal located to register with the charging ladle in its retracted position, means for controlling the flow of molten metal from the reservoir to the casting ladle and means operatively controlled by the bulk of metal remaining in the casting ladle when it is moved to retracted position for actuating the flow controlling means to replenish the casting ladle.

2. In a casting machine the combination with a mold having a gate to receive metal in its lower face, of a covered casting ladle having a gate to deliver metal in its cover which is adapted to register with the mold gate said ladle also having a gate to receive metal and means for opening and closing said last mentioned gate, and means for introducing air under pressure to the ladle to force metal therefrom into the mold, a reservoir ladle, means for moving the casting ladle vertically to and from a position in which it registers with the mold, means adapted to serve as a conduit of molten metal from the reservoir to the casting ladle when the ladle is in retracted position, means controlling the flow of metal from the reservoir and means operatively controlled by the bulk of metal in the casting ladle when said ladle is retracted for actuating said controlling means.

3. In a casting machine having the features of claim 2 in which a cover is provided to open and close the metal receiving gate of the ladle having supporting means secured to a fixed position of the frame and movable thereon to shift the cover from a position in which it is clamped against the ladle gate to a somewhat retracted position and means moving with the ladle in its vertical travel whereby the cover supports are shifted to clamping position as the ladle approaches its uppermost position.

4. A casting machine having the features of claim 2 and having in combination therewith a conduit for molten metal movable between a position in which when the ladle is in depressed position it will conduct molten metal from reservoir to the casting ladle and a retracted position and power actuated means for retracting and restoring to operative position the metal conduit.

5. A casting machine having the features of claim 2 and having in combination therewith locking mechanism normally engaging a ladle to prevent tilting but shiftable when the ladle is lowered to release the ladle as against tilting and to lock it in lowered position.

6. A casting machine having the features of claim 2 and having in combination therewith locking mechanism normally engaging the ladle to prevent tilting but shiftable when the ladle is lowered to release the ladle as against tilting and to lock it in lowered position and means interconnected with the locking mechanism operative to retract the ladle charging conduit when the lock is shifted to permit the ladle to tilt.

7. Casting mechanism having the features of claim 2 in which the means controlling the flow of metal from the reservoir consists of a scale beam arranged to support the ladle when in lowered position and means actuated by shifting position of said scale beam for actuating the controlling means.

8. Casting mechanism having the features of claim 2 in which the means controlling the flow of metal from the reservoir consists of a scale beam arranged to support the ladle when in lowered position, means actuated by shifting position of said scale beam for actuating the flow controlling means and retractable means operative when the ladle does not rest on the scale beam for holding the scale beam in depressed position.

9. Casting mechanism having the features of claim 2 in which the means controlling the flow of metal from the reservoir consists of a scale beam arranged to support the ladle when in lowered position, means actuated by shifting position of said scale beam for actuating the flow controlling means, means for shifting the feeding conduit from and to operative position, retractable means for locking the scale beam in depressed position and means interconnected with the means for shifting the feeding conduit whereby the beam locking means are movable to operative position when the feeding conduit is shifted to non-operative position.

10. Casting mechanism having the features of claim 2 in which the means controlling the

flow of metal from the reservoir consists of a scale beam arranged to support the ladle when in lowered position, means actuated by shifting position of said scale beam for actuating the flow controlling means, means for locking the casting ladle against tilting, retractable means for locking the scale beam in depressed position and means interconnecting said locking device whereby the beam lock is moved to operative position when the ladle lock is retracted.

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