July 2, 1929. J. S. GULLBORG 1,719,764

DIE CASTING MACHINE

Filed June 8, 1927 8 Sheets-Sheet 1

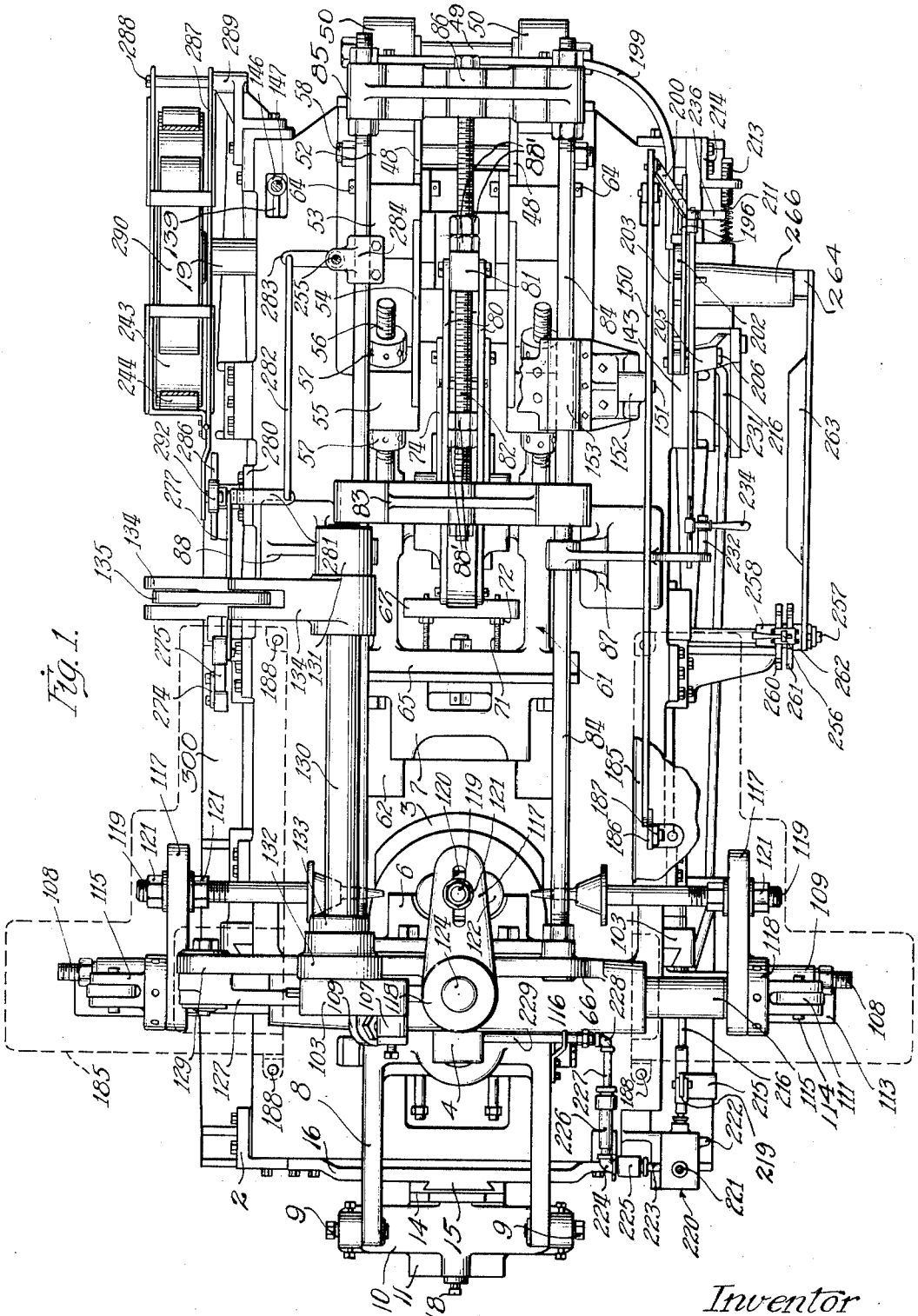


Fig. 1.

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DIE CASTING MACHINE

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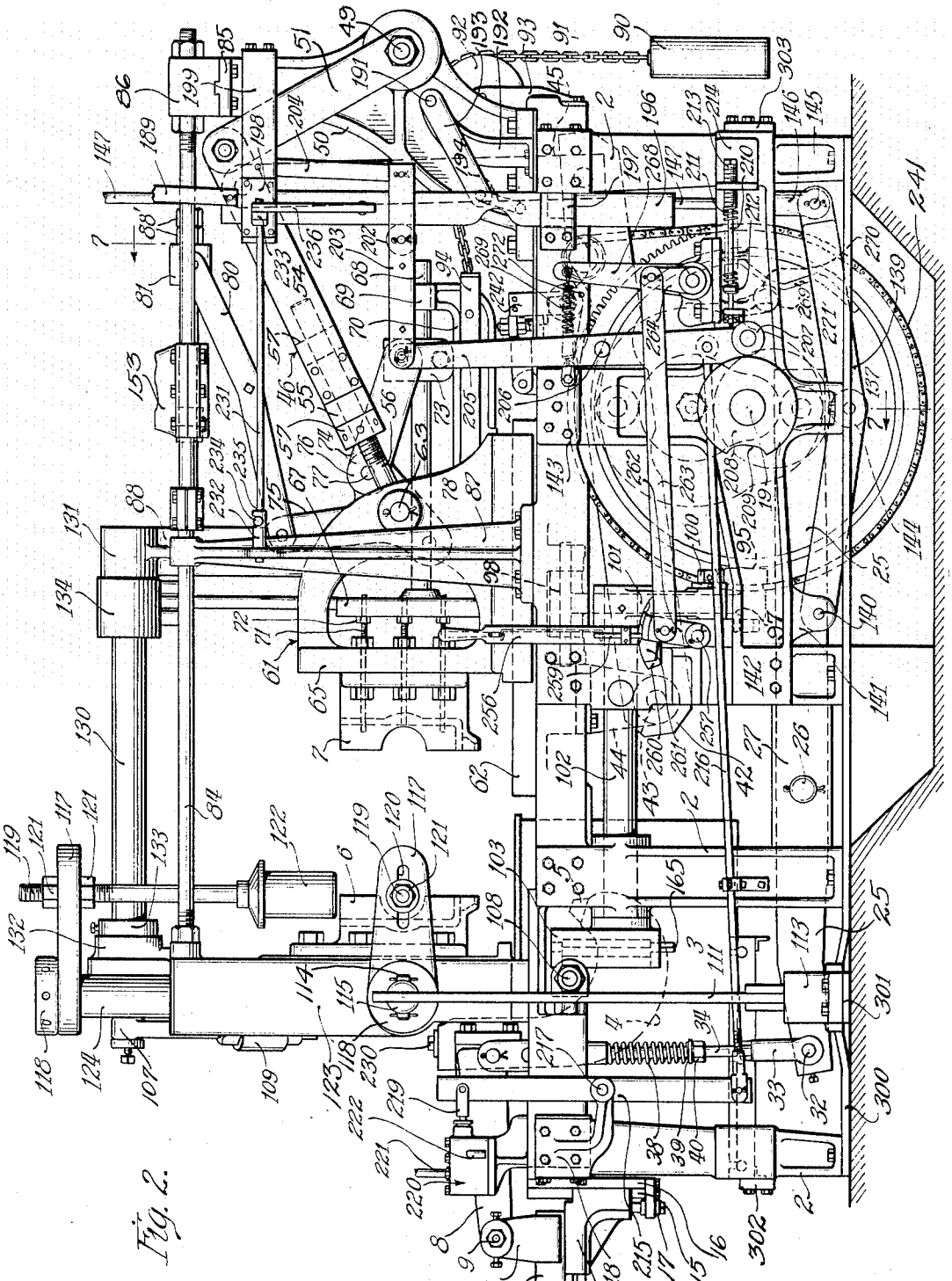


Fig. 2.

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July 2, 1929. J. S. GULLBORG 1,719,764

DIE CASTING MACHINE

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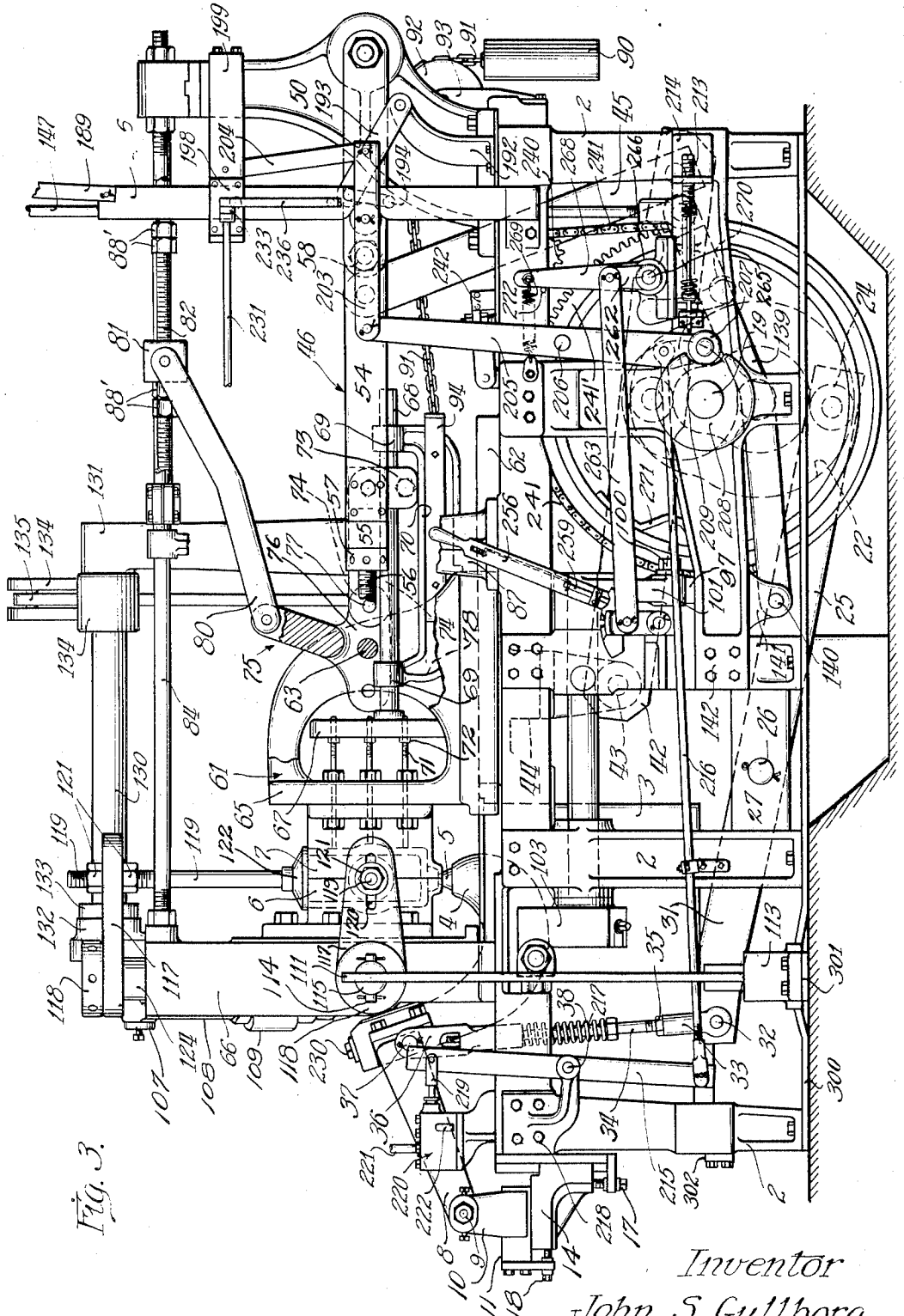


Fig. 3.

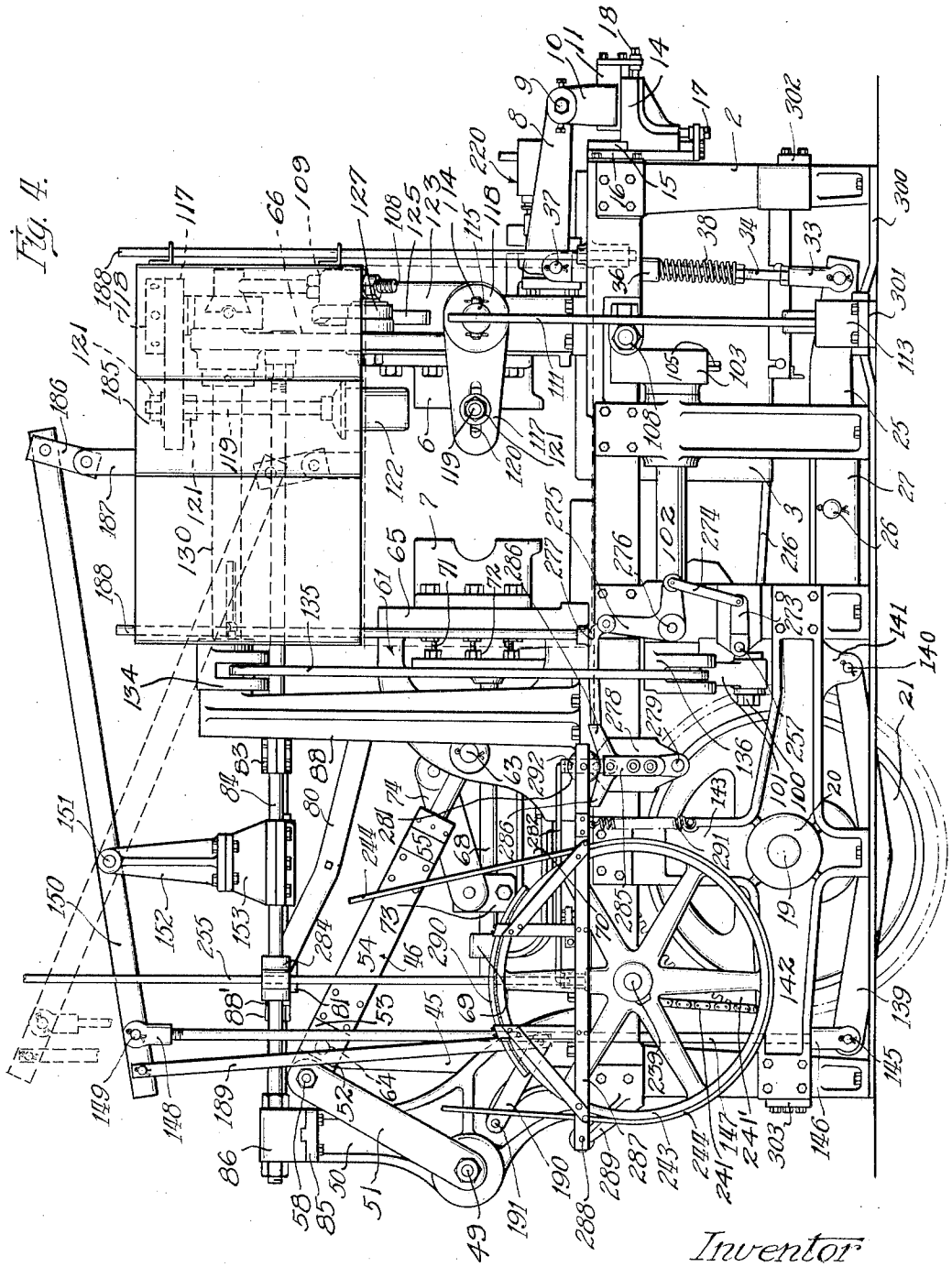
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July 2, 1929. J. S. GULLBORG 1,719,764

DIE CASTING MACHINE

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Fig. 4.



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DIE CASTING MACHINE

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Fig. 5.

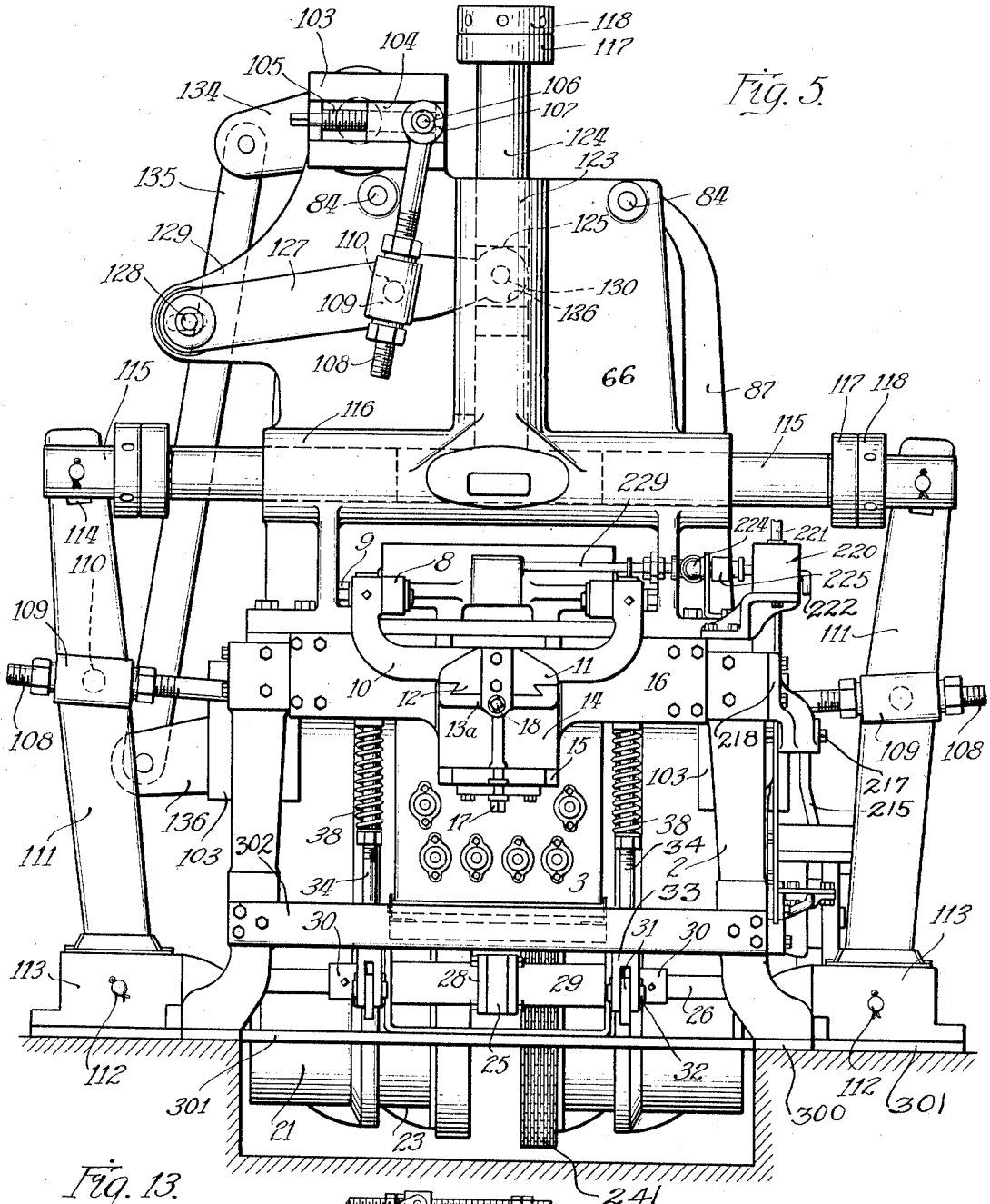
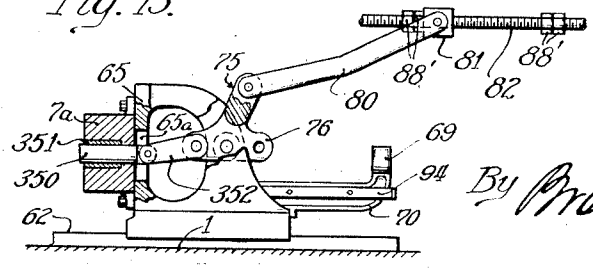


Fig. 13.



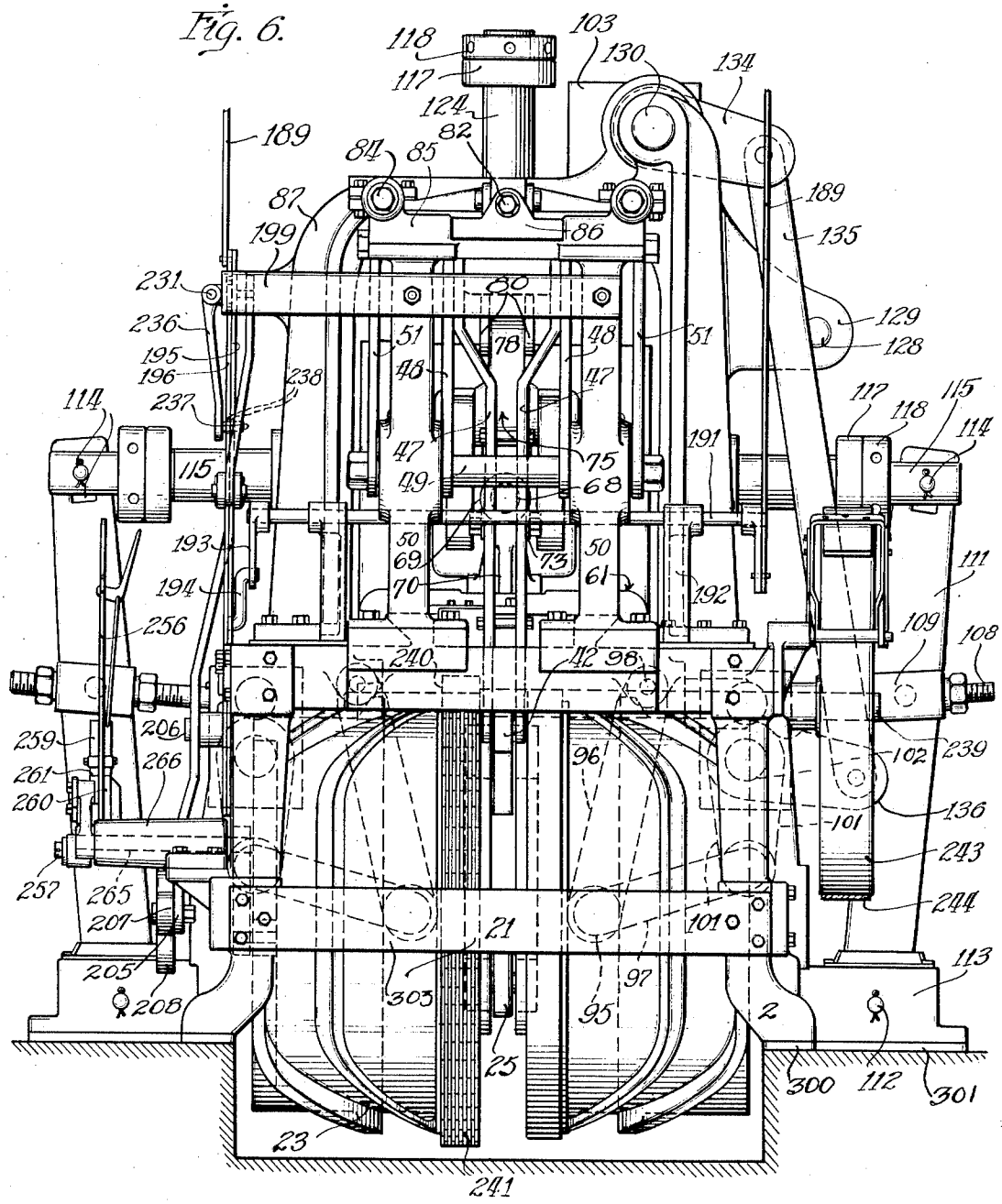
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DIE CASTING MACHINE

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Fig. 6.



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DIE CASTING MACHINE

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Fig. 7.

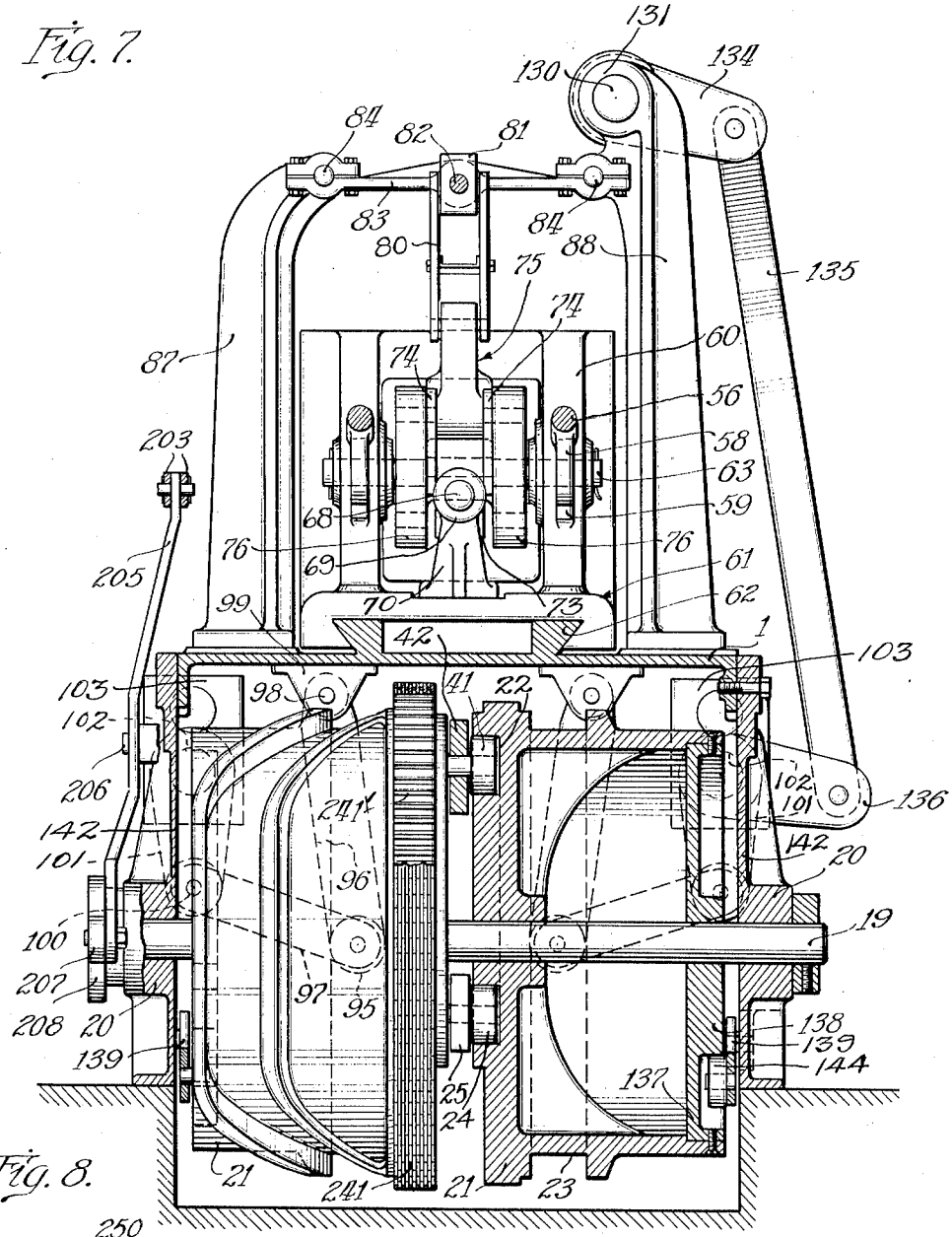
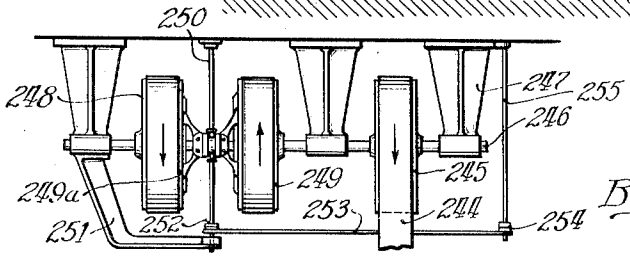


Fig. 8.



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DIE CASTING MACHINE

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Fig. 12.

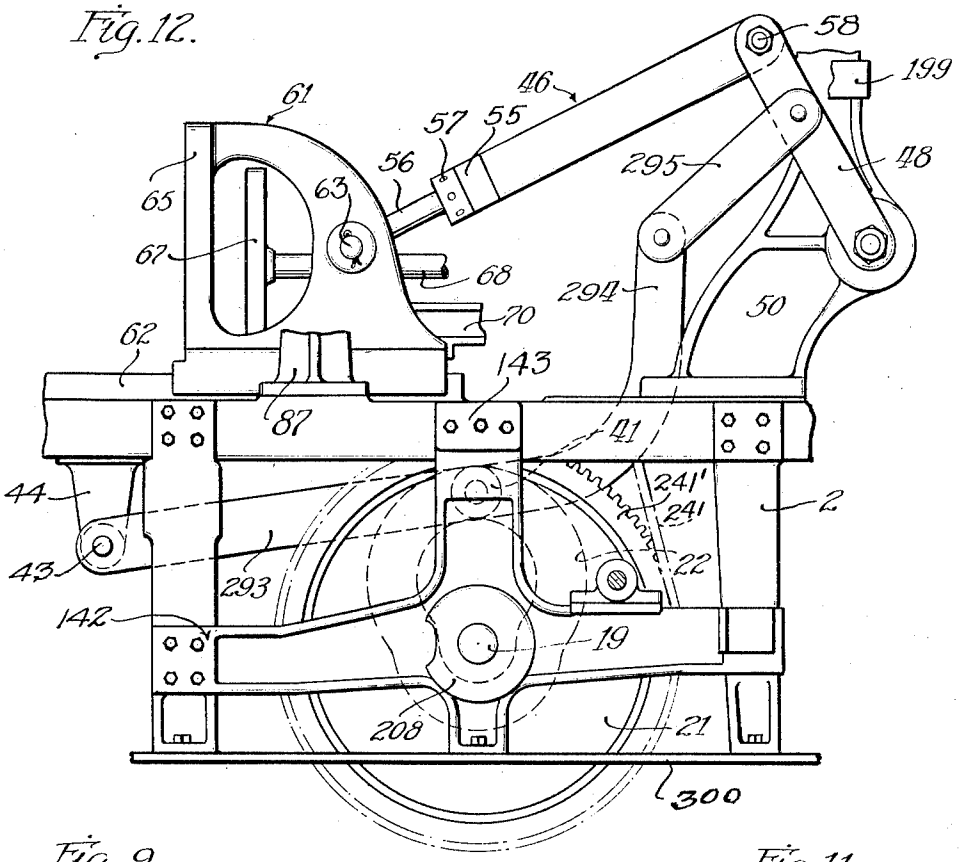


Fig. 9.

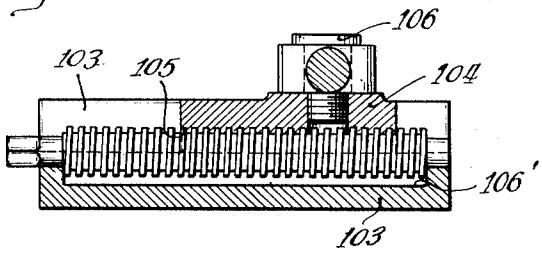


Fig. 11.

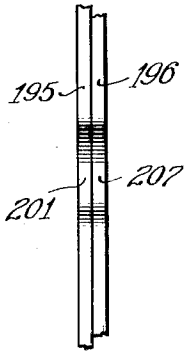


Fig. 10.

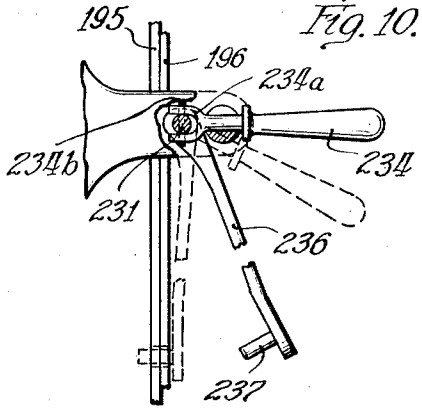
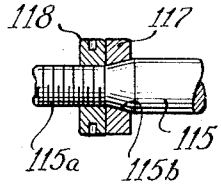


Fig. 14.



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Patented July 2, 1929. 1,719,764

UNITED STATES PATENT OFFICE.

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DIE-CASTING MACHINE.

Application filed June 8, 1927. Serial No. 197,337.

This invention relates to die casting machines, and more particularly to a machine employing core members in conjunction with the die mold, and pneumatic means for injecting the molten metal into the mold.

In die casting machines of the character referred to the cast metal in the mold shrinks about the core necessitating relatively great power for extracting or withdrawing the cores from the molds. One of the objects of the present invention is, therefore, to provide a suitable arrangement of shafts and levers whereby the power for pulling the cores can be readily developed without necessitating the provision of a machine of unusual size which would be objectionably cumbersome and heavy. In the machine of the application the parts are so arranged as to provide a neat and compact structure capable of developing relatively great power for pulling the cores.

I have found that, in die casting machines it is very desirable to have means whereby injection of the metal into the mold is prevented when the mold is closed, to permit adjustment of parts, cleaning of the mold section, etc. without danger to the operator due to injection of molten metal into the mold when the mold is not tightly closed. As a further protection to the operator I provide shield members which are raised and lowered in synchronism with the operation of the machine, these shield members being lowered so as to be positioned about the mold during the actual casting operation in which the molten metal is injected into the mold under pressure. The means for operating these shield members cooperate with the means for preventing injection of the metal into the mold in such manner that the shields are held in inoperative or raised position when the safety means referred to is operative to prevent injection of metal into the mold, thus permitting the mold sections and associated parts to be readily viewed and giving ready access to such members for adjustment thereof. The means for operating the shields and for controlling the air pressure for injecting the molten metal into the mold is also adapted to permit independent raising of the shields when they are in lowered or operative position, thus permitting access to the mold from either side of the machine. This is of practical importance as doing away with the necessity for raising both of the shields when it is desired to have access to one side of the mold only.

As the molten metal is injected into the mold under high pressure, approximately 350 pounds to the square inch, the cast articles have a tendency to adhere to the mold at times and it is desirable to provide means for loosening or stripping the articles from the mold. For this purpose I provide, in conjunction with the movable section of the mold, a plurality of stripping pins and a plate therefor. To operate this plate I provide means for limiting movement of the plate with the movable mold section, such means exerting a leverage effect on the plate providing very appreciable power for moving the plate, at the end of its travel in either direction with the movable mold part, oppositely to the mold section. This insures insertion and withdrawal of the pins into and from the mold section at proper time facilitating stripping of the work from the mold. This means for operating the stripping pins is also capable of adjustment to cause movement of such pins and, consequently, the plate toward the movable mold section so as to cause such pins to project into the mold during the molding or casting operation. In this case the pins are not employed as stripping members, but are replaced by a core to provide a suitable opening in the article cast or molded.

To insure accuracy of operation I provide means whereby the connection between the cores and the operating means therefor can be adjusted to vary the timed relation of the operation between such cores, this means also being capable of adjustment to vary, within limits, the leverage effect exerted on the respective cores for withdrawing the same. This adjustability of parts renders it possible to so dispose the operating mechanisms for the cores that such parts are disposed substantially on dead center when the cores are in operating position in the mold, thus locking these parts against displacement during injection of the molten metal into the mold. Further objects and advantages will appear from the detail description.

In the drawings:—

Fig. 1 is a plan view of a die casting machine constructed in accordance with my invention, the shields being omitted and indicated in broken lines;

Fig. 2 is a left side view of the machine with the mold open;

Fig. 3 is a view similar to Fig. 1 with the mold closed;

Fig. 4 is a right side view of the machine with the mold open;

Fig. 5 is a front view of the machine;

Fig. 6 is a rear view of the machine;

Fig. 7 is a section taken substantially on line 7—7 of Fig. 2;

Fig. 8 is a detail of the drive and reverse mechanism;

Fig. 9 is a sectional detail of the adjustable eccentric connection of one of the core operating arms;

Fig. 10 is a detail, partly in section, of the handle and associated parts for operating the safety lock;

Fig. 11 is a detail of the air switch safety control bars;

Fig. 12 is a semi-diagrammatic view of a modified form of toggle operating lever and associated parts;

Fig. 13 is a fragmentary detail showing the manner of using the stripping pin lever for pulling a core;

Fig. 14 is a detail, partly in section, of the mounting of one of the core supporting arms.

The machine includes a main frame including a table or bed 1 supported by suitable uprights or leg members 2, the bed and the legs being suitably braced and connected together. A tank or furnace 3 is suitably supported at the front of the machine for containing the molten metal, the furnace illustrated being gas heated, though it will be understood an electrically heated furnace or any other suitable or preferred type of furnace can be employed. A ladle 4 operates in the tank of furnace 3, this ladle being arched or curved upwardly at its inner portion and provided at its inner end with a nozzle 5 adapted to fit into the gate or sprue opening of the die mold formed, in this instance, of two sections 6 and 7. A particular construction of the furnace and the ladle is disclosed in my patent, for Die casting machine, Number 1,637,566, dated August 2, 1927. It is not necessary to illustrate or describe in detail the construction of the furnace and ladle, it being understood that any suitable furnace or ladle can be employed.

The upper portion of the ladle 4 is rigidly secured by bolting or otherwise to the bight portion of a U-shaped frame 8, the arms of which are pivotally secured at their outer ends, at 9, to the upper ends of the arms of a yoke 10 the base 11 of which is provided with a dove-tail under portion 12 slidably mounted in a correspondingly shaped recess in the upper arm 13a of an L-shaped bracket 14, the vertical arm of which is similarly mounted in a supporting and guide member 15 depending from a front bar 16 secured across the front end of the main frame. The bracket 14 is adjusted on member 15 by an adjusting screw 17, in a known manner, the yoke being adjusted on arm 13a in a similar manner by means of a screw 18. The ladle is thus supported for swinging movement about a horizontal axis extending transversely of the front of the main frame of the machine, and is capable of horizontal and vertical adjustment to insure proper register of the nozzle 5 with the sprue opening of the die mold.

A drum shaft 19 is rotatably mounted transversely of the machine and adjacent the rear end thereof in bearing blocks 20 of the main frame. Two drums 21 are secured on this shaft for rotation therewith. Each of these drums is provided, in its inner face, with a box cam 22. Each drum is also provided with a circumferential box cam 23. These cam drums are similar to the cam drums disclosed in my Patent 1,322,502 of November 19, 1919. The end box cams receive rollers 24 mounted at opposite sides of the rear end of a lever 25 rockably mounted on the lower portion of the main frame adjacent its forward end, at 26. The pivot rod 26 upon which the forward end of lever 25 is mounted passes through cross pieces 27 at opposite sides of the main frame and secured to two adjacent uprights or legs of this frame. As will be noted more clearly from Fig. 5, the front or forward end of lever 25 is bolted or otherwise suitably secured to flanges 28 at the inner ends of the sleeves 29 rockably mounted upon the pivot rod 26. The sleeves 29 are held against inward movement toward the ends of the rod 26 by collars 30 secured on the rod by set screws. Each sleeve is provided, at its outer end, with an arm 31 extending forwardly therefrom and pivotally secured at its forward end by a pin 32 in the lower end of the bifurcated clevis 33. A connecting rod 34 is threaded into the upper end of clevis 33 and secured in adjustment therein by a jam nut 35. The upper portion of this rod is slidably mounted in a clevis 36 pivoted at 37 to the inner end of the U-shaped supporting frame 8. An expansion coil spring 38 is mounted about the rod 34 and confined between the lower end of clevis 36 and a washer 39 held in adjustment on the rod by a nut 40 threaded thereon. Upon rotation of the drum shaft and, consequently, the drum, the lever 25 is rocked about the pivot rod 26 alternately raising and lowering the ladle 4, the nozzle 5 thereof fitting snugly into the sprue opening of the mold when the ladle is raised. The springs 38 possess sufficient strength to hold the nozzle 5 snugly to its seat during the injection of the metal into the mold and also provide cushioning means for preventing injury to the ladle or the parts associated therewith.

The box cams 22 also receive rollers 41 at opposite sides of a toggle operating lever 42 which is pivotally mounted at its forward end at 43, in a bracket 44 depending from table 1. This lever extends rearwardly of the machine between and beyond the cam drum and is connected, adjacent its rearward end, by a link 45 to the toggle construction 46. By reference to Fig. 6 it will be noted that the link 45 is formed of two members 47 bolted together and held in spaced relation by suitable spacers, the lower ends of these members being disposed at opposite sides of the rear end of the lever 42. At their upper ends the members 47 are bent outwardly to fit between a pair of inner toggle links 48 pivotally secured at their lower ends by a pivot rod 49 to bracket uprights 50 secured to the rear end of table 1. Outer links 51 similar to the links 48 are also secured to the upright 50 by pivot rod 49, the bracket uprights serving as spacers for the lower ends of each pair of links 48 and 51. The upper or forward ends of each link 48 and 51 is disposed at opposite sides of a lug 52 projecting from the rearward end of a spacing block 53 secured between the rearward ends of a pair of forward toggle links 54. A similar block 55 is secured between the forward ends of the links 54 and receives threaded rods 56 slidable therethrough, adjusting nuts 57 being threaded on these rods at the opposite ends of the block 55. The forward pairs of toggle links are hingedly secured to the rearward pair of toggle links by the pintle rod 58 secured through the forward ends of the links 48 and 51 and extending through the lugs 52. Each of the rods 56 is provided, at its forward end, with a clevis in the form of an eye which extends into a slot 59 provided in a bracing web 60 adjacent each side of a carriage 61 slidably mounted on bed or table 1 (Fig. 7). A pintle rod 63 passes through the eyes or shackles 58′ of the rod 56 establishing hinged connection between these rods and the carriage. The blocks and the adjusting nuts on the rods provide convenient means for adjusting the effective length of the toggle and, consequently, regulating the travel thereof to suit conditions.

As will be noted more clearly from Figs. 1 and 3, the connection between the upper end of the toggle operating link 45 and the toggle 46 formed by the links 54 and 51 is in advance of the hinge of the toggle, the link plate or members 47 being pivotally secured at their upper ends to the inner forward links 54 of the toggle by pins 64.

The carriage 61 is provided at its forward end with a rectangular plate 65 upon which is bolted or otherwise suitably secured the movable mold section 7. Upon rotation of the cam drum, the carriage 61 is moved forwardly so as to bring the mold section 7 into operating relation to mold section 6, at which time the toggle is on dead center, as illustrated in Fig. 3, to lock mold section 7 in operative position, mold section 6 being held rigidly in position by being bolted to the inner face of a heavy bracket plate 66 disposed transversely of table 1 adjacent the forward end thereof and fixedly secured to the table. When the mold has been closed and the cores have been moved into operative position relative to the mold, when cores are used, the ladle 4 is raised into operative position and air under pressure is admitted into the upper end of this ladle injecting the molten metal into the mold. The mold then remains closed for a short time, sufficient to permit the metal to set, the cores, if used, being then drawn and the ladle returned to lowered or inoperative position and the mold opened upon the continued rotation of the drum.

I preferably provide means for stripping the work from the movable die section 7 as it approaches the limit of its rearward travel in the opening of the mold. In its broader aspects this stripping means is similar to the stripping means disclosed in my Patent 1,637,566 issued August 2, 1927, on my application for Die casting machine, Serial No. 729,450, filed August 1, 1924, of which this application is a continuation in part. A stripping plate 67 is secured upon the forward end of a supporting and guide shaft 68 slidably mounted in short sleeve 69 at the upper ends of the arms of a supporting and guide frame 70 of substantially elongated U-shape which is secured to the upper face of the adjacent portion of carriage 61. Stripping pins 71 are threaded through plate 67 and are secured in adjustment therein by jam nuts 72. These plates operate through aligned openings through plate 65 of the carriage and movable section 7 of the die. A block 73 is suitably secured on the supporting and guide shaft 68, as by clamping. This block is connected by a pair of links 74 to the angle of an angle lever 75 rockably mounted on the pintle rod 63. The lower portion of this lever is bifurcated providing two arms 76 of substantially rectangular shape by means of which the lever is mounted upon the pintle rod 63, the space between these arms accomodating the shaft 68. The links 74 are pivotally secured at 77 to the upper ends of the arms 76, these links being disposed adjacent the inner faces of the arms. Each of the arms 76 is also provided, adjacent its lower end, with a suitable opening 78 by means of which the links 74 can be attached to the arms of the lever at the lower end thereof. Upper arm 75 of the lever extends forwardly therefrom and is connected by a link 80 to a block 81 slidably mounted on a guide rod 82 supported over the carriage centrally thereof and disposed

longitudinally above the table 1. The forward end of this rod is secured through a cross member 83, the end portions of which are clamped about brace rods 84 extending longitudinally of the machine and connecting bracket plate 66 and a cap member 85 secured to the upper ends of the bracket uprights 50. This cap member is provided with a central boss 86 through which the rearward end of the rod 82 is secured. The rods 84 also pass through eyes provided at the upper ends of uprights 87 and 88 disposed at opposite sides of the table 1 approximately centrally thereof, these uprights being tightly bolted to the table. Rod 82 is threaded to receive two pairs of nuts 88 threaded thereon, the inner one of each pair constituting a jam nut for securing the sets or pairs of nuts in adjustment on the rod. These pairs of nuts form abutment members which serve to positively limit movement of the block 81 in either direction upon the rod 82. With the carriage 61 in its forward position and the die mold closed, as illustrated in Fig. 3, the block 81 is in contact with the forward pair of nuts 88′ and the lever 75 has been swung into its rearward position retracting the pins 71 and moving them into inoperative position, as illustrated. With the parts in this position the plate 67 is in its rearmost position relative to the plate 65 and the link 74 is preferably on dead center so as to lock the plate 67 against rearward movement, though this is not essential.

Upon opening of the die, the carriage 61 is moved rearwardly of the machine into the position illustrated in Fig. 2. During this movement of the carriage, the plate 67 moves with the carriage until the block 81 contacts with the rear pair of nuts 88′. This prevents further rearward movement of the plate 67 and upon continued rearward movement of the carriage, lever 75 is rocked about the pintle rod 63 so as to exert a leverage effect acting through the links 74 which forces the plate 67 toward mold section 7, projecting the stripping pins through the mold openings so as to strip the work therefrom. In this connection it is to be noted that the work or article cast will adhere to the section 7 of the mold, rather than to the section 6, due to a small portion of the molten metal entering about the inner ends of the stripping pins during the casting operation. Particular attention is called to the fact that the connection between the plate 67 and the lever 75 is a toggle connection. This is important as the metal of the cast article is comparatively soft at the time of stripping thereof from the mold section and a sudden blow would be apt to cause a fracture which would not heal as the metal takes its final set, thus rendering the article worthless. The provision of the toggle connection avoids this objection as it ensures that the initiation of ejecting operation takes place relatively slowly. The stripping pins exert, at first, a relatively slow pushing effect which serves to loosen the article from the mold section without subjecting it to a sharp blow. As the opening movement of the mold section continues the relative movement of the stripping pins is accelerated, quickly stripping the work from the mold. Upon forward movement of the carriage to return the die section 7 to closed or operative position, the plate 67 will travel with the carriage until block 81 contacts with the forward pair of nuts 88′. This will stop the forward travel of the plate, after which the lever 75 will exert a leverage effect through the links 74 which will cause the plate 67 to be moved rearwardly away from plate 65, thus retracting the pin, as illustrated in Fig. 3. In either case quick operation is obtained since the plates 65 and 67 are caused to move oppositely, the movement of the plate 67 being relatively fast due to the connections between lever 75 and the supporting and guide shaft 68. This is particularly desirable in stripping the work from the mold and is also of some assistance in speeding up production.

It is desirable, at times, to substitute a core for the stripping pins as, for instance, when casting cylindrical shells. In Fig. 13 I have shown a mold section 7^a mounted on plate 65 of carriage 61. This section has an opening receiving a cylindrical core 350, and a recess surrounding the core for reception of metal to form a cylindrical casting 351. This core is connected by a link 352 to the forward ends of arms of lever 75. The plate 65 of the carriage is provided with a suitable opening 65^a to accommodate the core. With the core connected to the lever in this manner, when the mold section 7^a is moved forwardly into operative position, contact of block 81 with the forward pair of nuts 88 serves to project the core 350 into the mold and, upon opening of the mold, contact of block 81 with the rearward pair of nuts 88 serves to pull the core member out of the mold section 7^a. In this manner the lever 75 and associated parts can be quickly and easily adapted for operating a core member, when circumstances require.

To facilitate rearward movement of the carriage 61 I provide a counterweight 90 to which is secured a chain 91 passing over a pulley 92 mounted in a bracket 93 secured to the rear end of table 1. The forward end of this chain is secured to a securing strip 94 which, in turn, is secured to the plate or base portion of the elongated U-shaped frame 70.

Each of the box cams 23 receives a roller 95 mounted at the inner end of a pair of links 96 and 97, the inner ends of which are

pivotally secured together by a suitable pin upon which the roller is mounted. The upper end of link 96 is pivoted at 98 in a bracket 99 depending from table 1. The outer end of link 97 is pivotally secured at 100 to the lower end of an arm 101 which is secured on the rearward end of a rock shaft 102 mounted in suitable bearing members on the main frame of the machine. An arm 103 is secured on the forward end of each shaft 102. As will be noted more clearly from Fig. 9, this arm is slotted longitudinally to receive a block 104 of dovetail cross section. This block is provided with a central bore and is interiorly threaded for cooperation with an adjusting screw 105 confined in a recess 106 in arm 103. This provides simple and efficient means for adjusting the block longitudinally of the arm. This block is provided, on its outer face with a pin by means of which the eye 107 of a connecting rod 108 is pivotally secured to the arm. By adjusting the block 104 the eccentric connection between the shaft and the rod 108 can be varied to suit circumstances. Rod 108 passes through a sleeve 109 pivotally secured at 110 to an operating lever 111 pivoted at its lower end, at 112, in bearing blocks 113 secured to the base portion of the main frame. The upper end of lever 111 is connected by pin and slot connections 114 to the outer end of a supporting and guide rod 115 which is slidably mounted for horizontal reciprocation in a cylindrical enlargement 116 of the bracket plate 66. A core supporting and operating arm 117 is mounted on each rod 115 and is locked in adjustment thereon by a jam nut 118. This arm extends rearwardly of the machine beyond the bracket plate 66 and is slotted longitudinally for reception of a core supporting rod 119, which is adjustably secured in the slot 120 by nuts 121 threaded on the rod at opposite sides of arm 117. The rod 119 carries at its inner end a suitable core 122 for cooperation with the die mold it being understood that the particular size and shape of the core, as well as the construction thereof, may be varied within wide limits to suit the particular type of work being done. The rods 115 are held against turning movement in any suitable manner, as by being splined in the enlargement 116. It will also be noted that the outer ends of these rods are provided with diametrical slots which snugly receive the upper end portions of the levers 111 which serve to effectually prevent turning movement of these rods. In Fig. 14 I have illustrated rod 115 as having an outer reduced portion 115^a onto which the nut 118 is threaded. This reduced portion is connected to the body portion of the rod by a tapered or frusto-conical element 115^b which fits into a corresponding recess in arm 117. By loosening the nut 118 the arm is released and can be readily turned about the shaft into any desired position, after which it is very effectively secured in adjustment by turning the nut onto the shaft so as to force the arm into locking contact with element 115^b. The manner of mounting the arms 117 upon the supporting and guide rods therefor, combined with the manner of mounting the core rods on the arms, permits ready adjustment of the cores to insure proper relation thereof to the dies.

The bracket plate 66 is provided with a central vertical enlargement 123 extending from the central portion of the cylindrical enlargement 116 and forming therewith a T-shaped structure. The enlargement 123 slidably receives a supporting and guide rod 124 similar to the rod 115. A third core supporting arm 117 is secured on the upper end of rod 124 and receives a core supporting rod 119 adjustably secured in position by means of nuts 121 disposed at opposite sides or faces of the arm 117. The rod 124 is provided, adjacent its lower end, with a diametrical slot 125 which receives a rounded head 126 at the inner end of an operating lever 127 which is loosely connected at its outer end, at 128, to a bracket extension 129 of the bracket plate 66. The head 126 is pivotally secured to rod 124 by a suitable pin 130 passing through the rod and the head and the enlargement 123 is provided with a slot extending to within a short distance of the lower end thereof to accommodate vertical movement of the lever 127. The connection between the outer end of this lever and extension 129 is sufficiently loose to permit a certain amount of lengthwise movement of the lever 127 to accommodate reciprocation of the inner end thereof. This connection is preferably a pin and slot connection, though a loose connection of other type may be employed. The lever 127 is connected, adjacent its inner end, to a block 104 adjustably mounted in arm 103, this block being adjusted by screw 105. A block is provided with a pin 106 which passes through the eye 107 of a connecting rod 108 adjustably secured through sleeve 109 by means of nuts threaded on the rod at opposite ends of the sleeve, this sleeve being pivotally secured to the lever 127 at 110. It will be noted that the connections between the lever 127 and its operating arm are similar to the connections between the lever 111 and its operating arm. The arm 103 for operating the lever 127 is secured on the forward end of a counter shaft 130 rockably mounted at the right hand side of the machine in a bearing sleeve 131 formed at the upper end of upright 88, the forward end of this shaft being mounted in a boss 132 of bracket plate 66. A collar 133 secured on the shaft adjacent boss 132 prevents endwise movement of the shaft toward

the boss, and an arm 134 secured on the shaft adjacent the forward end of bearing sleeve 131 serves to prevent endwise movement of shaft 130 in the opposite direction. Arm 134 is connected by a link 135 to an arm 136 secured on the rearward end of shaft 102 at the right hand end of the machine. This arm 136 may be formed integrally with arm 101 or may be formed separately therefrom, as circumstances may require. In the form illustrated, the two arms are shown as being integrally united by a common hub which is secured upon the shaft.

During rotation of the cam drums, the box cams 23 thereof act to operate the levers 111 and 127 and, together with the associated shafts and arms, exert a powerful leverage effect which serves to very effectually pull the cores from the die mold. In the form of die mold illustrated, and the cores therefor, the upper or top core is considered as the main core and the connections between the core pulling levers and operating arms therefor are so adjusted that this top core is pulled first, the side cores acting to anchor the work in the mold until the main core is pulled, after which the side cores are pulled and the mold is then opened, the movable section being moved rearwardly of the machine with the carriage in the manner described. In this connection, the independently adjustable connections between the respective core operating levers and the operating shaft therefor are of value as permitting adjustment of the core operating means independently to obtain desired timing of the cores.

Each of the cam drums is provided with a head 137 secured in the outer end thereof, this head being provided with an eccentric 138. A shield operating lever 139 is pivoted at its forward end at 140 on a bracket 141 depending from a brace bar 142 connecting two of the uprights of the main frame, this bar also having a vertical arm 143 which carries the bearing block or sleeve 20 for shaft 19, the upper end of this vertical arm 143 being bolted to table 1. The lever 139 is of flattened V-shape and a roller 144 is mounted at the angle of this lever and bears against the periphery of the eccentric 138. The rearward end of the lever is pivotally secured at 145 to the lower end of a clevis 146 from which extends an operating rod 147. As will be more clearly noted from Fig. 4, this rod is provided at its upper end with a clevis 148 secured thereon, this clevis being pivotally secured at 149 to a shield raising and lowering lever 150 pivoted at 151 in the upper end of a standard 152 which is secured at its lower end to a cross piece 153 the ends of which are secured by clamps, or in any other suitable manner, to the brace rods 84. Sheet metal shields 185 are secured to the forward ends of the levers 150 by links 186 the upper ends of which are pivoted to the levers, the lower ends of these links being pivoted to arms 187 projecting upwardly from the shields. Each of the shields is slidably mounted, by means of associated brackets for vertical movement on guide rods 188 secured to the table 1. As indicated in Fig. 1, the shields are shaped to fit about and enclose a mold and the cores and the operating mechanisms therefor at the sides of the machine, these shields cooperating with the bracket plate 66 and the carriage 61 to so enclose the mold as to eliminate possibility of the molten metal being sprayed outwardly beyond the table in the event of a defective mold or core, or in the event that the air should be admitted to the mold before complete closing thereof due to a defective mold or an object becoming positioned between the mold sections. The eccentrics 138 for operating the levers 139 are so disposed that the shields are lowered into full operative position in contact with the upper face of table 1 as the movable die section approaches full closed position, and remain in this lowered operative position until after the metal has been injected into the mold and the air valve has been closed and the air exhausted from the ladle which is returned to inoperative position before the shield members are raised. This serves to effectually protect the operator and any bystanders from injury due to molten metal being sprayed out of or beyond the mold.

Referring more particularly to Figs. 2, 4 and 6, lever 150 at the right hand side of the machine (upper left hand side of Fig. 4) is connected, to the rear of clevis 148, to the upper end of a link 189 the lower end of which is pivotally secured to the forward end of an arm 190 secured on a rock shaft 191 which is rockably mounted through the bracket uprights 50 and through bearing brackets 192 secured to table 1. A forwardly directed arm 193 is secured to the other end of shaft 191 and is connected by link 194 to the inner one of two strips or plates 195 and 196 of elongated rectangular shape which are slidably mounted for vertical movement in guide structures 197 and 198 secured to the main frame and to a bracket 199, respectively, the bracket being of approximately L-shape and secured to the bracket uprights 50. The outer plate 196 is connected by a link 200 (Fig. 1) to the rearward end of lever 150 at the left hand side of the machine. The two plates 195 and 196 are thus connected to the shields so as to be raised when the shields are lowered and vice versa. As these plates are movable independently of each other, this permits raising of either of the shields independently of the other, when the shields are in lowered operative position, so as to permit ready access to the die mold and associated parts from either side of the ma-

chine. This feature is, at times, of great practical utility.

As will be noted more clearly from Figs. 3 and 11, each of the plates or bars 195 and 196 is provided in its forward end with a cut-out or recess 201 of arcuate shape adapted for reception of a roller 202 mounted between a pair of strips forming a link 203 the rearward end of which is connected by a second link 204 to the bracket 199. The forward end of links 203 is pivoted to the upper end of a lever 205 which is pivoted at 206 on a bracket secured to the main frame. A roller 207 is mounted on the outer face of this lever at the lower end thereof and contacts with the periphery of a cam disc 208 secured on the outer end of shaft 19. This disc is provided with a recess 209 disposed to permit forward movement of the lower end of the lever toward the shaft 19, and the lower end of the lever is urged toward the disc 208 by a plunger 210 which contacts with the lever adjacent the roller 207 and is urged toward the lever by an expansion spring 211 mounted about the plunger and confined between a collar 212 secured thereon and adjusting screw 213 which is bored out and slidably receives the rearward portion of the plunger. This screw is threaded through the outer arm of an L-shaped bracket 214 secured to the frame and the forward portion of the plunger is slidable through a bracket projecting from the frame. The disc 208 serves to normally hold the lever 205 in the position illustrated in Fig. 2 during the greater portion of the rotation of the cam drum. When the cut-out or recess 209 is brought into alignment with roller 207, in the normal operation of the machine, the roller enters this recess swinging the upper end of the lever rearwardly and causing the roller 202 to enter the recesses 201 of the plates or bars 195 and 196, this operation occuring when the shields are in lowered operative position raising the plates into such position as to permit entry of the roller 202 into the recesses 201. It is to be noted that, when the shields are not in full lowered position, the roller 202 contacts with the forward edges of the plates 195 and 196 and these plates serve to prevent rearward movement of the upper portion of lever 205 even though the recess 209 is brought into alignment with the roller 207.

The valve control lever 205 is connected, below its pivot 206, to the lower end of a valve operating lever 215, by means of a pull rod 216. The lever 215 is pivotally mounted at 217 upon a bracket 218 secured to the table 1. The upper end of lever 215 is connected, by means of a clevis 219, to the operating rod or stem of a valve indicated generally by 220. This valve includes a suitable casing within which is slidably mounted a valve proper of the D type the stem of which is connected to the lever 215 to be shifted thereby into operative and inoperative positions. Compressed air under a pressure of approximately 350 pounds per sq. inch is supplied to the casing of the valve by means of a pipe 221 opening through the top of the casing, and this casing is provided with a suitable outlet or exhaust elbow 222. For supplying air from the valve structure to the upper portion of the ladle a suitable connection is provided including a nipple 223 to which is connected an elbow 224 by a suitable coupling 225 permitting relative turning movement of the elbow. A short pipe 226 is secured to the elbow and slidably receives a length of pipe 227 connected by an elbow 228 to a short pipe 229 which is secured to the frame 8 for supporting the ladle, this latter pipe 229 being threaded into an opening adjacent the upper end of the ladle, this opening being disposed closely adjacent the lower end of a closure plug 230 threaded into the upper end of the ladle. This provides a suitable connection between the air control valve structure and the ladle for supplying air to the ladle above the molten metal therein and under pressure at suitable times in the operation of the machine. The particular construction of the valve employed and the arrangement of the air inlet and exhaust ports is disclosed in my Patent 1,322,501 of November 18, 1919 and need not be illustrated or described in detail here. The valve mechanism is so arranged that, when the lower end of the control lever 205 is moved forwardly and the roller 207 enters the recess 209 of cam disc 208, the valve is opened to admit air into the ladle injecting the molten metal into the mold. This opening of the valve takes place after the mold has been closed and the ladle has been raised into operative position, the shields being also in full lowered operative position. Upon continued rotation of disc 208 the recessed portion thereof is moved out of alignment with roller 207 and the lever 205 is rocked about its axis moving the pull rod 216 rearwardly and shifting the valve into inoperative or open position permitting the air in the upper portion of the ladle to discharge through the elbow 222. The shields are then lifted, the cores are pulled, and the mold is opened so as to strip or remove the work therefrom.

As previously pointed out, when the bars or plates 195 and 196 are in lowered position the recesses 201 thereof are below and out of alignment with the roller 202 so that the lever 205 cannot be rocked in proper direction to open the air valve. In conjunction with these plates I provide a safety device for holding the shields raised and for preventing opening of the air control valve

when the shields are so held. A rod 231 is rockably mounted at one end through a short sleeve 232 carried by the upright 87, the other end of this rod being mounted through a lug 233 projecting from the guide member 198. An operating handle 234 provided with a fork 234[a] which straddles rod 231, is pivotally secured to the rod by a pin 234[b], this handle normally resting in a recess 235 in an extended portion of the sleeve 232. An arm 236 is secured to the other end of the rod and is provided with a locking finger 237 disposed to engage through alined openings 238 in the plates 195 and 196 when these plates are lowered and the handle 234 is moved out of recess 235 and swung into position beyond the rearward end of sleeve 232 to permit turning of the shaft and lowering of arm 236 into operative position. When the arm 236 is lowered the finger 237 locks the plate in lowered position so as to hold the shields in raised or inoperative position and these plates cooperate with the roller 202 to prevent opening of the air control valve. This provides a very simple and highly efficient safety means which permits operation of the mold and associated parts without injecting metal into the mold. By this means I assure that no metal will be injected into the mold except when the shields are in lowered operative position. This feature is of great importance as protecting the operator against injury by molten metal in the event of defects in the mold or the cores, as previously pointed out, and is also of importance as permitting operation of the mold to obtain accurate adjustment thereof and of the cores without danger to the operator.

A drive shaft 239 is mounted in suitable bearing members adjacent the back of table 1 and transversely thereof. This shaft has a sprocket 240 (Fig. 3) keyed thereon which is connected by a sprocket chain 241 to a sprocket gear ring which is secured to the left hand drum 21 as considered in Figs. 6 and 7. A suitable tightening device 242 (Fig. 2) is provided for maintaining the chain under proper tension. A pulley 243 is keyed on the outer end of shaft 239 and is driven by a belt 244 which passes about a pulley 245 keyed on a pulley shaft 246 supported by suitably disposed hangers 247. Two other pulleys 248 and 249 are mounted loose on shaft 246 and are driven oppositely, as indicated by the arrows in Fig. 8, from pulleys on a line shaft (not shown). Either of these pulleys, selectively, can be operatively connected to shaft 246 through the medium of a suitable clutch 249 splined on the shaft and operated by a shift lever 250 having a fork for shifting the clutch, the rod portion of this lever being rockably mounted in a suitable bearing at its upper end and in a bracket 251, at its lower end, this bracket being secured to one of the hangers 247. An arm 252 is secured on rod 250 and is connected by a rod 253 to an arm 254 which is secured on a rod 255 extending upwardly from the machine. By shifting the clutch 249 pulley 243 may be driven in either direction or operation of the machine may be stopped by shifting the clutch into neutral or central position. Normally the pulley 243 is driven by pulley 248 so as to be rotated in a clockwise direction during operation of the machine. Pulley 249 is employed for reversing the direction of rotation of pulley 243 only in emergencies as, for instance, when it is desired to open the die mold after partially closing the same and without completely closing the mold.

For controlling the operation of the machine I provide a main control lever 256 which is secured on a rod 257 rockably supported in suitable bearings transversely of the machine, the left hand portion of this rod extending through a sleeve bracket 258 secured to the main frame of the machine. The mounting of this lever and associated parts will be better understood by referring to Figs. 1, 2, 4 and 6 of the drawings. The control lever is provided with a detent 259 which cooperates with a sector or rack 260 secured to the outer end of sleeve bracket 258, in a known manner, for holding the lever in adjustment. A cam plate 261 is secured to an arm 262 which is loosely mounted on shaft 257, this cam plate being disposed closely adjacent the outer face of lever 256. The detent 261 is of sufficient width to contact with the upper edges of the cam plate and the rack. The rack is provided with three notches, a central notch and one adjacent each end thereof, and the cam plate is provided with recesses receiving the detent 259 when the operating lever is in either neutral or operating position, these recesses having cam surfaces for raising the detent and releasing the lever.

Arm 262 is connected by a link 263 to an arm 264 secured on the outer end of a stub shaft 265 rockably mounted in a sleeve bearing 266 secured to the main frame of the machine. An arm 268 is secured on the inner end of this stub shaft and has its upper end connected by a tension spring 269 to arm 143 of the frame member 142. Arm 268 is further provided, at its lower end with an arm 269′ of approximately L-shape, at the lower end of which is mounted a roller 270 which projects into the adjacent head 137 of the drum and is disposed for contact with a cam member 271 secured to the peripheral flange of this head. When the casting operation is complete and the movable mold section 7 has been moved into full open position, cam member 271 contacts with roller 270 so as to swing the cam plate 261 in a clockwise direction, as considered

in Fig. 2, raising the detent 259 and releasing lever 256 permitting return thereof to central or inoperative position thus stopping the machine. In Fig. 2 the positions of the parts are shown after the control lever has been released by contact of the cam surfaces of the rearward recess in the cam plate 261, and the control lever has been returned to neutral position, the central or forward recess of the cam plate being merely to permit entry of the detent 259 into the central opening or slot of the rack 260. When the drum is again rotated roller 270 passes out of contact with the cam member, or, more correctly stated, the cam member passes out of contact with the roller, permitting movement of arm 268 in a counter clockwise direction under the influence of spring 269, this movement of the arm being limited by a stop pin 272. The construction of the rack plate and cam plate is disclosed in my Patent 1,322,501 issued November 18, 1919, and need not be more fully illustrated or described in detail here.

Referring more particularly to Figs. 1 and 4, an arm 273 is secured on the other end of rod 257 and is connected by link 274 to one arm of a bell crank lever 275 pivotally mounted at 276 on one of the uprights of the main frame. The other arm of this lever is connected by a link 277 to the upper end of a plate 278 rockably mounted at its lower end at 279 on a bracket 280 secured to table 1. The rearward end of link 277 is disposed between the plate and an arm 281 which is secured to the plate (Fig. 1). The inner end of this arm is connected by a rod 282 to an arm 283 which is secured on the shift rod 255, which passes through a guide member 284 secured on one of the brace rods 84. A Y-member 285 is secured on plate 278 with the arms of its head disposed in angular relation to form a flat V-shape, these arms forming cam elements 286 which are oppositely disposed. A suitable frame 287 is pivotally mounted at its rearward end at 288 on a bracket 289 extending from the table. This frame carries at its upper portion a brake shoe 290 disposed to contact with the upper portion of pulley 243 when the frame is lowered. A tension spring 291 connects the frame, adjacent the forward end thereof, to the frame of the machine and acts to hold brake shoe 290 tightly against the pulley when the brake shoe frame 287 is in its lowered position. A roller 292 is mounted in the front portion of the brake shoe frame and contacts with the head of the Y member 285 so as to travel upon the upper surfaces of the cam members 286. When the main control lever is in neutral or central position the roller 292 is disposed in the angle of the head of the Y member and the arm 281 is in such position as to hold the clutch 249ª in central or neutral position preventing operation of the machine. This also permits downward movement of the brake shoe frame by the spring 291 so as to apply the brake to the pulley 243 preventing turning thereof. When the control lever is rocked rearwardly of the machine into operative position, the plate 278 and consequently the Y member 285 are swung in a counter clockwise direction as considered in Fig. 4 shifting the clutch 249ª into position to establish driving connection between the pulley 248 and shaft 246. At the same time, the right hand arm 292, as considered in Fig. 4 of the Y member acts to lift the roller 292 raising the brake shoe frame 287 and releasing the pulley 243. At the end of the operation, when the main control lever is released so as to move from the position illustrated in Fig. 3 to that illustrated in Fig. 2, the pressure of the roller 292 upon the arm of the Y member acts to return the operating lever to neutral position through the shaft 257 and the connections between the shaft and the Y member. As previously explained, the control lever is moved into its forward reverse position only in emergency. For this reason the cam plate 262 preferably extends beyond the emergency slot in the rack so that the control lever can not be secured in emergency position and, if desired, the emergency slot in the rack plate may be omitted. In my Patent 1,322,501 I have shown an arrangement of control and shifting mechanisms very similar in their broader aspects to the mechanism herein illustrated and described, though I have found that the mechanisms of the present application are more satisfactory in operation than the mechanisms of my patent referred to.

It is thought that the operation of my machine will be readily understood from the above description, though a brief résumé may be desirable. In operation, assuming that the die mold is open and the parts are in the positions illustrated in Fig. 2, the shields being raised as in Fig. 4; upon rotation of the cam drum the die mold is closed, the shields are lowered into full operative position, the ladle is then raised so as to position the nozzle 5 tightly in the sprue opening of the mold, and the roller 207 then enters recess 209 of disc 208 permitting movement of lever 205 in proper direction to admit air into the upper portion of the ladle above the molten metal, thus injecting the metal into the mold. The recess 209 is preferably of sufficient length to insure that the metal in the ladle will be subjected to air pressure for a sufficient time to assure that the mold will be completely filled with the molten metal. Continued rotation of the drum rocks the arm 205, through the cam disc 208, in proper direction to exhaust the air from the top or upper portion of the ladle, after which the shields are

raised, the cores are pulled, and the mold is opened, the work being stripped from the mold section 7 as it approaches the limit of its rearward movement. At this time the control lever 256 is released and returned to central or inoperative position. It may be desirable at times, particularly when working on large pieces, to retain the air valve for admitting air pressure to the ladle open for a greater length of time than would be possible by permitting the continuous rotation of the drum. This result can be readily accomplished by throwing the control lever 256 into central or neutral position as the roller 207 enters recess 209. As long as the lever is maintained in this position the molten metal in the ladle 4 will be subjected to air pressure. In this connection it is particularly pointed out that the provision of the brake shoe and associated parts is advantageous in that the brake is applied to the pulley as soon as the lever is shifted into neutral position stopping rotation of the drums immediately and preventing opening of the air valve, when the roller 207 is in recess 209, until the lever has been returned to operative position.

The connections between the cores and the operating arms therefor are adjustable, as previously pointed out. In the mold illustrated in Fig. 2, the top core 122 is the main core and serves to close the upper end of the mold cavity, being provided with an annular flange at its upper end for this purpose. The connection for the operating arm for this main core is adjusted so that this core is pulled first, the other cores acting to anchor the work in the mold during pulling of the main core. After the main core has been pulled, the other cores are pulled and the mold is then opened. The adjustable connection between the respective cores and the operating arms therefore permits the adjustment of the cores so as to vary the timed relation thereof, permitting the cores to be pulled simultaneously or successively in any desired order as circumstances may require.

In Fig. 12 I have illustrated semi-diagrammatically modified means for operating the carriage toggle. This lever 293 consists of a forward straight portion pivoted at 43, the rearward end portion of which is bent substantially at right angles to provide an upwardly extending arm 294. Arm 294 is connected by a link 295 to the rearward link of toggle 46. During upward movement of the lever 293 the link 295 moves upwardly and rearwardly, the horizontal component of the movement of the link exerting a pulling effect on the forward link of the toggle 46 so as to assist in the rearward movement of the carriage and associated parts. During downward movement of the link 295 this horizontal component exerts a pushing effect forwardly of the machine which assists in moving the carriage 61 into position to close the die mold. As the link 295 approaches alignment with pivot point 43 during the upward stroke of lever 293 its pushing effect increasing the speed of travel of the carriage, and during the downward stroke of the lever the speed of travel of the carriage decreases. The lever 293 and link 295 form a second toggle and cooperate with toggle 46 to produce a double toggle structure which is highly efficient as giving ample travel of the carriage and sufficient force to pull the carriage and the movable die section back. This double toggle renders it possible to use smaller cam drums than is possible where the means for operating the carriage shown in Figs. 2 and 3 is employed, and to effect a corresponding reduction in size and weight of the associated parts of the machine. The form of carriage operating means shown in Fig. 12 is, therefore, to be considered as the preferred form.

The uprights or legs 2 upon which the forward ends of the rock-shafts 102 are journaled and boxes 113, are subjected to severe strains during pulling of the cores and it is necessary for this reason, to properly brace these members. Side sills 300 are bolted to the lower ends of the legs supporting the table 1. These sills are connected by a cross-bar 301 which extends beneath the sills and is bolted or otherwise suitably secured thereto. The end portions of bar 301 extend beyond the sills and form, in effect, bed plates upon which the boxes seat, these boxes being bolted to the ends of the bar. The front legs 2 are connected by a cross-bar 302 and the back legs are connected by a cross-bar 303. This produces, in effect, a box structure the interior of which is unobstructed to accommodate the drums and associated parts. The shafts 102 are disposed closely adjacent the upper ends of the legs 2 and the distance between the lower end of each of these legs and the corresponding member 113 is very short. During pulling of the core, the inward pressure exerted on the sill at the lower end of the leg is largely counteracted by the outward pressure exerted by lever 111. The cross-bar 301 acts as a tension member to resist the outward pressures of levers 111 and the short lengths of sills connecting members 113 and the lower ends of the next to the front legs 2 have ample strength to resist the inward pressures exerted by the legs. The table and the legs are thus combined with the sills to produce a structure well adapted to receive and support the various parts of the machine and which possesses ample strength to resist the severe strains to which these parts are necessarily subjected in use.

I have found, that when the form of lever illustrated in Fig. 12 is used, with the link

associated therewith in the manner illustrated, it is not necessary to employ a counterweight or equivalent means to obtain ease of operation of the carriage. In fact, the employment of the counterweight is not essential in either form of construction, but I find that it is advantageous in the form illustrated in Figs. 1 to 7 as facilitating ease and smoothness of operation of carriage.

What I claim is:—

1. In a die casting machine, a die mold including a movable section, means for operating said mold section, a plate mounted for movement with the mold section, link mechanism actuated by the movement of the mold section for moving the plate with respect to the mold section, stripping pins carried by the plate and slidable through the mold section, and stop means limiting the movement of the plate with the mold section in either direction for retracting and projecting the pins.

2. In a die casting machine, a die mold including a movable section, means for operating said mold section, a plate mounted for movement with the mold section, link mechanism actuated by the movement of the mold section for moving the plate with respect to the mold section, stripping pins carried by the plate and slidable through the mold section, and stop means limiting the movement of the plate with the mold section in either direction for retracting and projecting the pins, said stop means being adjustable to vary the extent of travel of the plate with the mold section.

3. In a die casting machine, a die mold including a movable section, means for operating said mold section, a plate mounted for movement with the mold section, th plate and the mold section having relative movement, stripping pins carried by the plate and slidable through the mold section, stop means limiting movement of the plate with the mold section in either direction for retracting and projecting the pins, and lever means cooperating with the stop means for moving the plate oppositely to the mold section when said plate reaches the limit of its travel in either direction with the mold section and during the remaining travel of said mold section.

4. In a die casting machine, a reciprocating carriage, a die mold section mounted on the carriage for travel therewith, a plate slidably mounted on the carriage for relative movement, pins carried by the plate and operating through the mold section and the adjacent portion of the carriage, a rod, a sleeve slidable on the rod, a lever on the carriage, a link connecting the lever and the sleeve, stops on the rod limiting travel of the sleeve in either direction, operating connections between the lever and the plate, and means for operating said carriage.

5. In a die casting machine, a reciprocating carriage, a die mold section mounted on the carriage for travel therewith, a plate slidably mounted in the carriage for relative movement, pins carried by the plate and operating through the mold section and the adjacent portion of the carriage, a rod above the carriage, a sleeve slidable on the rod, a lever on the carriage, a link connecting the lever and the sleeve, stops on the rod limiting travel of the sleeve in either direction, an operating rod extending from the plate, a link connection between the lever above its fulcrum and said rod, and means for operating said carriage.

6. In a die casting machine, a reciprocating carriage, a die mold including a section mounted on the carriage for travel therewith, core members cooperating with the die mold, a cam drum, a toggle for operating the carriage, a plate mounted on the carriage for travel therewith, the plate and the carriage having relative movement, means limiting movement of the plate with the carriage in either direction, pins carried by the plate and operating through said mold section and the adjacent portion of the carriage, and operating connections between the cam drum and the carriage and both the core members for operating said carriage and said core members in synchronism.

7. In a die casting machine, a reciprocating carriage, a die mold including a section mounted on the carriage for travel therewith, core members cooperating with the die mold, a cam drum, a toggle for operating the carriage, a plate mounted on the carriage for travel therewith, the plate and the carriage having relative movement, means limiting movement of the plate with the carriage in either direction, pins carried by the plate and operating through said mold section and the adjacent portion of the carriage, and lever operating connections between the cam drum and both the carriage and the core members for operating said carriage and said core members in synchronism.

8. In a die casting machine, a main bracket at the forward portion of the machine, a die mold section on said bracket, a reciprocating carriage, a second mold section mounted on the carriage and movable therewith into and out of operative relation to the first mold section, supporting and guide rods slidably mounted on the bracket for movement laterally thereof, arms secured on said rods, cores carried by the arms and cooperating with the mold laterally thereof, operating levers fulcrumed on axes disposed longitudinally of the machine and having loose connection with said rods, a cam drum adjacent the rear of the machine, operating connections between the drum and the carriage and operating connections between the drum and the levers for operating the cores

in synchronism with the operation of the carriage.

9. In a die casting machine, a main bracket at the forward portion of the machine, a die mold section on said bracket, a reciprocating carriage, a second mold section mounted on the carriage and movable therewith into and out of operative relation to the first mold section, supporting and guide rods slidably mounted on the bracket for movement laterally thereof, arms secured on said rods, cores carried by the arms and cooperating with the mold laterally thereof, operating levers fulcrumed on axes disposed longitudinally of the machine and having loose connection with said rods, a cam drum adjacent the rear of the machine, operating connections between the drum and the carriage, and operating connections between the drum and the levers for operating the cores in synchronism with the operation of the carriage, the connections between the drum and the respective levers being independently adjustable to vary the relative timing between the respective cores.

10. In a die casting machine, a main bracket at the forward portion of the machine, a die mold section on said bracket, a reciprocating carriage, a second mold section mounted on the carriage and movable therewith into and out of operative relation to the first mold section, supporting and guide rods slidably mounted on the bracket for movement laterally thereof, arms secured on said rods, cores carried by the arms and cooperating with the mold laterally thereof, operating levers fulcrumed on axes disposed longitudinally of the machine and having loose connection with said rods, a cam drum adjacent the rear of the machine, operating connections between the drum and the carriage, a third guiding and suporting rod slidably mounted on the bracket in angular relation to the first mentioned rods, an arm secured to said third rod, a core carried by the third rod arm, and operating conections between the drum and the levers and the third guiding and supporting rod for operating the cores in synchronism with the carriage, said connections being adjustable to vary the timing of the core of the third rod relative to the cores of the other rods.

11. In a die casting machine, a tank for containing molten metal, a die mold, a ladle operating in the tank, said ladle being closed at one end and having a nozzle at its other end adapted for engagement with the sprue opening of the die, an air pressure supply pipe connected to the ladle adjacent the closed end thereof, valve means controlling the admission and exhaust of air to and from the ladle, shields movable into and out of position to enclose the die, and positive connecting means for moving the shields into and out of operative position, said means permitting movement of the shields independently into inoperative position when said shields are in operative position.

12. In a die casting machine, a tank for containing molten metal, a die mold, a ladle operating in the tank, said ladle being closed at one end and having a nozzle at its other end adapted for engagement into the sprue opening of the die, an air pressure supply pipe connected to the ladle adjacent the closed end thereof, valve means controlling the admission and exhaust of air to and from the ladle, shields movable into and out of position to enclose the die mold, means for moving the ladle into operative position, positive connecting means for moving the shields into and out of operative position, said means permitting movement of the shields independently into inoperative position when said shields are in operative position, and means cooperating with said shield operating means for operating the air control valve in timed relation with the operation of the shields and the ladle, said cooperating means preventing opening of the air valve until the shields are in full operative position.

13. In a die casting machine, a tank for containing molten metal, a die mold, a ladle operating in the tank, said ladle being closed at one end and having a nozzle at its other end adapted for engagement into the sprue opening of the die, an air pressure supply pipe connected to the ladle adjacent the closed end thereof, valve means controlling the admission and exhaust of air to and from the ladle, shields movable into and out of position to enclose the die mold, operating means for the respective shields, two slidably mounted members disposed closely adjacent each other and connected to the respective shields for movement therewith, means operating in synchronism with the ladle and the shields for operating the air pressure control valve, said valve operating means coacting with the slidable members for holding the valve in inoperative position when the shields are in inoperative position, and means for securing the slidable members against movement when the shields are in inoperative position.

14. In a die casting machine, a die mold, means for injecting molten metal into the mold, said means including an air pressure supply pipe, a control valve in said pipe, shields mounted to be lowered and raised into and out of position to enclose the mold, a cam drum, cams on the drum, levers connected to the respective shields and held by the weight thereof in contact with the cams for raising and lowering the shields upon rotation of the drum, means for operating the valve in synchronism with raising and lowering of the shields, control means movable with the shields and cooperating with

said valve operating means for preventing opening of the control valve until said shields are in full lowered position, and means for locking said control means against movement when either of the shields are in raised position.

15. In a die casting machine, a die mold, means for injecting molten metal into the mold, said means including an air pressure supply pipe, a control valve in said pipe, shields mounted to be lowered and raised into and out of position to enclose the mold, a cam drum, cams on the drum, levers connected to the respective shields and held by the weight thereof in contact with the cams for raising and lowering the shields upon rotation of the drum, means for operating the valve in synchronism with raising and lowering of the shields, control means movable with the shields and cooperating with said valve operating means for preventing opening of the control valve until said shields are in full lowered position, and means for locking said control means against movement when either of the shields are in raised position, the control means permitting independent raising of the shields when in lowered position.

16. In a die casting machine, a die mold, means for injecting molten metal into the mold, said means including an air pressure supply pipe, a control valve in said pipe, shields mounted to be lowered and raised into and out of position to enclose the mold, a cam drum, cams on the drum, levers connected to the respective shields and held by the weight thereof in contact with the cams for raising and lowering the shields upon rotation of the drum, a control lever, operating connections between the control lever and the valve, means urging said control lever in valve opening direction, means normally holding the control lever in valve closing position and permitting movement of the control lever in valve opening direction after the drum has turned through a predetermined distance, two members slidably mounted adjacent to each other and connected to the respective shields for movement therewith, an arm connected to the lever and urged toward said slidably mounted members, and an abutment member carried by the arm and contacting with the adjacent edges of the slidably mounted members, said slidably mounted members having registering recesses disposed for reception of the abutment member when the shields are lowered and the lever holding means is in releasing position permitting movement of the control lever in valve opening direction.

17. In a die casting machine including a reciprocable carriage, a cam drum, means for rotating said drum, an operating lever pivoted at one end and having an upwardly extending arm at its other end, operating connections between the lever and the cam of the drum, a toggle anchored at its rear end and having operating connection with the carriage at its other end, and a link connection between said arm and one link of the toggle at a point spaced from the joint of the toggle.

18. In a die casting machine including a reciprocable carriage having a plate adapted to receive and support a mold section, a stripping plate mounted for movement with the carriage, the stripping plate and the carriage being capable of relative movement, stripping pins carried by the plate, and means for limiting movement of the stripping plate with the carriage and for causing movement of the stripping plate oppositely to that of the mold plate, said means acting to initiate movement of the stripping plate toward the mold plate at a relatively low speed and gradually increasing the speed.

19. In a die casting machine including a reciprocable carriage having a plate adapted to receive and support a mold section, a stripping plate mounted for movement with the carriage, the stripping plate and the carriage being capable of relative movement, stripping pins carried by the plate, a lever mounted on the carriage, means for limiting travel of the lever with the carriage and for causing rocking of the lever about its fulcrum during continued travel of the carriage, and toggle operating connections between the lever and the stripping plate for moving said stripping plate oppositely to the movement of the mold plate with the carriage upon rocking of said lever.

20. In a die casting machine, a mold, supporting and guide shafts, core carrying arms mounted on said shafts for adjustment about the same, cores carried by said arms and cooperating with the mold, means for securing the arms in adjustment on said shafts and means actuated upon the operation of the machine for moving the shafts to move the cores into and out of operative position.

21. In a die casting machine, a supporting and guide shaft having a tapered portion, a core supporting arm on said shaft and having a socket for reception of said tapered portion, and a member threaded on the shaft and bearing against the arm for forcing the same into binding contact with the tapered portion of the shaft.

22. In a die casting machine, a table, legs supporting the table, cross-bars connecting the ends legs, shafts rockably mounted on certain of said legs, side sills connecting the legs at each side of the table, bearing blocks secured to the side sills adjacent the legs on which the shafts are mounted, core operating levers fulcrumed in said blocks, and operating connections between the shafts and the levers, the pressures transmitted to the sills by the levers when pulling cores being op-

posed by the pressures transmitted to the sills by the shaft supporting legs.

23. In a die casting machine, a table, legs supporting the table, cross-bars connecting the end legs, shafts rockably mounted on certain of said legs, side sills connecting the legs at each side of the table, a cross-bar connecting the sills and extending beyond the same, bearing blocks secured to the extended portions of the cross-bar connecting the sills, said blocks being adjacent the shaft supporting legs, core pulling levers fulcrumed at their lower ends in said blocks, and operating connections between the shafts and the levers.

24. In a die casting machine, a die mold including a movable section, a stripper for stripping the casting from the mold, and means effective upon the initial movement of the movable mold section for moving the stripper in one direction with respect to the motion of the mold section and for thereafter moving it in the opposite direction.

25. In a die casting machine, a die mold including a movable mold section, a stripper for stripping the casting from the mold section, and link mechanism actuated by the movement of the movable section for moving the stripper.

26. In a die casting machine, a mold comprising two relatively movable sections, means for moving the sections, a plurality of cores within the mold, and means actuated in timed relationship with respect to the action of the first named means for successively drawing the cores from the mold.

27. In a die casting machine, a mold comprising two relatively movable sections, means for moving the sections, a plurality of cores within the mold, means for successively drawing the cores from the mold, and adjustable means for timing the sequence of the core extracting actions with respect to the time of moving of the two first named sections.

28. In a die casting machine, a mold comprising two relatively movable sections, means for moving the sections, a plurality of cores within the mold, lever mechanism actuated by the machine in timed relationship with the moving of the two first named sections for sequentially extracting the respective cores, and means for independently adjusting the sequence of operation of the core extracting lever mechanism to extract the cores in the desired time relationship.

29. In a die casting apparatus, cam operated mechanism for controlling the casting operation, a protecting shield, link means controlled by the cam operating mechanism and connecting the shield to the mechanism for moving the shield into and out of protecting position, said cam mechanism preventing the independent movement of the shield into the protecting position and permitting the independent movement of the shield into the non-protecting position, and means controlled by the shield for preventing the casting operation when the shield is in the non-protecting position.

30. In a die casting machine, a die mold including a movable mold section, a plurality of cores within the mold, a stripper for stripping the core from the mold, means for withdrawing each of the cores from the mold, common actuating means for actuated stripper and the core withdrawing means, and means for adjusting the sequence in which the cores are withdrawn.

In witness whereof I hereunto subscribe my name this 23 day of May, 1927.

JOHN S. GULLBORG.