Oct. 24, 1933. V. H. TANDY 1,931,907

DIE CASTING MACHINE FOR MOTOR PISTONS

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Fig. 1.

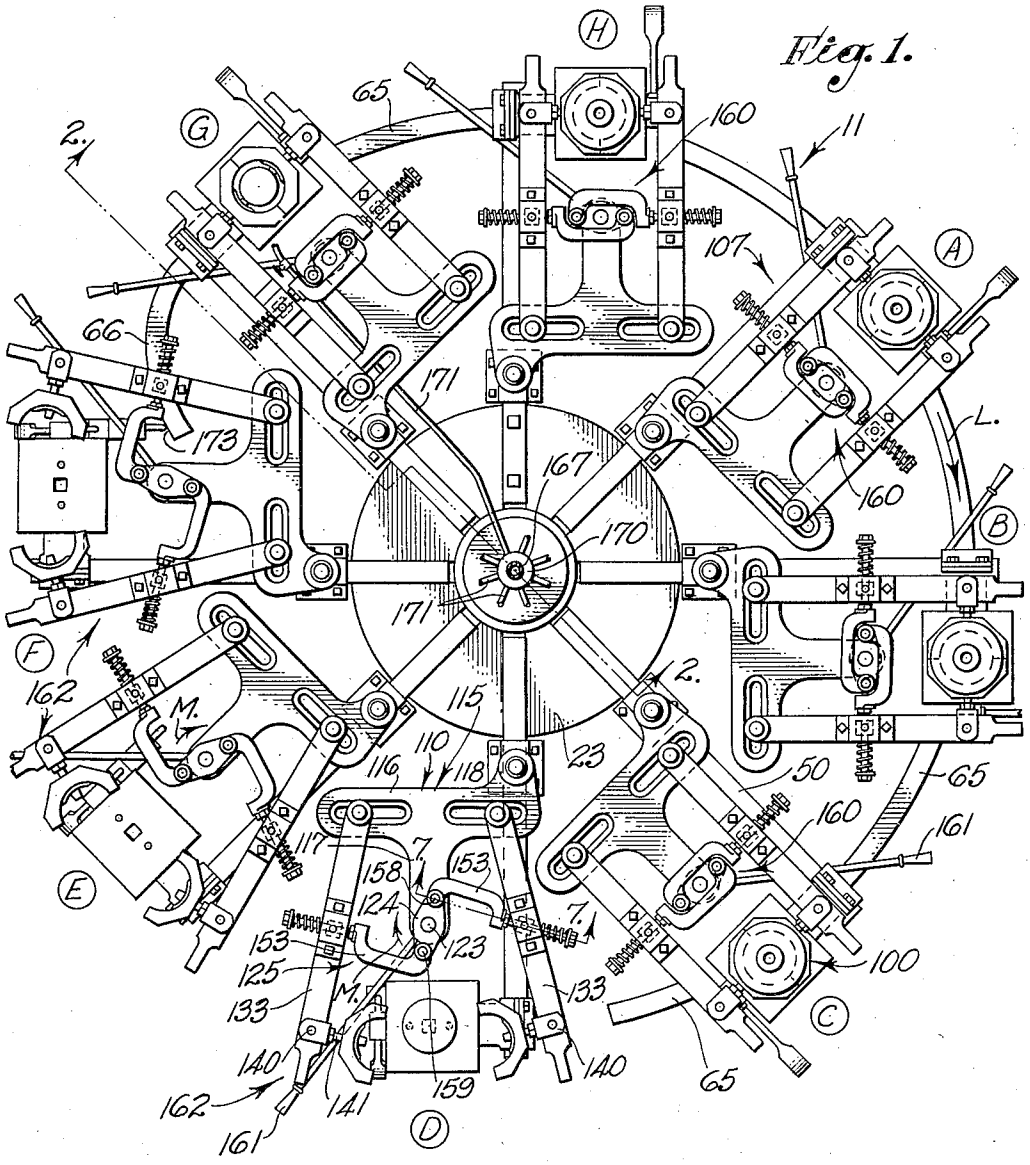
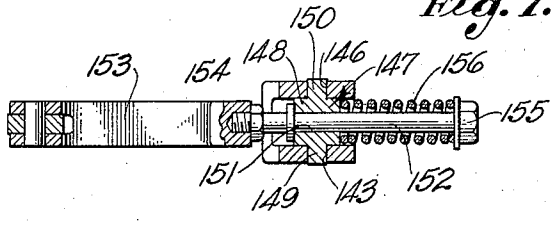


Fig. 7.



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Fig. 2.

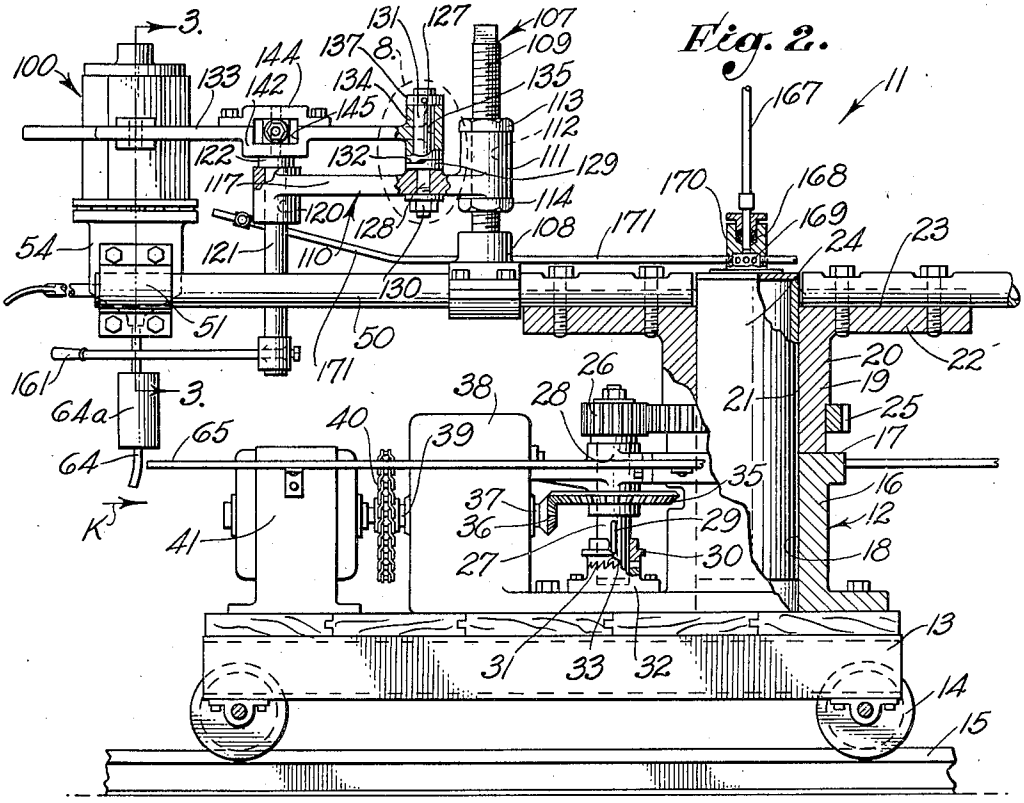


Fig. 8.

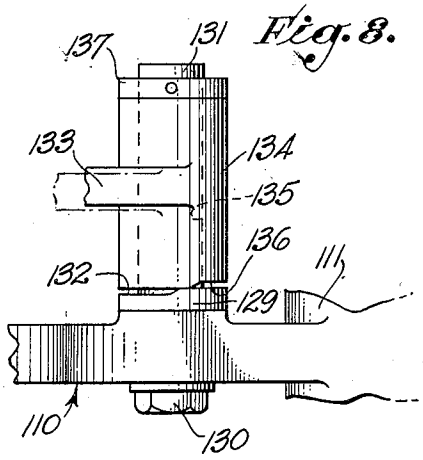
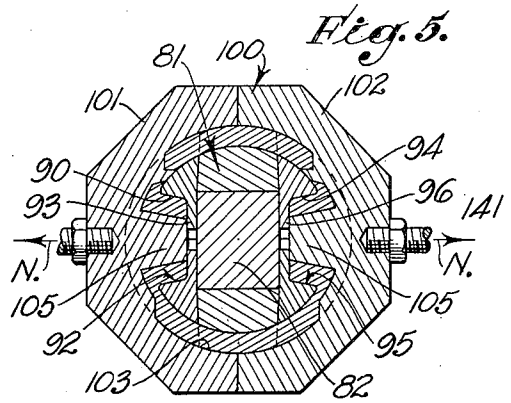


Fig. 5.



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DIE CASTING MACHINE FOR MOTOR PISTONS

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Fig. 3.

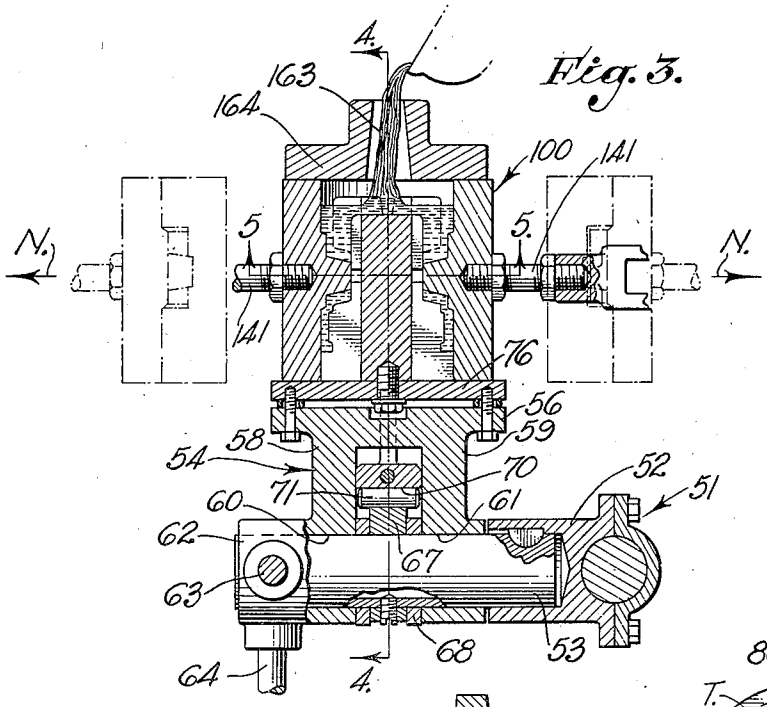


Fig. 6.

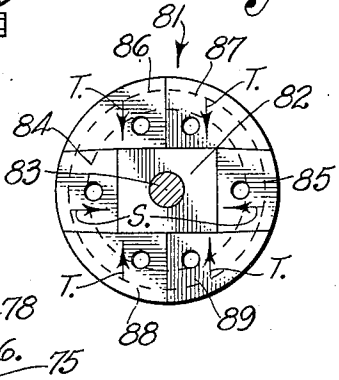
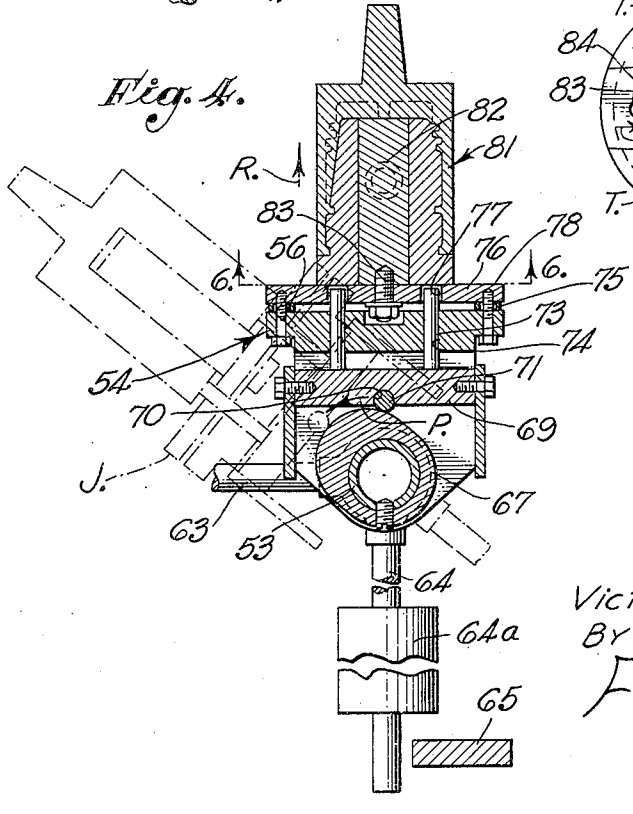


Fig. 4.



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UNITED STATES PATENT OFFICE

1,931,907

DIE CASTING MACHINE FOR MOTOR PISTONS

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Application August 24, 1931. Serial No. 559,006

15 Claims. (Cl. 22—77)

My invention relates to the die casting art, and relates in particular to a die casting machine utilizing a mold or a plurality of molds, each comprising a plurality of sections or parts so constructed and co-related as to form a complete permanent mold suitable for the reception of molten metal such as aluminum or aluminum alloys.

In the production of die castings in large quantities, it is customary to utilize a number of individual duplicate molds into which molten metal is poured by workmen who carry the molten metal in suitable hand-ladles to each of the individual molds. The metal is usually delivered from the kiln into a large container adjacent thereto and is dipped therefrom in the hand-ladles. It is necessary that this work of pouring be carried on rapidly, the workmen dipping the metal from the container and carrying it to one of the molds and pouring the metal as quickly as possible to prevent the molten metal from becoming chilled before the casting is completed. In this system of pouring molds, care must be taken to have a sufficient amount of metal in the ladle before starting to pour the mold, due to the fact that the molten metal chills and sets very rapidly upon contacting the chilling walls of the mold, and if the pouring operation is interrupted before the mold is completely filled, a premature contraction of the mold parts results, which may cause disalignment of the mold parts and a consequent warpage and distortion of the casting.

In view of this above mentioned disadvantage in the known method of pouring castings, my invention has for one of its objects the provision of a machine having a revolvable table upon which is mounted a plurality of molds, the table being adapted to carry the molds consecutively into and out of a pouring position, so that a workman may stand in one position adjacent the kiln and pour each mold without the necessity of carrying the metal from one mold to another.

It is another object of my invention to provide a machine of the type described in the above paragraph which includes means for locking the molds in closed position during a certain period in each revolution of the constantly rotating table, and for unlocking the molds at a certain definite point in the revolution of the table so that the metal is poured into the mold at a certain definite position and the mold cannot be opened to remove the casting therefrom until it reaches a certain definite position. This exactness in pouring and ejecting the molds maintains the relative temperatures of the molds substantially constant, and also provides a uniform time limit for the solidification or freezing of the castings in the various molds.

It is another object of my invention to provide a permanent mold, including the core, adapted for forming cup-shaped castings such as skirted motor pistons which may be provided with inwardly extending bosses, webs, extensions, etc., and the sections of which are so constructed and co-related that after pouring the mold these sections may be readily and quickly separated to permit the removal of the casting without damage thereto.

Another object of my invention resides in the provision of a core formed by a plurality of segments to facilitate their insertion into and the removal from the mold cavity, the segments being easily removable by a combined lateral and axial movement thereof relative to the casting.

Another object of my invention is the provision of an improved permanent mold including a core, for casting skirted pistons having internally projecting bosses, ribs, extensions, etc., which core comprises a central column and a plurality of segments cooperating therewith to form the inner wall of the piston, a number of these segments surrounding inwardly extending projections or bosses on the casting and which, after the removal of the central column, may be moved separately in a direction substantially parallel to the axis of these bosses until they are freed from the bosses, whereupon the segments may be withdrawn from the casting by a longitudinal or axial movement.

It is another object of my invention to provide a permanent mold embodying a core of the type described in the above paragraph and including a mold shell comprising complemental sections having walls cooperating to surround the core in spaced relationship therewith to form the outer walls of the piston casting.

Another object of my invention resides in the provision of a mold shell of the type described in the above paragraph in which the complemental sections are provided with inwardly extending projections, the sections being movable separately in directions substantially parallel to the axes of the projections to free these projections from the casting.

It is another object of my invention to provide a mechanism for moving the shell sections of the mold simultaneously in outward directions to free the sections from the casting.

It is another object of my invention to provide a mechanism operable to move the casting and

the core segments axially relative to the central column of the mold core to withdraw the central column from the casting so that the core segments may be removed therefrom as above described.

It is another object of my invention to provide a mold for a motor piston, which mold is provided with a pouring gate located at a point adjacent the largest cross-sectional portion of the mold cavity and at a point remote from the smallest cross-sectional portion thereof so that the setting of the casting will take place progressively from the smallest cross-sectional portion toward the largest cross-sectional portion, and at all times during the solidification period those portions of the chilling metal still liquid will be in constant communication with a source of liquid metal, say, for example, in the larger cross-sectional portion of the cavity. This progressive setting of the metal in the mold prevents segregation cavities which would normally tend to form in the casting and assures a casting structure free from porosity.

These and other objects will be made evident in the following part of the specification and the appended claims.

This specification might be better understood with reference to the accompanying drawings, in which—

Fig. 1 is a top plan view of the die casting machine embodying the features of my invention.

Fig. 2 is a partially sectioned elevation of a portion of the machine, this view being taken as indicated by the line 2—2 of Fig. 1.

Fig. 3 is a vertical sectional view taken on a median plane through one of the mold parts of the invention, this view being taken as indicated by the line 3—3 of Fig. 2.

Fig. 4 is a vertical sectional view taken as indicated by the line 4—4 of Fig. 3 but showing the mold shell sections separated from the casting.

Fig. 5 is a horizontal sectional view taken as indicated by the line 5—5 of Fig. 3.

Fig. 6 is a bottom plan view of the segmental core of the invention, this view being taken as indicated by the line 6—6 of Fig. 4.

Fig. 7 is a sectional view through a portion of a toggle mechanism comprising a part of my invention, this view being taken as indicated by the line 7—7 of Fig. 1.

Fig. 8 is an elevational view drawn to an enlarged scale, this view being comparable to that portion of the machine within the dotted circle 8 of Fig. 2.

Referring to Figs. 1 and 2 of the drawings, I show the die casting machine comprising my invention generally designated by the numeral 11. The machine 11 includes a non-rotatable base 12 which may be optionally supported by a truck 13 having wheels 14 adapted for rollable contact with a track 15, the truck 13 being provided for the purpose of moving the machine 11 bodily to various positions. The base 12 includes an upright portion 16 which terminates upwardly in a flange providing a horizontally extending bearing surface 17, and which is provided with a vertically extending bore 18.

Resting upon the bearing surface 17 is a table 19 which includes a body portion 20 having a vertical bore 21 and an annular flange portion 22 providing a horizontally extending table top 23. Secured in the bore 21 of the table 19 is a shaft 24 adapted to project downwardly into the bore 18 of the base 12 and rotatably support the table 19 relative to the base 12. Surrounding the exterior of the body portion 20 of the table 19 is a ring gear 25 adapted to mesh with a pinion 26 secured to a vertically extending stub shaft 27 which is supported by a bracket 28 secured to the base member 12 in the manner shown. Splined, or keyed, to the lower end of the shaft 27 in the manner shown at 29 is a clutch member 30 having downwardly extending teeth 31. The clutch member 30 is slidable axially on the shaft 27 but is prevented from rotation relative thereto by the key 29.

Secured to the base 12 is a stationary rack member 32 having upwardly facing ratchet teeth 33 adapted to mesh with the teeth 31 of the clutch member 30 in such a manner that the clutch 30 may rotate in one direction, riding over the teeth 33, but is held against rotation in the opposite direction by the teeth 33. Keyed or otherwise secured to the shaft 27 intermediate the clutch 30 and the bracket 28 is a bevel gear 35 adapted to mesh with and be driven by a bevel pinion 36 secured to a driven shaft 37 included in a gear reduction mechanism 38 of any suitable type. Also included in the gear reduction mechanism 38 is a driving shaft 39 adapted for chain and sprocket connection, as indicated at 40, with a suitable motor 41.

Secured to the table top 23 in the manner shown and extending radially outward therefrom is a plurality of supporting members 50, each of which carries at the outer end thereof individual die casting elements A, B, C, D, E, F, G, and H. Inasmuch as the details of construction and mode of operation of all of these die casting elements are identical, I will for the sake of convenience describe only one of the elements singly, such as the element A.

Referring to Figs. 2 and 3, the die casting element A includes a bracket member 51 secured in the manner shown to the extreme outer end of the supporting member 50. The bracket member 51 includes a horizontally extending portion 52, the axis of which is perpendicular to the longitudinal axis of the supporting member 50, this portion 52 rigidly supporting in the manner shown a non-rotatable, horizontally extending shaft 53. Rotatably supported on the shaft 53 is a die plate supporting bracket 54 comprising a horizontal plate 56 and a pair of normally vertically extending, relatively spaced legs 58 and 59 formed integrally therewith and depending therefrom.

Provided in the leg 58 is a horizontal bore 60, and provided in the leg 59 is a bore 61 coaxial with the bore 60. The shaft 53 is adapted to extend through the bores 60 and 61 in the manner shown, and support the rotatable bracket 54. Formed integrally with the leg 58 of the bracket 54 is an outwardly extending boss 62 to which is secured, in the manner shown, a manually operable lever 63, by which the bracket 54 may be rotated on the shaft 53 from its normal position shown in solid lines in Fig. 4 to the position indicated by the dotted lines "J" of this figure. Also secured to the boss 62 is a rod 64 which normally extends downwardly parallel to the longitudinal axis of the legs 58 and 59 of the bracket 54, and upon which is mounted in any suitable manner a counterweight 64a which serves to constantly gravitationally urge the bracket 54 into its normal vertical position.

Included in the machine 11 is a locking means for preventing rotational movement of the die plate supporting bracket 54 relative to the shaft 53; this lock means, as best shown in Figs. 1 and

2, comprises a segment of a ring 65 supported by suitable brackets in a horizontal plane, in such a manner that the inward movement of the rod 64 in the direction of the arrow "K" of Fig. 2, and thus a rotational movement of the bracket 54 relative to the shaft 53, is limited by the ring 65 during a certain definite period in each revolution of the table 19. One end of the ring segment 65 is bent inwardly as shown at 66 in Fig. 1 to form a cam surface which is provided for a purpose to be hereinafter explained in the description of the operation of the machine.

Fixedly secured to the shaft 53, as by the screw means shown, at a point intermediate of the depending legs 58 and 59 is a cam member 67. Placed on the shaft 53 on either side of the cam member 67 is a spacer 68 provided for the purpose of centralizing the cam member 67 relative to the legs 58 and 59.

Slidably positioned between the depending legs 58 and 59 above and adjacent the cam member 67 is a carriage member 69 provided with a downwardly facing semi-circular recess 70 adapted to rotatably receive a roller 71. As will be clearly seen by an inspection of Figs. 3 and 4, the roller 71 is of such a diameter as to extend outwardly from the recess 70, and is frictionally engaged by the cam member 67, which engagement serves to retain the roller 71 in the recess 70. Provided on the upper surface of the carriage member 69 is a pair of relatively spaced vertically extending lifting pins 73 which project through openings 74 provided in the upper surface of the bracket 54.

Supported in spaced relationship with the flange 56 of the bracket member 54 by suitable bolts and spacing washers indicated at 75 is a normally horizontally extending die plate 76. The die plate 76 is provided with vertical openings 77 adapted to receive the lifting pins 73. As shown in Fig. 4, the lifting pins 73 are of such a length that when the carriage member 69 is in its lowermost or normal position the pins 73 terminate just short of the upper surface 78 of the plate 76, and when the carriage member is in its uppermost position, as indicated in the dotted line position A of Fig. 4, the pins 73 project outwardly beyond the upper surface 78 of the plate 76, as shown.

Resting on the die plate 76 is a segmental core generally designated by the numeral 81. The core 81 includes an elongated vertically extending central column 82 which is substantially rectangular in cross-section and is secured at one end thereof to the plate 76 by bolt means 83 in the manner shown, the other end thereof being suitably shaped to form a part of the inner wall of a mold cavity. Resting on the die plate 76 and abutting opposite sides of the central column 82 is a pair of core segments 84 and 85 which cooperate with the central column 82 to form a center section of the core 81. Resting on the plate 76 and abutting one of the remaining opposite sides of the center column is a pair of core segments 86 and 87, these segments cooperating to form one of the side sections of the die core. Resting on the die plate 76 in a similar manner and abutting the remaining opposite side of the central column 82 is a pair of core segments 88 and 89 which cooperate to form another of the side sections of the core. All of these core segments have outer walls cooperating to form a substantially cylindrical core adapted to form the inner wall of the mold cavity.

Provided in each of the segments 86 and 87 between the opposite longitudinal ends thereof is a semi-circular depression 90, these depressions cooperating to form an inwardly extending boss cavity 92, which terminates inwardly in a vertically extending wall 93. Provided in each of the segments 88 and 89 at a point intermediate their longitudinal ends is a semi-circular depression 94, these depressions cooperating to form an inwardly extending boss cavity 95, which terminates inwardly in a vertically extending wall 96.

The segments comprising the core 81 are shown as providing various projections, ribs, bosses, etc., which cooperate to form the inner wall of a piston in a desired configuration. The number and arrangement of these bosses, ribs, extensions, etc., is immaterial, however, to the present invention, it being within the scope of the appended claims to produce a piston having various shapes and contours.

Supported on the die plate 76 is a mold shell generally designated by the numeral 100, which comprises complemental sections 101 and 102, each of which is provided with a vertically extending semi-circular inner wall 103, which cooperate when in their normal positions to surround the core 81 in relatively spaced relationship therewith. Each of the sections 101 and 102 is provided with an inwardly extending projection 105 adapted to extend axially into the recesses 92 and 95, the inner ends of these projections contacting the vertically extending walls 93 and 96. These projections 105 are provided to cooperate with the recesses 92 and 95 to form inwardly extending pin bosses on the casting, these bosses having cored openings therein.

Associated with the mold shell 100 is a mold opening mechanism generally designated by the numeral 107. The mechanism 107 includes a clamp member 108 rigidly secured to the supporting member 50 at a point adjacent the periphery of the table top 23. The clamp member 108 is provided with an upwardly extending boss adapted to rigidly support in any suitable manner a vertically extending threaded post 109. Supported by the post 109 is a mold supporting bracket 110 which includes a bearing portion 111 having a vertical bore 112 therein through which the post 109 slidably extends. Lock nuts 113 and 114 positioned above and below the bearing portion 111 and threadedly engaging the post 109 serve to adjustably retain the bracket member 110 in any desired plane relative to the supporting member 50. The bracket member 110 also includes a T-shaped body 115 comprising a horizontally extending head portion 116, formed integrally with the bearing portion 111 and extending perpendicular to the longitudinal axis of the supporting member 50, and a leg portion 117 extending at right angles to the longitudinal axis of the head portion 116 and parallel to the longitudinal axis of the supporting member 50. Provided in the head portion 116 of the body 110 is a pair of elongated vertical slots 118 extending from points adjacent the ends of the head portion 116 to points adjacent and relatively spaced from the longitudinal axis of the leg portion 117.

As is clearly shown in Fig. 1, the longitudinal axis of the leg portion 117 of the bracket member 110 intersects the longitudinal axis of the core 81 and is perpendicular thereto. Provided in the extreme outer end of the leg portion 117 is a vertical bore 120 adapted to slidably receive a

vertical shaft 121. Adjacent the upper end of the shaft 121 is an enlarged diameter portion forming a shoulder 122 adapted to contact the upper surface of the leg 117 and limit the downward movement of the shaft 121. Projecting upwardly from the shoulder 122 of the shaft 121 is a reduced diameter portion 123 to which is secured a knuckle 124 included in a toggle mechanism generally designated by the numeral 125 and which will be hereinafter described.

Positioned in each of the slots 118 in the head portion 116 is a pivot pin 127. Each pin 127 is provided with a lower reduced diameter portion 128 terminating upwardly in an annular shoulder 129, the reduced diameter portion extending downwardly through one of the slots 118 and being provided with a nut 130 adapted to rigidly clamp the pin 127 in a desired position in the slot 118. Extending upwardly from the shoulder 129 of each pin 127 is a bearing portion 131, this bearing portion 131 being of such a diameter as to provide an upwardly extending ledge upon which is formed a cam surface 132. Mounted on each of the bearing portions 131 of the pins 127 is a lever 133. The inner end of each of the levers 133 is provided with an enlarged boss portion 134 having an opening 135 therethrough through which the portion 131 of the pin upwardly extends. The lower surface of the boss portion 135 of each lever 133 is provided with a cam face 136 which engages the cam surface 132 and conforms to the configuration thereof. Secured to the upper end of the portion 131 of each of the pins 127 in relatively spaced relationship with the upper surface of the boss portions 134 is a stop ring 137 which is secured in the manner shown to the pins 127 and is adapted to limit the upward movement of the boss portions 134.

Pivotally secured in the manner shown to the outer end of each of the levers 133 is a clevis 140 which is provided with a horizontally extending rod 141 threadedly engaging one of the mold shell sections in such manner as to pivotally support these shell sections in the same horizontal plane. Each of the levers 133 is bent at a point intermediate the pivot pin 127 and the clevis 140 to form a U-shaped depression 142, there being provided in each of these depressions a centrally located vertical hole 143. Secured to each of the levers 133 in the manner shown is an inverted U-shaped strap 144, which cooperates with the U-shaped portion 142 to form a horizontally extending rectangular opening 145 in the levers 133, these straps being provided with a central vertical hole 146 formed co-axially with the hole 143. Positioned in the rectangular opening 145 of each of the levers 133 is a pivot block 147 comprising a body portion 148 having outwardly extending pins 149 and 150 adapted for pivotal reception respectively in the holes 143 and 146. Each of the pivot blocks 147 is provided with a horizontally extending opening 151 adapted to slidably receive the cylindrical portions 152 of a pair of toggle links 153 included in the above mentioned toggle mechanism 125. The cylindrical portions 152 of the toggle links 153 are provided with shoulders 154 adapted to abut the blocks 147 to limit the movement of the links 153 in one direction. Threadedly secured to the outer ends of each of the cylindrical portions 152 of the links 153 is a nut 155. Surrounding the cylindrical portions 152 and abutting the blocks 147 and the nuts 155 are compression springs 156 adapted to resiliently retain the shoulders 154 of the links 153 in contact with the blocks 147.

The inner ends of the toggle links 153 are pivotally connected in the manner shown to the previously mentioned toggle knuckle 124 at diametrically opposite points, these points being located on a circle generated around the longitudinal axis of the shaft 121, as shown at 158 and 159 respectively. The association of the toggle knuckle 124, the toggle links 153, and the levers 133 is such that when the knuckle 124 is rotated into such a position that the axes of the pivots 158 and 159 and the axis of the shaft 121 intersect at right angles the longitudinal axes of the cylindrical portions 152 of the links 153, as shown at 160 in Fig. 1, the levers 133 extend outwardly on either side of the core 81 in relatively parallel position and support the shell segments 101 and 102 in their normal or enclosed position.

It will be understood that a rotational movement of the shaft 121 by means of a manually operable lever 161 secured thereto will rotate the toggle knuckle 124, exerting an outward force in opposite directions on the links 133, causing these links to pivot on the pins 127 and swing outwardly to a non-parallel position, carrying the shell sections 101 and 102 outwardly away from the mold core 81 into the position indicated at 162 of Fig. 1.

The operation of my invention is as follows:

With the machine 11 in a desired position relative to a kiln (not shown) rotational movement is imparted to the table 19 by means of the motor 41 and the gear train, including the chain and sprocket means 40, the gear reduction mechanism 38, the bevel gears 35 and 36, the pinion 26 and the ring gear 25. As before stated, the clutch 30 and the ratchet 31 are operable to allow rotational movement of the table 19 in one direction and to prevent rotation thereof in the opposite direction. Assuming that the rotational movement of the table 19 is in the direction of the arrow "L" of Fig. 1, it will be seen that the element A will consecutively pass through the positions in which the elements B, C, D, E, F, G, and H are shown in this figure.

For the purpose of simplicity in the description of the operation of the device, I will disregard the comparatively slow rotational movement of the table and will hereinafter refer to the position in which the element A is shown in Fig. 1 as the loading position. The machine 11 being positioned so that the element A in the loading position is closely adjacent the kiln, the workman occupied in pouring the mold may stand at one place in the loading position and consecutively pour the molds associated with the various elements as these elements slowly move into and out of the loading position. The metal is poured into the molds through a gate opening 163 provided in a suitable riser-plate 164 which is placed on the upper surface of the mold shell prior to the entrance of the element A into the loading position.

As will be seen by an inspection of Fig. 3, the mold cavity for forming the piston is positioned in such a manner that the skirted part of the piston is formed by the lowermost part of the mold cavity, the lower end of the piston skirt being defined by a suitable annular shoulder formed by the core segments, and the head of the piston by the uppermost portion of the cavity. As the metal is poured into the mold and flows downwardly into the lowermost portions thereof, the

setting of the metal takes place progressively from the smallest cross-sectional portions of the mold cavity toward the largest cross-sectional portions thereof, and substantially at all times during the solidification period the portions of the chilling metal still liquid will be in direct communication with the source of liquid metal; say, for example, at first in the uppermost part of the mold cavity and finally in the gate 163 of the riser-plate 164.

I prefer to use in the production of the piston a metallic alloy having a relatively low specific gravity and a relatively high coefficient of heat conductivity, and have found that the most desirable composition consists predominantly of aluminum and contains copper, magnesium, and silica. This alloy produces a relatively small quantity of eutectic and a relatively small percentage of impurity in the form of iron or zinc or both. This alloy is particularly adapted for use in the production of high-speed motor pistons and, when formed in a mold of the above-described character, operable to cause a progressive setting of the metal as it is poured, is substantially free from porosity due to crystallization shrinkage during the pouring thereof and is of an unusually fine-grained structure.

After the mold has been poured it is carried consecutively through the positions in which the elements B and C are shown in Fig. 1 into the position in which the element D is shown in Fig. 1. This position I will hereinafter refer to as the mold stripping position, where the mold is separated from the casting. This separation of the mold from the casting is accomplished in the following manner. The riser-plate 164 is first removed from the mold. The lever 161 is then swung from the position in which it is shown on the elements A, B, C, G, and H into the position in which it is shown on the elements D, E, and F. The movement of this lever 161 causes a rotational movement of the knuckle 124 in the direction of the arrow M of Fig. 1 which, as has been before described, produces an outwardly directed force simultaneously on the levers 133 to move the levers into their non-parallel positions and separate the mold shell sections 101 and 102. Referring particularly to Fig. 3, it will be seen that as the shell sections 101 and 102 are drawn outwardly in the direction of the arrows N of Figs. 3 and 5, the inwardly extending projections 105 of the shell sections 101 and 102 will be withdrawn from the depressions 92 and 95 substantially axially of these depressions.

As the arms 133 pivot on the pins 127 and swing outwardly as just described, the engagement between the cam surface 132 and the cam face 136 associated with each of the levers 133 is operable to lift the levers slightly, as shown in Fig. 8, and consequently raise the mold sections 101 and 102 to relieve the frictional engagement between these sections and the die plate 76. The ratio between the lifting action of the cams 132 and 136 and the pivoting action of the levers 133 is such that the mold sections are moved horizontally outward a distance sufficient to free the projections 105 from the boss cavities 92 and 95 before the sections are raised from the die plate 76.

It will be seen in Fig. 1 that when the mold is in the position in which the element D is shown, the lever 63 has passed the end 171 of the ring segment 65 so that the lever 63 which is secured to the bracket 54 may be manipulated to rotate the bracket 54 from position shown in solid lines in Fig. 4 into the dotted line position J of this figure, as above described. This movement of the bracket 54 relative to the shaft 53 and the cam 67 causes the roller 71 of the carriage 69 to ride over the crown 170 of the cam 67 in the direction of the arrow P of Fig. 4, this movement being operable to raise the carriage 69 from the position in which it is shown in solid line position in Fig. 4 to the raised position in which it is shown in the above-mentioned dotted line position J. This upward movement of the carriage and the consequent upward movement of the pins 73 included therein is operable to force the piston segments and the casting in a longitudinal direction relative to the central column, as indicated by the arrow R of Fig. 4, which loosens the segments from the central column 82 so that the piston may be lifted from the die plate 76.

After the piston has been thus removed from the die plate a suitable instrument may be inserted in the holes provided in the bottom surface of the center segments 84 and 85 of Fig. 6, and these segments may be drawn inwardly in the directions of the arrows S, either separately or simultaneously, and then withdrawn from the cavity by a longitudinal or axial movement. After the center segments 84 and 85 have been thus withdrawn from the castings, a tool may be inserted in the opening provided in the side segments 86, 87, 88, and 89, and these segments may be moved inwardly in the directions of the arrows T of Fig. 6 and then withdrawn longitudinally from the casting. It will be clearly seen by an inspection of Fig. 5 that the removal of the side segments 86, 87, 88, and 89 may be easily accomplished after the removal of the center segments 84 and 85, the side segments being moved inwardly axially of the boss cavities 92 and 95 until free therefrom, and then withdrawn longitudinally as above described.

The removal of the casting from the die plate 76 and the removal of the core-segments from the casting is preferably accomplished by the workman while the elements are moving through the positions in which the elements D, E, and F are shown in Fig. 1. Subsequent to the passage of the elements through the position in which the element F is shown the levers 63 of the supporting brackets 54 contact the cam surface 66 of the ring 65, as indicated at 173 in Fig. 1, and these levers are forced outwardly in a direction opposite to that indicated by the arrow K of Fig. 2 which serves to return the bracket 54 into its normal upright position.

The core segments may then be reassembled in their relative positions, abutting the central column 82, and the mold shell sections 101 and 102 may be again closed by manipulation of the lever 161 and the riser-plate 164 placed thereon in preparation for an additional pouring operation. The reassembling of the core segments and the closing of the mold shell may take place at any desired position between the mold stripping position and the loading position.

In the operation of my invention a pre-heating means may be employed to pre-heat the mold before the continuous operation of the machine has been started. For this purpose I provide, as shown in Figs. 1 and 2, a gas supply pipe 167 which connects through a suitable gland 168 to a fluid chamber 169 provided in an upstanding hub portion 170 secured to the rotatble shaft 24. Communicating with the chamber 169 is a plurality of pipes 171 which extend radially out-

ward to points adjacent each of the molds included in the die casting elements, each of these pipes being provided at the outer end thereof with a suitable valve, so that flame may be projected from any or all of these valves onto the molds to bring the temperature of the molds to a certain predetermined degree before the continuous pouring operation is started.

Although I have herein disclosed and described only one complete embodiment of my invention it should be understood that various changes therein might be made and numerous embodiments thereof might be devised without departing from the spirit and scope of my invention.

I claim as my invention:

1. In a die casting apparatus of the character described, the combination of: a supporting member; a die plate supported by said supporting member; a permanent core carried by said die plate, said core comprising a central column secured to said plate and a plurality of removable complemental core segments abutting said column and having walls cooperating to form the inner walls of a mold cavity; a permanent mold shell comprising a pair of complemental sections having walls normally surrounding said core and cooperating to form the outer walls of said mold cavity; a supporting arm suitably connected to and supporting each of said shell sections and pivoted to said supporting member; a toggle mechanism associated with said arms and operable to pivot said arms to swing said shell sections outwardly in opposite directions to separate said shell sections from the casting after the mold has been poured; means for operating said toggle mechanism; and means effecting relative movement between said central column and said core segments for withdrawing said center column from said core to allow said core segments to be removed from said casting.

2. In a die casting apparatus of the character described, the combination of: a supporting member; a die plate supported by said supporting member; a permanent core carried by said die plate, said core comprising a central column secured to said plate and a plurality of removable complemental core segments abutting said column and having walls cooperating to form the inner walls of a mold cavity; a mold shell comprising a pair of complemental sections normally resting on said die plate and having walls normally surrounding said core and cooperating to form the outer walls of said mold cavity; a pair of supporting arms extending on opposite sides of said die plate adjacent said shell sections, each of said arms being pivoted at its opposite ends to said supporting member and to one of said shell sections; a toggle mechanism associated with said arms and operable to pivot said arms to swing said shell sections outwardly in opposite directions to separate said shell sections from the casting after the mold has been poured; means for operating said toggle mechanism; cam means associated with each of said arms and adapted to raise said arms to lift said shell sections out of engagement with said die plate as said sections are swung outwardly; and means effecting relative movement between said central column and said core segments for withdrawing said center column from said core to allow said core segments to be removed from said casting.

3. In a die casting apparatus of the character described, the combination of: a die plate supported by said supporting member; a supporting member; a permanent core carried by said die plate, said core comprising a central column secured to said plate and a plurality of removable complemental core segments abutting said column and having walls cooperating to form the inner walls of a mold cavity; a permanent mold shell comprising a pair of complemental sections having walls normally surrounding said core and cooperating to form the outer walls of said mold cavity; a supporting arm suitably connected to and supporting each of said shell sections and pivoted to said supporting member; a toggle mechanism associated with said arms and operable to pivot said arms to swing said shell sections outwardly in opposite directions to separate said shell sections from the casting after the mold has been poured; means for operating said toggle mechanism and manually operable cam means for forcing said casting and said core segments free from said center column to allow said segments to be subsequently removed from said casting.

4. In a die casting apparatus of the character described, the combination of: a supporting member; a die plate supported by said supporting member; a permanent core carried by said die plate, said core comprising a central column secured to said plate and a plurality of removable complemental core segments abutting said column and having walls cooperating to form the inner walls of a mold cavity; a mold shell comprising a pair of complemental sections normally resting on said die plate and having walls normally surrounding said core and cooperating to form the outer walls of said mold cavity; a pair of supporting arms extending on opposite sides of said die plate adjacent said shell sections, each of said arms being pivoted at its opposite ends to said supporting member and to one of said shell sections; a toggle mechanism associated with said arms and operable to pivot said arms to swing said shell sections outwardly in opposite directions to separate said shell sections from the casting after the mold has been poured; means for operating said toggle mechanism; cam means associated with each of said arms and adapted to raise said arms to lift said shell sections out of engagement with said die plate as said sections are swung outwardly; and manually operable cam means for forcing said casting and said core segments free from said center column to allow said segments to be subsequently removed from said casting.

5. In a die casting apparatus of the character described, the combination of: a supporting member; a die plate supported by said supporting member; a permanent core carried by said die plate, said core comprising a central column secured to said plate and a plurality of removable complemental core segments abutting said column and having walls cooperating to form the inner walls of a mold cavity; a mold shell comprising a pair of complemental sections normally resting on said die plate and having walls normally surrounding said core and cooperating to form the outer walls of said mold cavity; a pair of supporting arms normally extending on opposite sides of said die plate and in a plane perpendicular to the longitudinal axis of said core, each of said arms being pivoted at its opposite ends to said supporting member and to one of said shell sections; a toggle mechanism associated with said arms and operable to pivot said arms to swing said shell sections outwardly in opposite directions into non-parallel positions to separate said shell sections from the casting

after the mold has been poured; means for operating said toggle mechanism; cam means associated with each of said arms and adapted to raise said arms to lift said shell sections out of engagement with said die plate as said sections are swung outwardly; and manually operable cam means for forcing said casting and said core segments free from said center column to allow said segments to be subsequently removed from said casting.

6. In an apparatus for producing castings, the combination of: a die plate; core means carried by said die plate; a mold adapted to surround said core means; mold moving means for separating said mold from said core means; and die plate moving means for moving said die plate outwardly relative to said mold.

7. In an apparatus for producing castings, the combination of: a die plate; core means carried by said die plate; a mold adapted to surround said core means, said mold including a pair of mold members; mold moving means for separating said mold from said core means, said mold moving means moving said mold members laterally outward in the plane of said die plate; and die plate moving means for moving said die plate outwardly from said mold in a direction to move said die plate from below said mold members.

8. In an apparatus for producing castings, the combination of: a die plate; core means carried by said die plate; a mold adapted to surround said core means; mold moving means for separating said mold from said core means; die plate moving means for moving said die plate outwardly relative to said mold; and means for raising at least a part of said core means from said die plate.

9. In an apparatus for producing castings, the combination of: a die plate; core means carried by said die plate; a mold adapted to surround said core means; mold moving means for separating said mold from said core means; die plate moving means for moving said die plate outwardly from said mold; and means operable upon an actuation of said die plate moving means for raising at least a part of said core means from said die plate.

10. In an apparatus for producing castings, the combination of: a die plate; core means adapted to rest thereon; a mold including a pair of mold members adapted to surround said core means and to rest on said die plate; and means for moving said mold members outwardly from said core means in a plane extended adjacent said die plate, said mold members being raised from contact with said die plate during said outward movement thereof.

11. In an apparatus for producing castings, the combination of: a die plate; core means adapted to rest thereon; a mold including a pair of mold members adapted to surround said core means and to rest on said die plate; an arm connected to each of said mold members for moving same outwardly from said core means in a plane adjacent said die plate; and means for raising said arms during their outward movement.

12. In an apparatus for producing castings, the combination of: a die plate; core means supported thereby, including a permanent member and a removable member; a mold adapted to surround said core means, and being removable therefrom; and means raising said removable member from said die plate.

13. In an apparatus for producing castings, the combination of: a die plate; core means supported thereby, including a permanent member and a removable member; a mold adapted to surround said core means, and being removable therefrom; and means extending through said die plate and engaging said removable member for raising said removable member from said die plate.

14. In an apparatus for producing castings, the combination of: a die plate; support means for movably supporting said die plate; core means supported by said die plate, including a permanent member and a removable member; a mold adapted to surround said core means, and being removable therefrom; and means operated upon a movement of said die plate for raising said removable member from said die plate.

15. In an apparatus for producing castings, the combination of: a die plate; support means for movably supporting said die plate; core means supported by said die plate, including a permanent member and a removable member; a mold adapted to surround said core means, and being removable therefrom; and means operated upon a movement of said die plate extending through said die plate and engaging said removable member for raising said removable member from said die plate.

VICTOR H. TANDY.

CERTIFICATE OF CORRECTION.

Patent No. 1,931,907. October 24, 1933.

VICTOR H. TANDY.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 6, lines 74 and 75, claim 3, strike out the words and semicolon "a supporting member ;" and insert the same after "of:" in line 73, of same claim; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of February, A. D. 1934.

F. M. Hopkins

(Seal) Acting Commissioner of Patents.