

Nov. 11, 1924.

1,515,488

A. R. JOHNSON ET AL

DIE CASTING MACHINE

Filed Nov. 16 1921

9 Sheets-Sheet 1

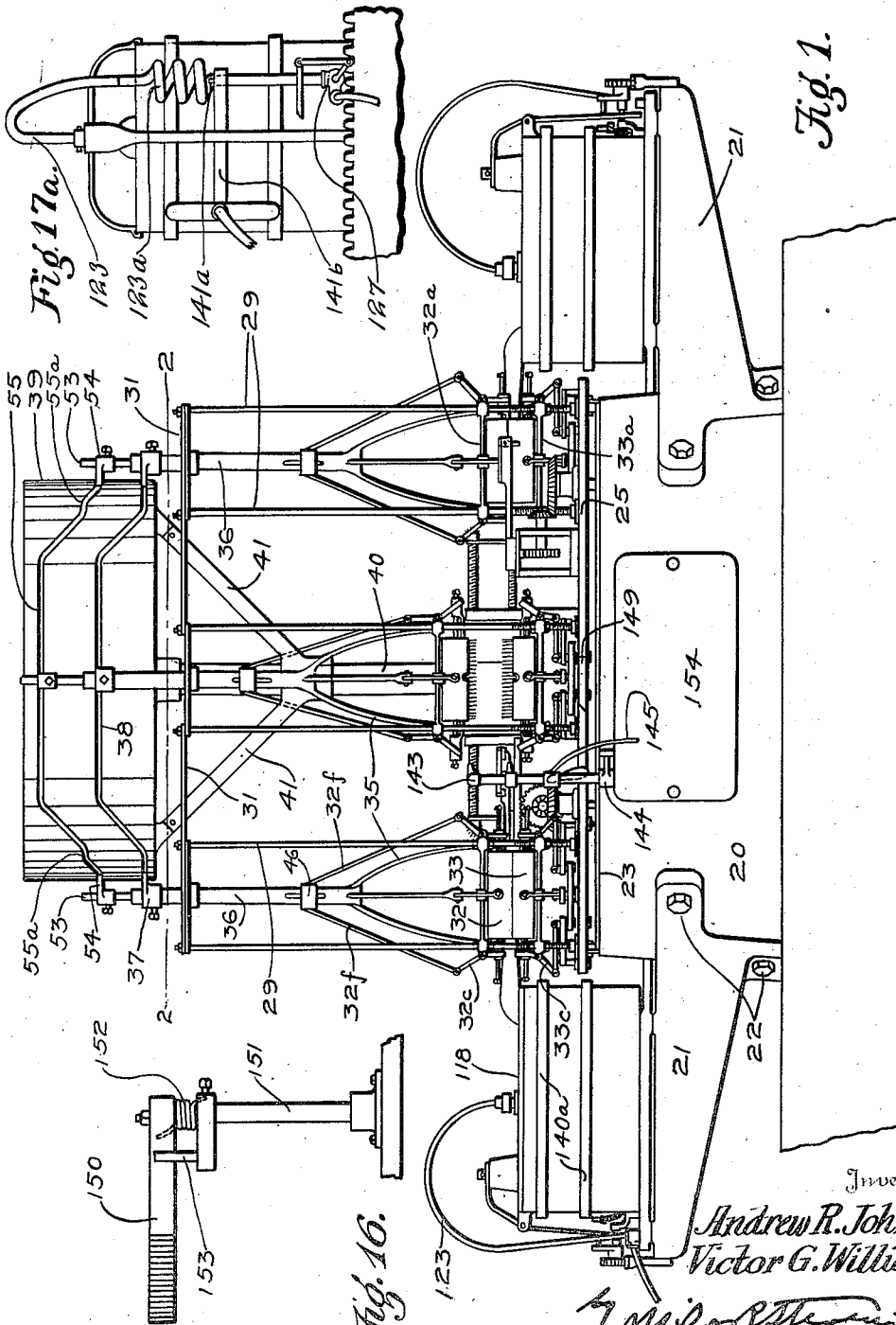


Fig. 1.

Fig. 16.

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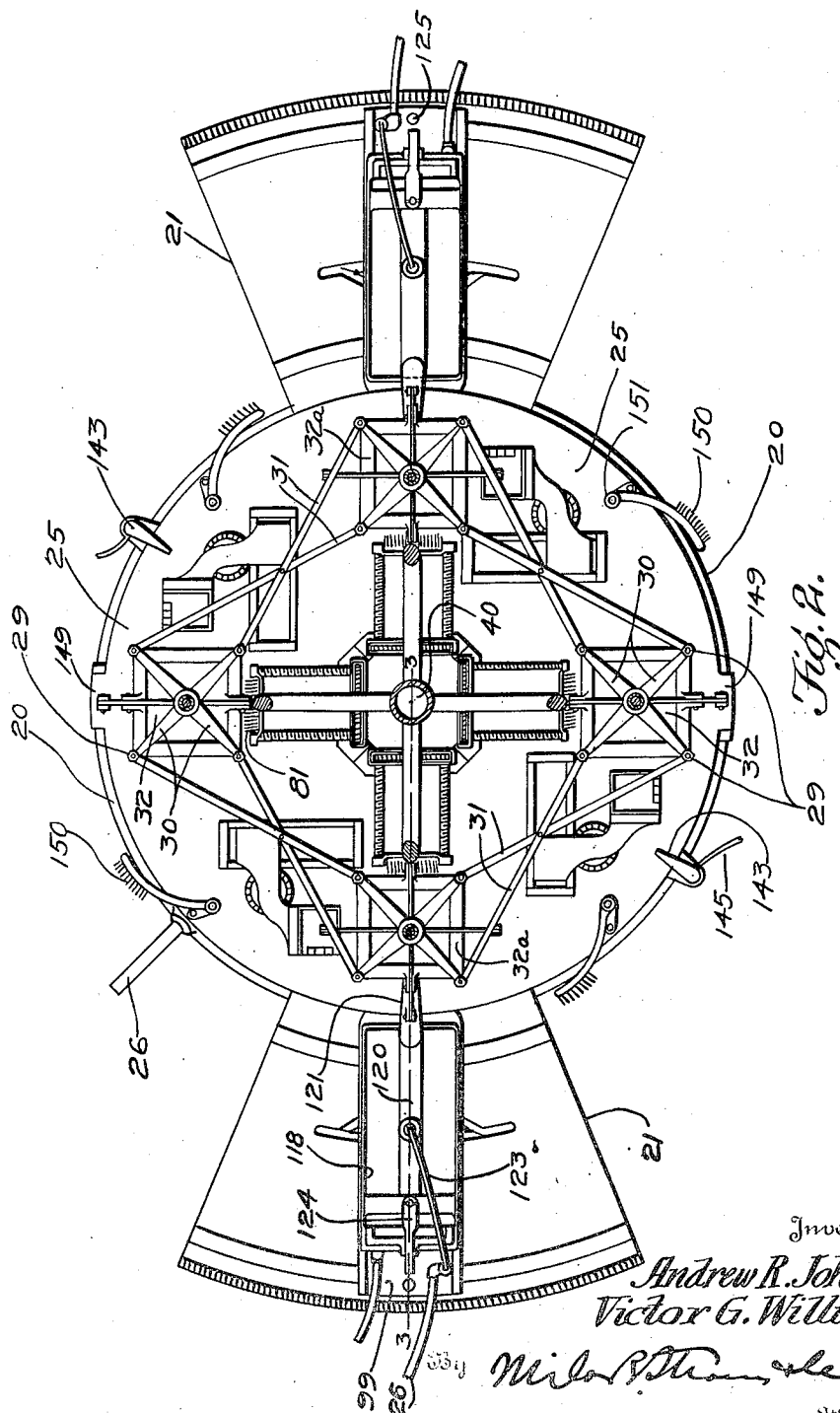
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9 Sheets-Sheet 2



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9 Sheets-Sheet 3

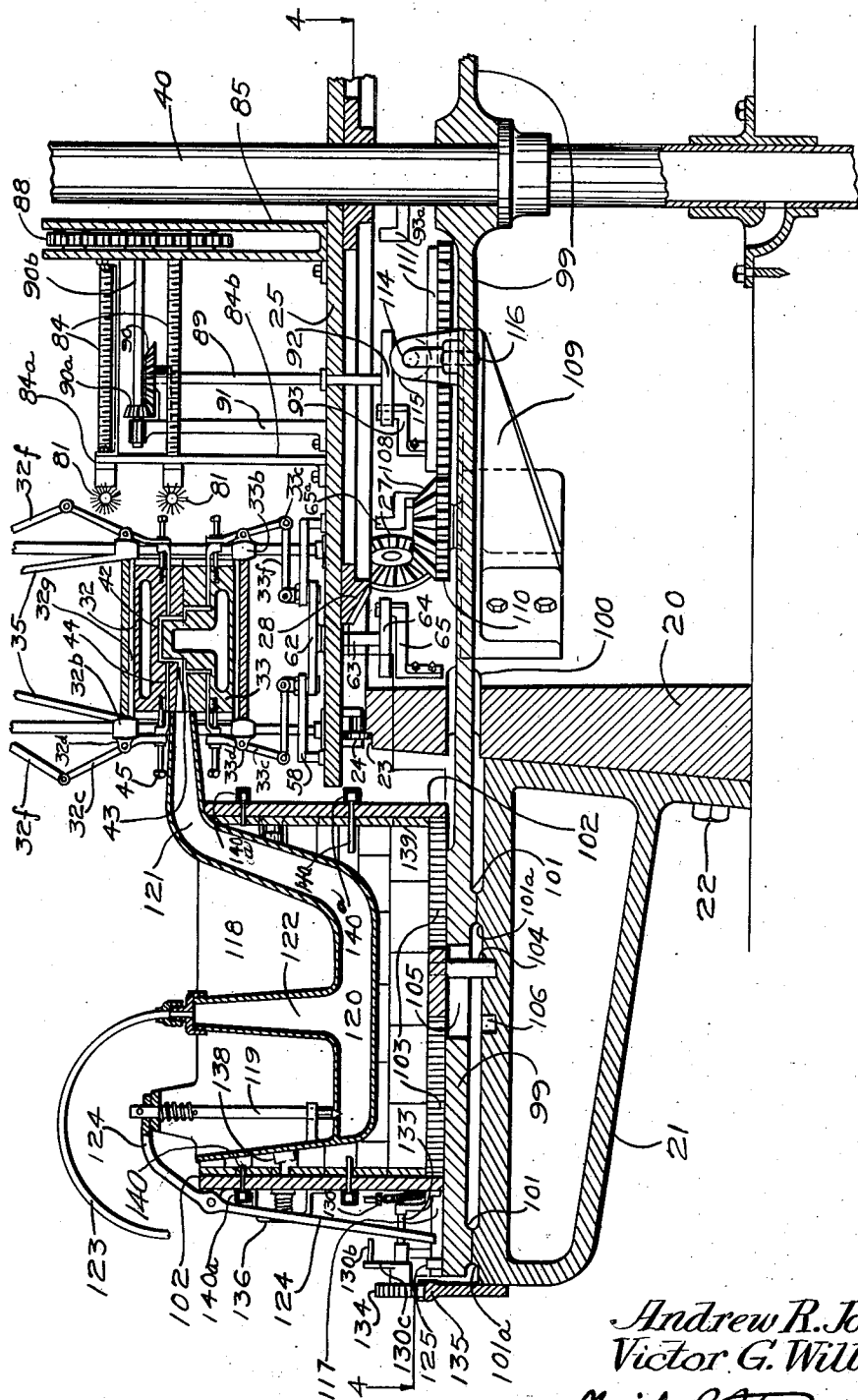


Fig. 3.

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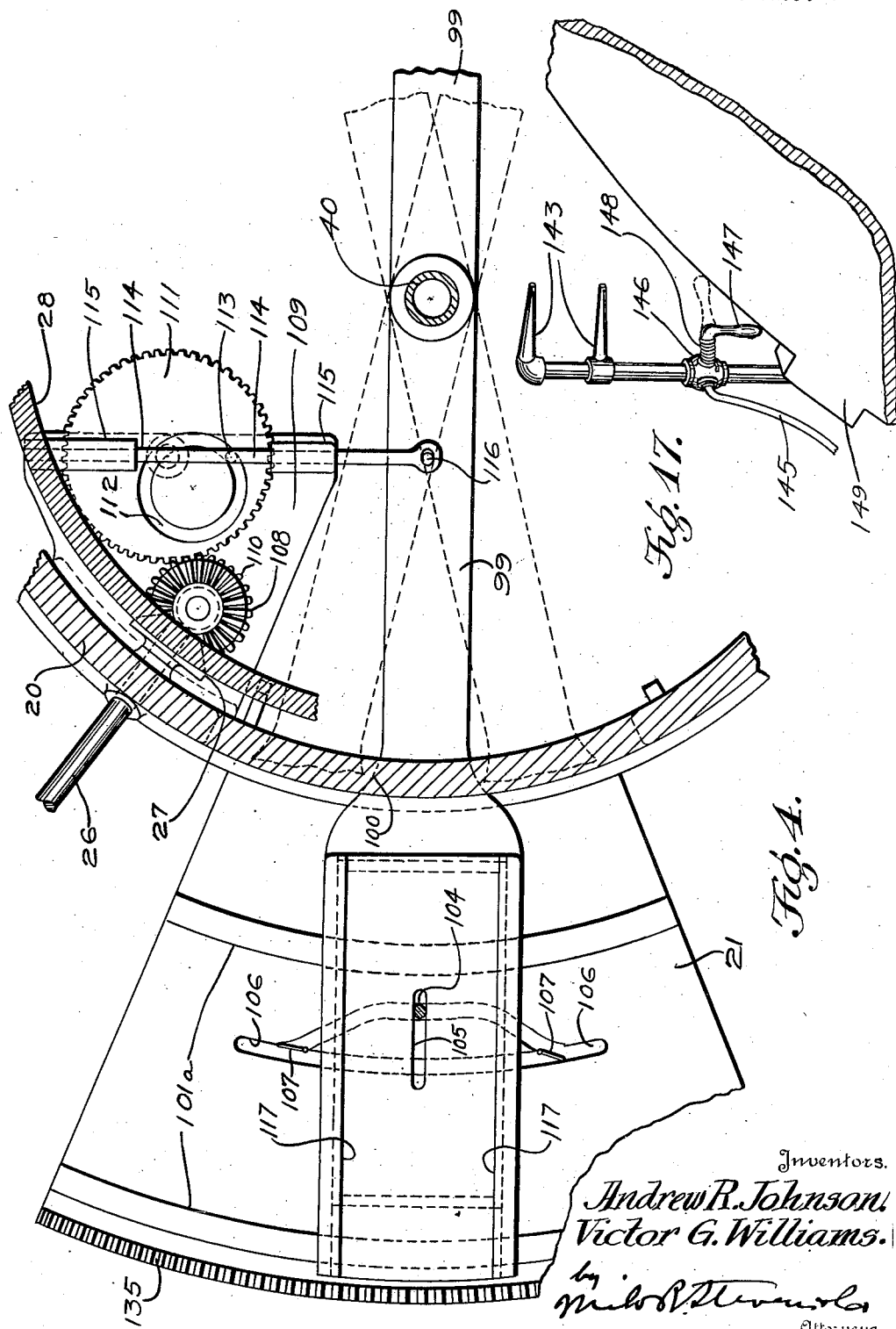
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Nov. 11, 1924.

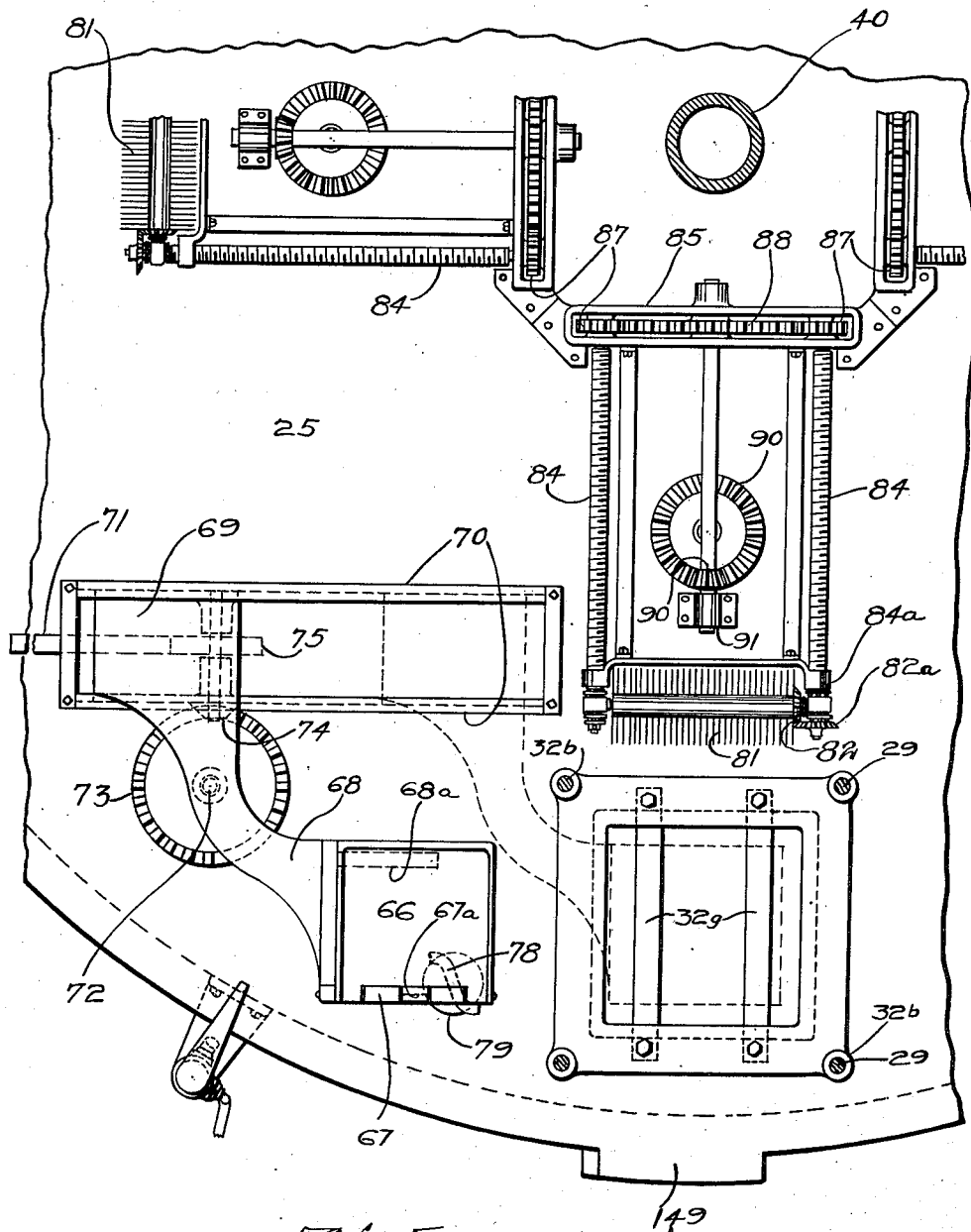
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Filed Nov. 16, 1921

9 Sheets-Sheet 5



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DIE CASTING MACHINE

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9 Sheets-Sheet 6

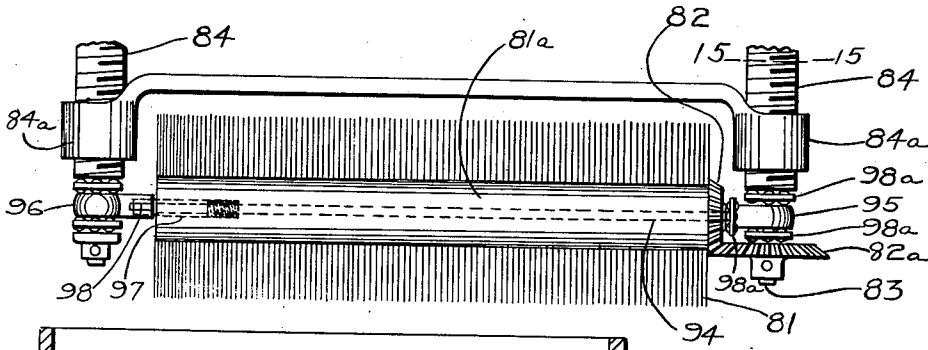
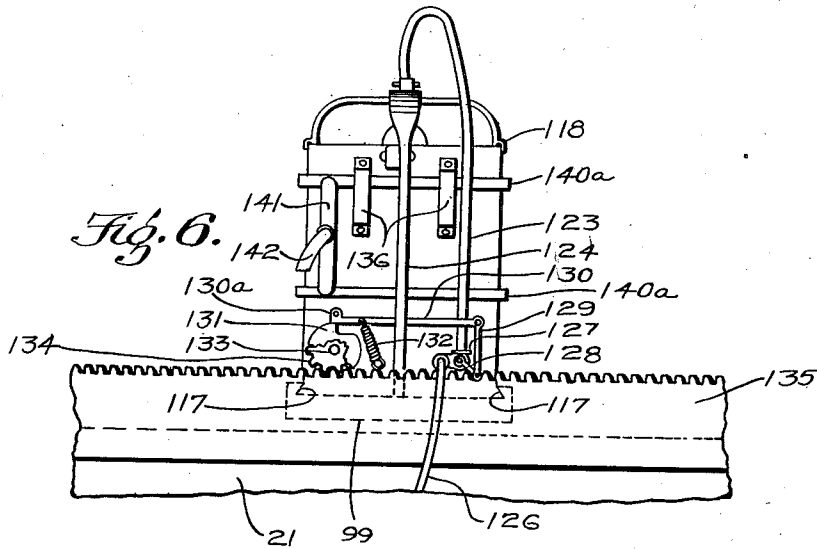


Fig. 7.

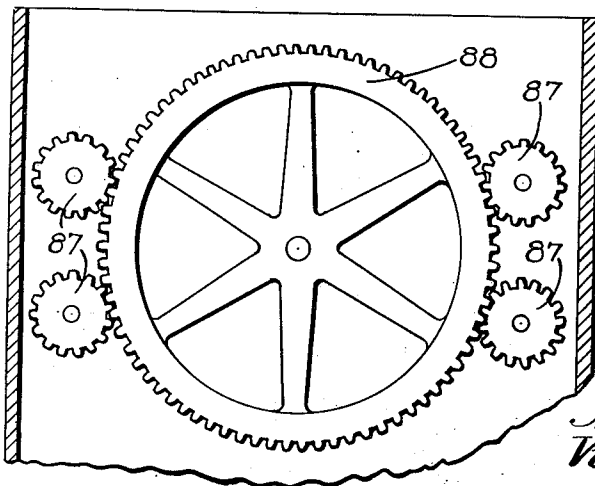


Fig. 8.

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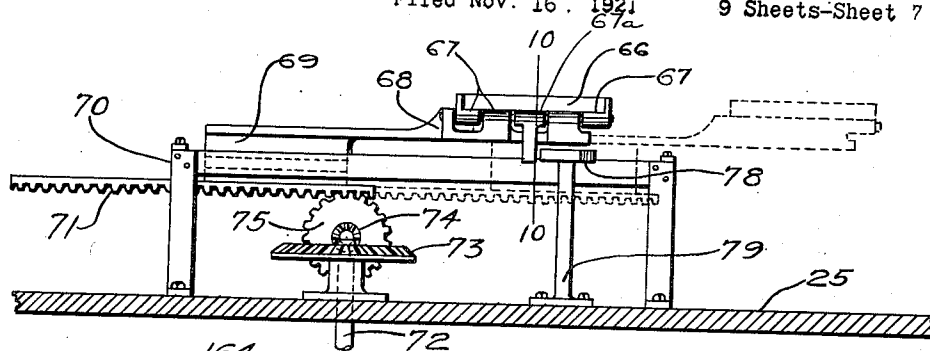


Fig. 9.

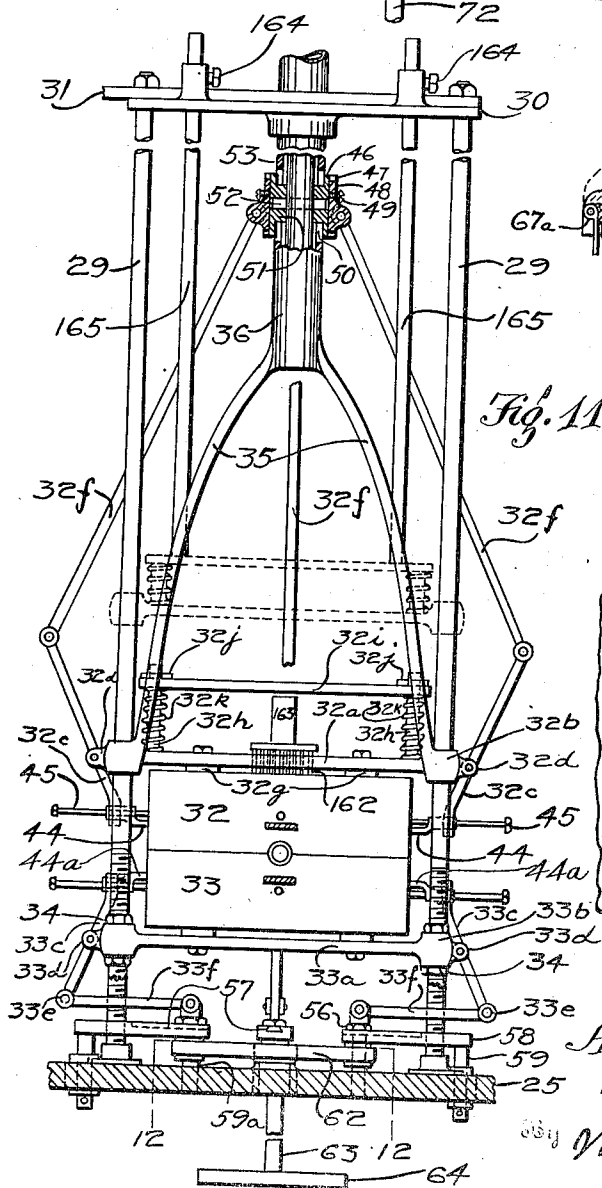


Fig. 11.

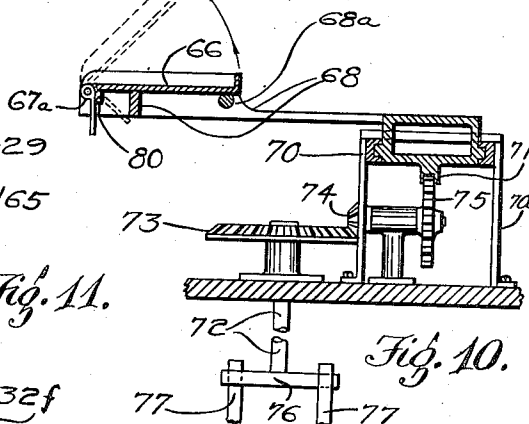


Fig. 10.

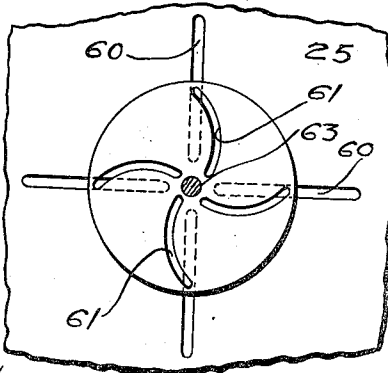


Fig. 12.

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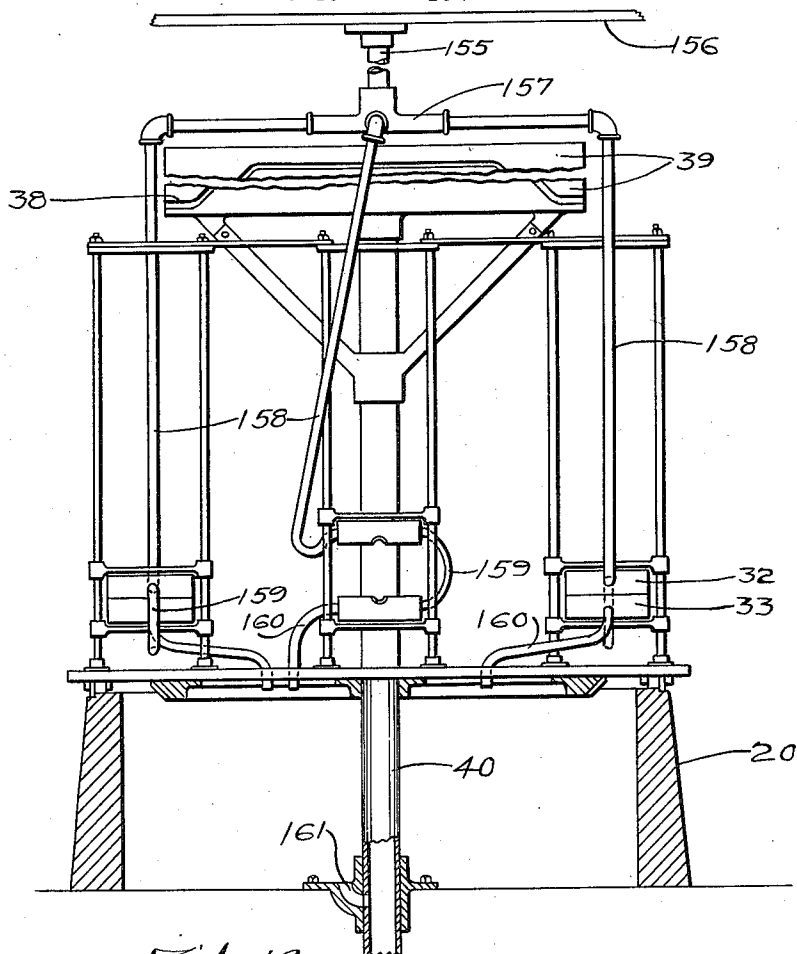


Fig. 13.

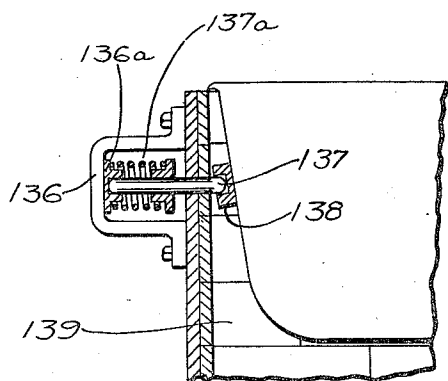


Fig. 14.

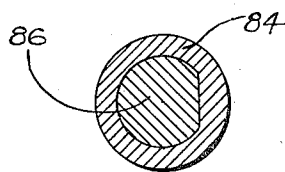


Fig. 15.

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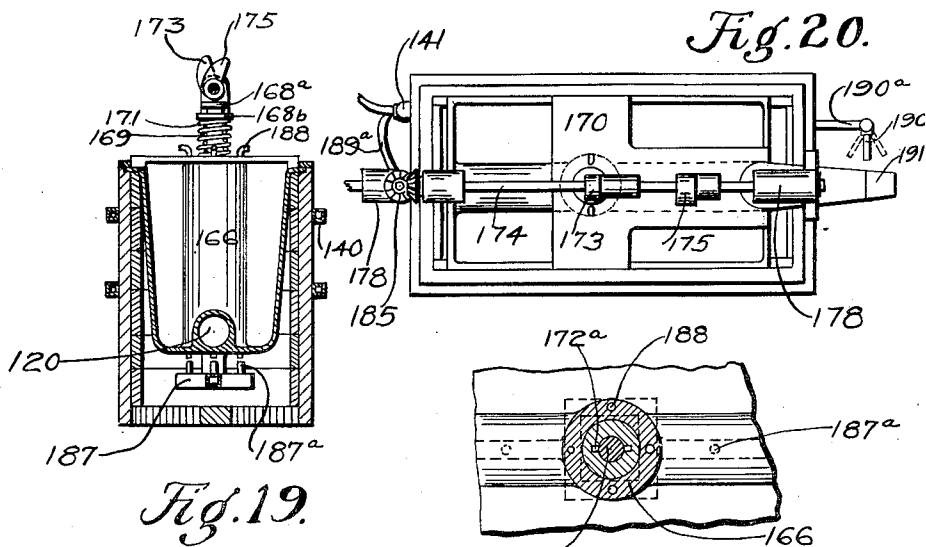
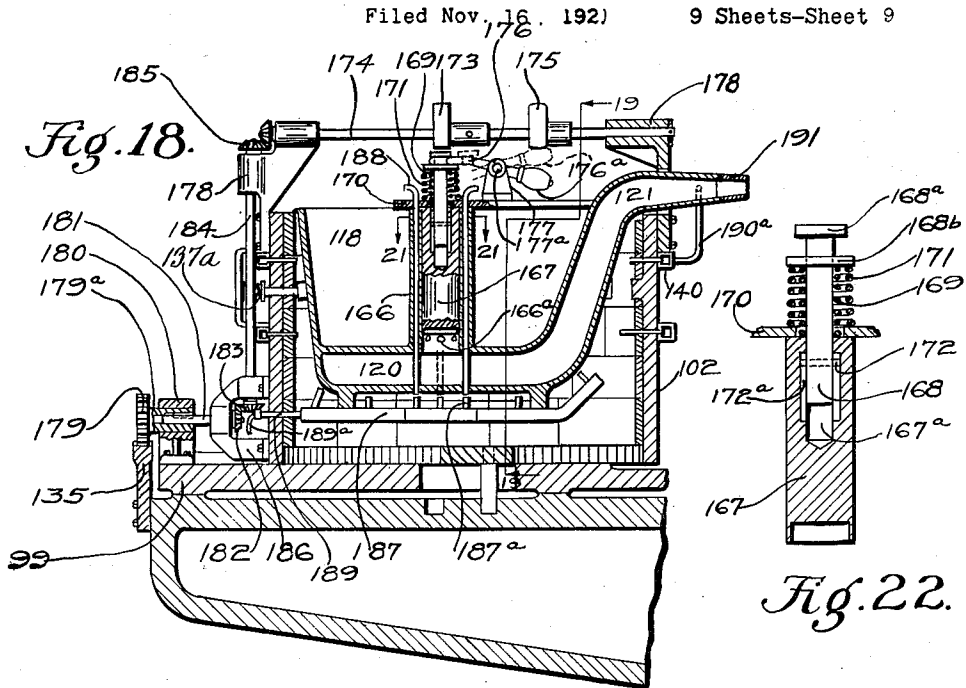
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9 Sheets-Sheet 9



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UNITED STATES PATENT OFFICE.

ANDREW R. JOHNSON AND VICTOR G. WILLIAMS, OF CHICAGO, ILLINOIS.

DIE-CASTING MACHINE.

Application filed November 16, 1921. Serial No. 515,606.

To all whom it may concern:

Be it known that we, ANDREW R. JOHNSON and VICTOR G. WILLIAMS, citizens of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented new and useful Improvements in Die-Casting Machines, of which the following is a specification.

This invention relates to die-casting machines, and its object is to provide a machine of this kind in which the various operations are automatically effected, whereby the whole process may be performed at a considerable greater speed than is now possible. The object stated is attained by means of a novel combination and arrangement of parts to be hereinafter described in detail, and in order that the same may be better understood, reference is had to the accompanying drawings forming a part of this specification.

In the drawings:

Figure 1 is a front elevation of the machine; Fig. 2 is a horizontal section on the line 2—2 of Fig. 1; Fig. 3 is an enlarged vertical section on the line 3—3 of Fig. 2; Fig. 4 is a horizontal section on the line 4—4 of Fig. 3; Fig. 5 is an enlarged plan view of a die or mold brushing mechanism and other parts associated with the die or mold; Fig. 6 is an elevation of a furnace or heating chamber carrying a melting pot; Fig. 7 is a plan view of the die or mold cleaning brush; Fig. 8 is an elevation of a gearing for operating said brush; Fig. 9 is an elevation of a casting-removing and dumping device; Fig. 10 is a section on the line 10—10 of Fig. 9; Fig. 11 is an enlarged elevation of one of the mold or die units; Fig. 12 is a horizontal section on the line 12—12 of Fig. 11; Fig. 13 is an elevation of a portion of the machine, showing a cooling equipment; Fig. 14 is a detail section of a cushioning device for the melting pot; Fig. 15 is a cross-section on the line 15—15 of Fig. 7; Fig. 16 is an elevation showing a device for cleaning the discharge nozzle or spout of the melting pot; Fig. 17 is a perspective view of an air-blower; Fig. 17^a is an elevation showing an air-heating means; Fig. 18 is a sectional view of a melting pot provided with a pump for ejecting the metal; Fig. 19 is a cross-section on the line 19—19 of Fig. 18; Fig. 20 is a plan view of the pot; Fig. 21 is an enlarged horizontal

section on the line 21—21 of Fig. 18, and Fig. 22 is an enlarged vertical section of a pump plunger.

Referring specifically to the drawings, the base of the machine is a heavy annular wall 20 carrying two diametrically opposite, outstanding shelves 21, the same being bolted or otherwise rigidly secured to the wall, as shown at 22. On top of the base wall 20 is a track 23 on which travel rollers 24 on the bottom of a rotatable mold or die carrier in the form of a turntable 25, the same being driven from a power shaft 26 through a bevel pinion 27 on said shaft and meshing with a ring gear 28 on the under side of the turntable. The melting pots for charging the molds with molten metal are carried by the shelves 21, there being two of such pots, and the same being diametrically opposite each other. The turntable 25 carries four molds which are equidistantly spaced and symmetrically arranged around the axis of rotation. The machine has been designed for rapid operation, this being effected by charging two molds simultaneously from the two diametrically opposite melting pots, and as the machine is equipped with four molds, it will be evident that two molds are charged every quarter revolution of the turntable. The molds are all alike and hence a description of one suffices for all.

The mold or die comprises upper and lower halves 32 and 33 supported by heavy plates 32^a and 33^a having corner bearings 32^b and 33^b through which pass standards 29 connected at the top by a spider 30. These standards are secured at the bottom to the top of the platform 25, and the four sets of standards are connected by diagonal braces or tie bars 31. The plate 32^a carrying the upper mold or die member 32 is slidable in a vertical direction it being so supported by the standards 29, whereas the lower mold or die member supporting plate 33^a is stationary, but capable of vertical adjustment on the standards 29, lock nuts 34 being provided for holding the same in adjusted position. It will therefore be seen that the upper mold member 32 is vertically movable, whereas the lower mold member 33 is stationary. The vertical movement of the upper mold member 32 is effected by the following means:

The supporting plate 32^a is formed or provided with an arch 35 terminating in a

tube 36 carrying near its upper end an adjustable and laterally extending finger 37 which seats in a cam groove 38 in the side of a stationary cylinder 39 having its axis vertical and coinciding with the axis of the turntable 25. The cam cylinder 39 is supported above the standards 29 by an upright post 40 assisted by diagonal braces 41. The post 40 passes through the center of the turntable. It will be evident from the foregoing that as the turntable 25 rotates, the upper mold member 32 is periodically elevated and lowered, the cam groove 38 being so designed that the downward motion takes place twice every revolution of the turntable and at the site of the two diametrically opposite mold charging devices, and as four molds are provided, it will be seen that two of them are charged at every quarter revolution of the turntable. In passing from one charging device to the other, the upper mold member 32 is elevated, the casting being now removed from the mold by a means to be presently described.

The upper mold member 32 is charged when it is down, and as it rises, the casting rises with it, certain pins holding it until they are withdrawn, allowing the finished casting to drop into a receiving tray which has in the mean time moved beneath the upper mold member. The tray now moves away from beneath the upper mold member, and while the latter is still elevated it is, with the lower mold member, subjected to a brushing and blowing action to remove metal scale, dust etc., after which the upper mold member goes down for the next charge.

The mold is best shown in Fig. 3, the cavity for the casting being shown at 42, and the metal inlet at 43. The casting-supporting pins 44 of the upper mold member 32 extends transversely through the latter and protrudes slightly into the cavity 42 to gain a hold as the metal flows around said protruding ends, and these pins are outwardly slidable, their outer ends being so supported by headed pins 45 threaded into the side faces of the member 32. The pins 44 are operated by levers 32^c having forked lower ends to straddle and seat in an annular groove in the same. The levers 32^c are pivoted to ears 32^a on the plate 32^a, and to their outer ends are connected links 32^f which extends upwardly and converge toward the tube 36, as more clearly shown in Fig. 11. Here the tube 36 carries a slidable external ring 46 which is vertically grooved, as shown at 47, in dovetail fashion, opposite the upper end of each link 32^f, to seat adjustably a slide block 48 made with pivot ears for attachment of the link ends, and provided with a set screw 49 locking the block in adjusted position. The tube 36 has opposite vertical slots 50 into which

extend lugs 51 on the back of the ring 46. The lugs 51 carry a cross pin 52 which passes through a rod 53 slidably mounted in the tube 36. The slots 50 limit the relative motion between the tube 36 and the rod 53, the latter rising from the upper end of the tube and having its upper end equipped with a laterally extending finger 54 seating in a cam groove 55 in the cylinder 39 above the cam groove 38 by which the elevation of the mold member 32 is obtained. The cam groove 55, through finger 54, rod 53, and the connections of said rod with links 32^f, causes levers 32^c to move in a direction to retract the pins 44 as the mold member 32 rises, and they remain retracted until said mold member again descends. The cam groove 38 and 55 are for the most part parallel, and the action of the levers 32^c will be synchronous with the upward movement of the mold member 32, except that the groove 55 will have its rise 55^a so located that the withdrawal of the pins 44 starts slightly in advance of the rise of said mold member.

The mold cavity 42 is also entered by pins 44^a similar to the pins 44, and having similar connections with levers 33^c pivoted to ears 33^a on the plate 33^a. In order that the upper mold member 32 may raise the casting with it, the pins 44^a must first be withdrawn. This is done by draw bars 33^f connected at one end, as shown at 33^e, to the outer ends of the levers 33^c and adjustably secured at their other ends by bolts 56 in a groove 57 in the top of a plate 58 having a depending stem 59 which passes through a slot 60 in the turntable 25. Each plate 58 has a second depending stem 59^a which passes through a curved slot 61 in a rotatable disk 62 having a depending shaft 63 supported by the turntable 25, and terminating at the bottom in a T-head 64 which is located to intercept a stationary abutment 65. Now, when the turntable 25 moves, one arm of the T-head 64 strikes the abutment 65, whereby the disk 62 is given a partial turn, and on the further travel, the other arm of the T-head strikes a second stationary abutment 65^a, causing the disk to turn in a reverse direction. This motion of the disk 62, through its connections with the levers 33^c swings the latter to retract and advance the lower pins 44^a.

When the casting is released from the upper mold member 32 upon withdrawal of the pins 44 as hereinbefore described, it is caught and carried away by a tray 66, the latter being normally in horizontal position, and hinged at one end, as shown at 67, to a bracket arm 68, and resting at its other end on a projecting pin 68^a of the bracket arm. The bracket arm 68 extends from a slide block 69 supported by guide rails 70, the latter, in turn, being supported by stand-

ards 70^a rising from the turntable 25. The tray 66 is therefore movable to come beneath the elevated mold member 32 as shown dotted in Fig. 5, and after receiving the casting it backs to the full line position, and dumps or discharges the casting. The movement of the tray to and from receiving position is effected by providing the slide block 69 with a rack bar 71 which is in mesh with a pinion 75 having its shaft provided with a bevel gear 74 which is in mesh with a bevel gear 73 on a shaft 72 carried by the turntable 25, and below the latter, the shaft 72 has a T-head 76 positioned so as to be intercepted by stationary abutments 77 as the turntable rotates, one abutment causing the shaft 72 to turn in one direction and the other abutment causing said shaft to turn in the opposite direction. Thus it will be seen that the tray 66 through the gearing between the shaft 72 and the rack bar 71 is carried to and from receiving position.

When the tray 66 has been retracted from its receiving position beneath the mold member 32, it is tilted to dump the casting which it has received and carried away from said mold member. For this purpose, there is loosely hung or hinged to its pivot a depending finger 67^a, back of which the bottom of the tray has a lug 80 against which the finger abuts when the tray is down in casting-supporting position. An S-shaped cam abutment 78 carried by a post 79 rising from the turntable 25 is in the path of the finger 67^a. When the tray 66 is retracted from beneath the mold member 32 one end of cam 78 strikes the finger 67^a causing the latter to press against the lug 80 and thereby tilt the tray as shown dotted in Fig. 10, whereupon the casting slides off the tray. Upon the finger 67^a clearing the cam 78 the tray drops back to its normal receiving position. On the return stroke of the tray 66 toward the mold member 32 the finger 67^a again encounters the cam 78 but it is now swung in a direction away from lug 80 so that no tilting movement is given the tray.

After the casting has been removed from the mold, the opposite sides of the two mold members 32 and 33 are brushed clear of scale and dust, this being done by a pair of rotary cylindrical brushes 81 placed at the proper height to engage said mold members. Each brush cylinder 81^a has a bevel gear 82 at one end which is in mesh with a bevel gear 82^a, whereby the brush is rotated, and each brush is supported by a pair of laterally spaced and parallel screws 84 threaded through stationary nuts 84^a on a stand 84^b rising from the turntable 25. The outer end of one screw 84 is reduced as shown at 83 in Fig. 7 and the same carries the bevel gear 82^a.

Each screw 84 is hollow and encloses a

shaft 86, said parts being so coupled that a relative sliding movement is permitted but the screw is constrained to rotate with the shaft. Fig. 15 shows the shaft with a flat portion on one side, the interior of the screw being correspondingly shaped, but any other expedient may be resorted to for obtaining the object stated.

The entire set of screws 84 and brushes 81 are driven from a shaft 89 supported by the turntable 25 and having at its upper end a bevel gear 90 which is in mesh with a bevel gear 90^a having its shaft 90^b supported by a bearing standard 91 rising from the turntable, and by a gear housing 85. On the shaft 90^b is a large spur gear 88 which is in mesh with pinions 87 carried by the shafts 86, said gear and pinions being located in the housing 85. Beneath the turntable 25 the shaft 89 has a T-head 92 which is positioned to be intercepted by a stationary abutment 93 for obtaining a motion in one direction and by a similar abutment 93^a for a motion in the opposite direction. The shaft 89 is therefore given an alternating rotary motion which is transmitted by the gears to the screws 84 and the bevel gears 82^a, the latter through gears 82 imparting a rotary motion to the brushes 81. The rotary movement of the screws 84 first in one direction and then in the opposite direction causes said screws (due to their being threaded through the stationary nuts 84^a) to advance to place the brushes 81 in operative position relative to the mold members 32 and 33, and then to be retracted to leave the mold members unobstructed.

Each brush cylinder 81^a is mounted loosely on a center rod 94 having an eye 95 at one end which is linked to the reduced end 83 of one of the screws 84, so that the cylinder may be swung up and removed, and another cylinder mounted in its place. The other end of rod 94 is connected to a keeper eye 96 on the other screw 84 by a spring-backed sleeve 97 on the rod, the sleeve entering the keeper, and the latter having a slot 98 for insertion of a suitable tool to back the sleeve out of the keeper, whereupon the rod is released so that it may be swung up and the brush cylinder slid off the same. Ball bearings 98^a are provided to reduce friction.

The pot which holds the molten metal to be injected into the molds or dies will now be described. As stated hereinbefore, two of these units are provided, one on each shelf 21, and as the two units are alike, a description of one suffices for both.

A horizontal beam 99 is centered at one end on the post 40 and passes through a hole 100 in the wall 20, said hole being elongated in a horizontal direction so that the beam may swing back and forth in this direction. The beam 99 has two transverse ribs

on its under side which seat slidably on similar raised portions or ribs 101^a on top of the shelf 21 to minimize the friction when the arm sweeps back and forth. On the beam 99 seats a furnace or heating chamber 102 for the pot 118 containing the supply of molten metal which is to be injected into the molds. The chamber 102 is open at the bottom except for diagonal braces 103 from the junction of which descends a pin 104 which passes through a longitudinal slot 105 in the beam 99 and into a looped groove 106 in the top of the shelf 21. The groove 106 has oppositely acting swinging gates 107 near its ends, said gates being pressed by springs or other suitable means (not shown) to seat as shown in Fig. 4. When the beam 99 swings back and forth across the shelf 21, the pin 104 will be made to travel in the groove 106, so that the chamber 102 and the pot 118 in addition to a swinging movement in an arc parallel to the path of travel of the molds when the turntable 25 is in motion, also have a radial movement toward and from the molds. The horizontal oscillatory motion of the beam 99 is obtained by a bevel gear 108 in mesh with the turntable driving gear 27, and supported by a suitable bracket 109 carried by the wall 20. Gear 108 has spur teeth 110 which are in mesh with a larger spur gear 111 also supported by the bracket 109. Gear 111 has a cam groove 112 in its face into which extends a follower pin 113 depending from a connecting rod 114 slidable at one end in a bearing 115 on bracket 109 and having its other end connected to the beam 99, as shown at 116. When the gear 108 is rotating, the rod 114 is reciprocated to oscillate the beam 99, this motion of the rod being obtained by the follower 113 and the cam groove 112. The reason for operating the beam 99 through a cam groove and follower, rather than by a more positive driving means, is that the rate of motion of the beam can be more readily varied by shaping the cam groove as required. The cam groove is shown as circular and off the center of gear 111, but in practice it may be desirable to redesign the groove to give the beam 99 a period of rest when in midway position, so that more time is had for the charging of the mold.

As the chamber 102 moves in the direction of the length of the beam 99, the latter has undercut marginal guides 117 for marginal ribs at the base of the chamber so that the latter will not rise off the beam during the operation.

In the heating chamber 102 is the pot 118 which is adapted to be filled with molten metal from time to time. This pot has a metal outlet provided with a spring-seated valve 119 for controlling the flow of metal to an outlet chamber 120 having a discharge nozzle

121. The chamber 120 has an upwardly extending branch 112 to receive compressed air by means of a hose 123 coupled to the top thereof, so that the molten metal is forcibly discharged from the nozzle 121 and thus injected into the mold when the nozzle is in line with the mold inlet 43, as shown in Fig. 3. By the hereinbefore described horizontal swing of the beam 99, the nozzle 121 meets and comes in line with the mold inlet 43 and follows the mold, traveling at the same rate of speed as the latter, so that the nozzle remains in charging position relative to the mold inlet for a sufficient length of time to insure the proper charge of molten metal being injected into the mold. At the end of the swing of the beam in a direction to obtain this action, the nozzle is retracted, and the beam swings in the opposite direction to meet the next mold and follow it as before.

The valve 119 has a rocker lifter 124 connected to its stem, said rocker being operated to open the valve when the lower end of the former strikes a lug or a stud on the beam 99, this action taking place at the end of the outward radial travel of the chamber 102. The outlet chamber 120 now receives a charge of molten metal, and at the end of the inward or forward radial movement of the chamber 102, the compressed air is turned on to force the molten metal into the mold.

The compressed air control is best shown in Figs. 3 and 6. The air hose 123 is connected to a supply hose 126 through a valve 127 having an operating arm 128 to which is connected a link 129 having connected to its outer end one end of an arm 130 bearing at its other end on the periphery of a cam 131 and held down thereon by a spring 132. The cam 131 is mounted on a shaft 133 provided with a pinion 134 (partly broken away in Fig. 6) which is in mesh with a stationary rack bar 135 supported transversely by the shelf 21. It will be evident that during the sweep of the beam 99 the cam will cause a drop of the arm 130 at a predetermined time, whereby the valve 127 is opened. In order that the air may not be released when the chamber 102 and the parts carried thereby are in retracted position, and thus cause an untimely discharge of metal, a safety device is provided. The cam-engaging end of arm 130 has an aperture 130^a which, as the parts recede, is entered by a pin 130^b held by a bracket 130^c forming part of the bearing support of shaft 133. This locks the valve actuating means.

The edges of the pot 118 overhang the sides of the chamber 102, and the pot is shorter than the room afforded it by the chamber, so that it may yield slightly when the mouth of the nozzle 121 strikes the mold on the charging stroke. As shown in Fig.

14, a bracket 136 is secured to the chamber 102, on the outside thereof, and the parts are shown as if the nozzle 121 had just made an impact with the mold. The pot 118 is now backed against a spring backed plunger 137, it carrying a socket 138 which is entered by the plunger, the latter passing through an aperture in the chamber wall and having its outer end seating in a socket 136^a carried by the bracket 136. As shown in Fig. 6 two of these cushioning devices are provided, and the reason for locating the spring 137^a of the plunger 137 on the outside of the chamber 102 is to have it as far away as possible from the extreme heat as this tends to take the temper out of the springs.

In order to keep the pot 118 heated to maintain the metal in a molten state, the chamber 102 has a lining 139 of refractory material and carries a number of jet burners 140 pointing toward the pot. These burners are supported by gas pipes 140^a encircling the chamber 102 externally, and leading from a manifold 141 having a supply connection 142.

As described hereinbefore, the mold or die members 32 and 33 are swept clean by rotary brushes 81, and in addition, the dust, scale etc., is blown out by compressed air jets. These blower devices are set in two places (see Fig. 2) and consist of twin air-nozzles 143 for acting on both mold members. The nozzles are stationary, and they are supported by brackets 144 (Fig. 1) on the wall 20, and supplied by a hose branch 145 leading from the main air supply. The air to the nozzles is controlled by a valve 146 having an operating handle 147 to which is connected a torsion spring 148 (Fig. 17) for closing the valve. At the proper time, a cam extension 149 on the periphery of the turntable 25 engages valve handle 147 and swings the same to the dotted line position in Fig. 17 to open the valve 146, whereupon a double jet of air is discharged across the opposite faces of the mold members 32 and 33. The spring 148 causes the valve to close immediately as the cam 149 clears the valve handle 147.

As the metal injecting nozzle 121 is apt to become clogged with scale, slag or dust, a brush to scrape it clean is provided, said brush operating after each charge. As the machine has four molds and two charging units, four brush devices are required, and they are best seen in Figs. 2 and 16. Each brush 150 is mounted on a stand 151 supported by the turntable 25, and is pivoted on said stand to swing in a horizontal direction, it being urged in one direction by a torsion spring 152, its swing in this direction being limited by a stop pin 153. It will be seen that with the travel of the turntable 25 in Fig. 2 in a clockwise direc-

tion, each brush sweeps across the mouth of a nozzle 121 and cleans the same before the next mold comes in line with the nozzle.

The wall 20 has an opening which is covered by a removable plate 154 (Fig. 1) so that access to the interior may be had for repairs and adjustments.

Fig. 13 illustrates a water cooling arrangement which has been left off in Fig. 1 to avoid confusion from a multiplicity of parts. A water main 155 drops from the ceiling 156 to a manifold 157 from which flexible hose lengths 158 are led to one side of the upper mold members 32 through which latter the water circulates, and is then led to the lower mold members 33 by hose connections 159, the water being carried away by final pipes 160 to discharge under the turntable 25. The water collects on the floor and escapes to the sewer by the way of a drain 161 into the hollow center post 40. The mold members are thus kept cool, which gives them longer life and hastens the cooling of the casting. The mold members, of course, have water jackets, as shown in Fig. 3, which are supplied by the aforementioned hose connections.

While it is possible for the casting to drop from the upper mold member 32 when the pins 44 are withdrawn, in actual practice it has been found that force must be employed to push the casting out in most cases. Hence, the supporting plate 32^a to which the upper mold member 32 is secured by straps 32^e, has two posts 32^h on which is slidably mounted a cross plate 32ⁱ, which latter is backed up against cross pins or other abutments 32^j on the posts by expansion springs 32^k. Through the top of the mold member 32 pass a number of push pins 162 adapted to enter the mold cavity 42, and being carried by a plunger 163. The top of the stand formed by the standards 29 carries two adjustable depending rods 165, the same being locked in adjusted position by set screws 164. When the mold member 32 rises with the casting as shown dotted in Fig. 11, the cross plate 32ⁱ strikes the rods 165, whereupon said plate is forced downwardly on the posts 32^h against the tension of the springs 32^k, and upon the plate engaging the plunger 163, the pins 162 advance and push the casting down out of the mold member.

Fig. 17^a shows a means for heating the air by which the molten metal is discharged from the nozzle 121 and injected into the molds. In the air line 123 is interposed a heating coil 123^a beneath which is located a gas burner 141^a supplied by a pipe 141^b leading from the manifold 141. By heating the air all danger of air-pockets being formed in the casting is eliminated.

Instead of injecting the molten metal into the molds by compressed air, the pump 130

shown in Figs. 18 to 22 may be provided. Here, the chamber 120, from which the nozzle 121 extends, has an upwardly extending pump cylinder 166 which passes into the pot 118, and has side inlet ports 166^a near its lower end opening into the pot. In the cylinder 166 operates a reciprocatory plunger 167, which latter, on the upward stroke permits the molten metal in pot 118 to pass from the same through the ports 166^a into the cylinder 166 and into the chamber 120, and on the downward stroke of the plunger, the metal is ejected from the nozzle 121 into the mold.

In the plunger 167 is an axial bore 167^a in which slidably seats a stem 168 which projects from the upper end of the plunger, and has above the latter two vertically spaced collars or abutments 168^a and 168^b. Between the lower abutment 168^b and the top of the plunger 167, there is coiled around the stem 168 a spring 169, and between said abutment and a bridge piece 170 extending across the top of the pot 118 and secured to the same, a spring 171 is coiled around the stem 168. The bridge piece is apertured as shown in Fig. 22 for the passage of the spring 169. In the bore 167^a, the stem 168 carries a cross pin 172 which projects from the stem and has its ends seating slidably in diametrically opposite vertical grooves 172^a in the wall of said bore to prevent the stem from rotating in the plunger.

The downward stroke of the plunger 167 is obtained by a cam 173 on a shaft 174, said cam being positioned to periodically strike the upper end of the stem 168. The shaft 174 is also fitted with a second cam 175 which is positioned to engage one end of a rocker lever 176 having its other end operatively connected to the stem by being here forked to seat between the collars 168^a and 168^b. The end of the lever 176 which is engageable by the cam 175 may be fitted with a roller 176^a, as shown in Fig. 18, and said lever is fulcrumed to a suitable support 177, as shown at 177^a, said support being carried by the bridge piece 170. The shaft 174 is supported by bearing brackets 178 carried by the chamber 102.

The cam shaft 174 obtains motion from the stationary rack bar 135. As shown in Fig. 18, a pinion 179 is in mesh with the rack bar 135, and the shaft 179^a of this pinion is supported in a bearing 180 on the beam 99. Pinion shaft 179^a is hollow and into the same extends slidably the shaft 181 of a bevel gear 182 which is in mesh with a bevel gear 183 on the lower end of a vertical shaft 184 having its upper end geared to the cam shaft 174 by a bevel gearing 185. It will therefore be seen that the sweep of the beam 99, through rack bar 135 and the gearing just described imparts motion to the cam shaft 174. The shafts 179^a and 181 are

splined or otherwise connected to turn together, and the sliding connection between said shafts has been provided to permit the hereinbefore described radial movement of the pot 118 toward and from the molds. Shaft 179^a and the lower end of shaft 184 are supported by a bearing bracket 186 on the chamber 102, and the upper end of shaft 184 is supported by one of the bearing brackets 178.

In the chamber 102, beneath the chamber 120, is a gas burner 187 having its burner tips 187^a positioned close to the chamber 120. Through the wall of cylinder 166 longitudinally pass four heating pipes 188 having their lower ends in line with and close to correspondingly located burner tips, so that the flames issuing from the latter may pass up the pipes 188 and heat the wall of the cylinder 166, and thereby prevent binding of the plunger 167. The upper ends of the pipes 188 are laterally deflected, as shown in Fig. 18, to direct the issuing flames away from the springs 169 and 171. Gas is supplied to burner 187 through a pipe 189 slidably passing through the side of chamber 102, with a flexible tube 189^a connecting said pipe to the manifold 141.

The discharge end of the nozzle 121 is also heated by a burner 190 connected by a pipe 190^a to one of the pipes 140^a. The burner 190 is swiveled so that it may be swung in different directions, as shown by dotted lines in Fig. 20, for directing the flame to any desired spot on the nozzle 121. Figs. 18 and 20 show the nozzle 121 provided with a tip 191 for regulating the size of the stream of metal to be discharged into the molds, it being understood that the tip is removable so that it may be replaced by a tip having a different sized outlet.

Fig. 18 shows the melting pot 118 in advanced position and the plunger 167 about to make a downward stroke to eject a charge of molten metal through the nozzle 121 into a mold. The mouth of the nozzle 121 has struck the mold, and the pot 118 has moved back in the chamber 102 as hereinbefore described. The upper end of the stem 168 is now directly beneath cam 173, and as the latter engages the stem, the plunger 167 is forced downwardly in cylinder 166 to eject the molten metal through nozzle 121 into the mold. This downward movement of plunger 167 causes rocker lever 176 to swing to the dotted line position shown in Fig. 18, so that its end which carries the roller 176^a is now in the path of cam 175, and hence when said cam hits roller 176^a, the rocker lever is swung to the full line position, thereby giving the plunger 167 its upward or return stroke. When the chamber 102 and the parts therein recede from the mold, and the pot 118 is advanced or moved to the right in Fig. 18 by the springs 137^a, as hereinbefore de-

scribed, the stem 168 moves out of the path of cam 173, as shown dotted in Fig. 18, and hence the pump cannot now be operated.

The purpose of the springs 169 and 171 is to provide a yieldable operative connection between the stem 168 and the pump plunger 167. On the downward stroke of stem 168 the motion thereof is transmitted to the plunger 167 by the spring 169, and at the same time spring 171 is compressed to assist the return or upward stroke of the plunger.

With a machine constructed on the above lines, the element of danger to human life and limb as well as that of damage to shop equipment and property, will be reduced to a minimum, if not entirely eliminated. With the operation of the machine well understood, it will be clear that the only manual operation or assistance required will be the periodical filling of the pots with molten metal; and it is not difficult to conceive an apparatus that could even eliminate the human agency in this part of the process; that is to say, an apparatus that would automatically convey the molten metal from the furnace in crucibles which would discharge into the pots of the die casting machine. Consequently, the danger of scalding by molten metal and of burns from handling freshly formed castings, which has prevailed in the die casting art, will be largely done away with in the use of the present machine. The make-up of the machine and the plan of its operation are conducive to a rapid delivery of castings which is a condition impossible to attain with machines of prevailing types, due to manual operation and the care employed to avoid injury.

While the machine has been described on given lines, it will be obvious that many changes and refinements may be made therein without departing from the scope and spirit of the invention.

While the pins 44 and 44^a have been mentioned as casting retainers when in advanced position, they need not serve as such necessarily, but rather to form recesses in the casting, which are often considered desirable.

We claim:

1. In a die-casting machine, a melting pot having a discharge nozzle, a plurality of molds consisting of upper and lower sections and having inlets positioned to register with the nozzle, a rotary carrier for the molds around the axis of which the molds are symmetrically arranged, means for operating the carrier to bring the inlets of the molds successively into and out of registry with the nozzle, a swinging support for the melting pot, and means for automatically operating said support to maintain the registering position of the mold inlets and the nozzle for a predetermined period of time, and means

associated with said upper sections for gripping a casting.

2. In a die casting machine, a plurality of molds consisting of upper and lower sections, the upper sections being movable away from the lower sections for removal of the casting, a melting pot for charging the molds, a movable carrier for the molds, means for operating said carrier to move the molds successively past the melting pot to receive a charge, means for elevating the upper section of each mold after the mold has been charged, a casting ejector operating upon the release of the casting, and a support movable beneath the elevated section to receive the released casting.

3. In a die-casting machine, a melting pot having a discharge nozzle, a plurality of molds having inlets positioned to register with the nozzle, a rotary carrier for the molds around the axis of which the molds are symmetrically arranged, means for operating the carrier to bring the inlets of the molds successively into and out of registry with the nozzle, a swinging support for the melting pot on which the latter is movable in a direction transverse of the path of travel of the molds to approach the same and recede therefrom, means for operating the melting pot support to maintain the registering position of the mold inlets and the nozzle for a predetermined period of time, and means for effecting the aforesaid advance and recession of the melting pot.

4. In a die casting machine, a plurality of molds consisting of upper and lower sections, the upper section being movable away from the lower section for removal of the casting, a melting pot for charging the molds, a movable carrier for the molds, means for operating said carrier to move the molds successively past the melting pot to receive a charge, means for elevating the upper section of the carrier after the carrier has been charged, a casting ejector, and a tray movable beneath the elevated mold section to receive the released casting.

5. In a die casting machine, a plurality of molds consisting of upper and lower sections, the upper section being movable away from the lower section for removal of the casting, a melting pot for charging the molds, a movable carrier for the molds, means for operating said carrier to move the molds successively past the melting pot to receive a charge, means for elevating the upper section of the carrier after the carrier has been charged, a casting ejector, and a tray movable beneath the elevated mold section to receive the released casting, and means for tilting the tray to discharge the casting.

6. In a die-casting machine, a melting pot having a discharge nozzle, a plurality of

molds having inlets adapted to register with the nozzle, a continuously operating rotary carrier for the molds around the axis of which the molds are symmetrically arranged, means for operating the carrier to bring the mold inlets successively into and out of registry with the nozzle, a swinging support on which the melting pot is movable in a direction transverse of the path of travel of the molds to approach the same and to recede therefrom, means for operating the swinging support to maintain the registering position of the nozzle for a predetermined period of time, and means for effecting the advance and recession of the melting pot.

7. In a die-casting machine, a mold composed of a pair of sections, one of the sections being movable away from the other section for removal of the casting, means for elevating one of the sections after the mold has been charged to permit removal of the casting, and a support movable beneath the elevated mold section to receive the casting.

8. In a die-casting machine, a melting pot having a discharge nozzle, a plurality of molds having inlets adapted to register with the nozzle, a traveling support for carrying the molds successively past the nozzle to register their inlets therewith, a swinging support on which the melting pot is movable in a direction transverse of the path of travel of the molds to approach the same and to recede therefrom, means for operating the swinging support to maintain the registering position of the nozzle for a predetermined period of time, and means for effecting the advance and recession of the melting pot.

9. In a die-casting machine, a melting pot having a discharge nozzle, a plurality of molds having inlets adapted to register with the nozzle, a continuously operating rotary carrier for the molds around the axis of which the molds are symmetrically arranged, means for operating the carrier to bring the mold inlets successively into and out of registry with the nozzle, a swinging support on which the melting pot is movable in a direction transverse of the path of travel of the molds to approach the same and to recede therefrom, means for operating said support to move the melting pot in a path parallel to the path of the moving molds for a predetermined time, and thereafter to move the melting pot in the opposite direction, and means for advancing the melting pot on its support as it starts to move with the molds, and for retracting it when it moves in the opposite direction.

10. In a die-casting machine, a plurality of molds each composed of upper and lower sections, the upper section being movable away from the lower section for removal of

the casting, means associated with said upper mold section for gripping the casting, a melting pot for charging the molds, a movable carrier for the molds, means for operating said carrier to move the molds successively past the melting pot to receive a charge, means for elevating the upper section of each mold after the mold has been charged, and means for operating the gripping means to release the casting when said mold section is elevated.

11. In a die-casting machine, a plurality of molds each composed of upper and lower sections, the upper section being movable away from the lower section for removal of the casting, means associated with said upper mold section for gripping the casting, a melting pot for charging the molds, a movable carrier for the molds, means for operating said carrier to move the molds successively past the melting pot to receive a charge, means for elevating the upper section of each mold after the mold has been charged, means for operating the gripping means to release the casting when said mold section is elevated, and a casting ejector operating upon the release of the casting.

12. In a die-casting machine, a plurality of molds each composed of upper and lower sections, the upper section being movable away from the lower section for removal of the casting, means associated with said upper mold section for gripping the casting, a melting pot for charging the molds, a movable carrier for the molds, means for operating said carrier to move the molds successively past the melting pot to receive a charge, means for elevating the upper section of each mold after the mold has been charged, means for operating the gripping means to release the casting when said mold section is elevated, and a support movable beneath the elevated mold section to receive the released casting.

13. In a die-casting machine, a plurality of molds each composed of upper and lower sections, the upper section being movable away from the lower section for removal of the casting, means associated with said upper mold section for gripping the casting, a melting pot for charging the molds, a movable carrier for the molds, means for operating said carrier to move the molds successively past the melting pot to receive a charge, means for elevating the upper section of each mold after the mold has been charged, means for operating the gripping means to release the casting when said mold section is elevated, a casting ejector operating upon the release of the casting, and a support movable beneath the elevated mold section to receive the released casting.

14. In a die-casting machine, a plurality of molds each composed of upper and lower sections, the upper section being movable

away from the lower section for removal of the casting, means associated with said upper mold section for gripping the casting, a melting pot for charging the molds, a
 5 movable carrier for the molds, means for operating said carrier to move the molds successively past the melting pot to receive a charge, means for elevating the upper section of each mold after the mold has been
 10 charged, means for operating the gripping means to release the casting when said mold section is elevated, a tray movable beneath the elevated mold section to receive the released casting, a support to which the tray is
 15 pivoted, and means for tilting the tray to discharge the casting therefrom.

15. In a die-casting machine, a plurality of molds each composed of upper and lower sections, the upper section being movable
 20 away from the lower section for removal of the casting, means associated with said upper mold section for gripping the casting, a melting pot for charging the molds, a movable carrier for the molds, means for
 25 operating said carrier to move the molds successively past the melting pot to receive a charge, means for elevating the upper section of each mold after the mold has been charged, means for operating the gripping
 30 means to release the casting when said mold section is elevated, a casting ejector operating upon the release of the casting, a shelf movable beneath the elevated mold section to receive the released casting, a support to
 35 which the shelf is pivoted, and means for tilting the shelf to discharge the casting therefrom.

16. In a die-casting machine, a plurality of molds each composed of upper and lower
 40 sections, the upper section being movable away from the lower section for removal of the casting, a melting pot for charging the molds, a movable carrier for the molds, means for operating said carrier to move
 45 the molds successively past the melting pot for receiving a charge, means for elevating the upper section of each mold after the mold has been charged, means for removing the casting when the mold sections are sep-
 50 arated, and rotary brushes movable between the separated mold sections to operate on the opposite surfaces thereof.

17. In a die-casting machine, a plurality of molds each composed of upper and lower
 55 sections, the upper section being movable away from the lower section for removal of the casting, a melting pot for charging the molds, a movable carrier for the molds, means for operating said carrier to move
 60 the molds successively past the melting pot for receiving a charge, means for elevating the upper section of each mold after the mold has been charged, means for removing the casting when the mold sections are
 65 separated, rotary brushes movable between

the separated mold sections to operate on the opposite surfaces thereof, and means for discharging blasts of air across such surfaces.

18. In a die-casting machine, a melting pot
 70 having a discharge nozzle, a support in which the pot is seated loosely to yield in one direction, a resilient cushioning means opposing such movement of the pot, a mold having an inlet, a carrier for moving the
 75 mold to the nozzle, and a member carrying the aforesaid support and movable in the direction of the mold for abutting the nozzle against the latter when it registers with the
 80 inlet.

19. In a die-casting machine, a mold consisting of separable members having water jackets, the water jacket of one mold member having an inlet and the water jacket of the other mold member having an outlet,
 85 and a flexible connection between the water jackets.

20. In a die-casting machine, a plurality of molds each composed of upper and lower sections, the upper section being movable
 90 away from the lower section for removal of the casting, a melting pot for charging the molds, a movable carrier for the molds, means for operating said carrier to move the molds successively past the melting pot for
 95 receiving a charge, means for elevating the upper section of each mold after the mold has been charged, and means for discharging blasts of air across opposite surfaces of the mold sections when said sections are separated.
 100

21. In a die-casting machine, a plurality of molds each composed of upper and lower sections, the upper section being
 105 movable away from the lower section for removal of the casting, a melting pot for charging the molds, a movable carrier for the molds, means for operating said carrier to move the molds successively past the melting pot for receiving a charge,
 110 and means for discharging blasts of air across the opposite surfaces of the mold sections when said sections are separated for removal of the casting.

22. In a die-casting machine, a sectional
 115 mold, a rotatable carrier, supports on the carrier for the mold sections, the support of one of the mold sections being movable for separating said section from the other section, a stationary cylindrical member having
 120 its axis coinciding with the carrier axis, and provided with a cam groove, and a follower on the support of the movable mold section seating in the cam groove.

23. In a die-casting machine, a mold composed of upper and lower sections, a rotatable carrier, supports on the carrier for the mold sections, the upper mold section being
 125 movably supported to recede from the lower section, a stationary cylindrical member hav-
 130

ing its axis coinciding with the axis of the carrier, and provided with a cam groove, and a follower on the support of the upper mold section seating in the cam groove.

24. In a die-casting machine, a mold, a rotatable carrier, a support on the carrier for the mold, casting-ejecting pins slidably carried by the mold, levers operatively connected to the pins, links connected to the levers for operating the same, a reciprocatory rod having an operative connection with the links, a stationary cylindrical member having its axis coinciding with the carrier axis, and provided with a cam groove, and a follower on the aforesaid rod seating in the cam groove.

25. In a die-casting machine, a mold, a rotatable carrier, a support on the carrier for the mold, casting-engaging pins slidably carried by the mold, levers operatively connected to the pins, draw bars connected to the levers for operating the same, reciprocatory members to which the draw bars are connected, stems extending from said members, the aforesaid carrier having slots into which the stems extend, a rotatable member having radial slots, the aforesaid reciprocatory members having stems extending into said slots, a shaft carrying the rotatable member, and supported by the carrier, a stationary abutment, and means on the aforesaid shaft engageable by the abutment for operating the shaft.

26. In a die-casting machine, a mold composed of stationary and movable sections, a support for the movable section, means for operating said support for separating the movable section from the stationary section after filling of the mold, a casting-ejecting member adapted to enter the movable mold section, an actuator for said member carried by the aforesaid support, and a stationary operating member engageable with the actuator when the support moves to separate the movable mold section from the stationary mold section.

27. In a die-casting machine, a mold composed of stationary and movable sections, a support for the movable section, means for operating said support for separating the movable section from the stationary section after filling of the mold, a casting-ejecting member adapted to enter the movable mold section, a cross bar yieldably supported by the aforesaid support and movable to actuate the ejecting member, and a stationary member against which the cross bar moves when the support moves in a direction to separate the movable mold section from the stationary section.

28. In a die-casting machine, a mold composed of upper and lower sections, the upper section being movable away from the lower section for removal of the casting, means for elevating the upper mold section

after the mold has been charged to permit removal of the casting, and a support movable beneath the elevated mold section to receive the casting.

29. In a die-casting machine, a mold composed of upper and lower sections, the upper section being movable away from the lower section for removal of the casting, means for elevating the upper mold section after the mold has been charged, a tray movable beneath the elevated mold section to receive the casting, a support to which the tray is pivoted, and means for tilting the tray to discharge the casting therefrom.

30. In a die-casting machine, a mold composed of upper and lower sections, the upper section being movable away from the lower section for removal of the casting, a carrier for the mold, means for elevating the upper mold section after charging, a tray movable beneath the elevated mold section to receive the casting, a slide pivotally supporting the tray, supporting means for the slide on the carrier, a rack bar on the slide, a pinion in mesh with the rack bar, and means for operating the pinion to reciprocate the rack bar.

31. In a die-casting machine, a mold composed of upper and lower sections, the upper section being movable away from the lower section for removal of the casting, a carrier for the mold, means for elevating the upper mold section after charging, a tray movable beneath the elevated mold section to receive the casting, a slide pivotally supporting the tray, supporting means for the slide on the carrier, a rack bar on the slide, a pinion in mesh with the rack bar, a bevel gear in mesh with the pinion, a shaft carrying the bevel gear and supported by the carrier, stationary abutments, and means on the bevel gear shaft alternately engageable by the abutments for imparting an alternating rotary movement to said shaft.

32. In a die-casting machine, a mold composed of upper and lower sections, the upper section being movable away from the lower section for removal of the casting, a carrier for the mold, means for elevating the upper mold section after charging, a tray movable beneath the elevated mold section to receive the casting, a slidable support to which the tray is pivoted, means for operating said support, a finger extending from the tray, and a stationary abutment on the carrier in the path of the finger for tilting the tray to discharge the casting therefrom.

33. In a die-casting machine, a mold composed of upper and lower sections, the upper section being movable away from the lower section for removal of the casting, a carrier for the mold, means for elevating the upper mold section after charging, a tray movable beneath the elevated mold section to receive the casting, a slidable support to which the

tray is pivoted, means for operating said support, a pivoted finger on the tray, a lug on the tray against which the finger abuts when the tray is in casting-supporting position, a stationary abutment on the carrier

in the path of the finger for tilting the tray to discharge the casting therefrom, said finger yielding in passing the abutment on the return stroke of the support.

34. In a die-casting machine, a mold composed of stationary and movable sections, means for operating the movable section for removal of the casting, rotary brushes movable between the mold sections when separated to operate on the opposite surfaces thereof, a support for the brushes including traveling screws and stationary nuts through which the screws are threaded, shafts extending through the screws and having driving connections with the brushes, said screw being connected to the shafts to rotate therewith, and means for imparting an alternate rotary movement to the shafts.

35. In a die-casting machine, a melting pot having a discharge nozzle, a support for the melting pot, a mold having its inlet positioned to register with said nozzle, a rotary carrier for the mold, means for operating the carrier to bring the mold inlet into and out of registry with the nozzle, a swinging support for the mold support, operating means for said swinging support, a pin extending through the melting pot support, and a stationary shelf having a looped groove into which the pin extends.

36. In a die-casting machine, a mold, a melting pot, a discharge nozzle, the melting pot having an outlet to said nozzle, a valve for said outlet, a support for the melting pot on which the latter is movable toward and from the mold, means for effecting such movement of the melting pot, means for discharging the contents of the nozzle into the mold on the forward stroke of the melting pot, and means for opening the aforesaid valve on the return stroke of the melting pot for admitting a charge into the nozzle.

37. In a die-casting machine, a mold, a melting pot, a discharge nozzle, the melting pot having an outlet to said nozzle, a valve for said outlet, a support for the melting pot on which the latter is movable toward and from the mold, means for effecting such movement of the melting pot, means for discharging the contents of the nozzle into the mold on the forward stroke of the melting pot, a pivoted actuator for the aforesaid valve, and an abutment on the melting pot support engageable by the actuator on the return stroke of the melting pot.

38. In a die-casting machine, a melting pot having a discharge nozzle, a support for the melting pot, a mold having its inlet positioned to register with said nozzle, a rotary carrier for the mold, means for operating

the carrier to bring the mold inlet into and out of registry with the nozzle, a swinging support for the melting pot support, operating means for said swinging support, a stationary shelf, a rack on said shelf, a pinion in mesh with the rack and carried by said support, a cam rotatable with the pinion, means for delivering a charge of compressed air into the nozzle to expel the contents thereof into the mold, a valve interposed in said means, an operating arm connected to the valve, and an arm connected to said operating arm and yieldably held in contact with the aforesaid cam.

39. In a die-casting machine, a melting pot having a discharge nozzle, a mold having its inlet positioned to register with said nozzle, a rotary carrier for the mold, means for operating the carrier to bring the mold inlet into and out of registry with the nozzle, a swinging support on which the melting pot is movable toward and from the mold, means for effecting such movement of the melting pot, means for operating the support, a stationary shelf, a rack on said shelf, a pinion in mesh with the rack and carried by the swinging support, a cam rotatable with the pinion, means for delivering a charge of compressed air into the nozzle to expel the contents thereof into the mold, a valve interposed in said means, an operating arm connected to the valve, an arm connected to said operating arm and yieldably held in contact with the aforesaid cam, the cam engaging end of said arm having an aperture, and a pin carried by the shelf and positioned to enter said aperture to lock the cam when the melting pot is in retracted position.

40. In a die-casting machine, a plurality of molds each composed of upper and lower sections, the upper section being movable away from the lower section for removal of the casting, a melting pot for charging the molds, a movable carrier for the molds, means for operating said carrier to move the molds successively past the melting pot for receiving a charge, means for elevating the upper section of each mold after the mold has been charged to permit removal of the casting, and means for discharging blasts of air across opposite surfaces of the mold sections for removal of the casting, said means comprising air nozzles, valves controlling the same and having operating means, cams on the movable carrier for actuating the valve operating means, and means for closing the valves when the cams clear the valve operating means.

41. In a die-casting machine, a melting pot having a discharge nozzle, a mold, a carrier for moving the mold past the nozzle to receive a charge therefrom, a brush pivotally supported by said carrier and positioned to wipe across the nozzle mouth upon passing

the same after the mold moves away from charging position, and resilient means for maintaining a wiping contact of the brush with the nozzle. pot, means for discharging molten metal therefrom by compressed air, and means for heating such air. 10

5 42. In a die-casting machine, a melting pot having a discharge nozzle, and means for heating said nozzle.

In testimony whereof we affix our signatures.

43. In a die-casting machine, a melting

ANDREW R. JOHNSON.
VICTOR G. WILLIAMS.