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D. M. MORGENSTERN
VACUUM FEEDING AND DEGASIFYING MEANS FOR
DIE CASTING APPARATUS

2,955,335

Filed Jan. 31, 1958

3 Sheets-Sheet 1

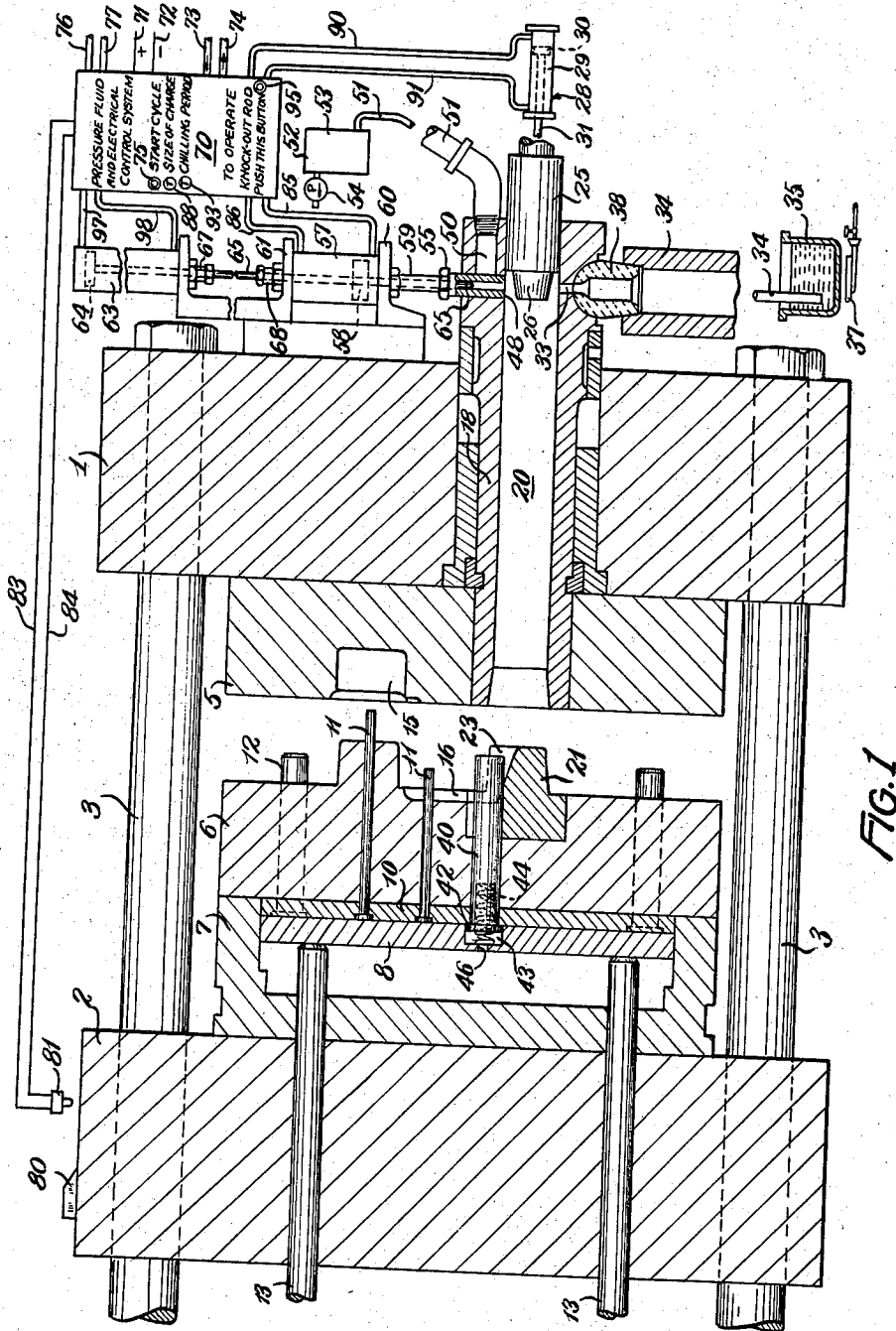


FIG. 1

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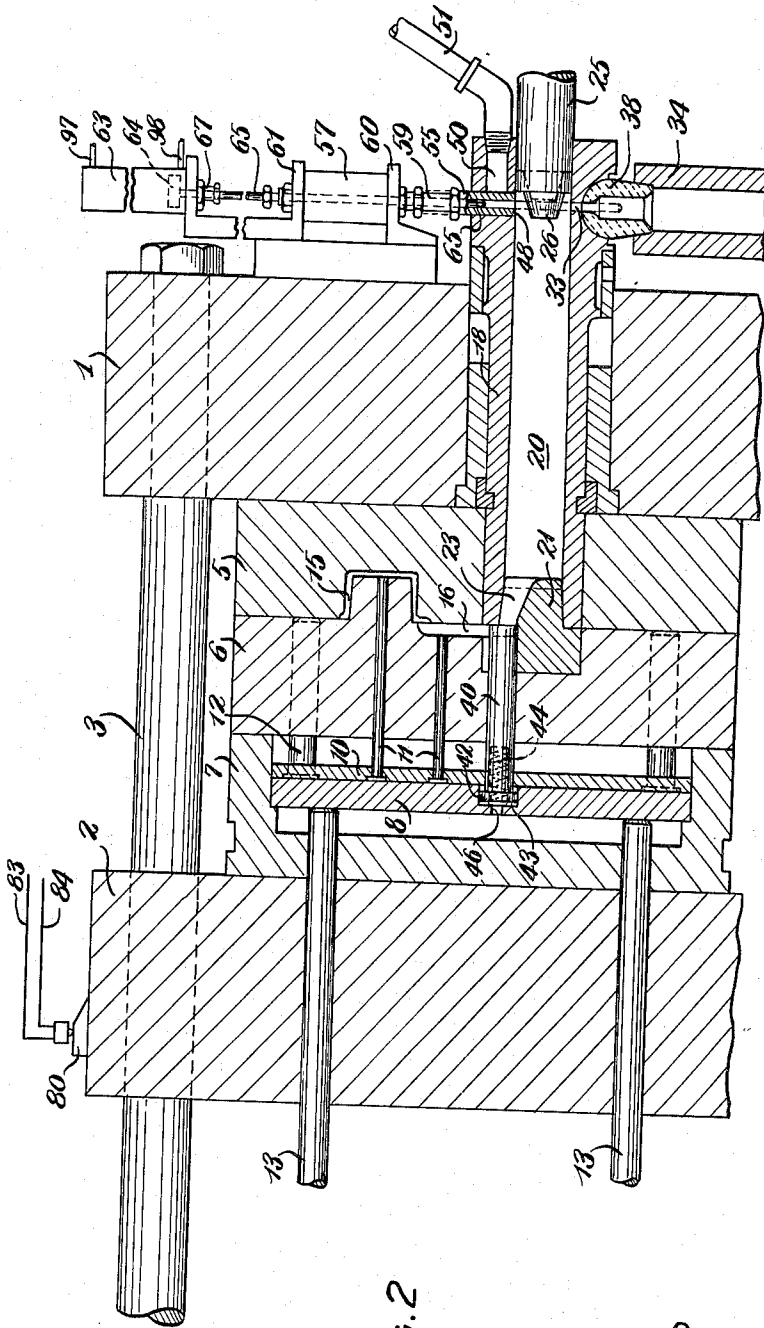


FIG. 2

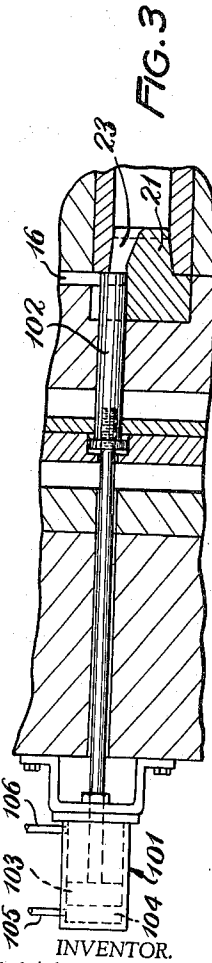


FIG. 3

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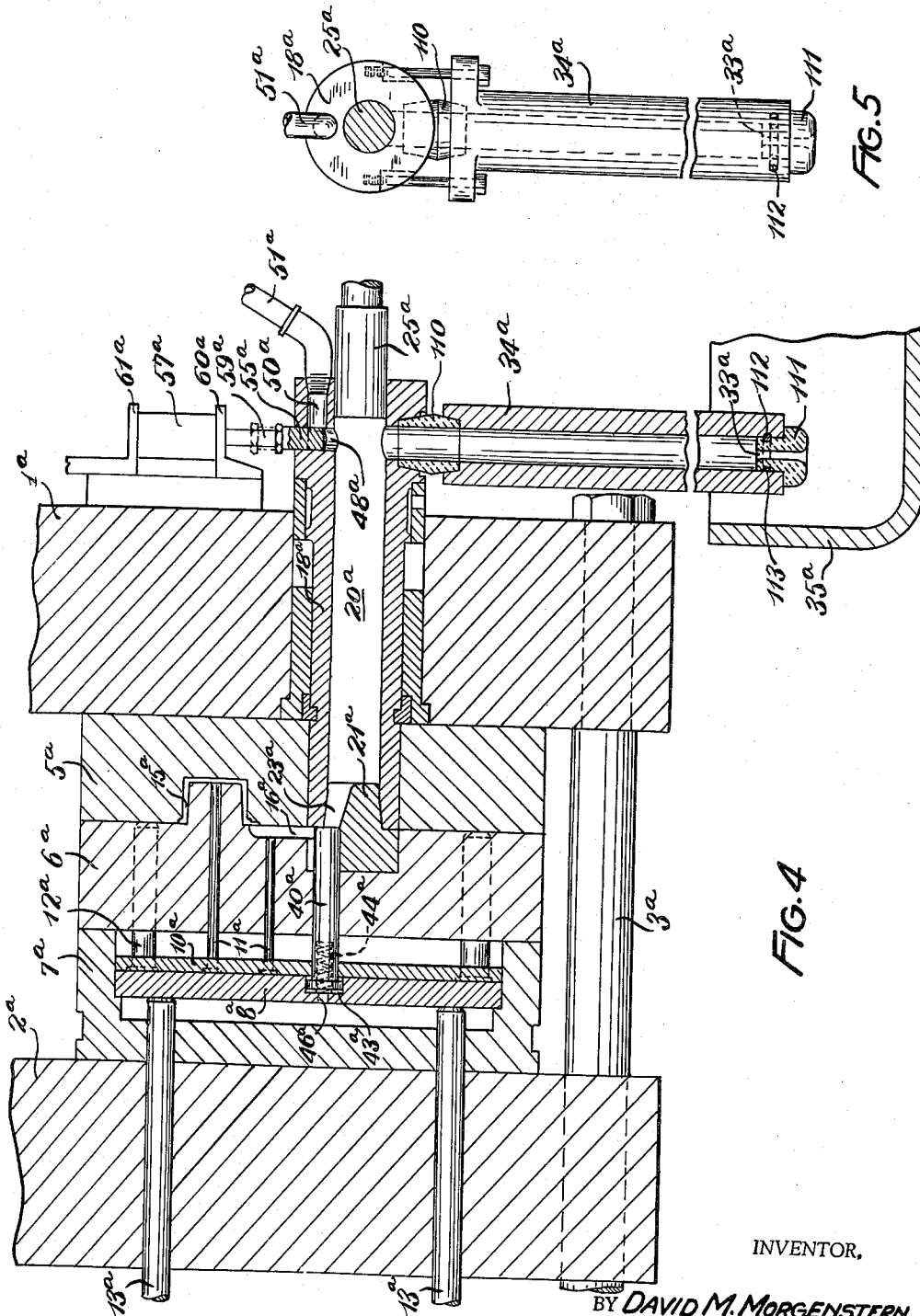
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VACUUM FEEDING AND DEGASIFYING MEANS FOR DIE CASTING APPARATUS

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5 Claims. (Cl. 22—73)

This invention relates to die casting apparatus, and more particularly to vacuum means for feeding molten material to the charging chamber of such apparatus and for degasifying the material in the course of its being fed.

An object of the invention is to provide simple and economical means that operates on the suction principle for feeding molten material to the charging chamber of die casting apparatus, and to provide feeding means of this nature that is reliable, speedy, and has the advantage of removing from the molten material, when the latter is fed to the charging chamber, a high percentage of occluded gases to the end that the resultant castings are denser, smoother of surface, and stronger than castings ordinarily produced by the conventional die casting machines devoid of vacuum facilities, said resultant castings, by reason of reduced porosity, being adapted to relatively thin wall constructions.

Another object of the invention is to provide, in die casting apparatus characterized by a charging chamber having a relatively small inlet port or metering orifice for the admission of molten material thereto, means that is simple of construction, effective, and convenient of operation, for dislodging casting material that solidified in or immediately in advance of the inlet port or metering orifice.

A further object is to provide an efficient valve for controlling the vacuum port of the charging chamber which valve is practically immune from disorder; and a still further and related object is to make said valve in the form of a tubular plunger and dispose it radially of the charging chamber and in alignment with the inlet port or metering orifice, and to constitute the means for dislodging solidified casting material from said port or orifice of a so-called "knock-out" rod which operates through the bore of said valve, such an arrangement contributing to compactness, strength and durability of construction.

Objects and advantages additional to those above set forth will appear as I proceed to describe the invention by reference to the accompanying drawings wherein embodiments of the invention are illustrated in a more or less schematic fashion.

In the drawings, wherein like parts are designated by like reference characters in the different views,

Fig. 1 is a fragmentary sectional side elevation of die casting apparatus incorporating my improvements, the parts being shown in the positions they assume when the dies are separated;

Fig. 2 is a similar view with the parts in the position they occupy when the dies are together and the apparatus is in readiness to receive a charge of molten material in the charging chamber, the ram which operates within said chamber being shown in full lines in normal retracted position, and in broken lines in a further retracted position to avoid interference with the knock-out rod when said rod is projected as shown in the present view in broken lines;

Fig. 3 is a detail view of a modification wherein pres-

sure fluid means is employed for actuating the valve that controls communication between the charging chamber and the die cavity; and

Figs. 4 and 5 are, respectively, a fragmentary sectional side elevation and an end elevation of a modification wherein the metering orifice is located at the entrance end of the supply conduit.

The die casting apparatus wherein I have shown my improvements incorporated is of conventional form and includes a stationary die plate 1 and a movable die plate 2. For descriptive purposes, I shall consider the right hand end of the apparatus as viewed in the drawings as the rear end. Guide bars 3 have their rear ends secured in the customary way to the stationary die plate 1, which plate constitutes a part of the frame of the apparatus; and the die plate 2 is reciprocable along said bars by suitable mechanism not shown herein but which is common to die casting apparatus.

A stationary or cover die 5 is fastened in the usual way to the die plate 1, and a movable die 6 is attached to the die plate 2 through the medium of a housing 7. The means for connecting these parts together are not shown, but are common and well known in the art and accordingly constitute no part of the invention.

Mounted for limited fore-and-aft movement within the housing 7 is a bumper plate 8 of ejecting mechanism. Suitably attached to the rear face of the bumper plate 8 is a face plate 10 through means of which headed ejector pins 11 and thrust pins 12 are clamped to the bumper plate 8 for movement therewith.

It is evident from the foregoing that, as the movable die 6 approaches the stationary die 5, the thrust pins 12 will engage the face of the latter die and arrest movement of the bumper plate 8. This will result in retraction of the ejector pins 11, relative to the movable die 6, and in disposing the bumper plate 8 in the position shown in Fig. 2. Bumper bars 13 that are guided within aligned bores of the die plate 2 and housing 7, will assume a corresponding position. As well known to those familiar with die casting apparatus of the class illustrated and described herein, the bumper bars 13 are arranged to engage a stationary plate or other fixed part of the apparatus (not shown) as the die plate 2 moves forwardly or in reverse direction to that above described, thereby to arrest forward movement of the bumper bars as well as the bumper plate 9, ejector pins 11, and thrust pins 12. As this reverse action occurs, the parts resume the positions illustrated in Fig. 1.

The meeting faces of the dies 5 and 6 are contoured to define by and between them, when closed, a die cavity 15 and a runner 16 that communicates with said cavity.

A tubular cylindrical housing 18, that is enlarged at its rear end, is projected forwardly through aligned bores of the stationary die plate 1 and the die 5 that is carried thereby; and the bore of said housing constitutes the charging chamber 20. The housing 18 is suitably locked in place within the bore of the die plate 1, and the forward or outlet end of the chamber 20 is shown as slightly flared to snugly receive a tapered plug 21 that is carried by the movable die 6. For expediency, the plug 21 is made separately from the die and has a base that is suitably secured within a recess of the die. The plug 21 has, on the upper side thereof, a channel 23, the forward end of which extends radially through the base of the plug 21 and registers with the runner 16. It will be observed that the terminal portion of the plug 21 is cylindrical and enters the chamber 20 rearwardly of the flared portion thereof when the adjacent faces of the dies 5 and 6 are together and the die cavity accordingly closed, as shown in Fig. 2.

Reciprocable in the charging chamber 20 is a ram 25 that is formed at its forward end with a deflector 26,

3 which may be frusto-conical in shape. The ram is shown in Fig. 1, and in solid lines in Fig. 2, as occupying its normal retracted position. It is adapted to be further retracted to the position indicated in broken lines in Fig. 2 under conditions that will presently be described. In accord with conventional practice, the ram 25 is reciprocated by means of a pressure fluid motor 28, schematically illustrated in the drawings and constituted of a cylinder 29, and a piston 30 that operates within said cylinder and has connection, through a rod 31, with the rear end of the ram.

The charging chamber 20 communicates, through a relatively small inlet port or metering orifice 33, with a supply conduit 34 that has its receiving end, as schematically illustrated in the drawings, disposed within a crucible or container 35, below the molten material level therein. The crucible may be heated by any suitable means, as by a gas burner 37. The upper end of the supply conduit 34 is shown as slightly counterbored and flared for the reception of the tapered lower end of a special nipple 38 of a refractory or other heat resistant material of low thermal conductivity, and the upper end of said nipple is shown as semi-spherical and as fitting snugly within a recess of complementary shape that opens through the exterior of the housing 18. The restricted upper end of the bore of the nipple 38 registers with the inlet port or metering orifice 33. The conduit 34 is secured by suitable means to the housing 18 with the nipple 38 clamped between the conduit 34 and the housing. By reason of this construction and the slow heat-dissipating property of the nipple 38, the conduit 34 and the nipple retain the maximum amount of heat and minimize the tendency of the casting material to solidify in the region of the inlet port 33.

A valve 40, shown as consisting of a plunger, is slidable in axially aligned bores of the die 6, face plate 10, and plug 21, and it has a head 42 at its forward end that is reciprocable in a recess 43 in the bumper plate 8. The valve is biased toward a rearward position, in the construction shown in Figs. 1 and 2, by a spring 44 that is compressed between an end wall of the recess 43 and the opposed wall of an axial recess in the adjacent end of the plunger. The recess 43 is vented through a hole 46 of the bumper plate 8.

A so-called "vacuum" port 48 opens into the charging chamber 20 adjacent the rear end of the housing 18, and it consists of a bore that is disposed radially of said chamber and is in axial alignment with the inlet port or metering orifice 33. Opening into the vacuum port is a passage 50 which is placed in communication, through a conduit 51 with evacuating means 52, illustrated in the drawing as comprising a tank 53 and a vacuum pump 54. Operating within the bore that constitutes the vacuum port 48 is a plunger which I shall refer to as the evacuating valve 55. This valve is adapted to be moved by means hereinafter described between closed position, wherein its inner end is flush with the inner surface of the peripheral wall of the chamber 20, and an open position, indicated in dotted lines in Fig. 2, wherein it uncovers the passage 50 so as to establish communication between the chamber 20 and the evacuating means 52. Pressure fluid means is employed to operate the valve 55 and may be either hydraulic or pneumatic, preferably the former, and it is shown as comprising a cylinder 57 and a piston 58 that operates in said cylinder and has connection through a tubular piston rod 59 with the valve 55, the piston 58 having an axial bore that registers with that of said tubular piston rod.

The cylinder 57 is shown as attached to and supported by the adjacent die plate 1 by means including brackets 60 and 61, the latter being elongated and supporting a cylinder 63 in properly spaced relation to and in alignment with the cylinder 57. A piston 64 operates in the cylinder 63, and the rod 65 thereof extends downwardly

through openings in the lower end of the cylinder 63 and in the upper end of the cylinder 57 and continues on through the bore of the piston 58 and the tubular piston rod 59 thereof, conventional packing glands designated 67 and 68 sealing said openings of the respective cylinders 63 and 57. The rod 65 is the one hereinbefore referred to as the "knock-out" rod because of the purpose it serves, as will hereinafter more fully appear. When the piston 64 is adjacent the upper end of the cylinder 63 and the knock-out rod 65 is, accordingly, fully retracted, the lower end of said rod reposes within the axial bore of the valve 55, as shown in Fig. 1. The knock-out rod is illustrated in dot-and-dash lines in Fig. 2 in projected position, and the piston 64 is similarly shown at the lower end of its stroke.

A pressure fluid and electrical control system is desirably employed for governing and coordinating the operations of the die casting machine or apparatus, along with the parts that constitute my improvements, and by means of which a cycle of operation is rendered automatic. The use of such control systems with die casting apparatus is relatively common and is exemplified, to mention one instance, in the Federman and Morgenstern Patent No. 2,799,066, dated July 16, 1957. Control systems of the sort referred to usually involve valves, electrical actuators therefor, relays, timers, etc. along with a push button or other type of manual switch for starting a cycle of operation.

A control system of the above described character is indicated schematically in Fig. 1 of the drawings, where the control panel thereof is designated 70. The system is supplied with electrical energy through a circuit represented by conductors 71 and 72, and with fluid under pressure from a suitable source (not shown) through a conduit 73 and, in the case of hydraulics, the fluid is returned to said source, through a conduit 74. 75 denotes a switch, incidentally of the push button type, for initiating a cycle of operation, and subsequent to the closing of this switch a circulation of pressure fluid occurs through pipes designated 76 and 77 that lead to a pressure fluid motor (not shown), usually consisting of a cylinder and piston, which functions, through the intervention of common and well known means, to move the die plate 2 toward and from the die plate 1, and cause engagement and disengagement of the dies carried thereby. The dies are shown in engagement in Fig. 2, with the die cavity accordingly closed. The movement of the die plate 2, as above described, causes a cam 80 that is shown as carried by said die plate to engage the actuator of a switch 81 thereby to close said switch. This results in a flow of current through conductors designated 83 and 84. Said switch—which is biased toward open position—and said conductors are parts of the control system.

At this point, the apparatus is in the condition illustrated in Fig. 2, with the valve 40 closed to shut off communication between the charging chamber 20 and the die cavity 15.

Energization of the circuit which includes the conductors 83 and 84 and the switch 81 results in fluid under pressure being delivered, through a conduit 85, to the lower end of the cylinder 57 so as to lift the piston 58, the fluid escaping from the upper end of the cylinder through a conduit 86. The movement of the piston 58 is transmitted through its rod 59 to the evacuating valve 55, and the retraction of said valve opened the vacuum port 48 and established communication between the charging chamber 20 and the evacuating means 53. The subatmospheric pressure now prevailing in the charging chamber 20 as a consequence of the opening of valve 55, enhances the seating force of the check valve 40 and induces a flow of molten material from the crucible 35 through the conduit 34, nipple 38, and inlet port or metering orifice 33 to the charging chamber.

The molten material will continue to flow into said cham-

ber as long as the evacuating valve 55 remains retracted or, in other words, in open position. An adjustable timer 88, in the circuit established when the switch 81 closed, governs the duration of energization of the circuit. Therefore, the size of the charge of molten material that is fed to the charging chamber 20 may be changed at will by adjusting the timer 88. When the period of time expires for which said timer 88 is set, flow of fluid to and from the cylinder 57 is reversed, fluid under pressure now being delivered to said cylinder through the conduit 86, thereby to depress the piston 58 and close the evacuating valve 55, the fluid escaping from the lower end of the cylinder through the conduit 85.

As the molten material enters the charging chamber 20 it is diverted away from the vacuum port by the deflector 26 that projects from the forward end of the ram 25. The molten material, in a more or less agitated condition as it enters the chamber 20, and with its surface tension reduced by reason of the sub-atmospheric pressure to which it is subjected, liberates occluded gases that are carried off through the vacuum port and the conduit 51 by the evacuating means 52. This degasifying of the material contributes to superior castings, as hereinbefore pointed out.

Immediately after the evacuating valve 55 is closed, the control system functions to deliver fluid under pressure through a conduit 90 to the rear end of the cylinder 29 of the pressure fluid motor 28 and force the piston 30 forwardly to impart like movement to the ram 25, thereby to shut off the supply of molten material through the port 33 and impel the charge of such material from the charging chamber 20 to the die cavity 15, the valve 40 being shifted to open position by the force of the charge so as to establish communication between the channel 23 and the runner 16. During this action of the pressure fluid motor 28 fluid escapes from the cylinder forwardly of the piston through a conduit 91. It may be mentioned that the size of the charge sufficiently exceeds the combined volume of the die cavity, runner and channel to leave a slug of the casting material between the forward end of the ram and the adjacent end of the plug 21. The parts remain in their present positions until the material solidifies and the flow of fluid is reversed through the conduits 76 and 77, thereby to retract the movable die plate 2 and separate the dies, as illustrated in Fig. 1. Upon such separation of the dies, the ejecting mechanism involving the pins 11 acts in a common and well known manner to loosen the casting from the movable die, the ram 25 having further advanced when the opposing forces ceased so as to project the slug of casting material through the flared forward end of the charging chamber. At this point the casting may be removed from between the die members in the customary way.

The dwell between the charging stroke of the ram 25 and the subsequent separation or opening of the dies, and which constitutes the chilling period, may be regulated as to duration by adjustment of a timer 93 in a circuit responsible for retraction of the die plate 2, as will be readily understood by those familiar with die casting procedure as carried out by means of modern equipment.

Upon retraction of the movable die plate 2 and the consequential separation of the dies, the control system acts to cause a flow of fluid through the conduits 90 and 91 in the direction opposite to that above described, thereby to shift the piston 30 toward the rear end of the cylinder 29 and retract the ram 25 to its normal retracted position shown in full lines in Figs. 1 and 2. The apparatus is now in condition for a subsequent cycle of operation which is initiated by the depression and closing of the push button switch 75.

It should be explained that when the ram 25 is forward, the inlet port or metering orifice 33 is uncovered and placed in communication with the atmosphere so that molten material left in the communicative connec-

tions between the crucible 35 and the charging chamber may return by gravity to the crucible. However, in some instances the material may chill within or in advance of the port or orifice 33 and clog the same. Also, under some circumstances, the vacuum port, or the bore of the evacuating valve, may contain a deposit of solidified casting material. Such solidified material may be removed by means now to be described.

When it becomes necessary to dislodge solidified casting material from one or more of the places above mentioned, a push button 95 on the control panel 70 is depressed to start a sequence of occurrences brought about by the automatic workings of the system. First, fluid under pressure is directed through the conduit 91 to the cylinder 29 to shift the piston 30 to its extreme rear position within said cylinder, the fluid back of the piston escaping through the conduit 90. The resultant movement of the ram 25 rearwardly beyond normal retracted position removes deflector 26 from the path of the knock-out rod 65. Secondly, pressurized fluid is caused to flow through a conduit 97 to the upper end of the cylinder 63, thereby to depress the piston 64 and project the knock-out rod 65. The rod is shown in projected position in dotted lines in Fig. 2. By this action, any solidified material in the path of the rod is dislodged so that it may drop into the container or crucible 35. During this operation, fluid beneath the piston 64 escapes through the conduit 98. Next, the preceding operation is reversed and the knock-out rod is retracted. Finally, the ram 25 is returned to normal retracted position by delivery of sufficient fluid under pressure through the conduit 90 to the rear end of the cylinder 29, a like amount of fluid escaping from the front end of said cylinder through the conduit 91.

It will be understood that, in accordance with common practice, any one or more of the following parts: the housing 18 of the charging chamber; the ram 25; and the dies 5 and 6, may be provided with passages through which a suitable coolant is adapted to be circulated.

In Fig. 3 I have illustrated a modification of the invention wherein pressure fluid means 101 is employed for actuating a plunger type valve 102, the latter replacing the spring loaded valve 40 of the first described form of the invention. The means 101 is shown as comprising a piston 103 and a cylinder 104, the latter being adapted to have connection with the control system through conduits 105 and 106. In this case said system functions to project the valve 102 to closed position prior to the opening of the evacuating valve 55 and the consequential feeding of the molten material to the charging chamber; and to retract the valve 102 to open position when the ram 25 is started on its forward stroke to transfer the material from the charging chamber to the die cavity.

The modification illustrated in Figs. 4 and 5 differs from the first described construction, principally in that the metering orifice 33^a is located at the entrance end of the supply conduit 34^a, and the inlet port of the charging chamber 20^a is relatively large, the same being shown as corresponding in diameter with the bore of the supply conduit 34^a and with the bore of equal diameter of a heat insulating nipple 110 that is clamped between said conduit and the housing 18^a of the charging chamber. The opposite ends of the nipple 110 are desirably tapered and fit within flaring counterbores of the conduit and said housing.

The metering orifice 33^a is in a thimble 111 having a neck that is projected into the lower end of the bore of the conduit 34^a and is shown as held in place by a pin 112 that occupies a hole in the conduit that is tangent to the bore, the side of said pin entering the adjacent part of a circumferential groove 113 of said neck. The thimble 111 and pin 112 are preferably composed of a heat resistant material, such as carbon or a suitable

refractory. The lower end of the supply conduit is relatively near the bottom of the crucible designated 35^a in Fig. 4.

The manner of securing the supply conduit to the housing of the charging chamber with the nipple 110 clamped between the two parts is disclosed in the rear elevational view of Fig. 5. This manner of attaching the conduit to the housing is common to both the first and last described forms of the apparatus.

The action of the control system is modified in the present case to effect a two-stage retraction of the evacuating valve 55^a. Said valve is shown in solid lines in Fig. 4 at first stage, wherein it uncovers only a small part of the cross-sectional area of the suction passage 50^a, and in dotted lines at second stage wherein said passage is in wide open communication with the vacuum port 48^a. The return stroke of the valve is continuous, as in the first described mode of operation.

The advantages of the present modification will be apparent from the following description of the feeding phase of a cycle of operation which is peculiar to said modification.

Assuming that the dies are together and the valve 40^a is closed, the evacuating valve 55^a will be retracted to its first stage position where it remains for about one-third of the feeding phase, according to the present preferred timing. During this period the molten material will rise comparatively slowly within the supply conduit 34^a and overflow at the present retarded speed into the charging chamber 20^a until a pool of metal is present therein. At this point the control system will function to cause complete retraction of the evacuating valve 55^a, whereupon the remainder of the complete charge of molten material will be sucked into the charging chamber at a considerably increased speed, but without undue agitation or turmoil, due to the presence of the fractional charge of material initially fed to the chamber. Consequently there will be no squirting or spraying of the molten material into the charging chamber, as results from the nozzle-like action of a metering orifice located at the inlet port of said chamber and which requires a deflector to shield the vacuum port from the vapor-like spray of molten material.

All parts of the apparatus shown in Figs. 4 and 5 are designated by the same reference characters as those applied to the corresponding parts of the first described form, augmented by the exponent *a*.

Having thus described my invention, what I claim is:

1. Improvements in die casting apparatus of the kind characterized by two dies relatively movable toward and from each other, the apparatus including a housing enclosing a charging chamber that opens, at its discharge end, through the front face of one die, the adjacent faces of the dies being contoured to define between them, when the dies are together, a die cavity and a passage through which said cavity communicates with the discharge end of the charging chamber, the charging chamber having an inlet port that opens into said chamber remote from the discharge end thereof, said apparatus incorporating a ram reciprocable in said chamber together with means for reciprocating the ram between a projected position wherein its forward end is adjacent the discharge end of the chamber, and a restricted position wherein the inlet port is uncovered by the ram and placed in communication with the charging chamber, the apparatus further including a container for molten material situated below the level of the charging chamber and being provided with communicative connections between said container and the inlet port of the charging chamber, all in accordance with prevailing practice; said improvements comprising the provision of a vacuum port that is spaced from the inlet port and that opens into the top of the charging chamber with its axis disposed substantially radially of said chamber, a plug carried by

and fixed against movement with respect to the die other than the one through which the charging chamber opens, the same being arranged to enter the discharge end of the chamber when the dies are together, the adjacent passage being defined in part by and between the upper portion of said plug and the adjacent part of the housing, the plug serving to close the discharge end of the charging chamber excepting for said passage, evacuating means that is adapted to have communication with the charging chamber through the vacuum port, an evacuating valve for controlling the vacuum port, means for actuating said valve, a second valve controlling the aforesaid passage, and means closing the second valve when the evacuating valve is open, said second valve being open when the ram advances to projected position to transfer molten material from the charging chamber to the die cavity, said communicative connections between the container for molten material and the charging chamber including a conduit having its lower end in receiving relation to said container and its upper end in spaced relation to the housing of the charging chamber in substantial axial alignment with the inlet port of said chamber, and a nipple clamped between the upper end of said conduit and an opposed portion of the charging chamber housing, the charging chamber housing being provided with an external semi-spherical concave seat surrounding the inlet port, and said nipple having a semi-spherical upper end fitting said seat, the end of the conduit adjacent the charging chamber housing being provided with an upwardly flared counterbore, and said nipple having a tapered lower end fitting within the flared counterbore of the conduit.

2. Improvements in die casting apparatus of the kind characterized by two dies relatively movable toward and from each other, the apparatus including a housing enclosing a charging chamber that opens, at its discharge end, through the front face of one die, the adjacent faces of the dies being contoured to define between them, when the dies are together, a die cavity and a passage through which said cavity communicates with the discharge end of the charging chamber, the charging chamber having an inlet port that opens into said chamber remote from the discharge end thereof, said apparatus incorporating a ram reciprocable in said chamber together with means for reciprocating the ram between a projected position wherein its forward end is adjacent the discharge end of the chamber, and a restricted position wherein the inlet port is uncovered by the ram and placed in communication with the charging chamber, the apparatus further including a container for molten material situated below the level of the charging chamber and being provided with communicative connections between said container and the inlet port of the charging chamber, all in accordance with prevailing practice; said improvements comprising the provision of a vacuum port that is spaced from the inlet port and that opens into the top of the charging chamber with its axis disposed substantially radially of said chamber, a plug carried by and fixed against movement with respect to the die other than the one through which the charging chamber opens, the same being arranged to enter the discharge end of the chamber when the dies are together, the adjacent passage being defined in part by and between the upper portion of said plug and the adjacent part of the housing, the plug serving to close the discharge end of the charging chamber excepting for said passage, evacuating means that is adapted to have communication with the charging chamber through the vacuum port, an evacuating valve for controlling the vacuum port, means for actuating said valve, a second valve controlling the aforesaid passage, and means closing the second valve when the evacuating valve is open, said second valve being open when the ram advances to projected position to transfer molten material from the charging chamber to

the die cavity, said communicative connections between the container for molten material and the charging chamber including a conduit having its lower end in receiving relation to said container and its upper end in spaced relation to the housing of the charging chamber in substantial axial alignment with the inlet port of said chamber, and a nipple clamped between the upper end of said conduit and an opposed portion of the charging chamber housing, the charging chamber housing being provided with an external semi-spherical concave seat surrounding the inlet port, and said nipple having a semi-spherical upper end fitting said seat, the end of the conduit adjacent the charging chamber housing being provided with an upwardly flared counterbore, and said nipple having a tapered lower end fitting within the flared counterbore of the conduit, said nipple being composed of material of low thermal conductivity.

3. Improvements in die casting apparatus of the kind characterized by two dies relatively movable toward and from each other, the apparatus including a housing enclosing a charging chamber that opens, at its discharge end, through the front face of one die, the adjacent faces of the dies being contoured to define between them, when the dies are together, a die cavity and a passage through which said cavity communicates with the discharge end of the charging chamber, the charging chamber having an inlet port that opens into said chamber remote from the discharge end thereof, said apparatus incorporating a ram reciprocable in said chamber together with means for reciprocating the ram between a projected position wherein its forward end is adjacent the discharge end of the chamber, and a restricted position wherein the inlet port is uncovered by the ram and placed in communication with the charging chamber, the apparatus further including a container for molten material situated below the level of the charging chamber and being provided with communicative connections between said container and the inlet port of the charging chamber, all in accordance with prevailing practice; said improvements comprising the provision of a vacuum port that is spaced from the inlet port and that opens into the top of the charging chamber with its axis disposed substantially radially of said chamber, a plug carried by and fixed against movement with respect to the die other than the one through which the charging chamber opens, the same being arranged to enter the discharge end of the chamber when the dies are together, the adjacent passage being defined in part by and between the upper portion of said plug and the adjacent part of the housing, the plug serving to close the discharge end of the charging chamber excepting for said passage, evacuating means that is adapted to have communication with the charging chamber through the vacuum port, an evacuating valve for controlling the vacuum port, means for actuating said valve, a second valve controlling the aforesaid passage, and means closing the second valve when the evacuating valve is open, said second valve being open when the ram advances to projected position to transfer molten material from the charging chamber to the die cavity, said communicative connections between the container for molten material and the charging chamber including a conduit having its bore, at a location a substantial distance below its upper end, restricted to a metering orifice of small cross-sectional area relative to the diameter of said bore, the inlet port of the charging chamber being substantially no less in cross-sectional area than said bore, means for imparting a two-stage movement to the evacuating valve in the retraction thereof so as to open the vacuum port, first, to a relatively small fraction of its capacity for a relatively brief part of the feeding phase of a cycle and then to substantially its full capacity.

4. Improvements in die casting apparatus of the kind characterized by two dies relatively movable toward and

from each other, the apparatus including a housing enclosing a charging chamber that opens, at its discharge end, through the front face of one die, the adjacent faces of the dies being contoured to define between them, when the dies are together, a die cavity and a passage through which said cavity communicates with the discharge end of the charging chamber, the charging chamber having an inlet port that opens into said chamber remote from the discharge end thereof, said apparatus incorporating a ram reciprocable in said chamber together with means for reciprocating the ram between a projected position wherein its forward end is adjacent the discharge end of the chamber, and a restricted position wherein the inlet port is uncovered by the ram and placed in communication with the charging chamber, the apparatus further including a container for molten material situated below the level of the charging chamber and being provided with communicative connections between said container and the inlet port of the charging chamber, all in accordance with prevailing practice; said improvements comprising the provision of a vacuum port that is spaced from the inlet port and that opens into the top of the charging chamber with its axis disposed substantially radially of said chamber, a plug carried by and fixed against movement with respect to the die other than the one through which the charging chamber opens, the same being arranged to enter the discharge end of the chamber when the dies are together, the adjacent passage being defined in part by and between the upper portion of said plug and the adjacent part of the housing, the plug serving to close the discharge end of the charging chamber excepting for said passage, evacuating means that is adapted to have communication with the charging chamber through the vacuum port, an evacuating valve for controlling the vacuum port, means for actuating said valve, a second valve controlling the aforesaid passage, and means closing the second valve when the evacuating valve is open, said second valve being open when the ram advances to projected position to transfer molten material from the charging chamber to the die cavity, said communicative connections between the container for molten material and the charging chamber including a conduit having its lower end in receiving relation to said container below the minimum level of molten material therein, the inlet port of the charging chamber being relatively large, a nipple composed of a material of low heat conductivity interposed between the housing of the charging chamber in substantially axial alignment with said inlet port, means for attaching the conduit to said housing in spaced relation thereto and with said nipple clamped between the housing and the upper end of the conduit, the cross sectional area of each the opening through the nipple and the bore of the conduit being substantially the same as the cross sectional area of the inlet port, and a thimble attached to the lower end of the conduit, the same having a metering orifice of small capacity relative to that of said inlet port and through which orifice the conduit communicates with the container.

5. Improvements in die casting apparatus of the kind characterized by two dies relatively movable toward and from each other, the apparatus including a housing enclosing a charging chamber that opens, at its discharge end, through the front face of one die, the adjacent faces of the dies being contoured to define between them, when the dies are together, a die cavity and a passage through which said cavity communicates with the discharge end of the charging chamber, the charging chamber having an inlet port that opens into said chamber remote from the discharge end thereof, said apparatus incorporating a ram reciprocable in said chamber together with means for reciprocating the ram between a projected position wherein its forward end is adjacent the discharge end of the chamber, and a restricted position wherein the inlet port is uncovered by the ram and placed in com-

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munication with the charging chamber, the apparatus further including a container for molten material situated below the level of the charging chamber and being provided with communicative connections between said container and the inlet port of the charging chamber, all in accordance with prevailing practice; said improvements comprising the provision of a vacuum port that is spaced from the inlet port and that opens into the top of the charging chamber with its axis disposed substantially radially of said chamber, a plug carried by and fixed against movement with respect to the die other than the one through which the charging chamber opens, the same being arranged to enter the discharge end of the chamber when the dies are together, the adjacent passage being defined in part by and between the upper portion of said plug and the adjacent part of the housing, the plug serving to close the discharge end of the charging chamber excepting for said passage, evacuating means that is adapted to have communication with the charging chamber through the vacuum port, an evacuating valve for controlling the vacuum port, means for actuating said valve, a second valve controlling the aforesaid passage, and means closing the second valve when the evacuating valve is open, said second valve being open when the ram advances to projected position to transfer molten material from the charging chamber to the die cavity, the said vacuum port being in axial

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alignment with the inlet port, the said evacuating valve being in the form of a plunger, the means for actuating the evacuating valve consisting of a cylinder and piston, the latter being connected to the valve by means of a piston rod, said piston, piston rod, and evacuating valve having aligned bores, a knock-out rod extending through said bores for projection through the vacuum and inlet ports, means for reciprocating the knock-out rod, a deflector incorporated in and projecting forwardly from the ram and disposed between the inlet port and the vacuum port when the ram is in normal retracted position, and means for further retracting the ram to prevent interference of said deflector with the knock-out rod when the latter is projected.

References Cited in the file of this patent

UNITED STATES PATENTS

1,939,831	Scheible	Dec. 19, 1933
2,105,586	Daesen	Jan. 18, 1938
2,112,343	Lester	Mar. 29, 1938
2,195,360	Daesen	Mar. 26, 1940
2,411,999	Lester	Dec. 3, 1946
2,582,029	Halward	Jan. 8, 1952
2,837,794	Ring	June 10, 1958

FOREIGN PATENTS

120,087	Sweden	Nov. 4, 1947
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