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APPARATUS FOR VACUUM FEEDING A DIE CASTING MACHINE

Filed Oct. 22, 1958

3 Sheets-Sheet 1

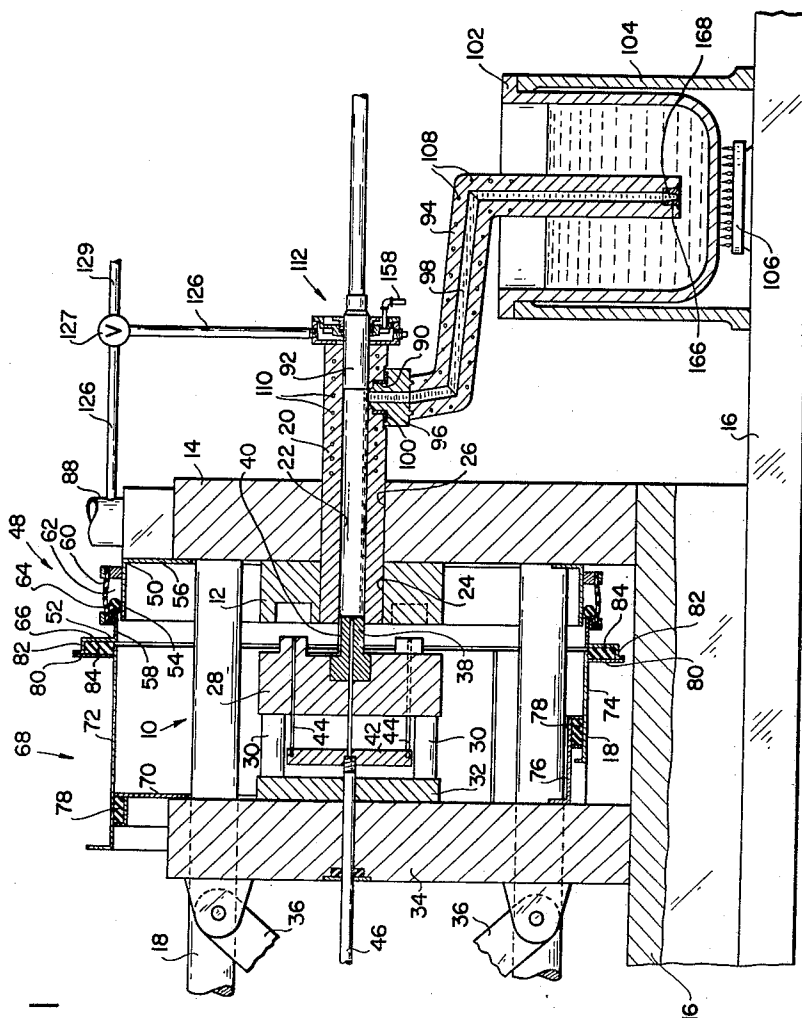


FIG. 1

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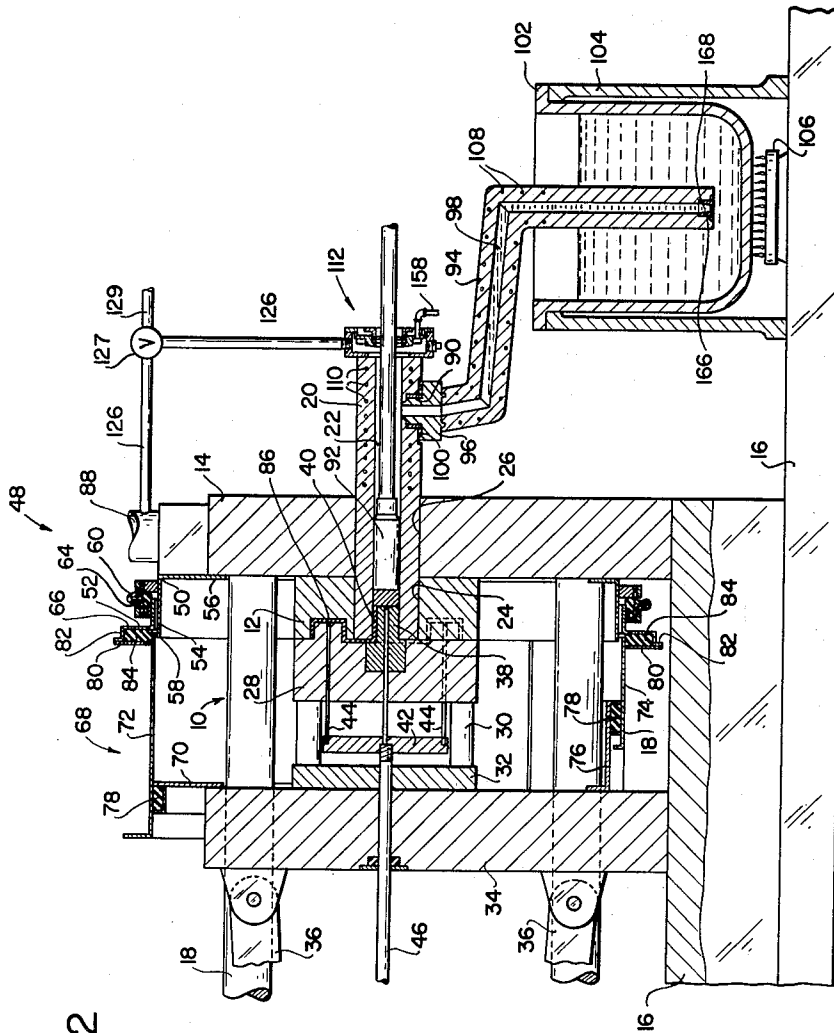
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3 Sheets-Sheet 2



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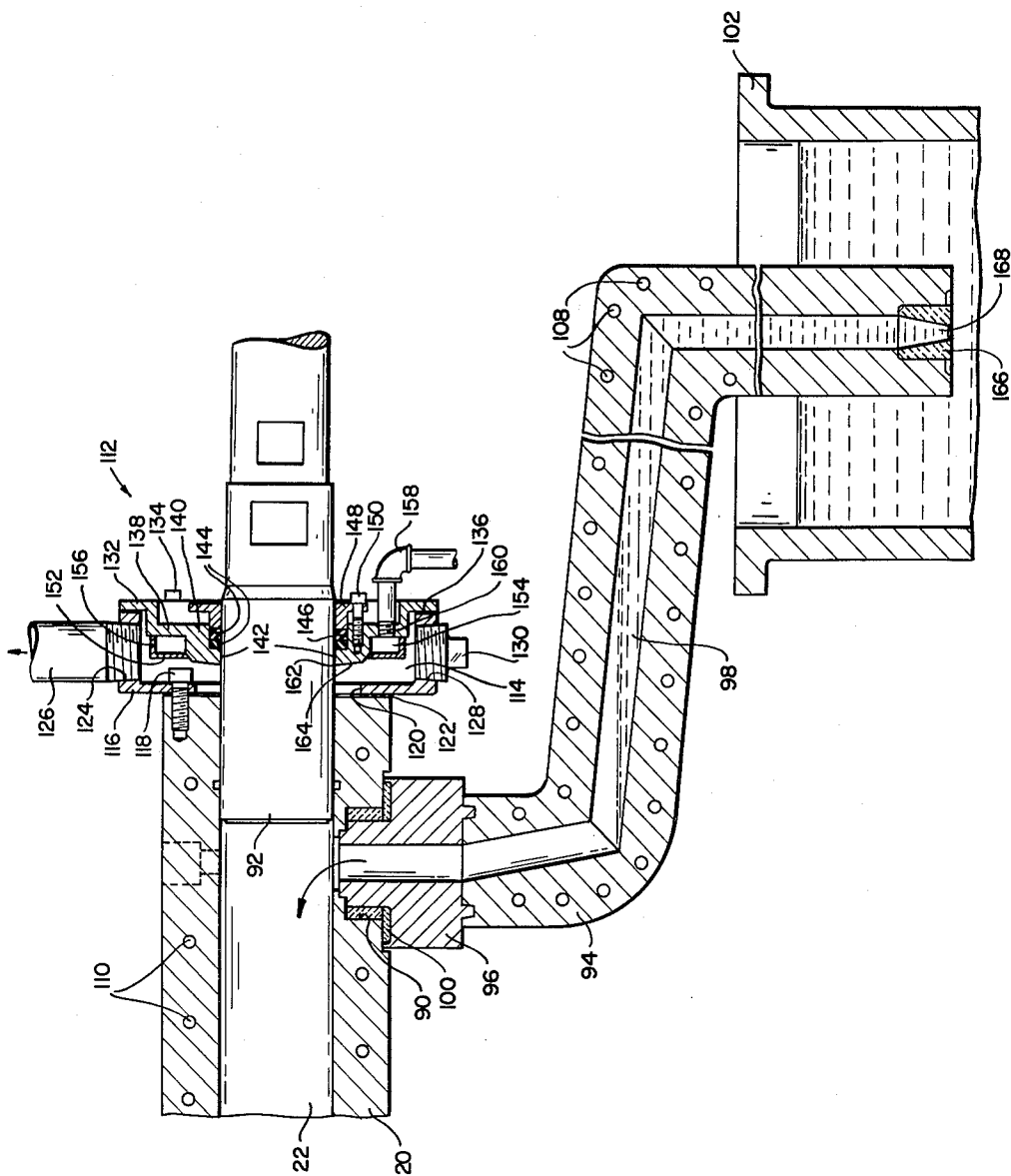


FIG. 3

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APPARATUS FOR VACUUM FEEDING A DIE CASTING MACHINE

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3 Claims. (Cl. 22—68)

This invention relates to die casting machines of the type wherein the delivery of molten casting material to a charging chamber communicating with a die cavity is accomplished by evacuating said chamber while a source of supply of molten casting material therefor is subjected to atmospheric pressure. More particularly, the invention relates to improved apparatus for effecting vacuum feeding of molten casting material from a source of supply of said material to the charging chamber of a die casting machine.

It is the general object of the invention to provide improved vacuum feed apparatus which includes means adapted to permit the establishment and maintenance of a vacuum in a die casting machine charging chamber which is of a higher degree than has heretofore been obtainable, and which also includes improved means for controlling the flow of molten casting material from a source of supply to the charging chamber, a known and uniform rate of flow of molten material with a minimum of turbulence being thus effected with the result that the size of each charge of molten material supplied to the charging chamber may be more precisely controlled than has heretofore been possible.

In fulfilling this general object of the invention, an improved sealing means is provided for positively preventing the flow of atmospheric air into the charging chamber of a die casting machine. The said sealing means is associated with the usual reciprocable ram which is provided for transferring charges of molten casting material from the charging chamber to the die cavity and is adapted to positively prevent the flow of atmospheric air along said ram and into the charging chamber when the said ram is retracted and a charge of molten casting material is being supplied to said chamber from a source of supply. There is additionally provided a wiping means which is also associated with the reciprocable ram and which serves to remove any casting material which may adhere to said ram. It will be apparent that the said wiping means contributes to the maintenance of a vacuum of superior degree in the charging chamber when consideration is given to the presence of solidified casting material on the ram as a possible cause of scoring of the charging chamber walls which will permit atmospheric air to leak past the ram and into the said chamber.

Further, in fulfilling the general object of the invention, there is provided a means defining a metering orifice in a fluid passageway which extends between a source of supply of molten casting material and the charging chamber. The rate of flow of molten casting material from the source of supply to the charging chamber is dependent upon the size of the metering orifice and thus the size of each charge of molten material supplied to the charging chamber is dependent upon said orifice size and is subject to control or regulation. By reason of the particular shape of the metering orifice and the location thereof in the fluid passageway which connects the source and the charging chamber, turbulence in the molten material flowing in said passageway and in the charging chamber is reduced to a minimum.

The drawings show a preferred embodiment of the invention and such embodiment will be described, but

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it will be understood that various changes may be made from the construction disclosed, and that the drawings and description are not to be construed as defining or limiting the scope of the invention, the claims forming a part of this specification being relied upon for that purpose.

Of the drawings:

FIG. 1 is a fragmentary sectional view of a vacuum die casting machine embodying the present invention and showing the parts of the machine in the positions occupied when molten material is being delivered from a source of supply to the machine charging chamber;

FIG. 2 is a fragmentary sectional view similar to FIG. 1, but showing the parts of the die casting machine in the positions occupied after the molten casting material has been forced by the reciprocable ram from the charging chamber into the die cavity; and

FIG. 3 is an enlarged fragmentary sectional view showing the improved vacuum feed apparatus of the present invention in greater detail.

While the invention is not so limited, its advantages are particularly well illustrated by a consideration of the use of the regulating apparatus thereof in a vacuum die casting machine of the type described in United States Patent No. 2,799,066 and in the copending application of Morgenstern, Serial No. 662,888, now Patent No. 2,904,861, granted September 22, 1959. A fragmentary showing of a vacuum die casting machine of the Morgenstern type is presented in the drawings and a general description of the machine deemed adequate for an understanding of the present invention is given below. For details of construction and operation of the die casting machine, reference may be had to the aforesaid patent and more particularly to the copending application.

In a vacuum die casting machine of the Morgenstern type, there are provided two relatively movable dies which may be engaged to define a die cavity therebetween. Surrounding the two relatively movable dies is a multi-section hood or enclosure which is adapted to be opened and closed to the surrounding atmosphere with relative die movement and which has associated therewith an evacuating means. A charging chamber which communicates at its discharge end with the die cavity is also provided and associated with said chamber is a reciprocable ram which is advanced to impel charges of molten casting material from the chamber to the die cavity. The charging chamber is connected by a suitable fluid passageway with a source of supply of molten casting material which is at a lower elevation than said chamber and which is subjected to atmospheric air pressure, the connection of said passageway with the charging chamber being effected forwardly of the reciprocable ram when said ram is in a retracted position.

The die casting machine is operable in cycles and during an initial part of each cycle of operation thereof relative movement of the dies is effected to establish a closely spaced relationship therebetween. Concurrently, the hood or enclosure surrounding the dies is closed to the atmosphere and the evacuating means associated therewith is operated to evacuate the same. Evacuation of the hood results in evacuation of the open die cavity, the charging chamber and the fluid passageway extending from the chamber to the source of supply of molten casting material whereupon the flow of molten material from the source to the charging chamber is induced. A dam which is supported on one of the dies and which extends into the discharge end of the charging chamber when the dies are positioned in closely spaced relationship as stated blocks a lower portion of the said chamber discharge end to retain the molten material in the chamber.

When a charge of molten material of desired size has been thus delivered to the charging chamber, relative movement of the dies is effected to engage the same and to define an evacuated die cavity therebetween whereupon the reciprocable ram is advanced to force the molten material over the dam and into the die cavity. The molten material in the die cavity is cooled and solidified. The hood or enclosure is then opened to the atmosphere and the dies are separated, the casting which has been produced being carried on one of the said dies. The casting is disengaged from said one die by a suitable ejecting means during separation of the dies and the reciprocable ram is retracted whereupon the machine is conditioned for a succeeding cycle of operation.

Referring now to the drawings and particularly to FIGS. 1 and 2, it will be observed that there is included in the fragmentary illustration of the die casting machine a die assembly indicated generally at 10 which comprises a stationary or fixed die member 12. The die member 12 is supported on the face of a stationary platen 14 which is supported on and extends upwardly from a table-like machine base 16, only a portion of which is shown. The platen 14 also supports one end of each of four longitudinally extending tie bars 18, 18, the opposite end of each of said tie bars being supported by a suitable upright plate (not shown). The front portion of a charging cylinder 20 within which a charging chamber or bore 22 is defined extends into axially aligned openings 24 and 26 formed respectively in the stationary die member 12 and in the platen 14. The forward or discharge end of the chamber 22 opens through the face of the said stationary die member 12.

The die assembly 10 also comprises a movable die member 28 which is supported by a plurality of posts 30, 30 in longitudinally spaced relationship with a movable die plate 32. The die plate 32 is secured to the face of a platen 34 which extends upwardly from the machine base 16 and which is supported thereon and on the tie bars 18, 18 for longitudinal movement. Shown connected to the platen 34 is a portion of a toggle device 36 which constitutes a part of the operating means for moving the said platen along the tie bars 18 so that the die member 28 is moved toward and away from the stationary die member 12. For a description of the said operating means, reference may be had to the previously mentioned copending application.

Supported at a central portion of the movable die member 28 and extending longitudinally from the face thereof is a dam 38. The dam 38 is shaped to fit within the forward or discharge end of the charging chamber or bore 22 to prevent the premature introduction of molten material from said chamber or bore into the space between the die members 12 and 28. A runner 40 formed along the top of the dam 38 provides communication between the said space and the charging chamber.

In the space between the movable die member 28 and the die plate 32, there is provided an ejecting mechanism comprising a head plate 42 and a plurality of ejecting pins 44, 44. The ejecting pins 44 are respectively secured at one end to the head plate 42 and are slidably received in suitable bores formed in the die member 28 and the dam 38. A plunger 46 has its forward or front end secured to the head plate 42 of the ejecting mechanism and extends rearwardly through axially aligned bores in the die plate 32 and the movable platen 34. When the movable platen 34 is retracted and closely approaches the limit of its rearward movement, the plunger 46 engages a stop (not shown) and its rearward movement is terminated. The continued movement of the platen to its rearward limit thereafter results in relative movement between said platen and plunger and between the ejecting pins 44 and the movable die 28, the front ends of said pins being urged

outwardly from the face of said die and the face of the dam 38 to dislodge the casting.

A vacuum hood or enclosure which surrounds the dies 12 and 28 in the die casting machine is shown as being formed in two sections which are adapted to be opened and closed to the surrounding atmosphere with relative die movement. A first section of the hood or enclosure indicated generally by the reference numeral 48 is supported on the stationary platen 14 and includes telescoping inner and outer parts 50 and 52. The inner part 50 has a longitudinally extending peripheral wall 54 which is formed integrally with and extends forwardly from a transverse flange 56. The flange 56 is secured to the front face of the stationary platen 14 as by suitable screws not shown.

The outer part 52 of the hood section 48 has a longitudinally extending peripheral wall 58 which surrounds a front portion of the peripheral wall 54 of the part 50 and which is adapted to slide longitudinally over said wall. A flexible wall section or bellows 60 has its front and rear edges respectively secured by suitable means to the telescoping peripheral walls 58 and 54 of the outer and inner parts 52 and 50 to form a leak proof chamber 62 around the periphery of said wall 54 of the inner part 50. The rear end of the peripheral wall 58 of the outer part 52 is disposed in said chamber 62 and has secured thereto a gasket 64 which slidably engages the peripheral wall 50 of said inner part. At the front end of the peripheral wall 58 of the outer part 52 there is formed integrally a transversely outwardly extending flange 66. Suitable spring means not shown bias the outer part 52 of the section 48 forwardly so that said hood section is normally maintained in an extended condition as illustrated in FIG. 1 of the drawings.

A second section of the vacuum hood or enclosure which is indicated generally by the reference numeral 68 is supported on the longitudinally movable platen 34. The said section includes a part 70 which is secured to the face of the platen 34 and also includes upper and lower parts 72 and 74 which are detachably secured to said part 70. The two detachable parts 72 and 74 are provided to facilitate maintenance of the dies 12 and 28 and other machine parts disposed within the hood. The part 70 of the hood section 68 has a forwardly offset lower portion 76 and carries a seal 78 which extends around the said part at its forward edge. The upper and lower parts 72 and 74 which are detachably connected to the part 70 are separated by a horizontal plane and said parts each have a longitudinally extending peripheral wall. The rear end portions of the peripheral walls of the parts 72 and 74 respectively surround upper and lower portions of the forward end portion of the part 70 and engage the seal 78, the wall of the part 74 being shorter than the wall of the part 72 so that the forward ends of said walls lie in a common transverse plane. Extending around the said forward ends of the parts 72 and 74 are similar transverse flanges 80, 80 which carry similar angles 82, 82. The flanges 80, 80 and angles 82, 82 define a peripheral channel around the parts 72 and 74 which receives a two-part seal 84 arranged to engage the aforementioned transverse flange 66 of the hood section 48.

From the foregoing, it will be seen that when the platen 34 is moved to the position shown in FIG. 1, the seal 84 at the forward edge of the hood parts 72 and 74 will engage the flange 66 on the hood part 52 to provide an air-tight chamber around the dies 12 and 28. Thus, the vacuum hood or enclosure is closed to the atmosphere prior to the engagement of the dies 12 and 28 to form a die cavity. It will be observed, however, that with the parts so positioned, the dam 38 enters the discharge end of the charging chamber 22 to block the flow of molten material therefrom. Thus, the hood may be evacuated and by reason of the communication established with the

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charging chamber 22 by the runner 40 in the dam 38, the said chamber will also be evacuated to induce the flow of molten material thereto. As illustrated in FIG. 2, the flexible wall section or bellows 60 collapses allowing the outer part 52 of the vacuum hood section 48 to be moved rearwardly to accommodate additional forward movement of the platen 34, which movement effects the engagement of the dies 12 and 28 and the formation of a die cavity 86 therebetween.

The means for evacuating the hood surrounding the dies 12 and 28 whereby there is provided an evacuated die cavity and whereby vacuum feeding of casting material to the charging chamber of the machine is accomplished are not shown in the drawings. If a detailed description of such evacuating means is desired, reference may be had to the previously mentioned copending application. For the purposes of the present invention, it is deemed adequate to point out that the said hood is connected by a suitable conduit (partially shown at 88) with a suitable evacuating means and that a valve (also not shown) disposed in said conduit is operable in timed relation with movement of the platen 34 to open the conduit for evacuation of the hood and to close the conduit and admit atmospheric air to said hood. As mentioned in the course of the abbreviated operational description of the machine given above, atmospheric air is introduced to the hood after a charge of casting material has been delivered to the die cavity and before the hood is opened to the atmosphere. Such introduction of air assists in the initial chilling of the casting material and prevents damage to the hood parts which might occur in the course of opening same while a vacuum of high degree prevailed therein.

The previously mentioned charging cylinder 20 within which the charging chamber or bore 22 is defined has a radial opening 90 near its rear end which forms an inlet port for the said chamber or bore. There is shown associated with the cylinder 20 a ram 92 which is reciprocable in the said chamber or bore 22 toward and away from the chamber discharge end which opens through the face of the die 12. It will be observed that when the ram 92 is in a retracted position, as shown in FIGS. 1 and 3, the charging chamber inlet port 90 is open for the supply of molten material to said chamber. When the ram is advanced to the position shown in FIG. 2, the inlet port 90 is opened to atmosphere by passage of the ram forwardly thereof, and a charge of molten casting material is forced from said chamber over the dam 38 through the runner 40 therein and into the die cavity 86. The ram 90 is reciprocated in the charging chamber 22 in suitably timed relation with the above described operation of the movable die 28, the two-section vacuum hood, and the evacuating means including the valve in the conduit 88 by operating means which includes an intermittently operable hydraulic motor. For details of said operating means, reference may be had to the previously mentioned copending Morgenstern application.

The fluid passageway which connects the charging chamber with a source of supply of molten casting material, as previously mentioned, is defined within a gooseneck supply pipe or conduit 94 and within an adapter 96. The reference numeral 98 designates the said passageway. As best illustrated in FIG. 3, the adapter 96 is secured to one end of the supply pipe or conduit 94 and has a reduced diameter portion which fits within a heat resistant and air-tight liner or seal 100 disposed in the radial opening or inlet port 90 in the charging cylinder 20. The other end of the supply pipe or conduit 94 is disposed near the bottom of a crucible 102 which holds a supply of molten casting material.

The crucible 102, as best illustrated in FIGS. 1 and 2, is supported by and within a suitable furnace casing 104 at a lower elevation than the charging cylinder 20 and said crucible is open at its upper end, the casting material therein being thus continuously subjected to atmospheric pressure. The furnace casing 104 is supported on the

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base 16 of the die casting machine and disposed therein and beneath the crucible 102 is a heating means which may comprise a gas burner 106.

From the foregoing, it will be apparent that when the parts of the die casting machine are positioned as illustrated in FIG. 1 and the hood surrounding the dies is evacuated, the charging chamber 22 and the fluid passageway 98 communicating therewith will also be evacuated through the dam runner 40. Thus, molten casting material in the crucible 102 will be induced by the pressure of atmospheric air thereon to flow upwardly through the said passageway and into said chamber. Suitable heating elements 108, 108 are shown inbedded in the walls of the conduit 94 for maintaining a desired temperature of the molten material in said conduit and a plurality of small interconnected annular passageways 110, 110 are shown in the walls of the cylinder 20 around the charging chamber 22. Said annular passageways 110, 110 contain a heat transfer medium such as water and serve to insure that the cylinder 20 is substantially uniformly heated by the molten material therein whereby to prevent deformation of the cylinder which might interfere with the free movement of the ram 92.

It will be noted that when the ram 92 is advanced to impel a charge of molten material from the charging chamber 22 to the die cavity 86, as shown in FIG. 2, the fluid passageway 98 is thereby opened to the atmosphere through the rear end of the said chamber and the molten material in the passageway recedes to the level of the material in the crucible 102. It is to be understood that the present invention is not limited to vacuum die casting machines wherein a reciprocable ram associated with a charging chamber operates in such manner to charge the die cavity with molten material and to terminate the flow of said material to the charging chamber. The apparatus of the present invention may be advantageously used, for example, in a die casting machine which includes a relatively long plunger which does not open the inlet port to the charging chamber when it is advanced so as to terminate the flow of molten material to said chamber. Moreover, the said apparatus, as indicated and as will become apparent from the description thereof which follows, may be used to advantage in any die casting machine wherein the delivery of molten material to a charging chamber is accomplished by evacuating the chamber while the source of supply of molten material therefor is subjected to pressure other than or in addition to atmospheric pressure.

In accordance with the invention and as previously mentioned, an improved sealing means is provided for preventing the flow of atmospheric air along the reciprocable ram and into the charging chamber of a die casting machine. A vacuum sealing device indicated generally by the reference numeral 112 and best illustrated in FIG. 3 of the drawings constitutes the presently preferred form of sealing means. As shown, the said device includes means for defining an annular air-tight enclosure or chamber 114 around the reciprocable ram 92 rearwardly of the inlet port 90 for the charging chamber and means for effecting a communicative connection between said annular chamber and an evacuating means. When a vacuum is established in the said annular chamber 114, atmospheric air which might otherwise flow forwardly along the ram 92 in retracted position and into the charging chamber 22 is diverted into said annular chamber.

The air-tight annular chamber 114 is shown as defined within a two-part cap which is secured to the rear end of the charging cylinder 20 and through which the reciprocable ram 92 extends. A first generally cup-shaped part 116 of said cap has its base attached to the rear end of the cylinder 20 by suitable screws 118 (one shown) and opens rearwardly or from said cylinder, the ram 92 extending through a circular opening 120 in the base of said cup-shaped part. Located adjacent the edge of said opening 120 and held tightly between said base and the end of the charging cylinder 20 is an annular seal

122 which is preferably of carbon or other heat resistant material. Formed in an upper portion of the rearwardly extending side wall of the part 116 is a first radial opening 124 which is adapted to receive and fit one end of an evacuating conduit 126. The conduit 126 extends from said opening 124 to the conduit 88 between the valve in said conduit and the vacuum hood or enclosure. In a lower portion of the side wall of the cup-shaped part 116 there is formed a second radial opening 128 which is adapted to receive and fit a removable clean-out plug 130.

A circular cover plate 132 constitutes the second part of the end cap for the charging cylinder 20. Suitable screws 134, 134 (one shown) secure the said cover plate at an outer edge portion thereof to the rear end surface of the side wall of the cup-shaped part 116, an annular seal 136 of carbon or other heat resistant material being clamped tightly between said wall end surface and cover plate. An annular portion 138 of the cover plate 132 adjacent the outer edge portion thereof is offset axially so as to project forwardly into the cup-shaped part 116 and a central portion 140 of said cover plate is further offset axially in the same direction. Formed in the said central portion 140 of the cover plate 132 is an axial opening 142 through which the ram 92 extends. Two ring seals 144, 144, which are preferably formed of a graphite impregnated asbestos, are disposed in an annular recess 146 defined by the ram 92 and the axially extending wall of the central offset portion 140 of the cover plate 132. The seals 144, 144 are held securely in said recess by a retaining ring 148 which may be attached to said cover plate central portion by suitable screws 150, 150 (one shown). Alternatively, the ring 148 may be spring loaded to resist axial rearward movement of the seals 144, 144.

Preferably but not necessarily, there is provided a second annular chamber 154 which is disposed adjacent the annular chamber 114 but separate therefrom and which is adapted to hold a quantity of water or other heat transfer fluid. The water or other fluid cools the parts of the cylinder end cap, particularly the cover plate 132 and the seals 144, 144 and the retainer 148, and insures that said parts are substantially uniformly heated, deformation of the parts which might interfere with free ram movement being thereby avoided. As shown, the end cap includes an annular member 152 which is adapted to be attached to the front surface of the cover plate 132 and to define therewith the annular chamber 154. The inner edge portion of the member 152 is secured by welding or other suitable means to the offset central portion 140 of the cover plate 132. Formed integrally at the outer edge portion of the member 152 is a flange 156 which extends axially rearwardly and which is attached at its end by welding or other means to the annular offset portion 138 of the cover plate 132. A suitable pipe or conduit 158 received in an opening 160 in the cover plate portion 138 supplies water or other fluid to the chamber 154.

From the foregoing, it will be apparent that when the ram 92 is in a retracted position, as shown in FIG. 3, the annular chamber 114 therearound may be evacuated through the conduit 126 to provide a low resistance branch path for atmospheric air which leaks between the ram 92 and the seals 144, 144 toward the charging chamber 22. That is, atmospheric air which might otherwise flow forwardly along the ram and into the charging chamber to lower the degree of the vacuum therein and to cause turbulence in the molten material therein will be diverted into the chamber 114. The evacuating conduit 126 is shown connected to the evacuating conduit 88 between the valve therein and the vacuum hood or enclosure and such connection of the conduit 126 is preferred. The invention is not, however, to be construed as being so limited, it being apparent that the conduit 126 may be connected in various ways either directly to an evacuating

means or indirectly with such means through a connection with an evacuated enclosure or passageway.

Preferably, a valve 127 is disposed in the vacuum line 126 and is arranged for operation selectively to connect that line with the main vacuum conduit 88 to establish a vacuum in the chamber 114 or to vent the said chamber to atmosphere through a vent conduit 129 connected with the said valve. In the preferred manner of operation, the valve 127 is opened to vent the chamber 114 at substantially the same instant the ram 92 is started forwardly in the feed stroke, and the said valve is closed when the ram is started rearwardly from the advance position. Thus, it is convenient to have the valve 127 operated by the same control means (not shown) which operates the ram.

The previously mentioned wiping means which prevents scoring of the charging chamber walls by solidified casting material which adheres to the ram 92 whereby to prevent air leakage to said chamber may take various forms within the scope of the invention. In the preferred embodiment of the invention shown, the ram 92 is wiped clean of solidified casting material during its rearward movement by a front edge portion 162 of the central offset portion 140 of the cap cover plate 132. The size of the opening 142 through said plate central portion which receives the ram 92 is such that the front edge portion 162 engages or is in closely spaced relationship with the ram surface. A portion 164 of the front surface of the plate central portion 140 adjacent the edge portion 162 is inclined rearwardly from the said edge portion so that a relatively sharp forwardly facing edge is formed. Thus, when the ram is retracted after forcing a charge of molten material into the die cavity 86, solidified casting material which may adhere to the ram is wiped or peeled therefrom by the said edge portion 162. The material thus removed from the ram falls to the bottom of the annular chamber 114 and may be removed periodically by means of the aforesaid clean-out plug 130.

An important feature of the invention is the provision of improved means for controlling the flow of molten casting material from a source of supply to the charging chamber of a die casting machine. In the preferred embodiment of the invention shown, an insert 166 which defines a metering orifice 168 of selected size is provided at the inlet end of the goose-neck supply conduit 94 for the charging chamber 22. It will be apparent that with an orifice of selected size, a known rate of flow of molten material through the conduit 94 will be established for a known pressure difference between the charging chamber 22 and the surrounding atmosphere. Thus, with a known period of time during which such flow occurs (i.e., the period of time that the ram 92 remains in a retracted position) the size of the charge of molten material delivered to the charging chamber may be accurately controlled. In order to accommodate different casting operations wherein charges of molten material of different sizes are required, a number of additional inserts adapted to be interchanged with the insert 166 and respectively having different size orifices may be provided.

While the insert 166 is shown located at the inlet end of the conduit 94, it is to be understood that the metering orifice may be otherwise positioned in the said conduit within the scope of the invention. In accordance with the invention, however, the said orifice is positioned in the said conduit a substantial distance from the charging chamber 22 and is formed to diverge toward said chamber as shown. As a result of the particular form of the orifice and its position in the passageway connecting the charging chamber with its source of supply, turbulence in the molten material flowing through said passageway and into the said chamber is substantially reduced.

From the foregoing, it will be apparent that an improved vacuum feed apparatus for and method of die casting have been provided. The vacuum sealing device and the wiping means provided at the rear end of the

charging cylinder 20 positively prevent the flow of atmospheric air forwardly along the reciprocable ram 92 and into the charging chamber 22. As a result, a vacuum of superior degree may be established and maintained in the said chamber and turbulence in the flowing molten material as it passes the front end of the reciprocable ram is substantially reduced. The metering orifice provided in the supply conduit for the charging chamber is so constructed and is so arranged in the said conduit that turbulence in the flow of molten material is further reduced. Thus, a regulated and uniform flow of molten material to and in the charging chamber is effected, premature spilling of material over the dam at the discharge end of said chamber due to excessive turbulence is avoided, and the size of each charge of molten casting material supplied to the chamber may be controlled with a high degree of accuracy.

The invention claimed is:

1. In a die casting machine of the type having dies which cooperatively define a die cavity, the combination of a charging cylinder having a charging chamber communicating at one end with the atmosphere and at the other end with the die cavity and provided with an inlet port connectible with a source of molten material subjected to pressure sufficient to force flow of the material to the charging chamber when the charging chamber is evacuated, a ram reciprocable in the charging chamber between a retracted position adjacent said one end of the charging chamber and an advanced position adjacent the other end thereof, and means cooperating with the ram only in its retracted position to define an air-tight enclosure therearound, said enclosure defining means and said charging chamber being independently connectible with means to establish a vacuum whereby to induce the flow of molten material to the charging chamber without the flow of air along said ram.

2. In a die casting machine of the type having dies which cooperatively define a die cavity, the combination of a charging cylinder having a bore defining a charging chamber communicating at one end with the atmosphere and at the other end with the die cavity and having a port between its ends which is connectible with a source of molten material subjected to pressure sufficient to force flow of the material to the charging chamber when the charging chamber is evacuated, a ram reciprocable in the charging chamber between a retracted position wherein it projects from said one end of the charging chamber and an advanced position adjacent the other end thereof, the charging chamber port being open forwardly of the ram in its retracted position and rearwardly of the ram in its advanced position, and a cap secured to the cylinder at said one end of the charging chamber to

surround the ram only in its retracted position and to define an air tight enclosure therewith; said cap and the die cavity being adapted for independent connection with means to establish a vacuum in the die cavity, the charging chamber and the enclosure whereby to induce flow of molten material to the charging chamber while the ram is retracted without the flow of air along said ram, the enclosure and the charging chamber rearwardly of the ram being subjected to atmospheric pressure when the ram is advanced to cut off the flow of molten material to the charging chamber.

3. In a die casting machine of the type having dies which cooperatively define a die cavity, the combination of a charging cylinder having a bore defining a charging chamber communicating at one end with the atmosphere and at the other end with the die cavity and having a port between its ends which is connectible with a source of molten material subjected to atmospheric pressure, a ram reciprocable in the charging chamber between a retracted position wherein it projects from said one end of the charging chamber and an advanced position adjacent the other end thereof, the charging chamber port being open forwardly of the ram in its retracted position and rearwardly of the ram in its advanced position, a cap secured to the cylinder at said one end of the charging chamber having a hollow interior and seal means surrounding the ram only in its retracted position to define an air tight enclosure therewith, and said cap having a scraper member surrounding the ram at the retracted position thereof; said cap and the die cavity being adapted for independent connection with means to establish a vacuum in the die cavity, the charging chamber and the enclosure whereby to induce the flow of molten material to the charging chamber while the ram is retracted without the flow of air along said ram, the enclosure and the charging chamber rearwardly of the ram being subjected to atmospheric pressure when the ram is advanced whereby to cut off the flow of molten material to the charging chamber, and the scraper member being operable while the ram is being retracted to discharge any residue collected thereon into the hollow interior of said cap.

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