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3,108,339

DIE CASTING MOLD BREATHER

Filed May 20, 1959

2 Sheets-Sheet 1

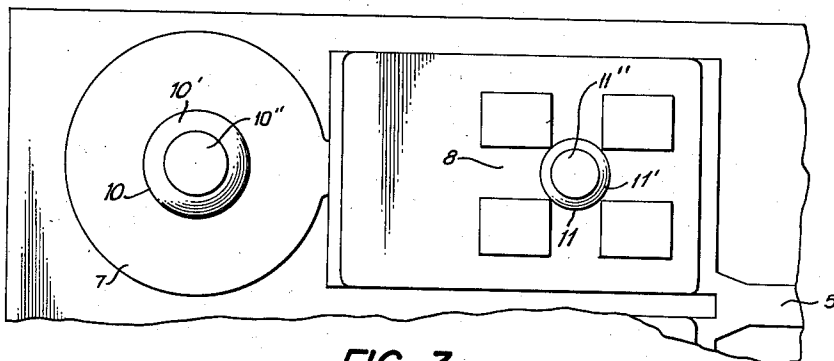


FIG. 3

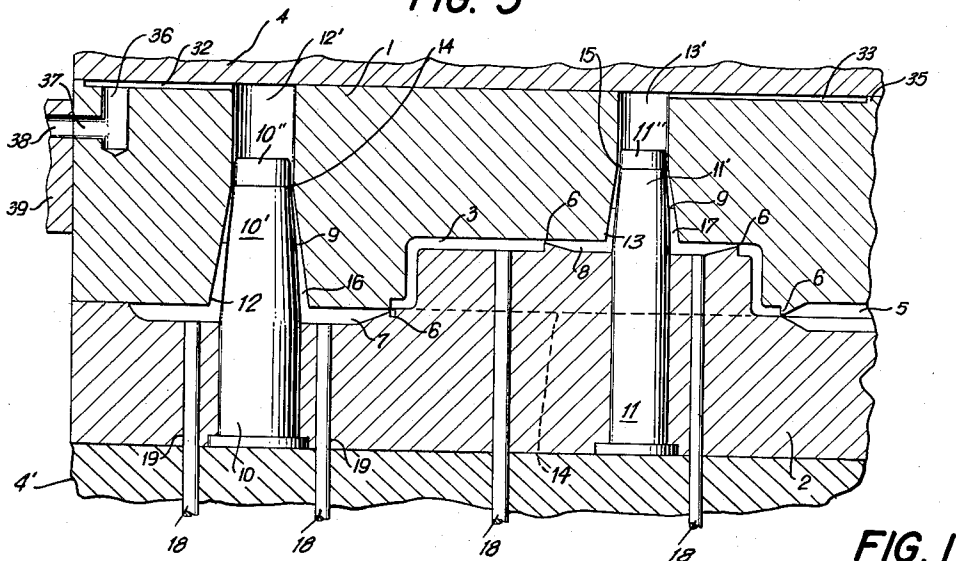


FIG. 1

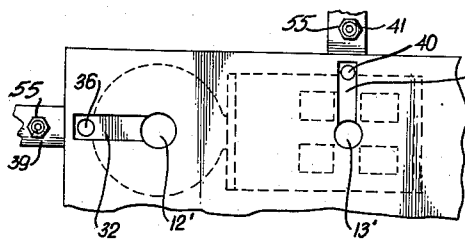


FIG. 4

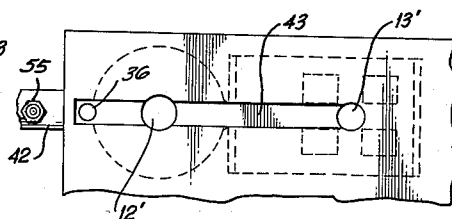


FIG. 5

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2 Sheets-Sheet 2

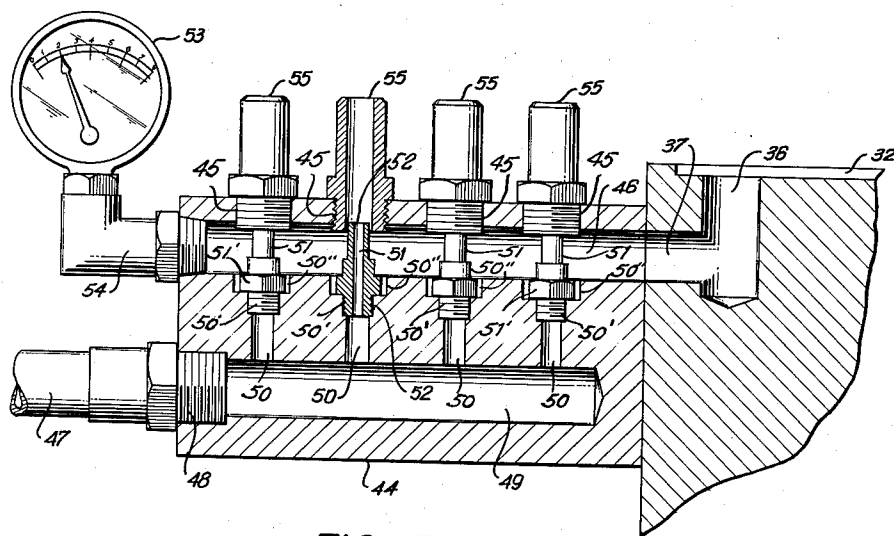


FIG. 7

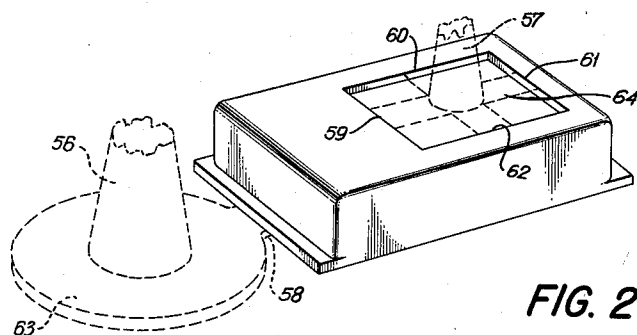


FIG. 2

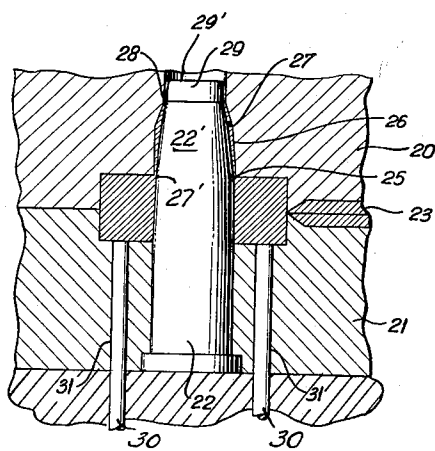


FIG. 6

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3,108,339

DIE CASTING MOLD BREATHER

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This invention relates to pressure die casting and more particularly to an improvement in the construction of the molds or dies whereby the flow of metal into and throughout the mold cavity is controlled and facilitated by the improved means for the expulsion of air from the mold cavity by the injected molten metal.

In the formation of die casting dies, the practice has been to form narrow vents comprising wide, shallow grooves having a depth of, say, .005" or less in the meeting faces of one or the other of the dies constituting a mold, said grooves leading from the mold cavity to the outside of the dies. Reference to such current practice will be found in the book entitled "Die Casting" by Charles O. Herb, published by The Industrial Press, copyright 1952, Second Edition, page 70, and in the book entitled "Die Casting" by H. H. Doehler, published by McGraw-Hill Books, copyright 1951, at page 84. Thus, venting has been possible only at the parting line of the dies. There have been proposals to vent the dies elsewhere by openings containing porous metal plugs but these soon fill with the molten metal.

Upon charging the mold cavity with molten metal, the air is forced out of these vents and if any air should be trapped in the mold cavity, a porous casting results. The molten metal extrudes part way into the vents before becoming chilled sufficiently to prevent further movement and thus seals the vents so that the final casting pressure can be applied. Obviously, if the vent were so wide as not to allow this self-sealing action, the die would be useless. The metal thus entering the vents leaves a fin on the casting which then must be removed.

These shallow vents often become at least partially closed either by the metal soldering itself to the groove or vent surface or by incrustation of carbon from any lubricant that may be applied to the dies. This, then, adds to the back pressure of the expelled air and results in porous castings. The removal of such metal or incrustation from these vent grooves without increasing the depth thereof to an extent unable to stop the molten metal from being expelled therefrom and without marring the cavity surface is a delicate and costly operation.

In efforts thus to remove the air from the mold cavity in advance of the incoming metal, many proposals have been made to enclose the meeting faces of the die with a vacuum means so that, in theory at least, all of the air or at least a significant part thereof will have been removed from the mold cavity before the "shot" is made. These proposals fail to take into account the fact that if the die vents should be partly or wholly plugged, the mold cavity may not have been sufficiently evacuated to produce a non-porous casting. Obviously, these vacuum devices make it impossible to determine whether or not the die vents are operating properly and the operator can only hope that the die or mold cavity is properly evacuated at the time he causes the metal to be injected.

The present invention takes into account all of these prior art difficulties and shortcomings and is directed to means for permitting the expulsion of air from the mold cavity at points other than the die meeting faces. To distinguish from the vents commonly employed on the meeting faces of the dies heretofore employed, the orifices employed in the present invention for allowing air to be expelled from the mold cavity will be designated as "breathers" since air actually moves therethrough both

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into and out of the mold cavity as will hereinafter be appreciated in connection with the description of the manner of use of these breathers. Moreover, as will also be explained in detail as the description of the invention proceeds, by choosing the position in the die for the various breathers and controlling the rates of air flow through individual breathers, the direction of flow of the molten metal through the mold cavity can be made to follow a pattern which will insure the filling of the cavity in the least possible time, wherefore, the danger of meeting streams of the metal in the die forming cold shuts will be eliminated.

An object of this invention is to provide an improved mold breather structure to enable air and gases to be expelled from the mold cavity at one or more points other than the meeting faces of the dies constituting the mold.

Another object of this invention is to provide an improved breather effective to permit the expulsion of air and gases from the mold cavity by the entry of the molten material into a die casting mold while preserving the integrity of the meeting faces of the dies forming the mold cavity.

Still another object of this invention is to provide a mold breather which is adaptable for location in areas of a mold cavity which would be unsuitable or impossible for vents used heretofore.

Still another object is to provide a mold breather which may be employed to control the amount of back pressure exerted by the expulsion of air from the mold cavity incident to the entry of the molten metal with reduction of the possibility of porosity of the casting.

Still another object is to provide an improved mold having a cavity so constructed that the metal or material to be cast therein will quickly flow to all parts of the mold and which the resulting casting is characterized by an absence of "flash" at the parting line of the dies constituting the mold.

A further object is to provide a mold breather which will permit changes to be made in the rate of air flow therethrough with resultant changes in the flow pattern of the molten material injected into the mold cavity.

These and other objects of the invention not specifically set forth above will be readily apparent from the accompanying description and drawings of certain presently preferred embodiments of the invention and in which:

FIGURE 1 is a fragmentary sectional view taken on a plane passing through the mold cavity portion of a pair of die casting dies showing details of two mold breathers of this invention.

FIGURE 2 is a perspective view of an untrimmed casting taken from a mold cavity comprising the dies shown in FIG. 1 and using the mold breathers of this invention; the overflow metal cast in the mold breathers being shown in phantom.

FIGURE 3 is a fragmentary view of the cavity surface of the die comprising the lower section of the mold shown in FIGURE 1.

FIGURE 4 is a view of the platen engaging surface of the top die of the mold of FIGURE 1 showing means for attaching a separate vacuum line to each of two breathers of the present invention for purposes hereinafter to be described.

FIGURE 5 is an alternative configuration of the die surface of FIGURE 4 showing means for attaching a single vacuum line.

FIGURE 6 is a sectional view of a mold in which the breather of this invention extends directly from the casting.

FIGURE 7 is a sectional view of a vacuum device

suitable for the new and novel use of vacuum employed in the present invention.

Heretofore, the only function of a mold vent has been to allow air and gases to escape from the cavity of a die or mold as the metal or other material to be cast is injected into the mold. However, if the capacity of the vents for air flow is too limited, the air tends to develop a back pressure in direct relation to the volume of metal injected within a given time. This back pressure may result in some of the air being entrapped by the cast metal. One function of the novel breather construction of the present invention is to reduce and control this back pressure and thereby minimize the possibility of porosity in the casting.

The construction of the breather of the present invention allows rapid but controlled escape of air and gases but, like the vents heretofore used, it is restrictive of the molten casting metal by reason of the viscosity thereof and similarly prevents the flow of metal therethrough to permit the final injection pressure to be imposed before the metal can escape from the breather.

Additionally, the breather construction of the present invention possesses advantages not heretofore available in the die casting art. First, it provides a means for pre-determining the flow pattern of the injected metal throughout the mold cavity. Second, it affords a means for determining that the metal can enter the mold cavity without deleterious back pressure opposition. Third, it makes unnecessary the complex "full vacuum" casting machines and processes heretofore employed in an effort to achieve non-porous castings.

Referring now to FIGURE 1, there is shown a fragmentary cross section of a mold suitable for casting a shallow, rectangular, open-sided, box-like object having an opening in one wall such as shown in FIG. 2. In the formation of this casting, two breathers of the present invention are employed. FIGURE 2 is a perspective view of the casting made by means of the mold of FIGURE 1. The material cast in the novel passages leading to the breathers is shown by the dotted outline 56 and 57. This surplus material is trimmed off at points 58-62, after the casting is removed from the mold. In one instance, a pad surplus metal has been cast in pocket 63 having a circular shape whereas the other breather projects from a cruciform pocket 64. It should be understood that any configuration of pocket suitable to the casting involved may be employed, and, as will be shown later, such pocket may be dispensed with altogether if the form of the casting permits.

In conventional die casting machines, the mold is composed of two die sections which separate when the machine is opened to permit removal of the casting. These sections are carried by two relatively movable platens of a die casting machine as is well known to those skilled in the art. The use of the terms "upper" and "lower" as applied to the drawings will be understood to relate only to the drawings and it will be understood that the dies shown may be employed either in vertical or horizontal die casting machines. Looking now at FIGURE 1, the mold vent is formed by dies 1 and 2 which define the mold cavity 3. The upper platen of the die casting machine is shown at 4 and the die supporting block for the lower die is shown at 4'. Molten metal is injected from the shot cylinder of the machine through sprue hole 5. Gates or bleed passages 6 for the molten metal can be located at a number of points around the edge of the mold cavity so that during die casting under pressure, the metal may be forced through cavity 3 towards overflow pockets 7 and 8. This arrangement will insure expulsion of air from cavity 3 and will also insure that the portion of the cavity occupied by the casting, per se, is completely filled with metal. It should be understood that overflow pockets may or may not actually be required, this being determined by actual molding conditions.

As above mentioned, die casting mold cavities have heretofore been vented to atmosphere through one or more very small passages extending from the mold cavity to the edges of the dies, this being usually a distance of not less than about $1\frac{1}{2}$ ". Thus, the air expelled from the mold cavity is subjected to high resistance through this long passage or vent. Also, as has been previously mentioned, the small cross-sectional area of the vent would tend to cause any metal which entered it to solder to the mold sections. This soldered metal is very difficult to remove, and if not removed, will plug the vent and cause malfunctioning during succeeding casting operation.

This difficulty is overcome by the novel breather of the present invention wherein the meeting faces of the dies are uninterrupted by vents and means is provided to afford escape passages for expelled air through one or the other of the dies.

Specifically, the breathers of the embodiment of the invention shown in FIGS. 1 through 5 comprise frusto-conical bores 12 and 13 disposed with the larger ends thereof communicating with the portions of the die cavity forming the centers of the casting portions 63 and 64 and thence extend to a point inwardly from the outer face of the die and thence continuing to said outer face as straight bore portions 12' and 13' of the same diameter as the smaller diameters of said frusto-conical bores. Cooperating with said breather bores are core members 10 and 11 carried by the die 2 and disposed to enter said bores; said core members having frusto-conical portions 10' and 11', respectively, beginning at the planes of the cavity surfaces in the die 2 from which they project and terminating at the plane of termination of the bore with which they respectively enter, said bores thence continuing into the straight bore portions 12' and 13' with straight cylindrical portions 10'' and 11'', respectively. The angle of the frusto-conical portions 10' and 11' of the cores 10 and 11 is slightly less than the angle of the frusto-conical bores with which they cooperate, thus forming hollow, frusto-conical cavities 16 and 17 and the clearance between the cores and the bores at the smaller ends thereof forms breather passages 14 and 15 of such limited clearance that air can freely flow therethrough but which, like the prior art vents, will not permit the molten metal to pass therethrough. Thus, as the molten metal enters the mold cavity driving out the air therefrom, it will also enter the breather cavities as far as the clearance between the bores and cores will permit and will eventually seal itself off in a usually ragged edge as indicated at the outer ends of the portions 56 and 57 shown in FIG. 2. As the metal cools and congeals it will shrink on to the cores 10 and 11 so that when the dies are separated, due both to the shrinkage of the metal to the cores and to the fact that the metal entering the breather cavities is of gradually increasing thickness toward the mold cavity, together with the fact that the faces of the tapered bores present a most favorable draft angle, all of the metal which has entered the breather cavities will usually pull out completely clean from the breather bores. When the casting is removed from the mold, the surplus portions 63 and 64 together with the portions 56 and 57 thereof which have entered the breather cavities are removed by shearing them from the casting at the various gates 6. It is to be noted particularly that the metal does not enter and seal off any breather cavity until the portion of the mold cavity served by that breather has been completely filled.

It will be noted that the restricted portions of the breather passages are very short, thus appreciably reducing the frictional resistance thereof to the escaping air. Moreover, since they are circular, they can be of much greater capacity than is possible with the prior art vents formed in the meeting surfaces of the dies, it being noted that a breather passage of $\frac{1}{2}$ " diameter is equivalent to a die surface vent $1\frac{1}{2}$ " wide. Still further, the

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various breathers for a single casting may be of different diameters and of different clearances so that the optimum sequence of metal flow through the various portions of the mold cavity can be predetermined, the metal first flowing toward the breather having the greater capacity for air escape and lastly toward the breather having the more limited rate of air flow therethrough. When all of the breathers are filled with metal and are sealed by the inflowing metal, the final casting pressure can be applied to achieve the desired homogeneity in the casting. In the construction of dies, the usual ejecting pins as at 18 are supplied to eject the casting from the portion of the mold cavity in the die in which the casting is retained after the dies are separated and, in the casting here shown, two of the ejector pins engage the disc like surplus portions 63 formed in the pocket 7, another engages a wall surface of the casting, while still another engages one of the arms of the cruciform surplus portion 8 as thus shown in FIG. 1. The number and location of such ejector pins is such as best suits the particular casting.

Looking now at FIGURE 6 there is shown a sectional view of a die for casting a ring-like object and which employs the breather core as a portion of the molding surface. In this embodiment of the invention, the walls of the mold cavity are defined by upper die 20, lower die 21, and breather core 22. The core 22 is carried by the die 21 and thence extends across the mold cavity. Beyond the mold cavity, it is provided with a tapered portion 22' disposed coaxially within and spaced from the wall surface of the frusto-conical breather bore 27. The tapered walls of the core and bore diverge from a narrow gate portion 27' at the juncture with the mold cavity and then converge to provide a narrow breather orifice 28 between them formed between the straight end portion 29 of the core and the corresponding straight portion 29' of the breather bore. The molten metal is injected through sprue 23 formed by the upper and lower dies. The metal fills mold cavity 24 and then fills the vent cavity 25 to the extent permitted by the approach of the core and vent surfaces toward each other in the formation of the breather orifice 28, the air in the mold cavity being, of course, expelled through the breather as the metal fills the cavity. Removal of the casting from the separated mold sections is facilitated by ejection pins 30 slidably mounted in holes 31 in the die 2. Thus this embodiment is similar to that first described above, the principal difference being that where the form of the casting permits, and overflow pocket can be dispensed with.

By lowering the back pressure of the air within the mold cavity, it is possible to remove more air within a given time than is possible with prior mold vents. This results in a further advantage in that the possibility of porosity in the casting caused by trapped air is, for all practical purposes, eliminated.

When the mold sections are separated, carbon or other extraneous material can be easily wiped or otherwise removed from the core and breather bore surfaces without the possibility of damage to critical die surfaces. Normally, any soldering of metal would collect on the core, rather than on the walls of the aperture, because of the thickness of metal thus forming. In the event that during molding the die is not securely locked up, it may be possible for metal to completely fill the opening beyond the bleed passage. Should this occur, this surplus material can be easily removed by simply punching out the cast material from the aperture through the back of the upper die section.

Many attempts have heretofore been made in the art of die casting to reduce the porosity of castings by exhausting the air and gases within the mold cavity by a vacuum means which isolates the mold cavity from atmospheric pressure while the metal is injected into the mold cavity. The present invention employs a vacuum

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means which could be so employed, if desired, but which has the primary function of making it possible to determine before each "shot" that each individual breather is functioning properly and is not even partially plugged up. Obviously, if there is no possibility that air will be trapped in the mold cavity, the need for expensive vacuum equipment is dispensed with. In those prior art molds in which the entire mold is isolated and subjected to vacuum, there is no possibility of checking the individual vents. It is, of course, necessary in all cases that upon filling the die with metal, that the metal seal off the breathers or vents for application of such pressure to the molten metal in the cavity as the die casting machine imposes.

The air escaping from the breathers of the present invention must be conducted to the exterior of the die without obstruction and since the breathers emerge at the face of the die which is fixed to the machine platen, grooves are formed in the outer or platen engaging face of the die and extend laterally from the breather bores 12 and 13 to combine with the adjacent face of the platen 4 to form air conducting passages 32 and 33. If no vacuum or breather operation test means is to be employed, these grooves can continue to the edge of the die. To attach the vacuum means of this invention to the breathers of this invention, the passages 32 and 33 are terminated short of the edges of the die and are thus sealed off at the points identified as 34 and 35 and vacuum lines are separately attached thereto. In a typical installation, as shown in FIGS. 3 and 7, a hole 36 may be drilled inward from the bottom of the groove 32 and a second hole 37 may be drilled to connect to the first hole from the outside edge of the die. This second hole 37 may be adapted for communication with a vacuum line 38 in a member 39 fixed to the side of the die 1.

There is shown in FIGURE 4 a top view of an upper die section which has been adapted for use with two vacuum lines. The top of apertures 12 and 13 communicate with passages 32 and 33 which may have as their upper boundary the surface of the upper platen 4 of the die casting machine. These passages connect with holes 36 and 40, which in turn connect with vacuum lines in members 39 and 41. As is shown in FIGURE 5, a single vacuum line member 42 may serve to exhaust two breather apertures 12 and 13 via a linking passage 43 forming a continuation of passage 32. Other variations will become apparent to one skilled in the art from the teaching of this invention.

A vacuum applied to line 38 during injection of the molten metal will permit the air and gases to be more readily expelled by the incoming casting metal. The resulting reduction in back pressure will further reduce the possibility of porosity in the casting.

When used to assist the flow of metal in the mold cavity, the vacuum is applied when the casting metal is in the shot cylinder of the die casting machine but before the plunger or a piston of the shot cylinder starts to inject the material through the sprue hole into the mold. This maintains a reduction of the atmospheric pressure within the cavity even though some air may still enter through the shot the ejection pin clearance in the mold or between the juxtaposed faces of the dies. The use of a vacuum to aid in more rapidly exhausting air from the mold cavity will also permit a larger casting to be made before the metal chills. Furthermore, this will permit the casting of structures having thinner wall sections and more detail than has been readily practical heretofore.

By means hereinafter to be described, the application of a vacuum to the breather of the present invention may be used for checking the proper operation of the vents to assure that they are not plugged. A vacuum gage connected to the vacuum line will indicate a predetermined lower desired vacuum when the breather is correctly functioning and a higher vacuum indicated on the

gage discloses that the breather is at least partially obstructed so that remedial steps can be taken before the "shot" is made.

In order to provide the vacuum suitable for exhausting the air from the die cavity, in the manner discussed above, a jet-top type of vacuum producing device such as generally indicated at 44 in FIG. 7 may be employed, it being understood that the body of said device may be the body indicated by any of the numerals 39, 41 or 42 in FIGS. 4 and 5, and the numerals 38 in FIG. 3 and 46 in FIG. 7 indicate identical passages. This is a well-known mechanism, sometimes referred to as a "vacuum-gun" and in the illustrated embodiment employs the venturi-like action of a high velocity jet of air delivered into the inlet end of a discharge nozzle which affords communication between a passage connected to the breather and the atmosphere.

Specifically, in the embodiment disclosed in FIG. 7, the body member 44 includes a passage 49 connected by a fitting 48 and the line 47 to a source of compressed air, it being understood that the line 47 will have valve means to permit and prevent the flow of compressed air to the device. The body 44, further, includes a second passage 46 extending parallel to the passage 49; said passage being in communication with the breather exhaust passage 37 at one end and with a fitting 45 mounting a vacuum gage 53 at the other end. The body 44 is provided with a series of large threaded bores 45 extending into the passage 46 with their axial lines disposed parallel to each other and in a plane containing the axial lines of the parallel passages 46 and 49. Threadedly engaging said bores are the inlet ends of discharge nozzles 55, the outer ends of which are open to atmosphere. Disposed in axial alignment with one each of the bores 45 is one each of an equal number of branch passages 50 extending between the passages 49 and 46; each of said branch passages at the juncture with the passage 46 terminating in a threaded portion 50' and a counterbore 50''; said counterbores being not larger than the internal diameter of the threaded bores 45. Threaded into the portions 50' are the ends 52 of jet nozzles 51, the opposite ends of which are smaller than and project into the axially aligned inlet ends of the discharge nozzles 55. Externally, each of the jet nozzles is provided with a hexagonal section 51' disposed in the counterbore 50''. It will be noted by this arrangement, the jet nozzles are mounted in their bores through the bores 45. The high velocity jet of air entering each discharge nozzle will draw air from the mold cavity through the connection thereof with the breather or breathers to which it is connected. Also, this arrangement permits axial adjustment of the jet nozzles in the discharge nozzles to vary the extent of vacuum produced thereby. It will be understood that while in the illustrated embodiment four "guns" are shown, any number can be employed according to the size of mold cavity and other considerations, and that each device may serve an individual breather or serve two or more breathers if practical to do so in individual molds.

The vacuum means contemplated for use in the present invention is far simpler and less costly than the so-called full vacuum equipment employed in prior die casting machines. That is, the entire machine need not be evacuated and it is not necessary to seal all leaks between the atmosphere and the mold cavity. Prior mold structures, employing the so-called flow vacuum means, have had the problem of the vacuum pulling the metal completely into the runout passages and/or vents. In the present invention, the novel breather construction obviates this difficulty.

Die casting, using the breather checking technique possible with the breather and vacuum means of this invention, typically may follow these steps:

- (1) Closing and lockup of die sections.
- (2) Actuating vacuum device and devices and inspec-

tion of vacuum gage or gages to detect any malfunctioning of the breathers.

- (3) Clean out any breather indicated as malfunctioning.
- (4) Inject metal into mold cavity.
- (5) Open die sections, remove casting, and clean and lubricate cavity surfaces.

The foregoing recitation of steps assumes that the compressed air to the vacuum device will have been turned off after the checking procedure has been completed. If, however, it is desired to maintain some degree of vacuum in the die while the shot is being made, the air can, of course, be left on until the shot is completed and then turned off. At this point it is believed to be appropriate to point out still another reason for the use of the term "breathers." When the vacuum device or devices are in use, air will, of course, be evacuated from the mold cavity to some degree. When the vacuum device is turned off, the air will enter through the breathers and the mold cavity will be subjected to normal atmospheric pressure again by reason of the air being free to enter through the disabled vacuum device and passages thereof and of the die to the breather bores.

The advantage of this procedure is that the operator is assured that the metal will fill the mold and breather cavities without entrapment of air by the metal. The employment of vacuum while the shot is being made is usually advisable only where the area and thinness of the sections of the casting make it desirable to effect filling of the mold cavity with the utmost rapidity to avoid the formation of cold shuts or kindred defects. In general, however, it is sufficient to employ the vacuum device or devices merely to determine that no breather is not functioning correctly. Further, where so doing will improve the flow pattern, vacuum may be applied through less than all of the breathers of a plural breather mold.

The spacing between the core ends 10' and 11' and the walls of apertures 12' and 13' can be varied within limits not permitting the flow of metal therethrough to determine the rate of flow of air from the mold cavity, while the diameter of the core and aperture determines the volume of air released to the atmosphere during the casting operation. Variation in this spacing in each breather attached to a given mold to exert a desired back pressure relative to the back pressure or pressures exerted by another breather or breathers incorporated in that mold. This will result in the desired distribution or flow pattern of the casting metal within the mold cavity. Any number of breathers may be employed and, of course, they are so located that the metal entering from the sprue 5 will push the air and gases within the cavity towards the breathers. For each casting the breathers are located and are of such diameters and clearances and relative rates of flow and volume of air released therethrough as to result in a desired flow pattern within the mold. Where the breathers are located to form an opening in the casting, they can be of any cross sectional configuration required. Otherwise the circular configuration shown is the most practical to employ. The only essential is that suitable relative tapers be maintained between the breather orifice forming components. Normally, this adjustment is effected in the making of the molds, the cores being adjusted grinding away the mounting shoulders or by inserting shims as test casting results may indicate that a change in the relative axial positioning of the core in the mold is desirable. Also, while the channels connecting the breather apertures with atmosphere may most readily be formed in the die as shown, it will be realized that any other means, such as channels or ducts formed wholly in the die or that the duct forming grooves may be in the surface upon which the die is mounted as may be most advantageous for a particular mold. While certain presently preferred embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may

be made without departing from this invention. For example, the breather core and aperture may be rectangular or of a shape other than circular; therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the purview of the invention.

I claim:

1. A mold for use in pressure die casting machines comprising a pair of dies attachable one each to each of the elements constituting the die supporting means of a die casting machine, portions adjacent faces of said dies being shaped, when juxtaposed to define a mold cavity bordered by the meeting faces of said dies and said meeting faces being interrupted only by a sprue hole formed in the said meeting faces of said dies for the conduct of molten metal into the mold cavity, means for permitting the expulsion of air and gases from the mold cavity incident to the entry of molten metal into the mold cavity; said means comprising at least one breather aperture extending through one of said dies from the mold cavity surface toward the face of said one die which is in contact with the machine element on which it is supported and means disposed on the other of said dies to project into said breather aperture when said dies are juxtaposed to form said mold cavity and to cooperate with the wall surface of said breather aperture at a point thereon spaced from said mold cavity to form a narrow orifice through which air and gas can flow but through which the molten metal, by reason of the viscosity thereof, cannot flow, and other means affording communication between the end of said breather aperture remote from said mold cavity with atmosphere.

2. A die casting mold as claimed in claim 1 in which said breather aperture extends to the face of said one die opposite the face which engages the other die and in which the interengaging faces of said one die and of the portion of the machine element to which said one die is secured are shaped to form at least part of said means affording communication between said one end of said breather aperture with atmosphere.

3. A die casting mold as claimed in claim 1 in which said breather aperture from the juncture thereof with said mold cavity surface to said orifice is of decreasing diameter and in which said means cooperating therewith to form said orifice comprises a core member disposed in the axial line of said breather aperture and projecting into said breather aperture when said dies are juxtaposed to form said mold cavity; said core member within said cavity being also of decreasing diameter toward said orifice but at a lesser included angle than the taper of said breather aperture and combining with said breather aperture to form said orifice at said point in said breather aperture remote from said mold cavity.

4. A die casting mold as claimed in claim 1 in which said one of said dies is provided with a plurality of said breather apertures in which the other of said dies is provided with a corresponding plurality of cooperating, orifice forming means, and in which said one die is provided with a single means cooperating with a surface of the machine element on which said one die is mounted to afford communication between all of the ends of said breather apertures remote from said mold cavity and atmosphere.

5. A die casting mold as claimed in claim 1 in which said one of said dies is provided with a plurality of said breather apertures and the other of said dies is provided with a corresponding plurality of cooperating, orifice forming means, and in which said one die is provided with a plurality of said other means cooperating with a surface of the machine element on which said one die is mounted to afford communication between the ends of said breather apertures remote from said mold cavity and atmosphere, at least one of said communication affording means serving one only of said plurality of breather apertures.

6. A die casting mold as claimed in claim 1 in which said other means affording communication between said end of said breather aperture remote from said die cavity and atmosphere includes a hole in a side of said one die adjacent to the face thereof opposite the face which engages said other die.

7. A die casting mold as claimed in claim 3 in which said core member serves additionally to cause the casting to be stripped from said one die upon separation of the dies for removal of the casting.

8. A die casting mold as claimed in claim 4 in which said means affording communication between said ends of said breather apertures remote from said mold cavity and atmosphere includes a single hole in a side of said one die adjacent to the face thereof opposite the face which engages said other die.

9. A die casting mold as claimed in claim 5 in which said means affording communication between said ends of said breather apertures and atmosphere includes a plurality of holes in the side surface of said one die at least one of said holes being connected to afford communication between said end of one only of said breather apertures and atmosphere.

10. A mold for use in pressure die casting machines comprising a pair of dies attachable one each to each of the opposed and relatively moving elements constituting die supporting means of a die casting machine, portions of the adjacent faces of said dies being shaped when juxtaposed to define a mold cavity bordered by the meeting faces of said dies and said meeting faces being interrupted only by a sprue hole formed in the said meeting faces of said dies for the conduct of molten metal into the mold cavity, means for permitting the expulsion of air and gases from the mold cavity incident to the entry of molten metal into the mold cavity; said means comprising at least one breather aperture extending through one of said dies from the mold cavity surface toward the face of said one die which is in contact with the machine element on which it is supported and means disposed on the other of said dies to project into said breather aperture when said dies are juxtaposed to form said mold cavity and to cooperate with the wall surface of said breather aperture at a point thereon spaced from said mold cavity to form a narrow orifice through which air and gas can flow but through which the molten metal, by reason of the viscosity thereof, cannot flow, other means affording communication between the end of said breather aperture remote from said mold cavity with atmosphere, and a pneumatic jet pump device having the intake port thereof connected to said other means effective to evacuate air from said breather aperture and said mold cavity while the jet means of said pump device is in operation.

11. A die casting mold as claimed in claim 10 in which said jet pump device includes a vacuum gauge for indicating the extent of evacuation effected by said jet pump device.

12. A die casting mold as claimed in claim 10 in which said one of said dies is provided with a plurality of said breather apertures and said other die is provided with a corresponding plurality of cooperating core members, and in which said other means affords communication between said ends of all of said breather apertures and atmosphere.

13. A mold for use in pressure die casting machines comprising a pair of dies attachable one each to each of the opposed and relatively moving elements constituting the die supporting means of a die casting machine, portions of the adjacent faces of said dies being shaped, when juxtaposed, to define a mold cavity bordered by the meeting faces of said dies and said meeting faces being interrupted only by a sprue hole formed in the said meeting faces of said dies for the conduct of molten metal into the mold cavity, means for permitting the expulsion of air and gases from the mold cavity inci-

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dent to the entry of molten metal into the mold cavity; said means comprising a plurality of breather apertures extending through one of said dies from the mold cavity surface thereof toward the face of said one die which is in contact with the element on which it is supported in the machine and a corresponding plurality of means disposed on the other of said dies and arranged to project into said breather apertures when said dies are juxtaposed to form said mold cavity and to cooperate with the wall surfaces of each of said breather apertures at a point thereon spaced from said mold cavity to form narrow orifices through which air and gas can flow but through which the molten metal, by reason of its viscosity, cannot flow, a plurality of other means each affording communication between at least one of said ends of breathers and atmosphere, and a plurality of pneumatic jet pump devices each having the intake port thereof connected to one each of said other means; said jet pump devices being independently operative, upon activation, to evacuate air from the mold cavity through the breather aperture or apertures to which the device is connected by said other means.

14. A mold for use in pressure die casting machines comprising a pair of dies attachable one each to each of the relatively movable elements constituting the die supporting means of a die casting machine, the adjacent faces of said dies being shaped, when juxtaposed, to define a

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mold cavity bordered by the meeting faces of said dies and said meeting faces being interrupted only in a sprue hole formed by the said meeting faces of said dies for the conduct of molten metal into the mold cavity, and breather aperture means extending from said mold cavity through one of said dies and effective to permit the expulsion of air and gas from said mold cavity incident to the injection of molten metal; said breather means including components carried by each of said dies operative upon closing of said dies to form a narrow orifice remote from said mold cavity through which air and gas can flow but through which the molten metal, by reason of its viscosity cannot flow, and other means at the side of said orifice remote from said mold cavity affording communication between said breather aperture means and atmosphere.

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