

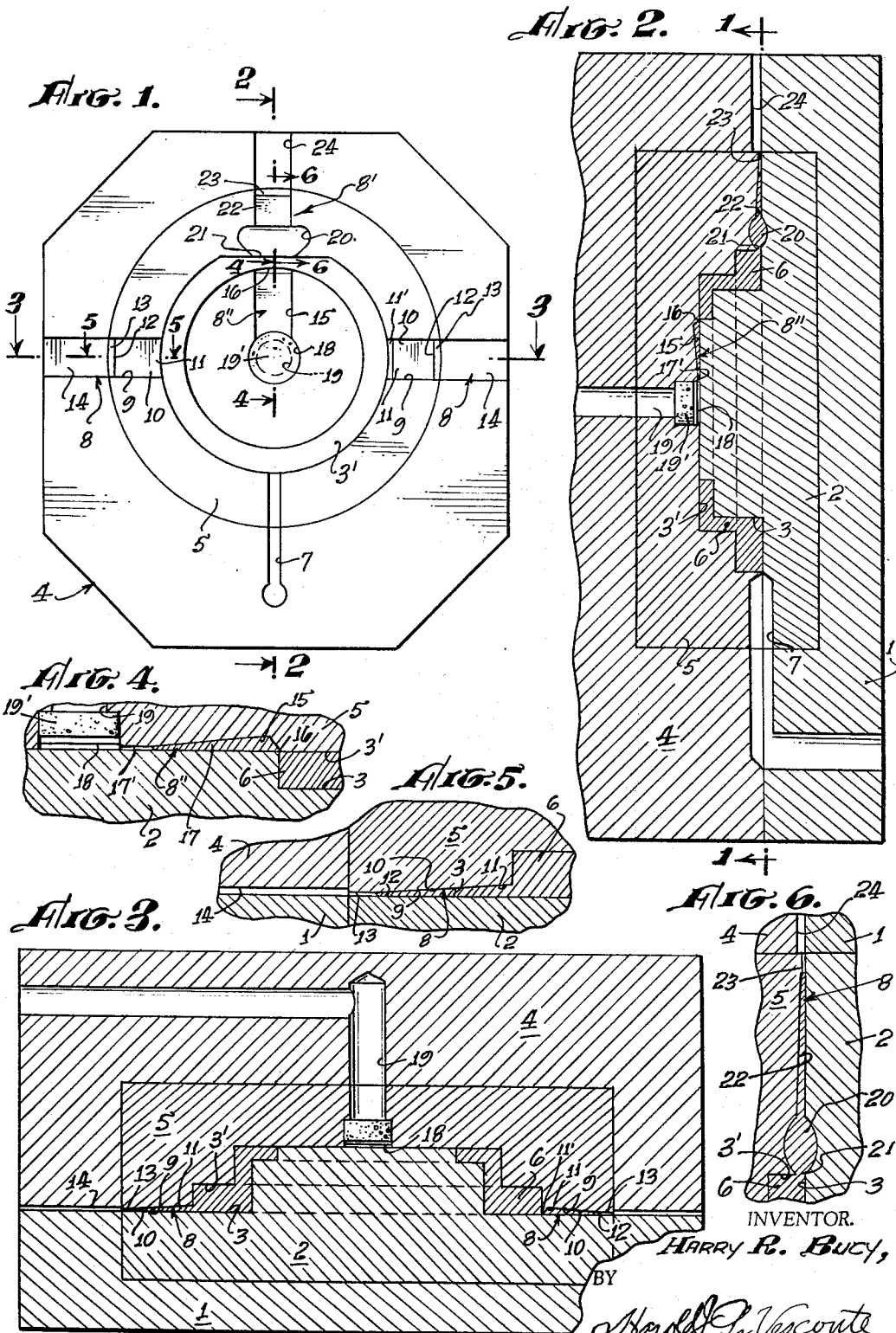
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MOLD PARTING LINE VENTING MEANS

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MOLD PARTING LINE VENTING MEANS

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This invention relates to molds for permitting the escape of air and gas from metal molds such as are used in die casting or similar molds into which material in fluid condition is introduced to harden in the form determined by the mold cavity.

In my prior Patent No. 3,108,339, dated October 9, 1963, and my prior applications, Serial No. 318,963, filed October 25, 1963, and Serial No. 322,772, filed November 12, 1963, there are disclosed certain inventions relating to the provision of breathers for the escape of gases from metal molds through orifices or vents referred to in the said patent and application as "breathers," as distinguished from a "vent." For the purpose of distinguishing the present invention from my said prior applications and patent, the latter term will be used for those instances in which the escaping air and gas is conducted through a passage which either interrupts the meeting face of one or the other of the mold components or which is formed wholly in one or the other of the mold components, and the term "breather" will be employed for those constructions in which the air and gases conducted through means which pass through one or the other of the mold components and in which the integrity of the meeting surfaces of the mold components against the passage of air or gas between them is maintained except for the interruption deriving from a runner by which the fluid material is conducted into the mold cavity. As here used, the term "mold cavity," will be employed to designate any space into which it is intended that the introduced material shall flow including any spaces known as "overflow" pockets and excluding those spaces or areas hereinafter referred to as "vents" or "vent pockets."

Heretofore such molds have been vented to permit the escape of air and gases from the mold cavity through relatively wide, very shallow slots or grooves called vents which were formed in the meeting face of one or the other of the mold components and which extended from the mold cavity to the outer surface of the mold. 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 the book entitled "Die Casting" by H. H. Doehler, published by McGraw-Hill Books, copyright 1951, at page 84, and with respect to the injection molding of plastics in Tool Engineers Handbook, first edition, fifth printing, published by McGraw-Hill Books, at page 400, there occurs the following statement:

"Venting of trapped air from close-fitting molds while material is being injected into them is accomplished by means of vents suitably located. Escape points a few thousandths of an inch deep are placed at the cavity edge on one parting plane of the mold."

The depth of such slots is intended to be so slight that only the air and gas may escape therethrough, but under heavy pressure, some of the injected material may move into the slots for a short distance, forming flash which must afterwards be removed and, at times, in die casting particularly, the molten material will adhere and "solder" itself to the vent surface and effectively plug the vent against the escape of at least a portion of the air and gas with the resultant production of an incomplete or porous casting or molding. When a vent of this character becomes plugged, it must be cleaned and the cleaning thereof must be so carefully done that it will not increase the depth of the vent beyond the maximum allowed for the type of material being introduced into the mold hav-

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ing regard at the same time for the pressure under which the material is thus introduced. Where the pressure is relatively low, these prior vents can be slightly deeper and under high pressure conditions, they must be decreased in depth. It is intended that the molten material shall not enter the vent but if it should enter, the length of the vent must be such as will cause the material to chill and act automatically to seal the vent while final molding pressure is applied without escape of the material from the mold. Obviously, if the cleaning of a plugged vent of this character results in deepening the vent to an extent that the molten material can be forced therethrough to the exterior surface of the mold, the probability is that the final pressure cannot be applied to the material without escape of the material from the mold and resultant production of an inferior casting or molding.

Recognizing all of these shortcomings in the prior art venting of separable metal molds and particularly those in which the material is injected under pressure and is then subjected to further pressure before it congeals, the principal object of the present invention is to provide an improved form of vent in the meeting or parting line faces of the mold components wherein the above described difficulties are at least less likely to occur if not completely obviated.

Another object of the invention is to provide a vent means for the escape of air and gas from a mold cavity disposed at a parting line surface and which can be connected to a breather extending through a die component of a mold and emerging therefrom at a point other than at the plane of the parting line surface without the necessity of forming a cooperating non-planar surface on the other mold component.

With the foregoing objects in view, together with such additional objects and advantages as may subsequently appear, the invention resides in the parts and in the construction, combination and arrangement of parts described, by way of example, in the following specification of a presently preferred embodiment of the invention, reference being had to the accompanying drawings which form a part of said specification and in which drawings:

FIG. 1 is a plan view of the parting line surface of one of a pair of die components of the mold embodying the invention, the view being taken on the line 1-1 of FIG. 2,

FIGS. 2 and 3 are enlarged scale, fragmentary, sectional views of the mold comprising the component shown in FIG. 1 and its complementary component, the sections being taken, respectively, in the planes of the lines 2-2 and 3-3 of FIG. 1,

FIG. 4 is a greatly enlarged, fragmentary, sectional view of one of the vents of the mold the section being on the line 4-4 of FIG. 1, and including portions of both mold components,

FIG. 5 is a view similar to FIG. 4 taken on the line 5-5 of FIG. 1 and including portions of both mold components, and

FIG. 6 is a view similar to FIGS. 4 and 5 taken on the line 6-6 of FIG. 1 and similarly including portions of both mold components.

In the drawings, all usual and necessary accessories for a mold such as leader pins, ejector pins, ejector pin retractor means, etc., have been omitted since the use thereof is well known and, as will be presently apparent, the usefulness of the invention nowise depends on the presence of such elements. Also, having regard only for the position of the mold components shown in the drawings and the fact that some machines in which molds of this character are used are vertical and others horizontal, the mold components will be designated as "upper" and "lower" for convenient identification.

The illustrated mold comprises a lower die component 1 provided with a die insert 2 in which a portion of the

surface 3 defining the mold cavity is formed. Similarly the upper die component 4 is provided with a mold insert 5 having a surface 3' delineating the remainder of the mold cavity in which the casting or molding 6 is formed. The die inserts 2 and 5 are formed of a variety of steel better able to withstand the heat of the molten material and to which, in the case of die castings, the molten metal may be less likely to "solder" itself and which steel is more expensive than the steel employed for the die components 1 and 4. Normally the meeting faces of the die inserts are disposed as few thousandths of an inch above the corresponding faces of the die components in which they are mounted so that the pressure of the machine in "locking up" the mold is applied directly to the opposing faces of the die inserts only. This is common and usual practice in the formation of metal molds employing die inserts. Obviously, the die components and inserts can be replaced by a one-piece component if desired.

In the mold shown in the drawings, the surfaces of the inserts which abut each other as above described are interrupted by a runner slot 7 through which the molten material is received and also by a pair of vents 8 at diametrically opposite locations on the perimeter of the mold cavity, by a vent 8' disposed at a point within said perimeter and by a vent 8'' including an overflow pocket; said vents forming the subject matter of the present invention. The nature of each of the vents is best shown in FIGS. 4, 5 and 6 and the principal novel form thereof is preferably formed wholly in one or the other of the die inserts. In the illustrated embodiments, the vents are shown as formed in the upper die insert 5 but it will be understood that if necessary or desirable they may be formed in the other die insert or may be formed partially in each of the side inserts as the nature of the individual casting or molding may make expedient. The meeting surfaces of the mold components in which the vents are formed constitute the parting line faces of the mold.

Three novel principles of vent design are involved in each of the embodiments of the invention to be described. The first principle is that the molten material is to be prevented (except for abnormal conditions) from reaching the vent orifice portion. Secondly, each vent is provided with a pocket portion upstream of the orifice portion thereof which is deeper than the orifice portion and in which the molten material is intended to flow and be congealed to seal the vent at a point upstream of the orifice portion. Thirdly, the passage between the mold cavity and the vent pocket or an interposed surplus metal cavity can be such as will cause the material that has entered the vent upstream of the vent orifice to break off cleanly at the juncture with the casting or molding to eliminate the need for trimming operations.

Considering the first embodiment of the invention comprising the vents 8 disposed at the opposite edges of the cavity, each vent includes a pocket 9 of uniform width, the wall 10 thereof opposing the mating face of the die insert 2 sloping at a slight angle toward the plane of said mating face of the die insert 2 and forming a deeper portion 11 adjacent to the mold cavity end thereof and decreasing in depth to an amount as at 12 which is so small that the molten material under the pressure involved cannot pass therethrough although air and gas expelled from the mold cavity can freely pass therethrough. The entrant end of this reduced depth portion of the vent is disposed at such a distance from the mold cavity that the molten material entering the pocket will congeal before it reaches this minimum depth portion of the vent. This minimum depth portion 13, hereinafter designated as the "orifice," extends away from the mold cavity at the same width as the pocket for a short distance, usually about $\frac{1}{4}$ " and terminates either at or inwardly from the outer edge of the die insert, as the length of the vent pocket dictates, and the width of the pocket and orifice portions of the vent are preferably constant although individual vents will be of different widths according to the size of the

mold cavity and the number of vents thus employed. Beyond the orifice portion thereof, the vent continues at a much greater depth as at 14 to the outer surface of the mold.

When fluid material is injected into the mold under pressure, some of the material will pass into the pockets 9 and will chill and congeal before it has completely reached the orifice 13 associated with each of these pockets, thus sealing the vents sufficiently so that pressure applied after the mold cavity is filled will not result in expulsion of material out through the vent unless, due to malfunction of the machine, the mold is not properly locked up. In general, the thicker portion of the slug formed by the pocket 9 should have sufficient rigidity to enable it to be readily detached from the casting or molding and at the same time seal off the vent without the material entering the orifice portion thereof. Where pressure conditions permit, the depth of the juncture of the vent with the mold cavity can be reduced as at 11' at the right hand side of FIG. 3 to facilitate removal of the slug.

When the mold is open, the slug of material formed in the pockets 9, 9' will be readily removed from the pockets along with the casting or molding and the orifices 13 will not have been subjected to the presence of the molten material and will not require cleaning, or at least, not nearly as often as the conventional type of vent.

It is now to be noted that this invention employs the same basic principles in relation to vents that is present in my said patent and prior applications which relate to breathers, the primary difference being that the principles are here applied to vents disposed in the parting line plane of a mold, viz, that of forming a vent including a longitudinally wedge shaped passage extending from the mold cavity or from an overflow pocket associated with the mold cavity toward atmosphere and into which passage the fluid material can initially move and which passage so restricts the thickness of the material thus injected that the material chills and hardens closing the vent before the material has reached the critical restriction or orifice portion of the vent through which the air and gas can escape but through which the fluid or molten material is incapable of flowing so long as the mold is properly locked up.

Referring next to FIGS. 2 and 4, there is shown another embodiment of the present invention not embodying, however, the escape of air and gases through an orifice extending wholly along a parting line surface but which exhausts the air and gas through one only of the mold components. In this respect, this embodiment of the invention is somewhat like the breathers of my said prior patent and applications. In this embodiment, the vent 8' includes a pocket 15 separated from the mold cavity by a slit formed by a knife edge 16 at the juncture with the surface 17 of the die insert 2. If, by reason of imposed pressure, the fluid material is caused to pass the knife edge 16, it will do so slowly and fill the pocket 15 relatively slowly giving the material so entering the pocket 15 time to congeal. The pocket terminates in a shallow orifice 17' similar to the orifices 13 in the first embodiment of the invention and the orifice 17', in turn, communicates with the deeper groove 18 which is in communication with a bore 19 affording communication either directly with atmosphere or through a jet pump means such as shown in my said prior patent and my said prior patent applications. The end of the bore 19 adjacent to the orifice is enlarged to receive a removable, porous metal plug 19' which is placed in that location to intercept any molten material that might escape through the orifice in the event that a shot was made with the mold improperly locked up thus preventing the molten material from entering and filling the bore 19 and thus disabling the mold. The metal entering the pocket 15 can be readily broken off at the weakened portion formed by the knife edge 16.

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Referring finally to FIGS. 1, 2 and 6 there is shown in a third embodiment of the invention that a pocket for surplus or overflow material may be interposed between the portion of the mold cavity forming the casting or molding, per se, and a vent here designated generally as 8". The pocket 20 is shown as being formed in both die inserts and is connected to the rest of the mold cavity by a very short, shallower channel portion 21 and the vent pocket 22, which corresponds to the pockets 9 and 15, extends from the opposite side of the overflow pocket 20 to the orifice 23 which is, of course, of the same character as the orifices 13 and 17'. A deeper channel 24 thence connects the orifice 23 with atmosphere. Again, it is to be noted that the juncture of the pocket to the mold cavity provides a weakened section which permits the slug of material to be cleanly broken off from the casting.

The depth of the openings between the mold cavity and the vent pockets depend to a very great extent upon the pressures to be employed. In general, the greater the pressure, the deeper this entrant portion of the vent pocket should be so that the flow into the pocket will be accomplished as the metal is flowing through the mold cavity rather than when the cavity is full and the full injection pressure is imposed. Where lower ranges of pressures are employed for injecting the material, the channels connecting the vent pockets with the mold cavity proper may be reduced in depth as the full injection pressure will not be sufficient to force molten material through the smaller gate or entrance to the vent pocket or, if it does, the pressure will not be sufficient for the molten material to reach the orifice before it chills and congeals. It must be borne in mind that in die casting of metals or injection molding of plastics, the time required to fill a mold is a very small fraction of a second and the time required to fill or partially fill one of these vent pockets is, likewise, an even smaller fraction of a second. The thinner the wall section of the metal in the pocket the faster it chills and sets unless it is kept moving at a high velocity. The effect of the wedge shaped vent pockets is to reduce the force and resultant velocity for the split second that the thinned out wall section of the molten material in the pockets requires to solidify and seal off the vent.

While in general, this invention will be advantageous in the formation of vents extending across the parting line surfaces of mold components, it is not necessarily limited to such use and where longitudinal space permits, vents of this novel characteristic can terminate at some point within the mold and the air and gas be conducted therefrom through one only of the components either directly to atmosphere or through a jet pump. Having reference to the disclosures in my said prior applications, it will be obvious that in some circumstances, the hole through which the air and gas is conducted from the vent downstream of the orifice portions thereof may be through either of the die components if such routing of the gas and air from the mold cavity is desired or if the nature of the casting and molding to be produced should make it impossible to form the vent directly to atmosphere across the parting line surfaces of the mold component. Also, while the parting line surfaces here shown lie in parallel planes extending at right angles to the direction of movement of the mold components toward and from one another, it will be obvious that for such molds as have parting line surfaces arranged at an angle to that line of movement, vents incorporating the present invention can be formed in those surfaces. Obviously, also these vents or any portion thereof may be formed in either or both the insert surfaces of such formation as desirable.

Due to the fact that the orifice portion of vents embodying the present invention is much shorter than the prior art vents, viz, a small fraction of an inch as compared with the prior art vents which have the same depth dimension as the orifice portion but which extend at that

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depth dimension from the mold cavity to the side surface of the mold (a distance which is seldom much less than about two inches) the said orifice portions can allow the passage therethrough of a greater volume of air and gas than a prior art vent of the same width in a given time, assuming equal pressures or, alternatively, the said orifice portions will allow the passage of an equal volume of air and gas in a given time at a lower pressure than would be required by a prior art vent of equal width and depth.

While in the foregoing specification certain presently preferred embodiments of the invention have been disclosed, the invention is not to be deemed to be limited to the precise and specific details of construction thus disclosed by way of example, wherefore, the invention will be understood to include, as well, all such changes and modifications in the parts and in the construction, combination and arrangement of parts as shall come within the purview of the appended claims.

I claim:

1. In a mold comprising at least two relatively movable metal components having parting line faces serving at least in part to define a cavity in said mold into which molten material is introduced under pressure, the combination of vent means affording passage means for the escape of gas and air from the cavity; said vent means being formed in and extending parallel to at least a portion of the parting line face of at least one of said components which is juxtaposed to the mating face of the other of said components when said components are juxtaposed to form the mold; said vent means extending from the mold cavity to a point of communication with atmosphere and including an orifice portion spaced from the mold cavity and comprising a short, wide groove in said one parting line face which is of such shallow depth as to be capable of permitting only gas and air to flow therethrough and said vent means further including a deeper portion disposed upstream of and communicating with said orifice portion and adapted to receive molten material from the mold cavity and to cause received molten material to be congealed therein before reaching said orifice portion.

2. A mold venting means as claimed in claim 1 in which said deeper portion of said vent means constitutes a pocket which is of greater depth adjacent to the mold cavity and of gradually decreasing depth until reaching the depth of said orifice portion at the juncture therewith.

3. A mold venting means as claimed in claim 1 in which a passage means of greater depth than said orifice portion connects the downstream side of said orifice portion with atmosphere.

4. A mold venting means as claimed in claim 1 in which said vent means is formed in a portion of said mold which is offset from the plane of the juncture of the opposing faces of said components with the exterior surface of the mold and in which one of said mold components includes passage means affording communication with the downstream side of said orifice portion of said venting means with atmosphere.

5. A mold venting means as claimed in claim 1 in which said mold includes a cavity for surplus molten material disposed in communication with the mold cavity and interposed between the mold cavity and said vent means.

6. A mold venting means as claimed in claim 2 in which the length of said pocket portion and the depth thereof at a point adjacent to the end thereof which is in communication with said orifice portion is such that molten material extending to said end of said pocket portion will be so reduced in thickness that it will congeal and seal said venting means before the molten material reaches the orifice portion of said venting means.

7. A mold venting means as claimed in claim 2 in which the deepest portion of said pocket portion is in direct communication with the mold cavity.

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8. A mold venting means as claimed in claim 2 in which means restricting the rate of flow of molten material into said pocket portion is interposed between said pocket portion and the mold cavity.

9. A mold venting means as claimed in claim 8 in which the length and rate of decrease in depth of said pocket portion of said venting means is such that the molten material entering therein from the mold cavity will be so reduced in thickness that it will congeal and seal said venting means before reaching said orifice portion thereof.

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