United States Patent

[11] 3,602,293

[72] Inventor **Charles W. Barrett**
2401 S. Wayne Road, Westland, Mich. 48185

[21] Appl. No. **48,934**
[22] Filed **June 19, 1970**
[45] Patented **Aug. 31, 1971**
Continuation of application Ser. No. 748,248, July 29, 1968, now abandoned.

[54] **CONTOURABLE SELF-CLEANING VENT FOR CORE BOXES AND THE LIKE**
14 Claims, 6 Drawing Figs.

[52] **U.S. Cl.** **164/410**
[51] **Int. Cl.** **B22c 23/00**
[50] **Field of Search** 164/234, 410

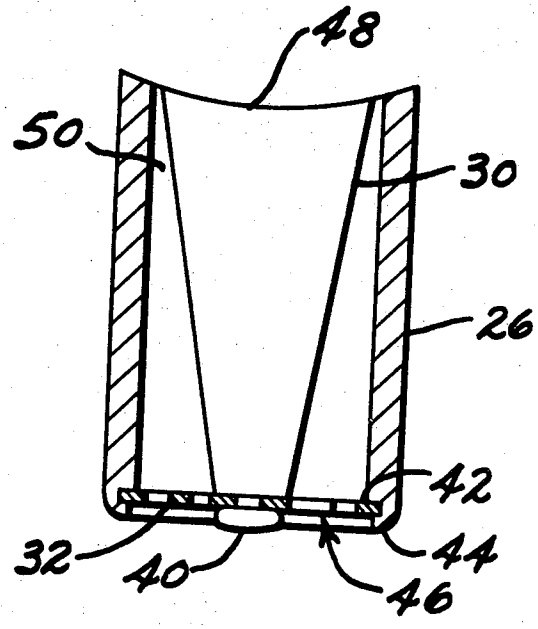
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Primary Examiner—J. Spencer Overholser
Assistant Examiner—John S. Brown
Attorney—William P. Hickey

ABSTRACT: A vent comprising a generally tubular body having a loosely fitting plug in the central opening to form an annular vent passage between the plug and the tubular body. The end surfaces of the plug and tubular body are coterminous and can be contoured as by grinding, machining, etc. to provide any desired contour to its face without appreciably effecting the width of the annular venting passage between the tubular member and the plug. The plug is sufficiently long and is provided with a sufficiently shallow taper that the removal of metal from the ends of the tubular member and plug does not open up the clearance between the tubular member and plug to a degree approaching the size of the particles of sand to be retained. The contouring operation, therefore, does not change the size of the clearance to a degree where sand passes therethrough.



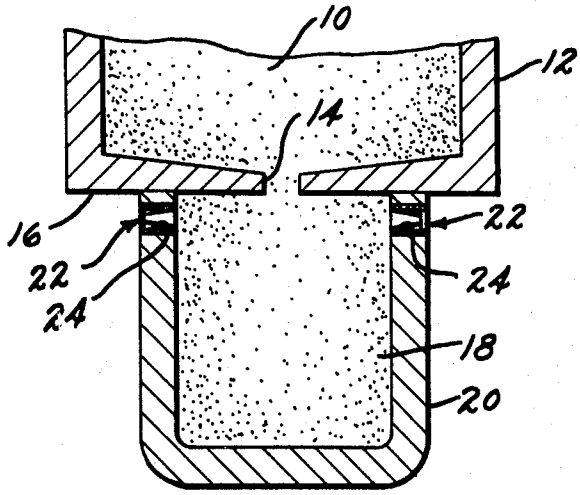


FIG. 1.

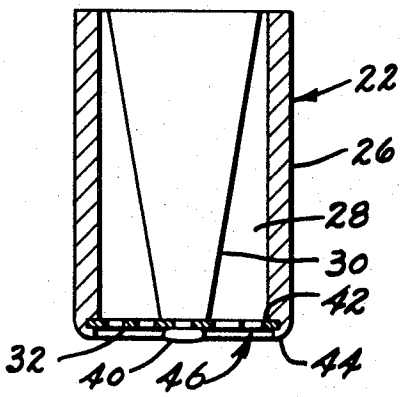


FIG. 3.

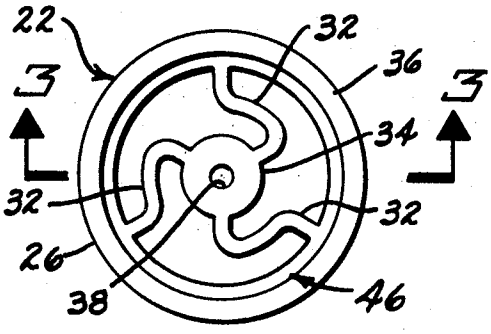


FIG. 2.

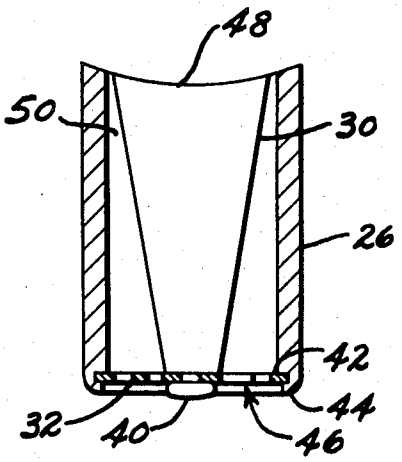


FIG. 5.

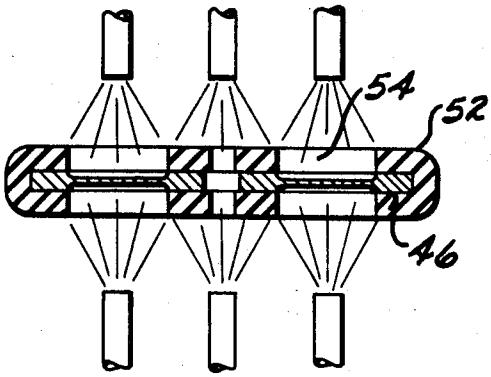


FIG. 4.

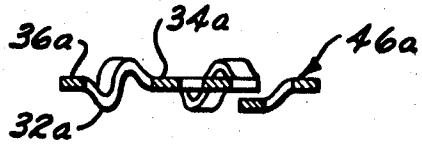


FIG. 6.

INVENTOR.
CHARLES W. BARRETT
BY
William O. Hickey
ATTORNEY

CONTOURABLE SELF-CLEANING VENT FOR CORE BOXES AND THE LIKE

This application is a continuation of Ser. No. 748,248, filed July 29, 1968, now abandoned.

BACKGROUND OF THE INVENTION

In the founding art, cavities are produced in cast metals by means of sand temporarily held together by a binder to produce what is known as a core. The molten metal is poured around the core and is allowed to solidify. The binders used are temporary and can be decomposed, usually by heat treatment and oxidation. The solidified metal having the core therein is subjected to conditions which decompose the binder, usually prolonged heating in air, following which the sand is shaken out of the cast metal body through one or more small openings.

The cores are produced in molds comprising two or more pieces (usually two) which can be disassembled to remove the core once the binder has hardened. The cores are produced by assembling the portions of the mold to provide an enclosure whose cavity corresponds in shape to the shape of the core desired. The cavity is filled with sand and binder, the binder is hardened, and the mold is disassembled to remove the finished core. In some instances the binder is a powder that is mixed with the sand that is forced into the mold cavity. In other instances, the sand is coated with the binder and the coated sand is forced into the mold cavity. The sand and binder may be tamped into the mold cavity, but in the process with which we are concerned, the sand is blown into the mold cavity by means of compressed air. The air displaced by the sand as well as any compressed air reaching the cavity must be vented therefrom in order to be sure that no air pockets or softspots exist in the finished cores. The air is vented through screening devices commonly called "vents" which retain the sand and binder while allowing the escape of the air. These vents are subject to sand abrasion, which can be quite severe in those instances where some of the sand particles are forced through the openings of the vent. In all prior art vents with which I am concerned, sand and binder tends to accumulate in the air passages of the vent. Sand particles just slightly larger than the openings through the vent become wedged in the opening, and this wedging process continues until substantially all of the openings through the vent become plugged. Most molds are designed with only sufficient venting capacity to make satisfactory molds when the vents are in an unplugged condition, and consequently the quality of the cores deteriorate when the vents start to become plugged. In many instances the core producing process is carried on in automatic machinery and the plugged condition of the vents is not ascertained until a sizable production of nonuseable cores has been produced.

Air blown cores are made by a number of different processes. In one commonly used process, an oil such as linseed oil is used to coat the sand which is air blown into the molds. The unhardened cores made with the oxidizing oil is removed and placed in dryers which allows air circulation therethrough. The dryers containing the cores are put in ovens where oxidization of the binder takes place to set the binder to a rigid condition. This is sometimes called a green sand molding process.

Another type of process commonly used is called the "hot box process." In the "hot box process," sand is either coated with or mixed with a thermosetting resin, (usually a phenol-formaldehyde) and is air blown into the cavity of the mold. The mold is heated, and after the resin and sand has become stationary against the mold cavity surface for a few seconds, the resin is transformed into its thermoset condition, and thereafter the mold is split and the core removed from the mold cavity. Other types of thermosetting resins can be used, as for example phenol-furfural resins, etc.

Air blown cores can also be made by several cold processes wherein a gas is caused to pass through the core to set up the binder after the sand and binder are blown into the mold cavity. In one such process, sand is coated with a sodium silicate binder and this binder coated sand is then blown into the mold cavity. Thereafter, carbon dioxide is caused to flow through the core to gel the sodium silicate. In order that properly uniform hard cores is made, the carbon dioxide must reach all parts of the core and must displace the air in the pores between the sand particles. In this process it is particularly necessary that the vents remain open and in an unplugged condition, otherwise the air in some portions of the core is not displaced with the carbon dioxide, and a soft core results.

In another type of cold core making process, sand and an oil containing a polyalcohol, such as a glycol, is air blown into the mold cavity. Thereafter a diisocyanate, as for example methylene bis (phenylene isocyanate) or 2, 4-toluenediisocyanate is blown through the pores of the core to set the binder oil into a cross-linked condition. Here again the openings of the vents must be kept open if soft cores are to be avoided.

Still other cold methods of making cores involving blowing gases through the sand and binder have been, and will be developed, and in all of these processes it is critical that the passages through the vents remain open.

All of the above described processes are used to make cores of various sizes and shapes including small arcuate shapes, as for example, small cylindrical bodies. It is necessary in many instances that these vents have a contour that is flush with the sidewalls of the mold cavity in order that an imprint of the vent surface will not be formed in the finished core, which imprint, of course, would be reproduced in the finished cast metal.

The prior art has attempted to produce vents the end of which could be ground or machined into a desired contour so as to form cores with a smooth surface. The vents which the prior art has made, however, are not completely satisfactory, since they quickly become plugged with sand and produce a high percentage of cores which are not usable.

One such prior art vent comprises a shallow annular disk having a depth approximately one half of its diameter and an annular opening therethrough of a diameter approximately one half that of the O.D. of the disk. A short plug is positioned in the central opening through the disk with the bottom end of the plug being flush with the bottom end of the disk. The plug is supported centrally of the disk by means of a U-shaped rod, one leg of which extends through a longitudinal opening of the sidewall of the annular disk and the other leg of which extends through an axial opening through the plug. The U-shaped rod is secured to the disk and plug by a weld at the upper end of each leg. The top surface of the vent can be held against a grinding wheel and contoured; but if contoured to any appreciable extent, the welds are removed and when not removed are weakened such that failures occur during use. In addition, the vent becomes plugged with sand for reasons not fully appreciable heretofore.

An object of the present invention is the provision of a new and improved core vent and the like of the type having a plug located in the central opening of the tubular body which vent can be contoured without producing conditions which cause the vent to become quickly plugged with sand or broken apart in the contouring process.

Another object of the invention is the provision of a new and improved core vent of the above described type in which relative movement between the plug and the tubular body is automatically produced during the core forming process which will free sand that becomes lodged in the passage through the vent.

Another object of the invention is the provision of a new and improved core vent of the above described type which can be contoured without producing conditions that materially increase the plugging tendencies of the vent.

A further object of the invention is the provision of a new and improved core vent the above described type having a mechanism for offsetting the deflection of the plug which is produced by the compaction of the sand thereagainst.

Further objects and advantages of the invention will become apparent to those skilled in the art to which the invention relates from the following description of several preferred embodiments described with reference to the accompanying drawings forming a part of this specification.

SUMMARY OF THE INVENTION

According to the invention, a core vent and the like is formed by means of a generally conically shaped plug positioned in a central opening of a tubular body member. One end of the plug and tubular body member are substantially coterminous, and the other end of the plug and body member are connected together by means of thin flexible fingers (usually three or more) which extend between the lower end of the plug and the adjacent end of the tubular member. Each finger is preferably connected to the body member at a point radially displaced from the point of attachment to the plug or is vertically bowed or both in order to provide increased flexibility. By so doing, the fingers provide an increased amplitude of vibration, and a lower frequency of vibration, which is generally in the range of the frequency of vibration produced by fluid flow through the vent. In the preferred construction, the ends of the fingers are made integral with inner and outer rings, the outer ring of which is supported by the tubular member and the inner ring of which is secured to the plug. The plug preferably has a shallow taper extending from its upper end to the inner ring to provide a smooth unobstructed fluid flow passage through the vent. The taper which is provided is the most shallow taper which can be provided in a vent of a given depth, so that the contouring of the vent creates minimum enlargement of the annular opening at the upper face of the vent. The plug can be moved axially a few thousandths of an inch with a small amount of force by reason of the flexible nature of each of the fingers. The fingers prevent large axial movement, however, because tension is produced in the fingers when the fingers are straightened from an arcuate or bowed configuration. Where the fingers are nonradial, a twisting action of the fingers accompanies the movement of the plug axially of the tubular member, but the plug remains centrally located regardless of its axial position. During the twisting action of the fingers a slight rotation of the plug occurs to help dislodge particles from the space between the plug and annular body member. In the preferred embodiment, the fingers are made of a bimetallic material having the layer with the greatest coefficient of expansion adjacent the bottom face of the fingers, so that the fingers and plug are biased upwardly when the temperature of the vent is increased. The fingers are designed so that this change in temperature produces a deflection which generally offsets the sand compaction pressure that is produced on the plug during the core molding process. The fingers are preferably made from a sheet of metal by acid etching openings between the fingers.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic sectional view through an assembled core box, blow plate and sand reservoir and depicts the process of air blowing a core;

FIG. 2 is a bottom or outside view of the vent shown in FIG. 1;

FIG. 3 is a sectional view taken approximately on the line 3—3 of FIG. 2;

FIG. 4 is a schematic sectional view depicting a preferred method of making the plug support shown in FIGS. 2 and 3;

FIG. 5 is a sectional view showing a vent of the present invention whose upper end has been contoured in cylindrical fashion to conform to the curvature of the sidewalls of a cylindrical core forming mold; and

FIG. 6 is a sectional view through another embodiment of plug support similar to that shown in FIGS. 2, 3, and 5 but which is deformed vertically.

DESCRIPTION OF THE PREFERRED EMBODIMENT

One of the principal uses of the vents of the present invention will be the venting of air blown core molds and the like depicted in FIG. 1 of the drawing. In the process of air blowing cores, a mixture of sand and binder 10 is blown from a pressure reservoir 12 through an orifice plate 14 in a blow plate 16 into the cavity 18 of a core mold 20. The air that is displaced from the cavity 18 by the sand and binder exits through self-cleaning vent 22 of the present invention. The vents 22 are positioned in openings 24 which communicate the cavity 18 to the atmosphere. The vents 22 are usually positioned to vent the portions of the cavity 18 which are the last to be filled with sand and binder to prevent air from being trapped in the cavity, and the cavity from becoming completely filled with sand and binder. If the cavity is not completely filled, "soft spots" in the cores are produced, and cores having "soft spots" cannot be used in the metal casting operation. During the final stages of compaction of sand and binder in the cavity 18, the sand and binder is compacted against the surface of the vents 22. The vents 22 of the present invention have a smooth end surface and do not leave an imprint in the finished core.

One embodiment of the present invention is shown in FIGS. 2 and 3 of the drawings. The vent 22 generally comprises a tubular body portion 26 having an axially extending opening 28 therethrough in which a loosely fitting plug 30 is positioned. The plug 30 is generally frustoconically shaped with its large diameter end positioned generally coterminous with one end of the tubular body 26. The other end of the plug 30 is secured to a plurality of fingers 32 (three shown in the drawing) which connect the bottom of the plug to the bottom end of the tubular member 26 to support the plug 30 relative to the body member 26. The fingers 32 are generally planer so that the force required to move the fingers out of their plane increases with the finger movement. Because the plug 30 is free floating, the plug 30 can oscillate a few thousandths of an inch above and below its static condition, and the length of the fingers is such that the natural period of vibration is in the order of magnitude of the pulses generated by gases passing through the vent. In the preferred embodiment, the fingers 32 are made with inner ring or hub 34 and outer ring 36, and with the inner ring or hub being secured to the bottom end of the tubular member 26. The ring 34 has an annular opening 38 therethrough, and the bottom end of the plug 30 is provided with a reduced end portion which extends through the opening 38 in the inner ring and which is riveted over as at 40. The outer ring 36 is seated in an internal counterbore 42. The remaining wall section 44 is rolled over against the ring 36 to hold it in place.

It will now be seen that the support structure 46, which includes the fingers 32 and the inner and outer rings 34 and 36 respectively have an axial minimum dimension so that the full depth of the vent 22 can be used for providing a uniform taper on the outside of the plug 30. Although not required in all instances, this taper may have a bottom end whose diameter is equal to the outer surface of the inner ring 34, so that a smooth flow passage is provided in which the only obstruction to flow are the fingers 32.

FIG. 5 is a cross-sectional view of a plug of the type shown in FIGS. 2 and 3 which has been held against a grinding wheel to provide a cylindrical surface to the upper end of the tubular member 26 and plug 30. By using a grinding wheel of approximately the same diameter as the cavity 18 of the mold in which the vent is to be used, the contoured surface 48 will be coterminous with the surface of the cavity. It can be seen by referring to FIG. 4, that the clearance between the plug and the tubular member 26 increases as material is ground away from the vent, but it will further be seen that the width of the annular passage 50 at the deepest point of the contour of surface 48 is only slightly more than at the highest point of the contour. Inasmuch as the plug and tubular member are surfaces of revolution, this can be determined by projecting the lowest point of the surface 48 laterally to the sidewalls of the plug and tubular member.

In the most preferred construction of the present invention, the support structure **46** including the fingers **32** and inner and outer rings **34** and **36** are made integrally from a bimetallic sheet with the layer of metal having the highest coefficient of expansion being positioned at the bottom of the vent. By so doing, the plug **30** is caused to raise upwardly when the vent is heated. In the hot box process of making cores, the mold is usually heated to approximately 200° F. before the sand and binder is blown into the cavity. At 200° F., the top surface of the plug will be raised upwardly approximately two thousandths of an inch above the top surface of the tubular member. When the sand and binder is blown and packed against the surface of the vent **22**, the plug **30** is pushed downwardly by approximately two thousandths of an inch, depending upon the configuration of the fingers **32** and the air pressure that is used. The mold is then heated to between 400° F. and 600° F. to cure the resin and the core is removed therefrom. When the core is removed the plug will move outwardly by approximately four thousandths of an inch to release sand from the vent opening. It will now be seen that the spring deflection produced by the pressure of the sand on the plug can be offset by the deflection due to the bimetallic nature of the support, and that the finished cores will have a surface that is perfectly smooth and devoid of a vent imprint.

The support structure **46** is preferably made by the acid etching process depicted in FIG. **5** of the drawing. A "resist" material is applied over both surfaces of a strip of stainless steel bimetallic material and the top and bottom surfaces of the "resist" material **52** is light struck through a photographic plate having a pattern or image corresponding to the desired shape of the support structure **46**. In the preferred embodiment shown in the drawings, the fingers **32** will have a generally S-shape. The "resist" material is developed to dissolve away the light struck portions corresponding to the openings between the fingers, and the developed "resist" coated strip is then subjected to an acid spray which impinges upon the top and bottom surface until the metal is eaten away in the areas of the openings **54** in the "resist" material. By this process the side edges of the fingers and rings are rounded adjacent their top and bottom surfaces so that they are devoid of sharp edges which may cause the generation of cracks. During use, particularly where the support structure is continually flexed, the construction makes possible economic production of vents less than one-half inch in diameter. The preferred embodiments may be one-fourth inch or less in diameter. The vents will usually have an annular opening greater than ½ that of the smallest particle size to be retained. Where sand having a particle size range of from 0.034 inch to 0.012 inch is used, the vents preferably have an annular opening at their sand engaging surface of 0.010 inch. This large clearance can be safely used since the fingers keep the plug generally centrally located.

In addition to the self-cleaning action above described, another type of self-cleaning action may occur which may be particularly advantageous in the cold core forming processes. After the cores are formed, compressed gases are blown through the cavity to remove sand and debris. Passage of gases over and through the vents produces vibration in the annular passages **50** and against the top surface of the plug. Because the length of the fingers is such as to provide a period of vibration in the order of magnitude of the air vibrations that are created, a vibration in the plug and support structure is set up sufficient to move the plug several thousandths of an inch. These gas flows should proceed counter current to the normal venting flow to remove the sand particles that are lodged between the upper end of the plug and tubular body. The S-shaped fingers shown have a length approximately twice their radial span and are particularly advantageous in providing a period of vibration which allows the plug to be vibrated by these gas flows. The plug shown has a length greater than twice the distance spanned by the fingers. This aids in a side to side movement of the top of the plug which helps in dislodging particles from between the plug and body member.

FIG. **6** of the drawings shows a plug support **46***a* similar to that shown in FIGS. **2**, **3** and **5** but differs principally therefrom in that the fingers **32***a* are bowed vertically. Those portions of the embodiment shown in FIG. **6** which are similar to the embodiment shown in FIGS. **2**, **3** and **5** are designated by a like reference numeral characterized further in that a suffix "*a*" is affixed thereto. The vertically deformed fingers or legs **32***a* are S-shaped and provide greater flexibility than do the fingers **32**. In some instances vertically bowed or deformed radial fingers can be used since the bowing in a vertical direction prevents the fingers from being placed in direct tension during vertical deflection, such as occurs during loading of a flat plate.

While the invention has been described in considerable detail, I do not wish to be limited to the particular embodiments shown and described, and it is my intention to cover hereby all novel adaptations, modifications, and arrangements thereof which come within the practice of those skilled in the art to which the invention relates.

I claim:

1. A core vent and the like for preventing passage of solids of a predetermined size comprising: a generally tubular body having a central opening therethrough, a plug in said central opening with the outer face of said plug being generally coextensive with one end surface of said tubular body, said plug having clearance with respect to said tubular body which clearance is less than said predetermined size of said solids, and at least three fingers connecting the bottom of said plug and said tubular body for supporting said plug, said fingers extending nonradially between said plug and their point of attachment to said tubular body.

2. The core vent of claim **1** wherein said fingers are arcuately shaped.

3. The core vent of claim **1** wherein the fingers are arcuately shaped in a vertical direction.

4. The core vent of claim **1** wherein the fingers are attached to said body member at a point circumferentially displaced from their point of attachment to said plug.

5. The core vent of claim **1** wherein the fingers are made of a bimetal.

6. The core vent of claim **1** wherein said fingers have a length at least approximately two times the radial distance spanned by the fingers.

7. The core vent of claim **1** wherein said fingers support said plug a distance beneath said one end of said tubular body which distance is at least approximately two times the radial distance spanned by said fingers.

8. The core vent of claim **1** wherein said clearance is greater than ½ said predetermined size.

9. The core vent of claim **1** wherein said fingers are formed integrally with a centrally located hub and a circumferential ring, said plug being secured to said hub, and said circumferential ring being supported by said tubular body.

10. The core vent of claim **9** wherein said one end of said tubular body is counterbored around said central opening, said circumferential ring is seated in said counterbore, and the walls of said tubular body are rolled over said circumferential ring.

11. The core vent of claim **9** wherein said plug is tapered with its large diameter end positioned adjacent said one end surface of said tubular body, and with its small diameter end being positioned adjacent to and having a diameter generally equal to that of said hub.

12. The core vent of claim **9** wherein said fingers are secured to said hub at a location spaced circumferentially from their attachment to said body member and whereby relative axial movement produces a rotating action on the plug.

13. The core vent of claim **9** wherein said fingers are generally S-shaped.

14. The core vent of claim **13** wherein said sheet of metal is a bimetal laminate which produces thermal deflection.