Sept. 15, 1970 E. DUNKELIS 3,528,453

MAGNETIC BIAS ADJUSTING MEANS FOR TANK VENT

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FIG. 1

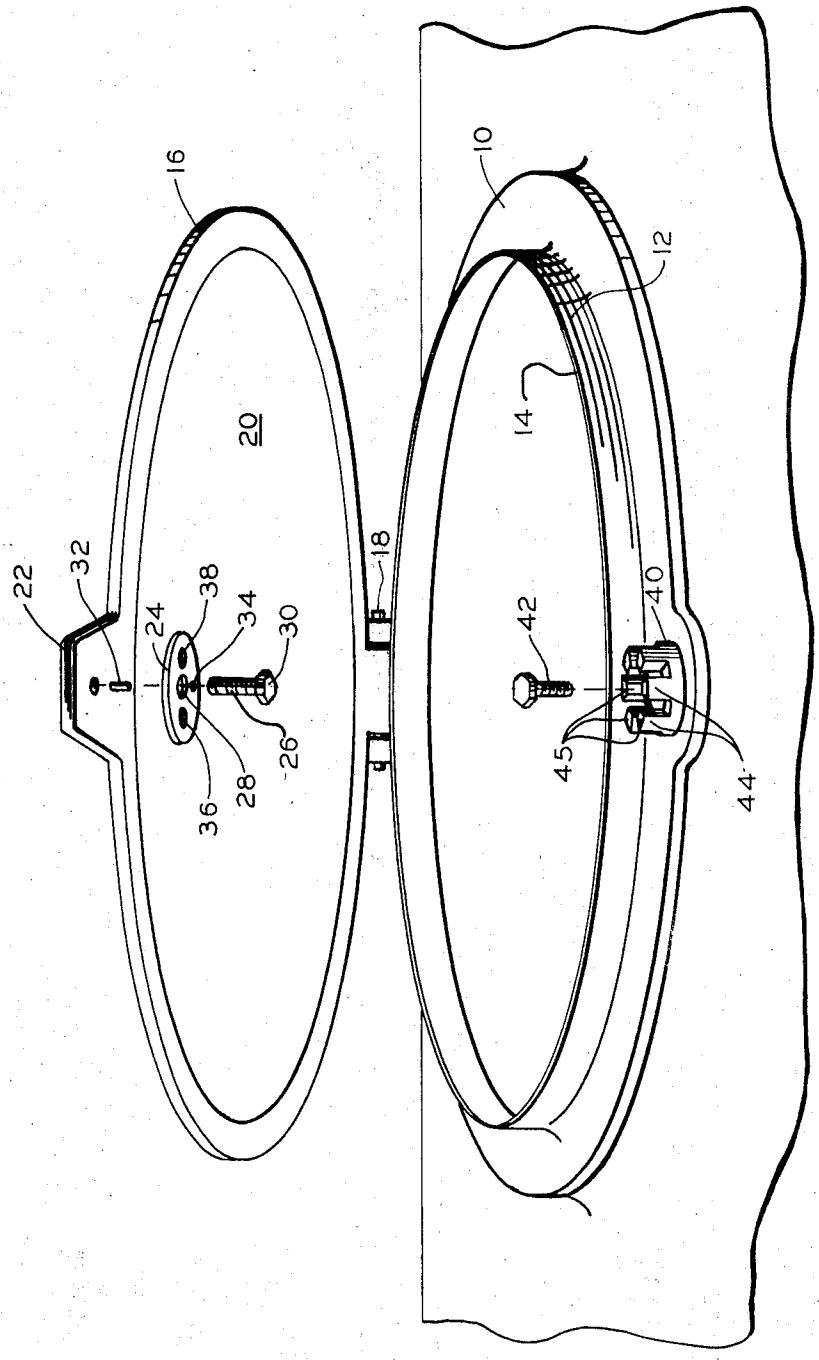

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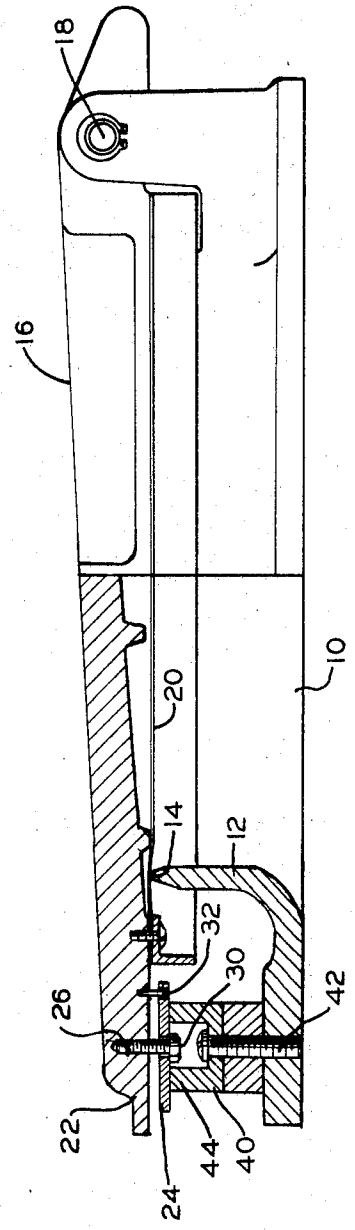
FIG. 2



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MAGNETIC BIAS ADJUSTING MEANS FOR TANK VENT

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ABSTRACT OF THE DISCLOSURE

A tank vent fitting of the type having a cover which is held in the closed position by the biasing force of a permanent magnet wherein means are provided for conveniently adjusting the magnetic bias, and thereby the set pressure at which the vent opens.

The present invention relates to vent fittings such as breather or emergency vents for storage tanks, and the like, and more particularly to novel means for adjusting the magnetic bias tending to hold the cover of such a device in the closed position.

In co-pending U.S. application Ser. No. 625,758, filed Mar. 24, 1967, now Pat. No. 3,454,040, and assigned to applicant's assignee, there is disclosed a valve device wherein the biasing force of a permanent magnet is utilized to hold the valve pallet in the closed position until the pressure differential on opposite sides of the pallet sufficient to overcome the magnetic biasing force. As is common in valves of this type, the pallet is arranged for movement with respect to the valve seat along an essentially straight line path, as opposed to the arcuate path of a hingedly mounted vent cover as in the present invention. While preserving the advantages associated with magnetic biasing pointed out in the aforementioned application, the present invention provides a structure which allows magnetic biasing for a hingedly mounted cover for a tank opening in a manner which achieves superior performance.

In the illustrated embodiment of the invention, the cover is provided with a lip portion extending outwardly from one edge thereof, outside the valve seat. Preferably, the lip is diametrically opposite the hinged mounting of the cover upon the base. In the illustrated embodiment, the permanent magnet is fixedly attached to the base with its pole pieces facing upwardly toward the lip on the cover. Loosely affixed to the lip is a plate of magnetically permeable material. The loose mounting may be accomplished, for example, by means of a bolt affixed to the lip and passing through an oversized hole in the plate of magnetically permeable material. The plate is retained by the head of the bolt and a pin extending through another hole in the plate, which allows a certain amount of movement of the plate between the bolt head and the lip on the cover while restraining the plate against rotational movement. The magnet is retained by a screw about which the magnet may be rotated when the screw is loosened. One or more openings of predetermined size, shape and location are provided in the plate and may be juxtaposed in varying degrees with the face surfaces of the magnet pole pieces in accordance with the rotational position of the magnet.

It is a principal object of the present invention to provide a vent cover construction biased in the closed position by a permanent magnet in a manner providing superior operating characteristics at relatively low cost.

It is a further object to provide a cover construction mounted for hinged movement between open and closed positions with respect to a base portion with means to allow rapid and simple adjustment of the set pressure at which the cover opens.

Other objects of the invention will in part be obvious and will in part appear hereinafter.

For a fuller understanding of the nature and objects of the invention reference should be had to the following detailed description taken in connection with the accompanying drawing, in which:

FIG. 1 is a perspective view of a preferred embodiment of the invention showing the cover in the open position with certain elements axially exploded; and

FIG. 2 is a side elevation, partially in section, showing the cover in the closed position.

The invention is intended for incorporation in hingedly mounted cover constructions for tank fittings such as breather or emergency vents, and the like. Although the illustrated embodiment shows the invention in an application for the relief of over-pressure within a tank or other enclosed structure with which it is associated, it will be immediately apparent that conventional modifications in the manner of mounting would allow its use to relieve a vacuum within the tank. Likewise, it will be readily apparent that the nature of many conventional elements, shown by way of example in the present disclosure, is subject to variation within scope of the art.

Annular base portion **10** is designed for fixed attachment to a tank structure, or like enclosure, in registration with an appropriate opening therein. Base **10** includes an upstanding flange **12** terminating in an upper surface defining annular seat **14**. Generally circular cover **16** is hingedly attached in a conventional manner such as hinge pin **18** to base **10** for movement between open and closed positions with respect to seat **14**. A conventional diaphragm structure, such as that indicated by reference numeral **20** in FIG. 2, may be provided to insure sealing of the cover against the seat, thus preventing or minimizing leakage through the opening when the cover is in the closed position.

Cover **16** includes lip portion **22** extending outwardly from the side thereof opposite the connection of cover **16** to base **10** by hinge pin **18**. Plate **24** is loosely affixed to the side of lip **22** facing base **10** by means of bolt **26** which extends through central opening **28** in plate **24** into an appropriately threaded opening in lip **22**. That is, opening **28** is somewhat larger than the outer diameter of bolt **26**, but smaller than head **30** of the bolt, so that plate **24** is loosely retained between lip **22** and head **30** of bolt **26**. As best seen in FIG. 2, bolt **26** is threaded into lip **22** by such an amount that a desired distance of clearance or movement is provided for plate **24**. Roll pin **32** extends fixedly from lip **22** loosely through opening **34** in plate **24**. Thus, roll pin **32** prevents rotation of plate **24** about bolt **26**, but still allows the aforementioned axial travel along the bolt of the plate. Plate **24** includes two further openings **36** and **38**, for a purpose which will be presently described.

Permanent magnet **40** is fixedly attached to base **10** by means of screw **42** which passes through a central opening in the magnet and is threaded in an opening in the base. Magnet **40**, in the illustrated embodiment, is generally circular and includes segmented pole pieces **44** which face upwardly toward lip **22** and in registration with plate **24**, when the magnet is affixed as shown in FIG. 2. Pole pieces **44** terminate in face surfaces **45**, all of which lie in a single, flat plane.

The dimensioning and arrangement of the afore-described elements is such that when cover **16** is in the closed position, as seen in FIG. 2, the lower, planar surface of plate **24** contacts face surfaces **45** or the pole pieces of magnet **40** and the plate is held thereby in firm engagement with head **30** of bolt **26**. Thus, the biasing force of magnet **40** tends to hold cover **16** firmly in its closed position with diaphragm **20** in sealing engage-

ment with seat **14**. Pressure within the tank with which the device is associated in exerted on the lower side of cover **16** within seat **14**, in opposition to the atmospheric pressure on the upper side of the cover. When the tank pressure exceeds atmospheric pressure by an amount sufficient to overcome the combined loading force of magnet **40** and the weight of cover **16**, the latter will be lifted off seat **14**, thereby breaking the magnetic bond between magnet **40** and plate **24**. The force of magnetic attraction between the magnet and plate decreases rapidly, of course, as the distance between the two increases. Since the magnetic biasing force is an appreciable portion of the total force tending to hold cover **16** in the closed position, the slight lifting of the cover required to essentially break the magnetic bond between the magnet and plate will remove enough of the biasing force to allow rapid movement of the cover to substantially the fully opened position.

When the pressure within the tank has dropped to the point that the unit weight of the cover is greater than the upward force exerted thereon by the gas escaping from the tank, the cover will return to the closed position. Since the cover represents an appreciable mass which may be moving about hinge pin **18** at a relatively high velocity when it reaches the closed position, magnet **40** could be seriously damaged by absorbing this impact. As previously mentioned, however, the elements are so dimensiond and positioned that cover **16** (or diaphragm **20**) makes contact with valve seat **14**, thereby stopping the movement of cover **16**, before any impact is transferred from the cover to magnet **40**. Although plate **24** makes contact with pole pieces **44** of the magnet during movement of cover **16**, the mass of plate **24** is low enough that no damage to the magnet will result. The space provided for movement of plate **24** between head **30** of bolt **26** and the lower surface of lip **22** insures that substantially no impact will be transmitted from cover **16** to magnet **40**.

Means are provided for quickly and easily adjusting the amount of force exerted by the magnet on cover **16**. Holes **36** and **38** in plate **24** are so positioned with respect to the segmented pole pieces **44** of magnet **40** that the relative rotational positions of plate **24** and magnet **40** determine the degree of alignment between these holes and face surfaces **45** of two of the pole pieces. In the illustrated embodiment, pin **32** prevents rotational movement of plate **24**. However, magnet **40** may be set in any desired rotational position and retained therein by tightening screw **42**. The total pulling force exerted by magnet **40** is a function of the degree of magnetization of the magnet and the contacting area of face surfaces **45** and plate **24**.

The magnet is designed to have a predetermined total area of the faces of pole pieces **44**. This is the maximum area over which the face surfaces of the magnet and plate **24** can be in mutual contact, assuming holes **36** and **38** are no greater in diameter than the spaces between the pole pieces. Thus, by fixing the rotational position of magnet **40** with holes **36** and **38** in registration with two of the spaces between face surfaces **45**, magnet **40** will exert a maximum biasing force on cover **16**. By rotating the magnet to a position where the faces of two pole pieces are aligned with holes **36** and **38**, the magnet will exert a biasing force about 25% less than maximum. The pole pieces, as well as the holes in the magnet plate, may be provided in any desired number and configuration. Fore example, rather than being round, the holes could be made in the same shape as the pole pieces.

The magnet material is initially formed in the desired configuration and is then fully magnetized or saturated in conventional manner. The magnet is then "knocked down" or stabilized at a point preferably between 5% and 15% below saturation. Plate **24**, for most applications, may be formed by a stamping operation followed by deburring or polishing. The plate is made, of course, from a material with a high degree of magnetic permeability such as stainless steel.

For normal applications in conjunction with petroleum storage tanks, emergency vents of the type described herein are typically loaded to open at a tank pressure of from, for example, a few ounces to several pounds per square inch above atmospheric pressure. A permanent magnet of the type illustrated, having six hole faces of equal size and shape with one another and with the spaces therebetween, may easily be fabricated to exert a pulling force on the cover of 15 pounds with an outer diameter of about 1¼ inches. Since the cover is held on one side by the hinge and the magnet is placed diametrically opposite the hinged mounting, the pressure required to lift the cover would be double the pulling force exerted by the magnet. Hence, a magnet exerting 15 pounds pulling force would provide the required holding force for a set pressure of about 9 ounces per square inch on an 8 inch emergency vent. This set pressure may be continuously varied down to about 6¾ ounces per square inch since the force adjusting means illustrated provides the capability of setting the pulling force exerted on the cover anywhere between about 11¼ and 15 pounds. Obviously, larger and more strongly magnetized magnets may be used in conjunction with larger cover constructions, or those in which a larger unit loading is desired.

From the foregoing description it may be seen that the invention provides a vent construction which may be loaded or biased in the closed position in an extremely simple and inexpensive manner. The cost of making and assembling the component parts will normally be as low or lower than that for a conventionally weight-loaded cover construction. Since the heavy and bulky lead weights normally attached directly to the cover are eliminated by the present invention shipment, storage and maintenance costs are minimized. Furthermore, operating efficiency is improved since the cover tends to move to the fully opened position as soon as the set pressure has been reached. The unique manner of mounting the elements provided by the present invention allows simple and rapid adjustment within a desired range of the pulling force exerted on the cover, and thereby the pressure at which the cover is set to open.

What is claimed is:

1. A tank vent fitting having a cover hingedly mounted for movement between open and closed positions with respect to an opening defined by a seat formed on a fixed base, said vent comprising, in combination:

(a) a lip portion extending outwardly from one edge of said cover opposite the hinged mounting thereof;

(b) a permanent magnet member having at least one pole piece with a face surface of predetermined area;

(c) first means for mounting said magnet member on one of said lip portion and an opposing portion of said base over which said lip portion extends when said cover is in its closed position;

(d) said first means being constructed and arranged to hold said magnet member with said face surface in facing relation to the opposite of said lip portion and said opposing portion from the one of said portions upon which said magnet member is mounted;

(e) a magnetically permeable member having at least one opening of predetermined area extending therethrough;

(f) second means for mounting said permeable member on said opposite one of said lip portion and said opposing portion in registration with said face surface for contact therewith when said cover is in its closed position; and

(g) one of said first or second means adjustably fixing the relative positions of said magnet and permeable members to selectively vary the area of said opening facing said magnet member face surface which is juxtaposed with said face surface when said cover is

in its closed position, thereby varying the holding force exerted by said magnet member on said permeable member and the biasing force tending to hold said cover in its closed position.

2. The invention according to claim 1 wherein the rotational position of one of said magnet and permeable members is permanently fixed and the rotational position of the other of said magnet and permeable members may be varied.

3. The invention according to claim 2 wherein said magnet member is mounted on said opposing portion of said base and said permeable member is mounted on said lip portion.

4. The invention according to claim 2 wherein said magnet member includes a plurality of spaced pole pieces each terminating in an end forming a portion of said face surface and lying in a flat plate, and the surface of said permeable member which contacts said face surface comprises a substantially plane surface.

5. The invention according to claim 4 wherein said

spaced pole pieces are arranged in a generally circular configuration.

6. The invention according to claim 5 wherein said first means comprises a screw which may be loosened to allow adjustment of the rotational position of said magnet member and tightened to retain said magnet member in a desired position.

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