Nov. 28, 1967 F. E. OBERMAIER 3,354,902

PLASTIC VACUUM STORAGE TANK

Filed May 11, 1964

FIG. 1

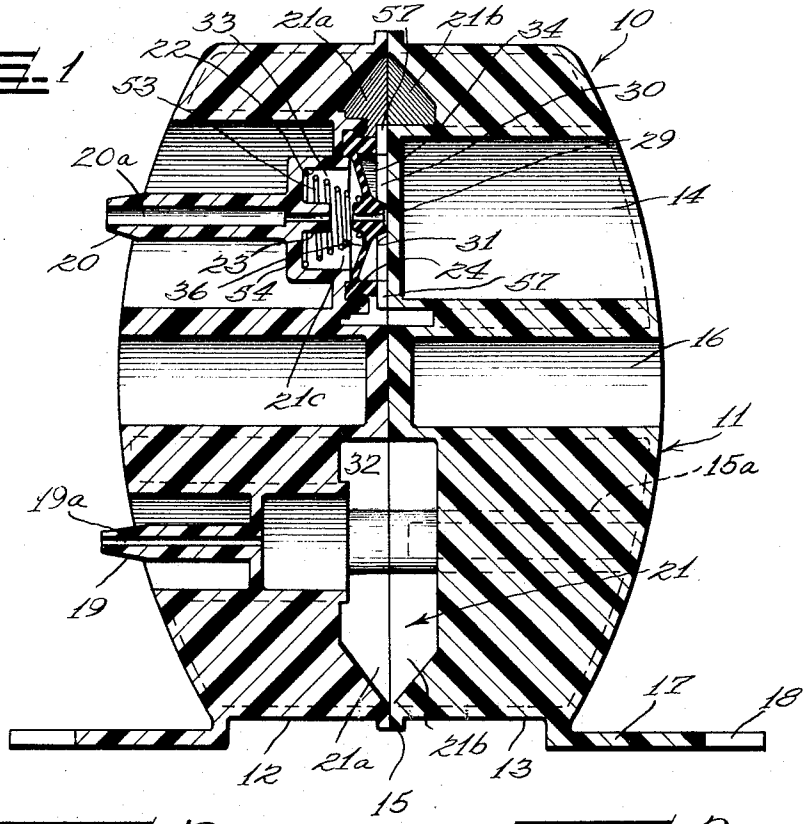


FIG. 2

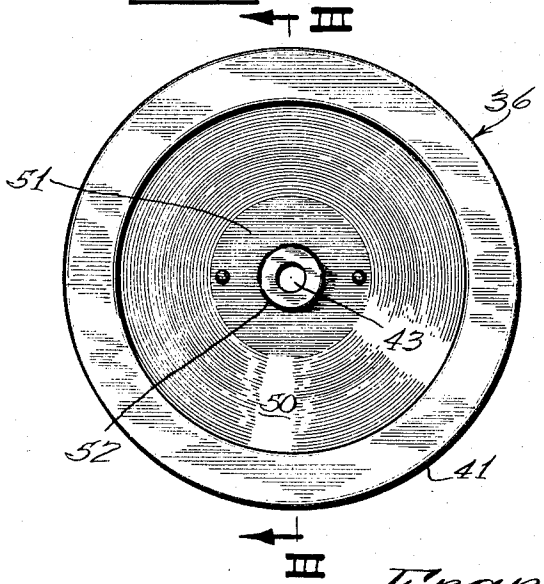
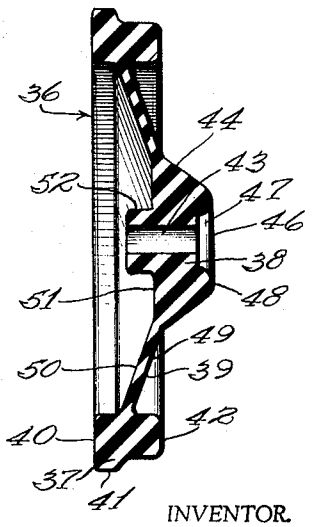


FIG. 3



INVENTOR.

Frank E. Obermaier

BY

Hill, Sherman, Meroni, Gross & Simpson

ATTORNEYS

United States Patent Office 3,354,902 Patented Nov. 28, 1967

3,354,902

PLASTIC VACUUM STORAGE TANK

Frank E. Obermaier, Park Ridge, Ill., assignor to The Dole Valve Company, Morton Grove, Ill., a corporation of Illinois

Filed May 11, 1964, Ser. No. 366,282
1 Claim. (Cl. 137—496)

This invention relates generally to a combined vacuum storage tank and valve assembly and more particularly relates to an improved fluid valve mechanism operative to accommodate flow through the valve in one direction while preventing backflow or leakage through the valve in an opposite direction.

Although the principles of the invention are of general utility, one particularly useful application is made to vacuum systems wherein a vacuum pump or similar apparatus is utilized to withdraw fluid such as air from a given zone or machine such as a vacuum motor. It may be necessary or desirable in such systems to deactivate the vacuum pump while maintaining a vacuum condition in the vacuum motor such as by preventing the backflow or leakage of air to the motor. By means of the present invention, which may effectively serve as a check valve to prevent leakage of air back through the system, a vacuum may be maintained over an extended period of time while the vacuum pump itself remains inoperative.

The present invention is simple in design, easily constructed and assembled, inexpensive in manufacture, rugged, durable and adapted to serve a long, useful life.

It is, therefore, an object of the present invention to provide a combined vacuum storage tank and valve assembly for utilization in a vacuum system capable of maintaining a vacuum in the system over an extended period of time.

Another object of the invention is to provide a vacuum storage tank and check valve assembly wherein the valve member cooperates with an abutment wall of the tank to increase the sealing effect of the valve member and to preclude leakage or backflow through the valve member.

Still another object of the invention is to provide a valve mechanism constructed in a manner such that flow through the valve in one direction is accommodated with a minimum pressure differential across the valve while only a minimum reverse acting pressure differential across the valve will preclude backflow or flow through the valve in an opposite direction.

Yet another object of the present invention is to provide a valve mechanism responsive to pressure differential thereacross for opening and closing the valve and wherein the pressure differential required to maintain the valve in a closed position is reduced after the valve has obtained a closed position.

Another object of the present invention is to provide a valve mechanism which is simple in design, is easily and inexpensively constructed and assembled and provides for improved sealing against back-flow.

Many other features, advantages and additional objects of the present invention will become mainifest to those versed in the art upon making reference to the detailed description which follows and the accompanying sheet of drawings in which a preferred structural embodiment incorporating the principles of the present invention is shown by way of illustrative example only.

In the drawings:

FIGURE 1 is a vertical cross-sectional view of a combined vacuum storage tank and valve assembly constructed in accordance with the principles of the present invention;

FIGURE 2 is a side-elevational view of a diaphragm valve member which constitutes one important part of the invention; and

FIGURE 3 is a vertical sectional view of the valve member taken substantially along lines III—III of FIGURE 2.

As shown in the drawings:

Referring to FIGURE 1, reference numeral **10** indicates generally an illustrative embodiment of the combined vacuum storage tank and valve assembly of the present invention. One important usage of the invention arises in connection with vacuum systems, wherein, a vacuum-producing mechanism such as a vacuum pump may be utilized to reduce the pressure of a fluid such as air in a particular zone or apparatus such as a vacuum motor, and wherein it is necessary or desirable to maintain a vacuum condition in such zone or apparatus for an extended period of time after the vacuum pump has been deactivated.

In contemplation of such exemplary usage, the assembly **10** comprises a tank body **11** which may conveniently be assembled from a pair of vertically split half-portions **12** and **13** bonded together by means of a heat seal at their mating edges **15**, and which may, in its assembled form, assume the general configuration of a barrel. The body **11** may be, for purposes of economy of cost and weight, ease in construction and assembly and other considerations, be constituted of plastic material which may be cut out at nonstrategic zones such as at **14** and **16** in order to reduce weight as well as material requirements. In order to prevent collapse of the body **11** at high vacuum conditions, a plurality of ribs as at **15***a* are provided to strengthen and to rigidify the body. For mounting purposes a flange plate **17** is formed at the lower end of the barrel-shaped tank, and a pair of slots as at **18** are formed in the plate to receive respectively a mounting bolt or other suitable fastening device.

In order to connect the tank **11** in a vacuum system a pair of connector nipples **19** and **20** extend from the tank body for connection, respectively, to a zone or apparatus in which a vacuum condition is to be produced, such as a vacuum motor, and to a mechanism such as a vacuum pump effective to produce the vacuum condition. The connectors **19** and **20** are tubularly shaped with slightly converging end portions to accommodate easy connection to, for example, reinforced air hoses of a vacuum system.

A vertically oriented annularly configurated cavity **21** is formed within the tank body **11** by mating annular recessed walls **21***a* and **21***b* formed in the split sections **12** and **13**. The annular cavity is, in turn, communicable with flow passageways **19***a* and **20***a* formed within the connectors **19** and **20**.

An outlet well **21***c*, defined by a cylindrical wall **22**, is formed within the cavity **21** in surrounding relation to an inwardly extending boss **23**, which boss has the innermost end of passageway **20***a* formed therein. A flat annular shoulder is formed in surrounding relation to the wall **22** and has and undercut annular groove **24** formed therein which groove is provided to receive the peripheral beaded portion of a flexible annular diaphragm later to be described.

A flat abutment wall **29** is formed integrally with the right hand half section **13** and presents a flat seating surface **31**, which surface is circumscribed by an annular raised ridge **32**.

Situated within the well **21***c* substantially transversely to the direction of flow through such portion and effective to partition such portion into a pair of divided chambers **33** and **34**, is an annular flexible disc-shaped diaphragm valve member **36**. Referring to FIGURES 2 and 3, the valve member **36** is more particularly characterized as comprising an outer annular rim portion or bead **37**, an enlarged central portion or protuberance **38** and a web

web portion 39 interconnecting the rim and the central portion.

It will be noted that the rim portion 37 comprises a back wall 40, a peripheral wall 41 and a front wall 42, and is shaped complemental to the groove 28 (FIGURE 1) and is fixedly supported thereby in the assembled position of the valve member 36, such as to produce in effect a seal bead around the valve member 36 to prevent leakage of fluid about the peripheral edge thereof.

The central portion or protuberance 38 is generally frustoconically shaped and is axially forwardly offset in the direction of the abutment wall 29, in its assembled position. The protuberance 38 is further characterized as comprising a central axial aperture or passageway 43 and a converging side wall 44 which terminates in a radially extending wall member 46. A recess 47 is formed in the wall 46 such as to form a raised annular sealing bead 48 encircling the aperture 43.

The web 39 is also forwardly inclined and comprises a front wall or face 49, which blends into the side wall 44 of the protuberance 38, and a rear wall or face 50, which blends into a rear wall 51 of the protuberance 38. That portion of the rear wall 51 surrounding the aperture 43 forms a cylindircally shaped axially extending collar 52.

The valve member 36, or at least the web portion 39 thereof, constitutes flexible material such as rubber so as to accommodate axial movement of the protuberance or central portion 38. In the illustrated embodiment, the entire valve member 36 is made of rubber, thereby enhancing the sealing effect thereof between the valve and the engaging surfaces of the tank 11.

As shown in FIGURE 1, a biasing member or spring 53 is housed within the cylindrical wall 22 in the chamber 33 and bottoms at one end thereof on an inturned portion 54 of the wall 22, and at the other end thereof, on the rear wall 51 of the valve member 36 about the collar 52. The spring 53 is constructed such as to impart a constant biasing force on the valve member 36 in the direction of the abutment wall 29 so as to engage the sealing bead 48 of the protuberance 38 into the face 31 of the abutment wall 29.

In operation, fluid such as air may be drawn through a bore 56 formed in the inlet connector 19 from a pressurizable zone or apparatus such as a vacuum motor and into the cavity 21 which forms a flow path to the well 21c. A pair of radially extending slots as at 57 are formed in the shoulder portion 32 of the abutment wall 29 to provide flow there through into the chamber 34 on one side of the valve member 36.

Simultaneously, air is drawn from the chamber 33 on the opposite side of the valve member through a bore 58 formed in the outlet connector 20, and when the fluid pressure in chamber 33 is reduced sufficiently below that which exists in chamber 34, the biasing force of the spring 53 will be overcome and the front wall 46 of the protuberance 38 will move away from and become disengaged with the face 31 of the abutment wall 29. Thus, the fluid in chamber 34 will flow through aperture 43 of the valve member 36, which is the only flow path across the valve member, and out through bore 58 to the vacuum pump or similar apparatus.

Upon deactivation of the vacuum pump, fluid pressure in chambers 33 and 34 will become equalized and the spring 53 will again urge the sealing face 46 of the valve member into engagement with the face 31 of the abutment wall 29, and in this "closed" position, the valve member 36 acts as a check valve to prevent backflow or leakage from chamber 33 to chamber 34.

It will be noted, however, that in the "closed" position of the valve member 36, as illustrated in FIGURE 1, the area of the face 50 of the valve member 36 which is subject to fluid pressure in the chamber 33 which pressure acts to urge the protuberance 38 axially into engagement with the face 31 of the abutment wall 29, is greater than the area of the face 49 of the valve member which is subjected to fluid pressure in the chamber 34, by that area encircled by the seal bead 48 in engagement with the face 31.

Accordingly, even when the pressure in chambers 33 and 34 is equalized, the seal bead 48 is urged by fluid pressure into good sealing engagement with face 31 by a force which exceeds the force exerted by the spring 53. However, when the vacuum pump again becomes activated and the valve member 36 is moved to an "open" position, that is, out of engagement with face 31, the areas on both sides of the valve member 36 which are subjected to fluid pressure in their respective chambers are equal, thereby reducing the pressure differential necessary across the valve member to maintain the member in an "open" position.

Although minor modifications might be suggested by those versed in the art, it should be understood that I wish to embody within the scope of the patent warranted hereon all such modifications as reasonably come within the scope of my contribution to the art.

I claim as my invention:

A valve assembly comprising,

a body having a flow path therethrough,

an abutment wall in said flow path,

a diaphragm supported at its periphery and disposed in said flow path, and

a coil spring engaging and biasing said diaphragm toward said abutment wall,

said diaphragm comprising an outer annular bead, an enlarged central portion and a web portion interconnecting said bead and said central portion,

said central portion being axially forwardly offset in the direction of said abutment wall, said central portion further comprising a central axial aperture, a converging side wall terminating in a radially extending wall member, and a recess formed in said radially extending wall member to provide a raised annular sealing bead encircling said aperture substantially radially outwardly thereof, said web portion being axially inclined from said annular bead toward said central portion and comprising flat parallel front and rear walls, said rear wall comprising a portion surrounding said aperture and forming a cylindrically shaped axially extending collar for receiving one end of said coil spring to center said spring against said diaphragm.

References Cited

UNITED STATES PATENTS

1,910,961	5/1933	Perry	137—525 X
3,073,339	1/1963	Stelzer	137—527 X

WILLIAM F. O'DEA, *Primary Examiner.*

H. W. WEAKLEY, *Assistant Examiner.*