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Bryant et al.

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[54] **FLAME-ARRESTING VENT VALVE**

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[52] **U.S. Cl.** **417/53,** 417/424, 310/87, 310/88

[51] **Int. Cl.** **F04b 17/00,** F04b 35/04, H02k 5/10

[58] **Field of Search** ....103/89, 87 D, 87 E, 111 D, 103/221; 222/189; 220/88; 310/88, 87; 417/366, 367, 368, 369, 370, 371, 372, 373, 423, 424

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[57] **ABSTRACT**

This invention relates to a flame-arresting vent valve which is positioned to communicate with the uppermost portion of the motor casing of a submersible pump. The vent includes a pressure-actuated valve member and a flame arrester made of porous material to prevent the propagation of flame across the valve. This invention is especially suited for use in pumps which deliver combustible fluids.

16 Claims, 3 Drawing Figures

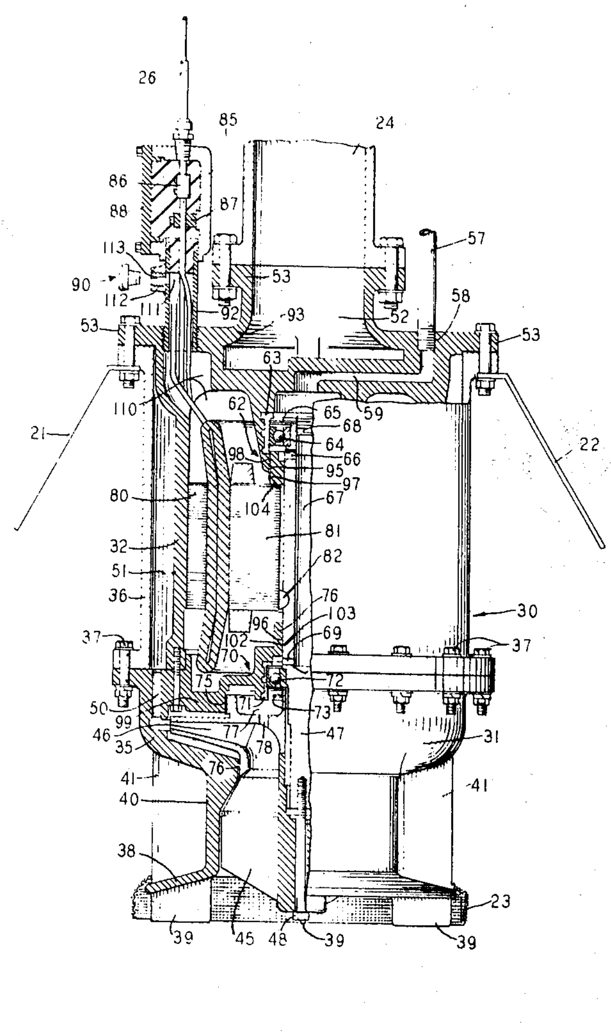

FIG. 1

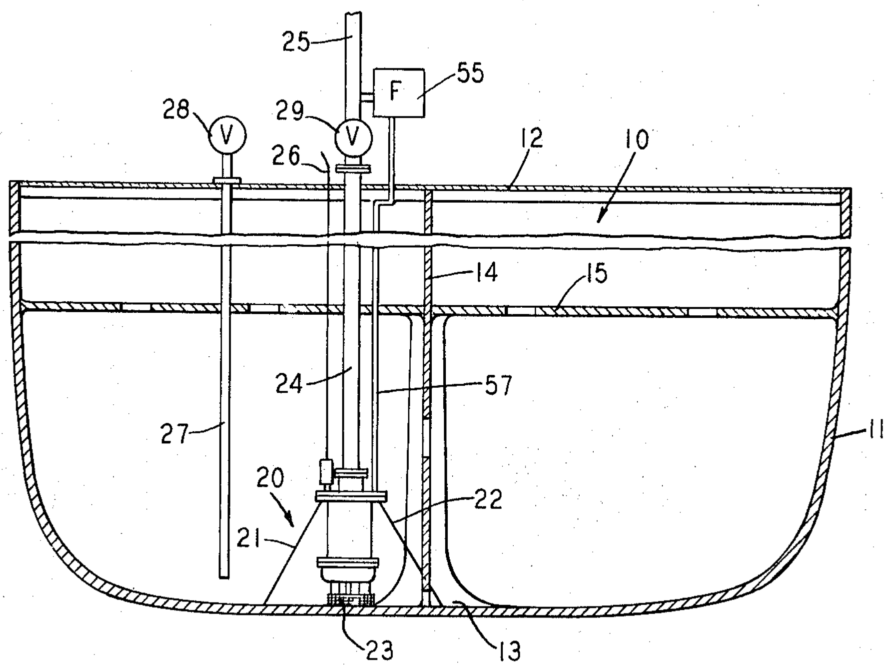

FIG. 3

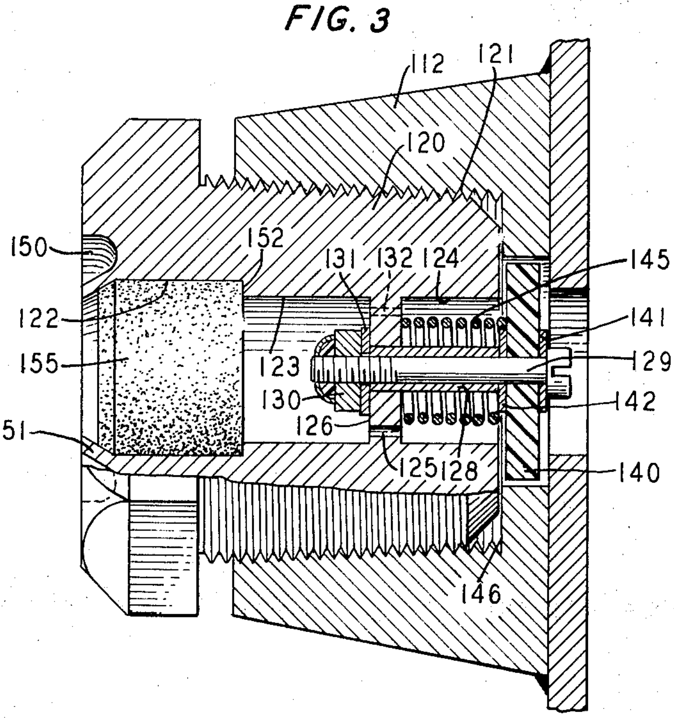

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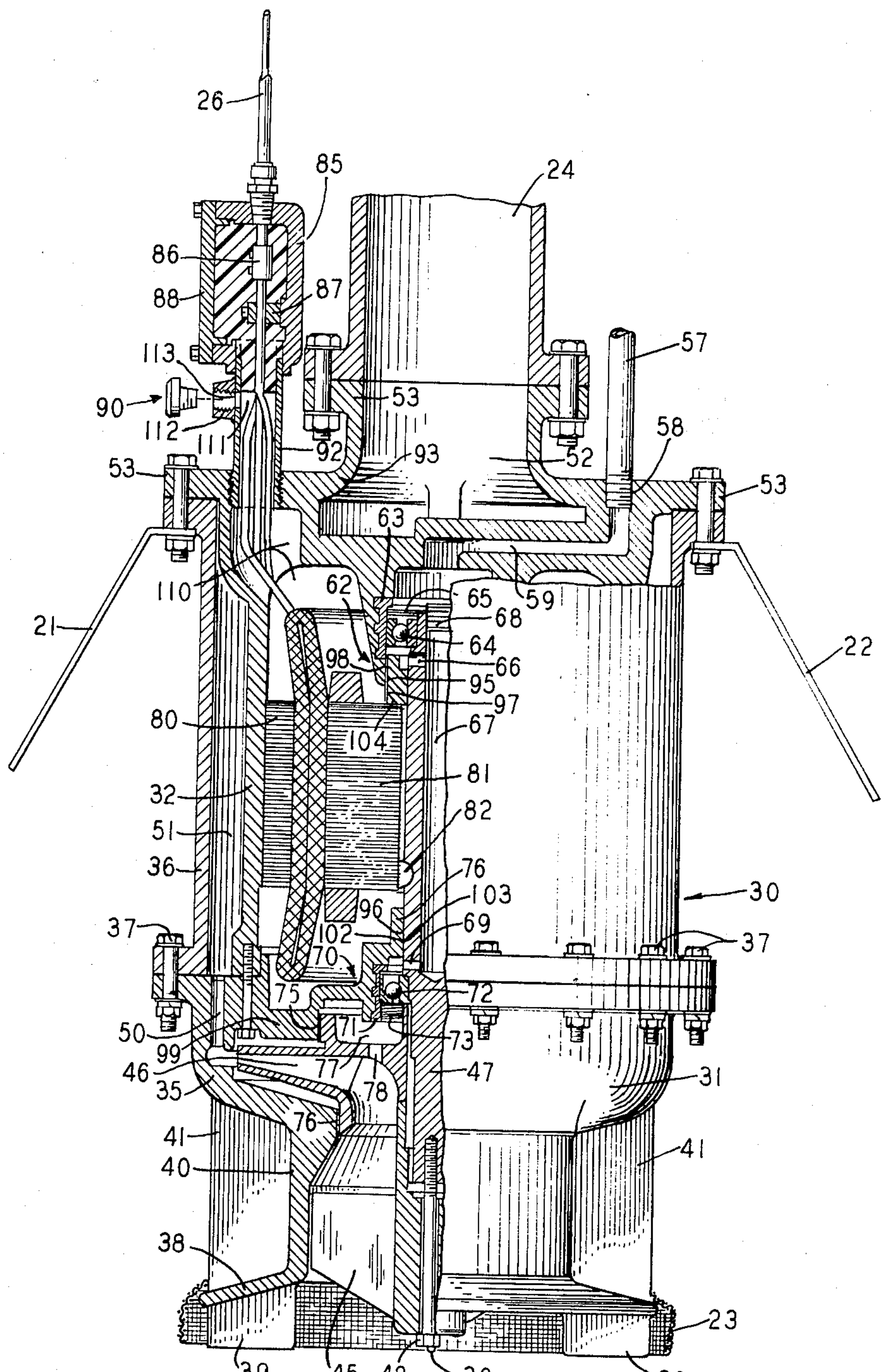
FIG. 2



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FLAME-ARRESTING VENT VALVE

Heretofore, the submersible pumps which were designed to pump liquefied natural gas (LNG) or other liquefied gases such as methane, propane, butane, ethylene, ammonia, and the like, had no provision for venting the air which is normally trapped in the motor casing of the pump. In conventional storage installations in which the submersible pump is mounted in the lower portion of the storage vessel, air is trapped in at least the upper portion of the motor casing due to the fact that there is no venting system by which the air can escape from the motor casing. As the storage vessel is filled with the liquid being stored the liquid permeates the bearings of the pump and seeks its way into the motor casing wherein it compresses the air into the upper portion of the motor casing. The air remains in the upper portion of the motor casing under pressure when the pump starts and during the normal operation of the pump. This presents a safety hazard in that the air contains oxygen, which mixes with vapors from the combustible fluid which is being pumped and this gaseous mixture surrounds the rotor and stator and a portion of the electrical leads in the motor casing. In the event that a spark occurs during the startup or the operation of the pump motor there is a good possibility that the spark will result in an explosion in the interior of the motor casing due to the presence of the dissassociated oxygen in mixture with the vapor of the product liquid. Explosions of this type have occurred. Fortunately, serious injury has been avoided due to the fact that the explosions have not permeated the motor casing housing but have merely destroyed the interior of the pump. If the motor casing fails, however, the flames, etc., may be transmitted into the liquid product in the interior of the storage tank possibly causing the whole storage tank to explode.

In the prior art form of submersible pumps there was no provision for effectively venting the motor casing and preventing the escape of flames from the interior of the motor casing to the exterior of the motor casing. The present invention prevents the flames from propagating into either the storage tank or the discharge lines leading to the exterior of the storage tank.

It is the primary object of this invention to vent any and all air which is present in the motor casing. The venting takes place upon the lowering of the submersible pump into the liquid which is to be pumped. The venting also takes place when the pump is in a fixed position in the bottom portion of a storage tank and the tank is then filled with the liquid which will eventually be pumped out.

It is another object of this invention to prevent flames from leaving the motor casing of the submersible pump.

Another object of this invention is to prevent the flow of liquid through the motor casing of a submersible pump while the pump is in operation. The object is to maintain an atmosphere entirely of the vapor of the liquid being pumped in the motor casing. This prevents the continuous vaporization of the liquid in the motor casing.

It is a further object of this invention to keep the motor casing of a submersible pump substantially free of liquid, in order that the efficiency of the pump may be optimized.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawing, wherein a preferred embodiment of the present invention is clearly shown.

In the drawing:

FIG. 1 is a diagrammatic vertical sectional view, partly broken away, of a storage tank with a submersible pump constructed in accordance with the principles of this invention located in the bottom of the storage tank.

FIG. 2 is a side elevational view, partly broken away, partly in section, showing portions of the submersible pump and showing the location of the flame-arresting vent valve.

FIG. 3 is a side sectional view of a flame arresting vent valve showing the details thereof.

In FIG. 1 there is illustrated a cross-sectional view of the storage tank of an ocean going cryogenic liquid transport vessel. In order to simplify the disclosure of this invention the drawing is presented in a schematic form. The reference numeral **10** generally indicates the hold of the vessel which is defined by sidewalls **11**, deck **12** and bottom portion **13**. The pump and motor assembly **20** is positioned on the bottom of the tank and is held in position by means of struts **21**, **22**. As can be expected, the bottom portion of the tank collects a considerable amount of residual matter and foreign matter which would quickly contaminate the pumping system causing the malfunction of the pump, etc. In order to prevent the entrance of this material into the pumping system a screen **23** is normally positioned around the pump entrance opening. The pump normally pulls a suction through the screen **23** and discharges the liquid into a discharge conduit **24** which directs the liquid top side to a further conduit system **25** which leads the liquid off the ship to storage tanks on shore. While the invention is especially suited for use in storage tanks on board ships, the invention may also be used in storage tanks or vessels on shore, under water or under ground. For example, the pumping system with the flame-arresting vent valve may also be used in the well-known "frozen hole" storage facility. The flame-arresting vent valve can also of course be used with any pumping system having the requirement that the motor casing be purged of air.

The electrical leads leading to the pumping system extend through a fluid tight conduit **26** from the deck area down to the pump and motor assembly. A suitable inlet conduit **27** is provided for filling the tank. From FIG. **1** it can be observed that as the fluid enters through conduit **27** it fills the bottom portion of the tank **10** at first and then the level of liquid rises above the pump and motor assembly **20** and fills the remaining portion of the tank **10**. In normal operation the tank **10** is filled to the extent possible, this being done to reduce the free surface effect of the liquid in the tank and also to leave as little vapor space as possible in the upper portion of the tank **10**. Both conduits **24** and **27** are equipped with suitable valves **28** and **29** which are used to seal off the tank **10** from the atmosphere.

In view of the fact that the details of the conduit system **25** through **27** and the tank **10** form no part of the present invention, this structure is shown in schematic form in FIG. **1**. Perforated members **14**, **15** are used to strengthen the interior of the tank. The perforations allow free communication between the different portions of tank **10**. FIG. **1** is of course not to scale but is illustrative of the form the tanks take.

FIG. **2** illustrates in more detail the elements of the pump and motor assembly and of the flame-arresting vent valve. The pump and motor assembly is generally indicated by the reference numeral **30** and comprises a pump assembly **31** and a motor assembly **32**. This assembly is shown in a sectional view which is partly broken away for purposes of clarity.

The pump assembly comprises a bottom housing **35** which is bolted to the motor casing **36** by means of a plurality of bolts **37**. The lowermost portion of the housing **35** contains a flared annular member **38** which supports a plurality of radially extending guide vanes **39**. The guide vanes prevent the swirling of the liquid that is being sucked into the pump and serve to guide the flow of the liquid in a radial direction into the interior of the pump. A substantially cylindrical portion **40** interconnects the annular member **38** and the upper housing **35**. A plurality of axially extending struts **41** interconnect the annular member **38** and the upper housing **35** for the purposes of strengthening the entire pump casing.

For purposes of simplifying the illustration the conventional screening arrangement which is positioned around the antivortex guide vane and the inlet opening to the pump is not shown in FIG. **2**.

The rotating portions of the pump assembly include the inducer **45** and the impeller **46** both of which are mounted on the shaft **47**. Both the inducer and the impeller may be removed from the shaft by removing bolt **48**. The inducer **45** contains helical vanes which force the fluid being pumped up into the impeller **46**. The impeller forces the fluid into the diffuser **50**. The liquid being pumped then passes up through annular chamber **51** and by means of passages not shown enters into discharge chamber **52**. A flange **53** is positioned on the upper edge of the discharge chamber **52** and is adapted to connect with a flange on the lower end of the discharge conduit **24**.

A portion of the liquid which is being discharged is taken from the conduit system **25** and passed through a mechanical filtering mechanism **55** and is then passed down through conduit **57** to opening **58** located in the upper portion of the motor casing. The opening **58** communicates with internal conduit **59** which directs the liquid to the upper bearing assembly **62**. In the pump and motor assembly illustrated in FIG. **2** the bearings are lubricated by the fluid being pumped. This technique avoids the use of sealed bearings which are prone to failure in this type of environment. The liquid which is used to lubricate the bearings is filtered on deck in a removable or replaceable filter **55** so that the contaminants which pass through the screen and enter into the pumping system do no contaminate or interfere with the normal operation of the bearings.

The upper bearing assembly **62** comprises an annular stainless steel support ring **63**, an angular contact ball bearing assembly **64** which is loaded by a Bellville spring **65**. The outer race of the bearing contacts the ring **63** and the inner race of the bearing contacts the shaft **47**.

A plurality of ports **66** are drilled through the wall of the shaft **47**. For a portion of its length the shaft **47** is drilled out to form a chamber **67** which communicates with the conduits or ports **66**. The upper portion of the chamber **67** is sealed by means of plug **68**. The lower portion of the chamber **67** communicates with ports **69**. As can be seen from FIG. **2** the liquid which enters through port **58** passes through inner conduit **59** and lubricates the upper bearing assembly **62**. The fluid then passes through ports **66** into the shaft **47** and flows downwardly through chamber **67** and then outwardly through ports **69** into the lower bearing assembly **70**. The lower bearing assembly **70** is constructed in a manner comparable to the upper bearing assembly and includes a support ring **71**, a ball bearing assembly **72** and a Bellville spring assembly **73**. The liquid which enters the lower bearing assembly **70** from ports **69** passes through the bearing assembly and then passes into the area of the impeller **46**. Conventional wear rings **75** and **76** define a tight restriction between the rotating portion of the impeller and the adjacent housing in order that the high-pressure fluid which is generated by the impeller does not flow through the areas of the wear rings **75** and **76**. Thus the fluid which passes through the bearing assembly **70** enters chamber **77** and then passes through ports **78** in the lower portion of the impeller wheel. The bearing liquid is then discharged by the impeller into the diffuser section **50** and then upward again into chamber **51** for discharge. Thus a portion of the discharge fluid is recirculated for the purposes of lubricating the bearings.

The details of the motor assembly will now be described. The motor assembly comprises a stator **80** and a rotor **81**. The rotor is keyed **82** to the shaft **47**. Suitable electrical leads extend from top side through fluid-type conduit **26** and pass into the conduit box **85**. Suitable electrical connectors **86** are utilized to connect the incoming electrical leads to the electrical leads leading to the stator. A spacing block **87** is utilized to separate the electrical leads and to hold them in a fixed position thereby preventing the wear or fraying of the insulation which surrounds the electrical leads and the possible shorting of the electrical system. In the conventional conduit box a replaceable cover **88** is utilized so that inspection of the electrical leads and the connection **86** may be made and so that the electrical leads may be disconnected from the power source when desired. It has been found that certain electrical codes demand that the conduit box be filled with epoxy compound. This is apparently done in order to rigidly position the electrical connection **86** and the electrical leads leading into the connection in order to prevent short circuits, etc. The epoxy is shown in FIG. **2**. The use of epoxy of course presents certain problems in that it must be chipped away or cut away if the electrical leads are to be replaced or repaired or connected in another manner.

Attention is directed to the fact that the motor casing contains a cavity of considerable volume. The cavity surrounds the rotor and stator and extends upward to the conduit box. If the conduit box were not packed with epoxy it would also constitute a portion of this motor casing cavity. When the motor casing is not submersed in the storage tank or other operative position the cavity normally contains air. It is the purpose of the present invention to vent this air when the pump is submersed. In order to vent the air from the motor casing cavity a flame-arresting vent valve generally indicated by the reference number **90** is positioned to communicate with the uppermost portion of the cavity. In FIG. **2** the flame-arresting vent valve is mounted on the uppermost portion of cylinder **92** which connects the conduit box **85** to the upper portion **93** of the motor casing.

If for example the pump and motor assembly of FIG. **2** is positioned as shown in FIG. **1** and the storage tank **10** is flooded with liquid, the liquid level will rise in the pump itself in that the pump directly communicates with the fluid in the storage tank. The fluid will pass through the inducer and the impeller **46** and will pass up into chamber **51** and into discharge chamber **52** and into the discharge conduit **24**. The liquid will also pass through port **78** and through the lower bearing assembly, port **69**, chamber **67**, port **66**, upper bearing assembly **62**, and into the conduit **59**. The liquid will rise in conduits **24** and **57** displacing the air therein which is normally vented by suitable valves topside. In normal circumstances the level of liquid in the conduits **57**, **24**, and in the tank **11**, will be above the motor and the pump assembly. The liquid which has passed into the interior of the motor assembly will pass through flame paths **95** and **96**. The flame path **95** is defined by a cylindrical surface **97** on an extension **104** of shaft **47** and by a cylindrical surface **98** machined into the upper portion of the motor casing housing. In its preferred form the flame path has a maximum clearance of 0.025 inch and is 1½ inches in length. The purpose of the flame path is to prevent the propagation of a flame from the interior of the cavity to the exterior of the cavity through the bearing assembly. The flame paths effectively prevent this in the well-known manner. Flame path **96** is similarly defined by a cylindrical surface **102** machined into the lower portion of the motor casing assembly and by cylindrical surface **103** on the shaft **47**. The dimensions of the flame path **96** should be essentially identical with the dimensions of flame path **95**.

It can be seen that as the liquid enters the bearing assemblies it will permeate the flame paths and enter the motor casing cavity. The liquid will continue to enter the motor casing cavity due to the head of the liquid in the storage tank and the liquid will compress the air or vapor in the cavity into the uppermost portion of the cavity. In the motor casing configuration of FIG. **2** the uppermost portion of the cavity is indicated by the reference numerals **110** and **111**. If the flame-arresting vent valve **90** were not positioned as indicated in FIG. **2**, the compressed air would remain in the cavity portions **110** and **111**, there being no means of escape. If in fact there were no vent valve this Compressed air would remain in the cavity **110** and **111** until the pump motor was started. Upon starting, the rotation of the rotor and the heat generated by the actuation of the pump would at least partially vaporize the liquid product in the motor cavity. The vapor formed by this vaporization would mix with the air in the cavity **110** and **111** and would result in a gaseous mixture highly susceptible to ignition if the mixture came into contact with an electrical spark, excessive heat, hot wire, or any other mechanism which would bring the mixture to its ignition temperature. Since the air that is trapped in the motors casing contains oxygen and since the liquid which is normally pumped in this type of pumping system is highly combustible, all the elements necessary for combustion are present if the ignition temperature of the mixture can be reached.

In the embodiment shown in FIG. 2 the flame-arresting vent valve is shown mounted in an annular collar **112** which is welded or otherwise affixed to the cylinder **92**. The internal portion of the collar **112** communicates with the port **113** which is drilled into the cylinder **92**. As can be seen from FIG. 2 the port **113** communicates with the uppermost portion of cavity **111**. Thus any air in the motor casing cavity will be displaced by liquid rising in the cavity and will vent through the port **113** through the vent valve **90**. In the interests of clarity, the details of the vent valve are not shown in FIG. 2 but are illustrated in FIG. 3 which is a detailed view in cross section of the flame-arresting vent valve.

In the preferred form of the valve the body portion **120** is made from an aluminum alloy pipe plug having a hexagonal head. A portion of the periphery of the body is threaded **121** so that it can be screwed into position in the collar **112**. The flame-arresting vent valve could of course be screwed into the threaded opening in the conduit box if the epoxy compound were not utilized to pack the box, or it could be threaded directly into cylindrical member **92**. In the embodiment shown the wall thickness of cylinder **92** prevented the vent valve from being directly threaded through it and therefore the annular collar **112** was utilized as a support member. A hole **122** is partially drilled through the body portion **120**. The body portion is then further drilled to form holes **123** and **124** of equal diameter. Note that the diameter of hole **122** is greater than the diameter of hole **123** and hole **124**. The purpose for this will be explained below. The portion of the body remaining between the holes **123** and **124** is drilled centrally to form central opening **125** and is drilled to form four equally spaced openings surrounding the central opening. One of these last-mentioned ports is indicated by reference number **126**. Slidably mounted through the central opening **125** is an elongated spacer **128**. A bolt **129** extends through the spacer and is threaded at one end to receive lock nut **130**. A flat washer **131** is positioned between the lock nut and the body portion **132**. A valve assembly **140** is slidably mounted on the bolt **129**. The valve assembly which is preferably made of Teflon is partially supported by washers **141** and **142**. Valve **140** is biased to an open position by means of spring **145** which rests on body portion **132** and forces the valve **140** away from the valve seat **146**. Teflon is utilized as the valve material due to the fact that it retains it characteristics at cryogenic temperatures and does not become brittle and hard at cryogenic temperatures (below about −100° F.). The type of material used depends on the temperature and characteristics of the fluid being pumped.

An annular groove **150** is machined in the surface of body **120** concentric with the hole **122**. The internal rim of the groove **150** is normally axially extending but is crimped inwardly in order to firmly hold in place a block of sintered material which is positioned in the hole **122**. In its preferred form the sintered material is formed from sintered bronze having a 40-micron nominal porosity. It has been found that a sintered bronze block having the aforementioned porosity and being one-half inch long is entirely suitable for preventing flame propagation when liquefied natural gas, methane, etc., is being handled. The cylindrical block of sintered bronze is positioned in the hole **122** and bottoms on the annular wall portion **152**. The annular internal rim **151** is then crimped over the exposed frustoconical edge of the sintered bronze block with a crimping tool.

It is evident from FIG. 2 that the flame-arresting vent valve is positioned in such an attitude so as to allow the sintered material to directly contact the liquid which is in the storage tank. The valve mechanism is positioned so that it is communicating directly with the contents of the motor casing cavity. With the valve **140** in an open position, liquid and vapor may pass through the flame-arresting vent valve. For example, when the storage tank is initially filled with liquid and the liquid level in the motor casing cavity rises to displace the air in the cavity, the air is forced out of the cavity through the vent valve **90**. The valve assembly **140** forms no restriction for the air in that it is in its normally spring-loaded open position. The sintered material while forming a partial restriction for the passage of air has been designed with a porosity which allows the air to escape from the cavity. Thus the liquid which floods the motor casing entirely displaces the air in the motor casing. When the liquid level in the tank and the liquid level in the motor casing reaches the vent valve, the motor casing will be entirely flooded with the liquid product and no air will remain inside the motor casing.

When the pump is started up, the liquid product which is in the motor casing will begin to vaporize. This will cause an increase in pressure in the motor casing which will close the valve **140**, there being a differential pressure across said valve caused by the vaporization of the liquid product and the consequent buildup of pressure in the motor casing. The vapor pressure in the motor casing will increase until it exceeds the pressure of the liquid being pumped through the bearing-lubricating system and then the vapor will flow through the flame paths **95** and **96** into the bearing-lubricating system and the vapor will then exit through port **78** and go into the discharge system. The excess pressure in the motor casing will be bled off until an equilibrium situation exists wherein the pressure within the motor casing is substantially equal to the pressure of the fluid being pumped through the bearing-lubricating system.

Thus in the applicants' system there is substantially no continuous vaporization of the liquid product in the motor casing cavity. The liquid which is initially in the motor casing cavity is of course vaporized when the pump is energized but due to the pressure which is generated and maintained in the motor casing cavity, substantially no additional liquid is allowed to bleed into the cavity through the flame paths. Consequently, there is little or no continuous vaporization of the liquid being pumped in the motor casing.

When the pump is shut down, the pressure in the bearing-lubricating system drops. The higher vapor pressure in the motor casing then bleeds out through the flame paths. The motor casing vapor pressure continues to drop until valve **140** pops open allowing communication between the interior of the motor casing and the tank through the flame-arresting vent valve. The vapor in the motor casing will then be displaced by the liquid product and escape through the valve. Upon pump startup the above-described cycle repeats itself.

In its preferred form the body of the flame-arresting vent valve is formed of aluminum and the sintered material is formed of a porous bronze or other sintered material having a rating of from about 10 to about 500 microns—nominal (preferably about 40 microns or less), and a length of at least about 0.2 inch and preferably approximately one-half inch. It is understood that other suitable sintered materials could be used in place of sintered bronze; for example, sintered stainless steel or sintered copper could also be utilized. However, the micron rating of the sintered material and its length should be such that it prevents the propagation of flames through the sintered material so that any flames which do occur either in the motor casing cavity or exterior of the motor casing will not be transmitted through the sintered material. The micron rating refers to the nominal size of a particle which will pass through the material.

It is evident that if there is a flame within the motor casing cavity it will be unable to successfully traverse either the flame paths **95** and **96** or the sintered material **155**.

Although sintered material having the above characteristics is preferred for the purpose of flame arresting in this invention, it is also possible to use other mechanisms for this purpose. For example one or more elongated small drilled holes in the body **120** could be used in place of the sintered block **155**. The holes would have to be of such a diameter and length so as to prevent flame propagation across the valve. The sintered material is preferred in that due to its porous nature it is less apt to plug up with contaminants, foreign matter etc.

Other porous materials (such as for example sand, etc., having flame-arresting characteristics could also be used in place of the sintered material. It is preferred, however, that the material not be loose in that this might lead to excessive wear or destruction of the bearings.

The flame-arresting vent valve can be utilized with any pumping system in which the motor cavity is flooded with the liquid being pumped. It must always be positioned so that it communicates directly with the air which is trapped in the upper portion of the motor cavity. It must be positioned in such a location that all of the air in the cavity has a tendency to vent through the vent valve.

The flame-arresting vent valve can also be used to vent undesired fluids from the interior of dynamoelectric machines and to arrest flame propagation either into or out of said machines. Further use of the invention may be made where it is necessary to vent apparatus and at the same time insulate the surroundings from flames generated within the apparatus.

To those skilled in the art to which our invention relates, many changes in construction and widely differing embodiments and applications of the invention may suggest themselves without departing from the spirit and scope of the invention. Our disclosure and the description herein are purely illustrative and are not intended to be in any sense limiting.

We claim:

1. A submersible pump system comprising a pump and motor assembly positioned in a liquid storage tank, discharge means leading from said pump and motor assembly, vent means to vent the air in the motor casing of said motor assembly as the pump and motor assembly is submerged in the liquid, said vent means comprising a flame-arresting vent valve having a body portion, an opening extending though said body portion and communicating with the uppermost portions of the interior of the motor casing whereby as the liquid level rises in said motor casing the displaced air is forced through said vent means and flame-arresting means positioned in said opening to prevent the passage of flame through said opening.

2. The pump system of claim **1** having means to lubricate the bearings of said pump and motor assembly with the liquid product being pumped.

3. The pump system of claim **2** having flame path means allowing restricted communication between the interior of the motor casing of the motor assembly and the storage tank.

4. The pump system of claim **1** in which said flame-arresting means comprises a sintered metal block which extends across a portion of said opening.

5. The pump system of claim **4** in which the sintered metal block contains openings of a nominal diameter of from about 10 to about 500 microns.

6. The pump system of claim **4** in which the sintered material is made of material taken from the class consisting of sintered bronze, sintered stainless steel and sintered copper.

7. The pump system of claim **1** in which said vent means further comprises a spring-loaded vent valve positioned in said opening between said flame-arresting means and said motor casing, said valve being normally urged toward an open position by said spring.

8. A method of starting and operating a submersible pump having a motor comprising the steps of submersing the pump

in liquid, displacing the air in the motor casing of said pump with said liquid, venting the air so that it escapes from said pump, starting the pump motor, vaporizing at least part of the liquid in said casing and maintaining a pressure therein which substantially prevents the entry of further liquid into said motor casing.

9. A method as defined in claim **8** characterized by supplying liquid to bearings of the pump to lubricate the same.

10. A motor driven pump comprising a motor casing, vent means communicating with the interior of said motor casing to allow the escape of fluid from said motor casing, said vent means including flame-arresting means to prevent the passage of flame from the interior of the motor casing, said vent means further including pressure-responsive means adapted to maintain said vent means open while the pressure in said motor casing remains substantially equal to the pressure without said motor casing and to close said vent means in response to a predetermined pressure buildup in said motor casing.

11. The motor driven pump of claim **10** in which said pressure-responsive means includes a spring-loaded valve which closes in response to a buildup of pressure in the motor casing.

12. A motor-driven submersible pump comprising a pump assembly, a motor assembly having a motor casing, means to lubricate the bearings of said pump with the fluid being pumped, vent means communicating with said motor casing to permit fluid to displace the undesired gases in said casing when the pump is submersed in fluid, said vent means including pressure-responsive means adapted to close said vent means when a predetermined differential pressure across said pressure-responsive means is reached.

13. The pump of claim **12** in which said vent means further comprises flame arresting means to prevent the passage of flame from the interior of the motor casing.

14. A motor-driven submersible pump for delivering combustible fluids comprising a pump assembly, a motor assembly having a casing, means to lubricate the bearings of the pump with the combustible fluid being pumped, vent means connected to said motor casing to vent air from said casing as said pump is submersed in said combustible fluid, said vent means including valve means responsive to pressure buildup in said casing to close said vent means.

15. A motor driven pump as defined in claim **14** in which said vent means further comprises flame-arresting means to prevent the passage of flame from the interior of the motor casing.

16. A motor-driven pump comprising a motor assembly and a pump assembly, said motor assembly including a motor casing defining a cavity, a stator and a rotor positioned in said cavity, means to lubricate the pump bearings with the fluid being pumped, vent means connected to said motor casing to vent gas in said cavity, said vent means including flame-arresting means to prevent the passage of flame through the vent means and valve means operable in response to a predetermined pressure increase in said casing to close said vent means and thereby prevent the passage of fluid through said vent means.

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