United States Patent

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[54] **CENTRIFUGAL REFRIGERANT GAS COMPRESSOR**
5 Claims, 3 Drawing Figs.

[52] **U.S. Cl.** **415/14,** 415/118
[51] **Int. Cl.** **F01d 25/00**
[50] **Field of Search** 415/131, 118, 9, 14

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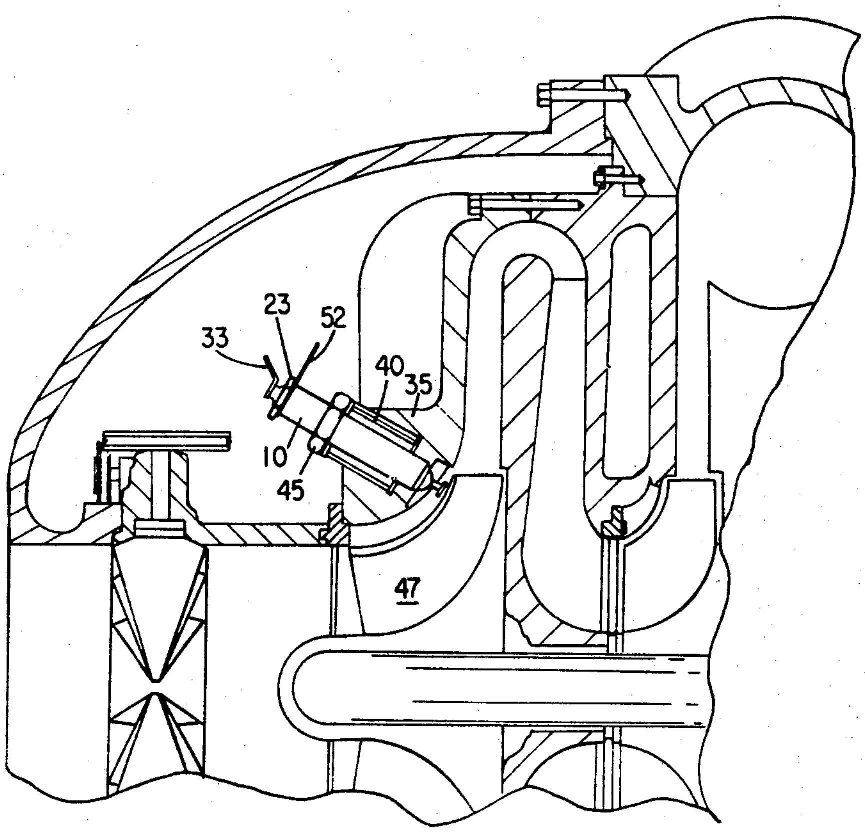
ABSTRACT: The compressor includes a member engaged by the impeller if the same moves from normal operating position. Instantaneously, upon such engagement, the member is moved out of engagement with the impeller and effects actuation of contacts in an electrical circuit to signal the movement of the impeller and/or shut down the compressor before damage to the machine takes place.



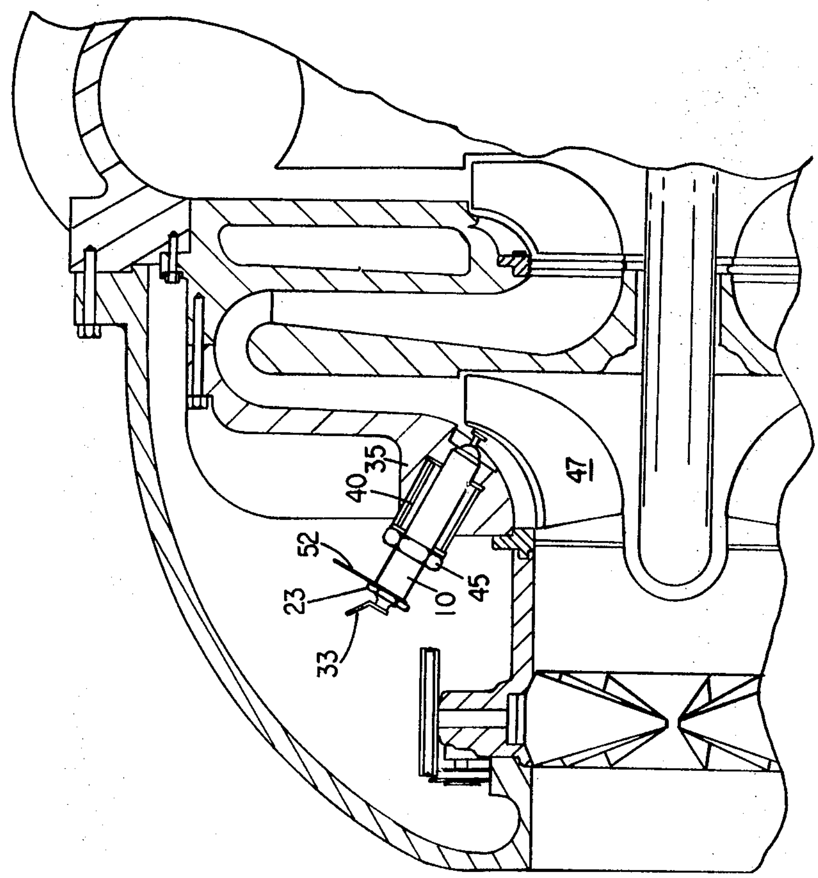


FIG. 1

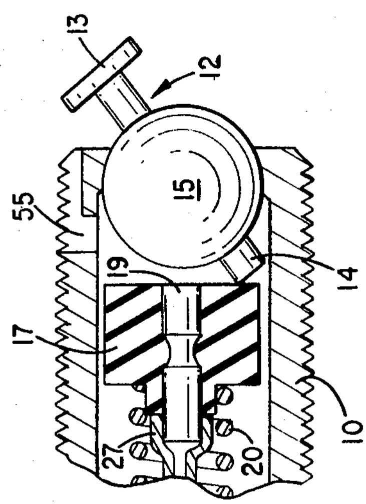


FIG. 2

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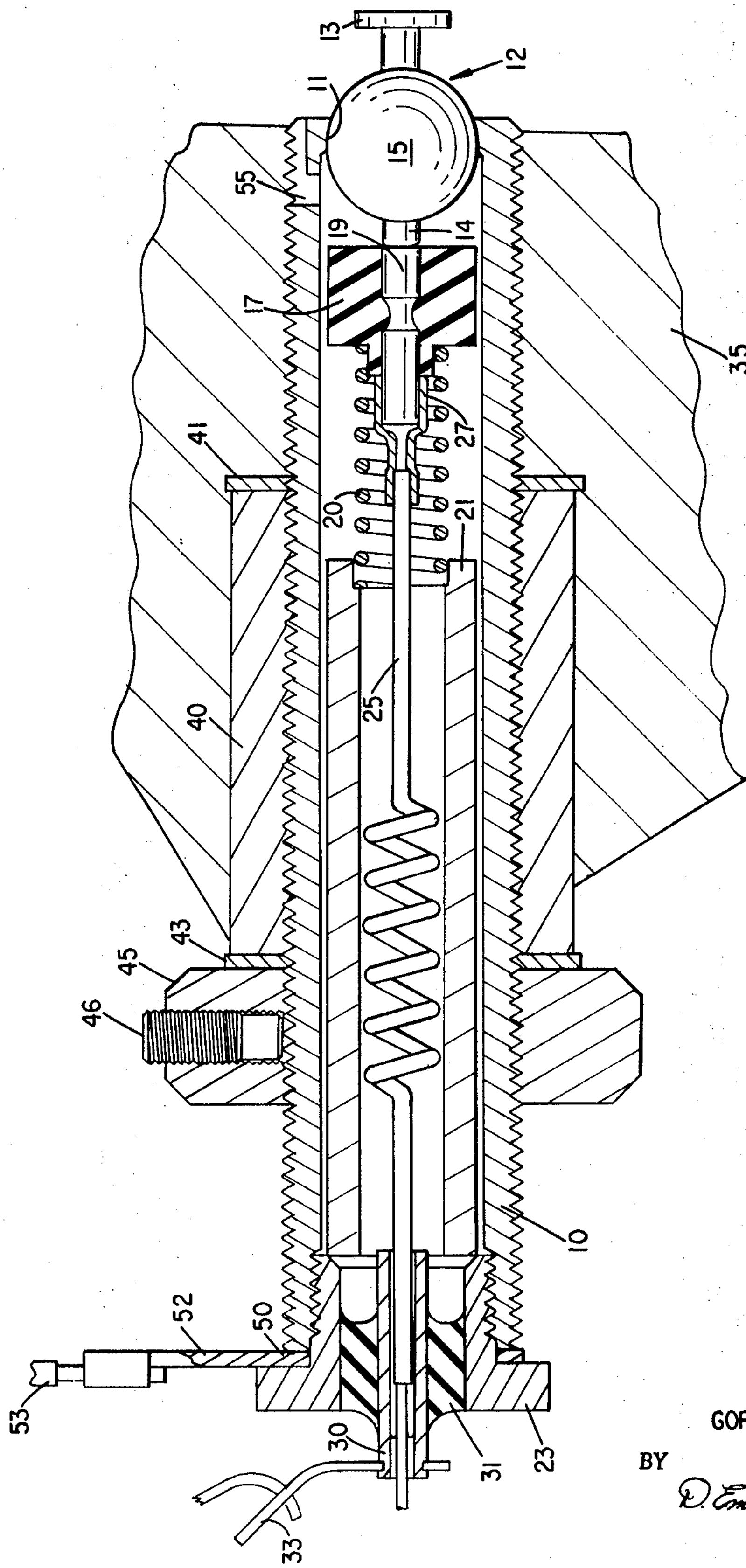

FIG. 3

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CENTRIFUGAL REFRIGERANT GAS COMPRESSOR

BACKGROUND OF THE INVENTION

The impellers of centrifugal gas compressors are rotated at high speed. Such machines are assembled with relatively close tolerances. If movement of the impeller takes place in excess of normal running clearance from normal operating position, the impeller will rub on the casing of the machine. Such undesired movement of the impeller may be axial or radial and may result from a bearing failure, unbalance, or a loose impeller retaining nut. Due to the high-rotational speed of the impeller, the frictional engagement between the impeller and the casing results in the production of excessive temperature in these parts followed by serious damage to the machine.

In the case of a centrifugal refrigerant gas compressor, the impellers are often formed of aluminum. Also, the refrigerant employed contains a halogen element. Even a slight rubbing of the impeller on the machine casing will result in damaging the protective surface of the aluminum impeller, whereupon halogenation of the impeller will take place, bringing about its complete destruction and causing contamination of the refrigerant system.

SUMMARY OF THE INVENTION

The refrigerant compressor of my invention embodies a support fixedly mounted in the impeller casing and carries a probe element positioned in proximity to the impeller. The arrangement is such that upon slight displacement of the impeller from normal operating position, the probe element is contacted by the impeller and moved to actuate contacts in an electrical circuit which may serve to give a signal of impending trouble or, preferably, shut down the machine. An important feature of the invention is that instantly upon the impeller contacting the probe element, the latter is moved out of engagement with the impeller, thus avoiding any rubbing on the impeller to injure the surface thereof and avoid any possibility of halogenation of the impeller.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary sectional view of a conventional centrifugal compressor, illustrating the mounting therein of the detecting device embodying my invention;

FIG. 2 is an enlarged sectional view of the inner end of the detecting device, illustrating the probe in tripped condition subsequent to contact by the impeller; and

FIG. 3 is an enlarged lengthwise sectional view of the detecting device and including a contiguous portion of the machine casing in which it is mounted.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Making reference to the embodiment of the invention as shown in FIG. 3, the detecting device includes a support member **10** shown in the form of a tube or sleeve formed with threads on the periphery thereof throughout its length. The inner end of the bore of the sleeve **10** is of spherical formation as indicated at **11**. A probe member **12** is mounted in the inner end of the support **10** and is formed with end portions **13** and **14** in the form of protuberances arranged diametrically at opposite sides of an intermediate spherical portion **15**. The spherical portion **15** is dimensioned comparable to the spherical portion **11** of the bore of the support **10**, the arrangement being such that the probe cannot pass outwardly through the bore from the support **10** (see FIG. 3).

A circular block **17** of insulating material is slidably mounted in the bore of the support **10**. The block **17** is molded about a contact insert **19** having an exposed end portion for engagement with the protruding end **14** of the probe. The block **17** is yieldingly urged toward the probe by a helical compression spring **20** interposed between the block **17** and an inner sleeve **21**. The opposite end of the sleeve **21** engages a nut **23** threaded into the outer end of the bore of the support member **10**.

A flexible conductor **25** has one end electrically connected to the contact **19**. This connection, and the exposed portion of the contact **19**, is enclosed by an insulating sheath **27**. The opposite end of the conductor **25** is connected and sealed to a tube **30** of conducting material fixedly sealed in the nut **23** by insulating material **31**. A terminal **33** is attached to the outer end of the tube **30**.

The spring **20** serves to yieldingly press the contact **19** against the end portion **14** of the probe **12**, and to press the spherical portion against the spherical end **11** of the support bore. It also serves to maintain the probe with the end protuberances **13**, **14** in registration with the axis of the support **10**, as shown in FIG. 3.

The casing **35** of the compressor is formed with a bore, the inner portion of which is of reduced diameter and provided with threads. The support **10** is mounted in the casing bore, the inner end of the support having threaded engagement with the inner end of the casing bore (see FIG. 3). A spacer sleeve **40** is positioned in the enlarged outer portion of the casing bore, the inner end of the spacer engaging a shock proof lockwasher **41** positioned against the shoulder at the inner end of the bore enlargement. A similar washer **43** is positioned against the outer end of the spacer sleeve **40** and is engaged by a locknut **45** threaded on the support **10**. The locknut may be provided with a setscrew **46** to fix it in adjusted position.

With this arrangement, the support **10** is threaded into the machine casing **35** to position the end contact portion **13** of the probe in close proximity to the impeller **47**, as shown in FIG. 1. Thereupon, the locknut **45** is tightened and secured. This construction permits axial adjustment of the support **10** to locate the probe contact end **13** in proper relation to the rotating impeller.

A washer **50** is interposed between the head of the nut **23** and the outer end of the support **10** and is formed with a radial arm portion **52** serving as a terminal for connection with a conductor **53**. It will be observed that instantly upon the impeller **47** contacting the end contact portion **13** of the probe, the probe will be rotated about the axis of the spherical portion **15** in the direction of the movement of the impeller, the end **13** moving with the impeller out of engagement therewith; thereby, there is no rubbing action between the impeller and the probe. Upon engagement of the probe by the impeller, it is moved to the position shown in FIG. 2; and because of the pivotal movement of the probe, the end portion **13** is moved out of engagement with the impeller. Therefore, there is no rubbing action between the probe and the impeller to cause damage to the surface of the impeller which might lead to halogenation, as previously pointed out. Accordingly, the substantially instantaneous movement of the probe out of engagement with the rotating aluminum member is of particular importance. Despite the fact that the power supply to the prime mover may be interrupted upon initial movement of the probe, the impeller will continue to rotate during the coast down period. While the coast down period in modern centrifugal compressors may be reduced to a duration of one-half minute, during such period with the impeller rotating at high speed, the surface of the impeller would be damaged by a fixed probe to the extent that the impeller would have to be replaced. Upon movement of the probe, the projection **14** of the probe is moved out of engagement with the contact **19**, opening the electrical circuit connected to the terminals **33**,**53**. This variation in the electrical circuit can be used to give a signal that the probe has been tripped; and it may also be used to interrupt the power supply to the prime mover, rotating the impeller. It will be further observed that when the probe has been tripped and moved to the position shown in FIG. 2, the probe is yieldingly maintained in this position by engagement between the spring-pressed block **17** and the protuberance **14**, preventing any further engagement between the impeller and the probe.

The inner end of the support **10** may be formed in its periphery with a slot **55**. The slot **55** extends from the inner end of the support **10** along the periphery thereof and connects with a radial passage communicating with the interior of the support behind the spherical portion **15** of the probe. This effects equalization of the gas pressure on both sides of the spherical portion **15**. Otherwise, the gas pressure on the outer side of the spherical portion might move the probe inwardly against the action of spring **20**, adversely affecting the normal or preset clearance between the contact end **13** of the probe and the impeller **47**.

It is believed apparent that the flat abutting surfaces of the protruding end portion **14** of the probe, and the contact **19**, serve in conjunction with spring **20** to yieldingly maintain the probe in operative position for engagement by the impeller in the event of axial or radial movement thereof from normal running position. Also, because of the spherical mounting of the probe, it has universal movement relative to the support; also, that the device is conveniently mounted in the frame or casing of the machine and adjusted with proper initial clearance in respect to the impeller. Furthermore, after the probe has been tripped to the position shown in FIG. **2**, it is reusable by simply returning the probe to normal operative position as shown in FIG. **3**. Accordingly, the detecting device is operable to detect movement of the impeller from normal position and without any injury to the impeller.

A further advantage in my invention resides in the ease in which the detecting device is mounted in the machine. Due to the universal movement of the probe, resulting from the coacting spherical surfaces between the probe and the support, the probe is simply threaded into the casing of the machine to an extent to provide the proper running clearance between the probe and the rotating member. Regardless of where rotation of the support ceases, the probe will be properly actuated when contacted by the impeller.

I claim:

1. A centrifugal refrigerant gas compressor including a casing and an impeller journaled for rotation in said casing, detecting means for detecting movement of said impeller from normal operating position, said detecting means including a support fixedly mounted in said casing with the inner end of said support located in juxtaposition to said impeller, a probe pivotally mounted in said end of said support and having a contact portion extending outwardly from said support, means cooperable with said probe to yieldingly maintain said contact

portion thereof in operative position in proximity to said impeller for engagement thereby upon movement of said impeller out of normal operating position, said probe upon contact by said impeller being instantaneously movable about said pivotal mounting in the direction of rotation of said impeller out of engagement therewith, electrical contact means mounted in said support for actuation by said probe upon movement of said contact portion out of operative position, and means operable to hold said probe out of said operative position subsequent to contact by said impeller.

2. A centrifugal refrigerant gas compressor as set forth in claim **1** wherein said probe and said support are formed with coacting spherical surfaces, whereby said probe is capable of universal movement about the center of said spherical surfaces.

3. A centrifugal refrigerant gas compressor including a casing and an impeller journaled for rotation in said casing, detecting means for detecting movement of said impeller from normal operating position comprising a tubular support fixedly mounted in said casing and having an inner end located in juxtaposition to said impeller, a probe member mounted in said inner end of said support and having a contact portion extending outwardly from said support in operative position in proximity to said impeller or contact thereby upon movement of said impeller out of normal operating position, said probe and support having coacting spherical surfaces, said contact portion being movable about the center of said spherical surfaces upon contact by said impeller out of contacting engagement therewith, a block formed of insulating material slidably mounted in said tubular support, an electrical contact carried by said block, spring means mounted in said support and operable to yieldingly urge said block toward said probe and maintain said contact in engagement with a portion of said probe inwardly of said spherical surfaces, and an electrical conductor connected to said contact and extending outwardly through said support.

4. A centrifugal refrigerant gas compressor as set forth in claim **3** wherein said tubular support is of circular form and having threaded engagement with said support.

5. A centrifugal refrigerant gas compressor as set forth in claim **3** and including means for sealing the outer portion of said electrical conductor in the outer portion of said support.