United States Patent

Richardson et al.

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[54] CENTRIFUGAL REFRIGERANT GAS COMPRESSOR CAPACITY CONTROL

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[21] Appl. No.: **14,471**

[52] **U.S. Cl.**.....**415/150**, 415/219, 415/183

[51] **Int. Cl.**.....**F04d 27/00**

[58] **Field of Search**.....415/146, 147, 148, 150, 151, 415/209; 62/217, 201

[56] **References Cited**

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3,289,919 12/1966 Wood.....415/150

3,160,112 12/1964 Flaton et al.....415/147

FOREIGN PATENTS OR APPLICATIONS

736,207 6/1943 Germany.....415/147

727,649 4/1955 Great Britain.....415/150

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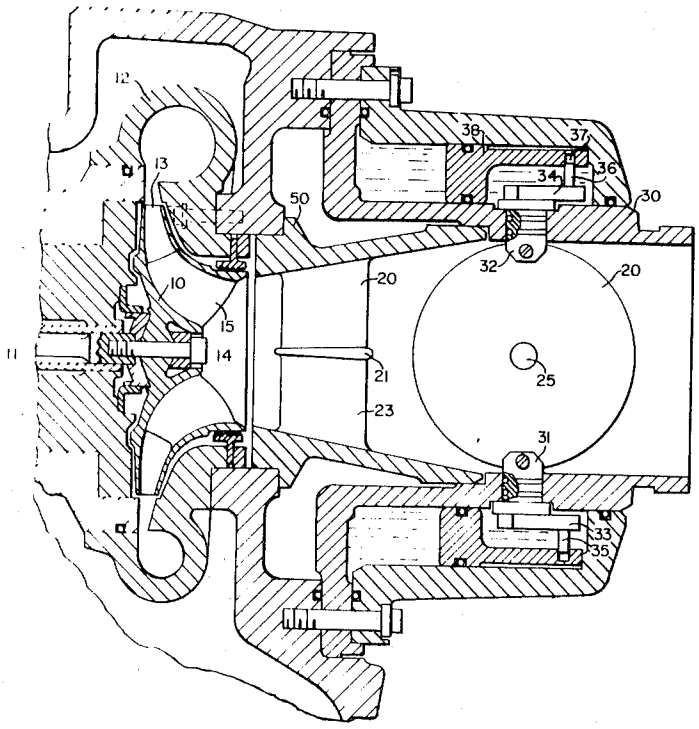
[57] **ABSTRACT**

A capacity control for a refrigerant gas compressor is comprised of a throttle disk in a throttle intake passage leading to a nozzle intake passage extending to the intake portions of a rotatable centrifugal gas impeller and gas flow directing vanes are positioned within the nozzle intake passage to properly direct the gas flow from the throttle disk to the impeller vanes.

2 Claims, 5 Drawing Figures



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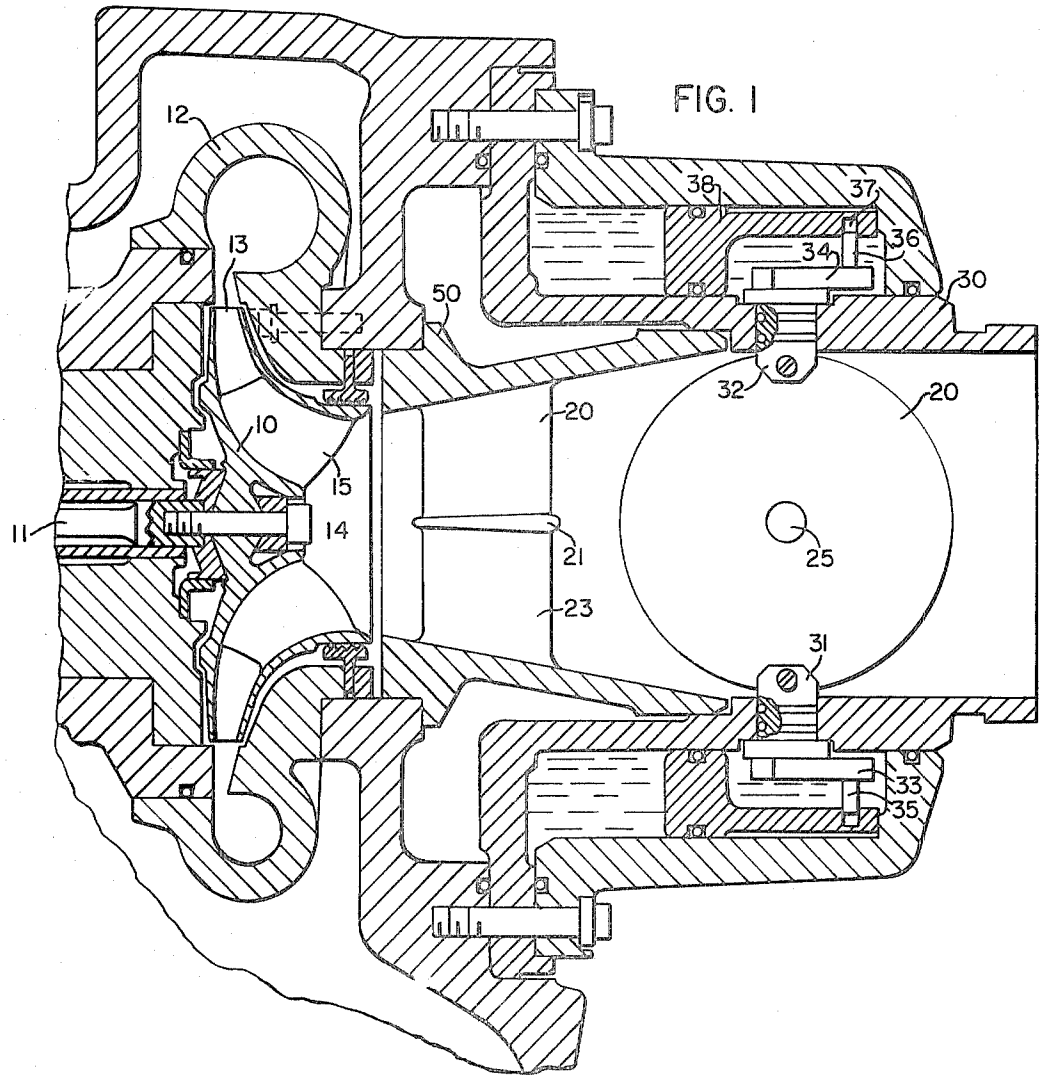

FIG. 1

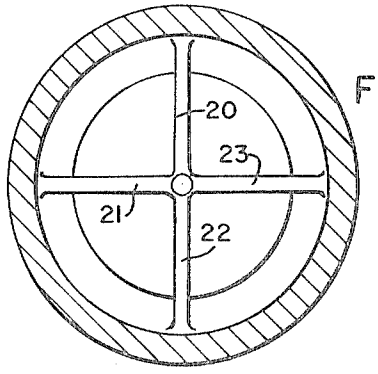

FIG. 3

WITNESSES

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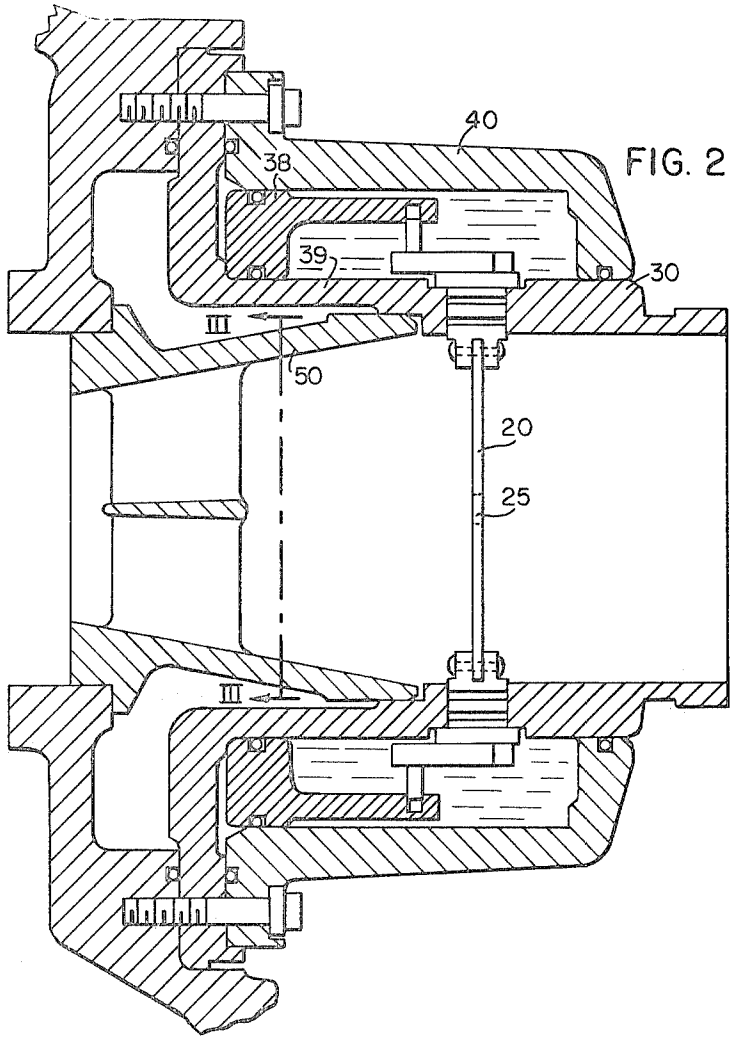

FIG. 2

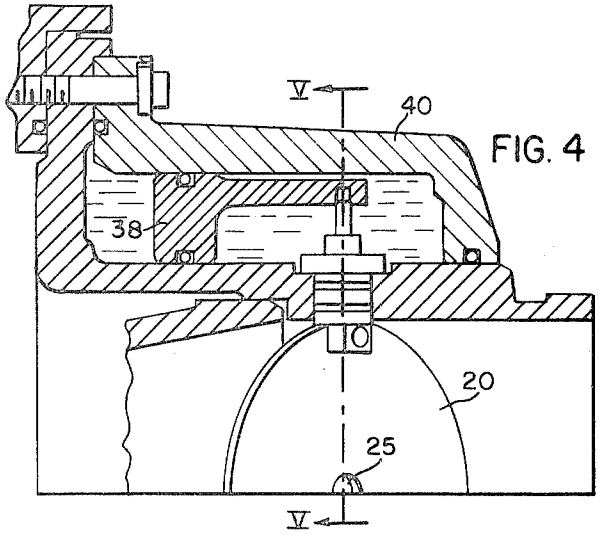

FIG. 4

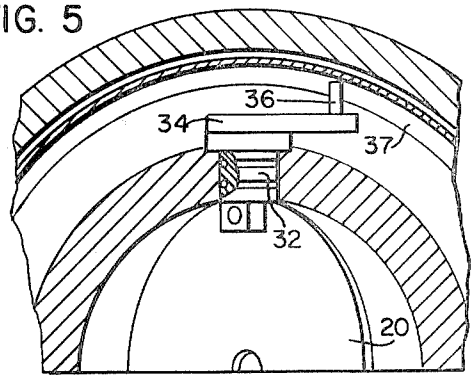

FIG. 5

CENTRIFUGAL REFRIGERANT GAS COMPRESSOR CAPACITY CONTROL

CROSS REFERENCES TO RELATED PATENT APPLICATIONS

A centrifugal refrigerant gas compressor for which the capacity control of the present invention may be particularly suitable is disclosed in the copending patent application Ser. No. 14469.

BACKGROUND OF THE INVENTION

Recent developments have enabled the use of centrifugal refrigerant gas compressors for relatively small air-conditioning machinery for which reciprocating gas compressors have previously been considered to be more economically suitable. In order to have the many advantages of a centrifugal type of gas compressor in these smaller air-conditioning systems, it is desirable to have a simple, inexpensive and reliable capacity control for varying the compressed gas output of the centrifugal compressor to meet air-conditioning system requirements without appreciably varying the speed of the compressor impeller from its most efficient design speed.

PRIOR ART

Capacity controls for centrifugal refrigerant gas compressors as used in air-conditioning systems are disclosed in U.S. Pat. No. 3,248,896 to Plaster issued May 4, 1966, U.S. Pat. No. 3,350,897 to Plaster issued Nov. 7, 1967, and U.S. Pat. No. 3,362,185 to Harnish issued Jan. 9, 1968. The capacity controls as disclosed in the above patents are of the movable inlet spin vane-type and are relatively more complex than the capacity control of the present invention. Applicants are unaware of any prior disclosures disclosing a centrifugal gas compressor capacity control of the nature described and claimed herein.

SUMMARY OF THE INVENTION

In accordance with the present invention, a throttle intake passage leads through a nozzle intake passage that extends to the rotatable centrifugal gas compressor impeller. A throttle disk is pivotally mounted with the throttle intake passage and is movable from a minimum capacity position with the disk positioned transverse to the gas flow to a maximum capacity position with the disk positioned in parallel to the gas flow. In order to eliminate a vortex at the impeller inlet, a plurality of flow-directing vanes are positioned within the nozzle intake passage that extends between the throttle disk passage and the impeller vanes. The throttle disk may be provided with at least one aperture to predetermine the gas flow for the minimum capacity of the gas compressor. In the preferred form of the invention, a ring piston is concentrically positioned about the outer walls of the throttle intake passage and is connected by suitable linkage such as a bellcrank to translate the reciprocatory movement of the piston to pivotal movement of the piston to pivotal movement of the throttle disk. In order to reciprocate the piston, a cylinder is arranged concentric to the outer walls of the throttle intake passage and surrounding the piston so that fluid under pressure may be selectively applied to either side of the piston to move the piston accordingly.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the invention will be apparent with reference to the following specification and drawings in which:

FIG. 1 is a fragmentary sectional view partly in elevation of a centrifugal gas compressor with the capacity control of the invention and showing the throttle disk in the full capacity position;

FIG. 2 is a view similar to FIG. 1 but showing only the throttle passage and the intake nozzle passage with the throttle disk in the minimum capacity position;

FIG. 3 is a fragmentary section on the line III—III of FIG. 2;

FIG. 4 is an even more fragmentary view similar to FIG. 2 but showing the throttle disk in an intermediate capacity position; and

FIG. 5 is a section on the line V—V of FIG. 4.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1 of the drawings, the centrifugal refrigerant gas compressor is shown to include the rotatable impeller **10** mounted on the end of the impeller shaft **11** for rotation therewith. A gas-collecting scroll **12** is positioned to surround the impeller **10** and collect through the diffuser structure the compressed gases issuing from the compressed gas passages **13** of the impeller **10**. The impeller **10** is also provided with intake gas passages **14** that are centrally located and the rotation of the impeller **10** causes the gas entering the impeller intake passages **14** and passing between the impeller vanes such as shown at **15**, to be discharged under pressure from the discharge passages such as shown at **13** around the periphery of the impeller **10** as is well known to those skilled in the art.

In order to vary the capacity of the centrifugal gas compressor without substantially changing the speed of the rotation for the impeller **10**, this invention provides for a novel arrangement of movable throttle disk **20** and a plurality of gas directing vanes such as shown at **20** through **23**. It should be understood that the invention is not limited to any particular number or precise configuration or angle of direction of the gas flow directing vanes **20–23**.

It will be noted that the throttle disk **20** is mounted within a throttle intake housing **30** and is pivotal therein from the maximum capacity position shown in FIG. **1** to the minimum capacity position shown by FIG. **2** of the drawings. In order to enable the throttle disk **20** to be so moved within the throttle intake passage **30**, the throttle disk **20** is secured to pivotal stub shafts **31** and **32**. The stub shaft **31** is connected by a bellcrank **33** and the stub shaft **32** is connected by a bellcrank **34** to respective pins **35** and **36** received in a groove **37** of a reciprocatory piston **38**.

As shown in more detail by FIGS. **2**, **4** and **5** of the drawings, the piston **38** is a ring piston concentrically mounted around the outer wall **39** of the throttle intake passage **30**. A cylinder wall **40** is also concentrically mounted around the outer wall **39** of the throttle intake passage **30** in a manner to enclose the reciprocatory piston **38** and fluid under pressure is introduced within the cylinder selectively to either or both sides of the piston **38** for reciprocating the piston accordingly in a manner to move or maintain the throttle disk **20** at a desired position. The aforementioned U.S. Pat. Nos. 3,350,897 and 3,362,185 disclose various ways for valving fluid under pressure to either or both sides of a capacity control piston such as the piston **38** as used in the present invention. Since the arrangement for supplying fluid under pressure selectively to either or both sides of the piston **38** is not a part of the present invention, and any suitable arrangements well known to those skilled in the art may be used, the details of such an arrangement have been omitted from the present disclosure.

Referring now to FIGS. **1**, **2** and **3** of the drawings, it will be seen that a nozzle intake passage **50** is positioned between the throttle intake passage **30** and the impeller **10** to converge and direct the gas flow from the throttle disk **20** into the intake passages **14** of the centrifugal gas compressor impeller **10**. A feature of the invention is the provision of the aforementioned gas flow directing vanes such as shown at **20–23**, to direct the flow of gas coming from the throttle disk **20** to the centrifugal gas impeller.

Referring again to the drawings, it will be seen that the throttle disk **20** is provided with the aperture **25**, which, when the throttle disk **20** is in the minimum capacity position shown by FIG. **2** of the drawings, provides a minimum gas flow into the intake nozzle **50** and the gas impeller. This invention is not limited to the provision of a centrally located aperture such as shown at **25** but one or more apertures may be used in various positions as will be obvious to those skilled in the art.

There has been described an exceedingly simple, inexpensive and reliable capacity control for a centrifugal refrigerant gas compressor in which a single valve disk in combination with suitably positioned gas flow directing vanes are used to modify the flow of refrigerant gas into the centrifugal gas compressor impeller and thereby vary its capacity. Various modifications will occur to those skilled in the art.

We claim:

1. A capacity control for a centrifugal refrigerant gas compressor having a rotatable impeller with centrally located intake passages and peripherally located compressed gas passages, comprising, a throttle intake passage, a nozzle intake passage extending from said throttle intake passage to the centrally located intake passages of said impeller, a throttle disk pivotally mounted in said throttle intake passage and having at least one aperture for determining the minimum capacity of said compressor when the throttle disk is in a minimum capacity position, means to move said disk from a position transverse to the gas flow for minimum capacity to a position parallel to the gas flow for full capacity and any position therebetween, and a plurality of gas flow directing and straightening vanes extending within said nozzle intake passage to direct the flow of gas into said impeller after passage from said throttle disk.

2. The invention of claim 1 in which the means to move said disk is comprised of a ring piston concentrically mounted on the outside of said throttle intake passage and connected to said disk by means of a bellcrank to translate reciprocatory movement of said piston to pivotal movement of said disk, and means to enclose said piston in a cylinder concentric with said throttle intake passage for applying a fluid under pressure within said cylinder to either side of said piston for reciprocating the piston in accordance therewith.

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