# United States Patent [19]

**St. Laurent**

[11] **3,855,813**

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[54] **COMPRESSOR CONTROL FOR REFRIGERATION SYSTEM**


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[52] **U.S. Cl.** ..... **62/196**
[51] **Int. Cl.** ..... **F25b 41/00**
[58] **Field of Search** ..... 62/196



[56] **References Cited**

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| 2,579,439 | 12/1951 | Noe | 62/196 |
| 3,626,979 | 12/1971 | Abell | 62/196 |



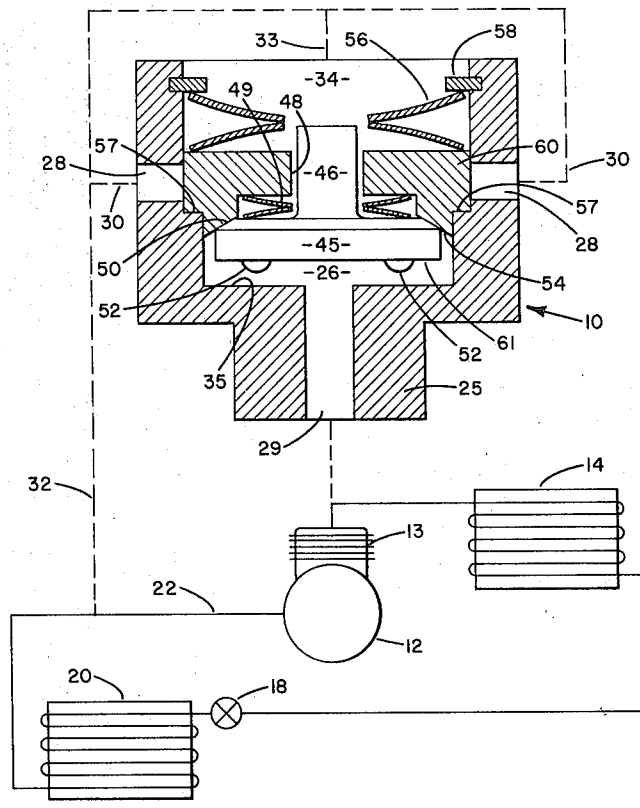
*Primary Examiner*—Meyer Perlin
*Attorney, Agent, or Firm*—J. Raymond Curtin; Barry E. Deutsch



[57] **ABSTRACT**

A combination equalizer and over-pressure control for use with fluid compressors comprises a passage having a first piston including a relief port therethrough, the piston when in a first position preventing any flow of fluid through a second relief port. A second piston, disposed upstream of the first piston, is movable relative thereto. A first spring provides a force to maintain the second piston in spaced relationship relative to the first piston, the second piston moving into sealing abutment with the first piston to close the first relief port when fluid pressure acting on the second piston exceeds a predetermined value. A second spring provides a force to maintain the first and second pistons in position relative to the second relief port to prevent any fluid flow therethrough. The first and second pistons move jointly at a predetermined over-pressure condition to open the second relief port. Upon the de-energization of the fluid compressor the second piston moves relative to the first piston, whereby the first relief port is opened to relatively quickly equalize pressures across the control.


**2 Claims, 3 Drawing Figures**



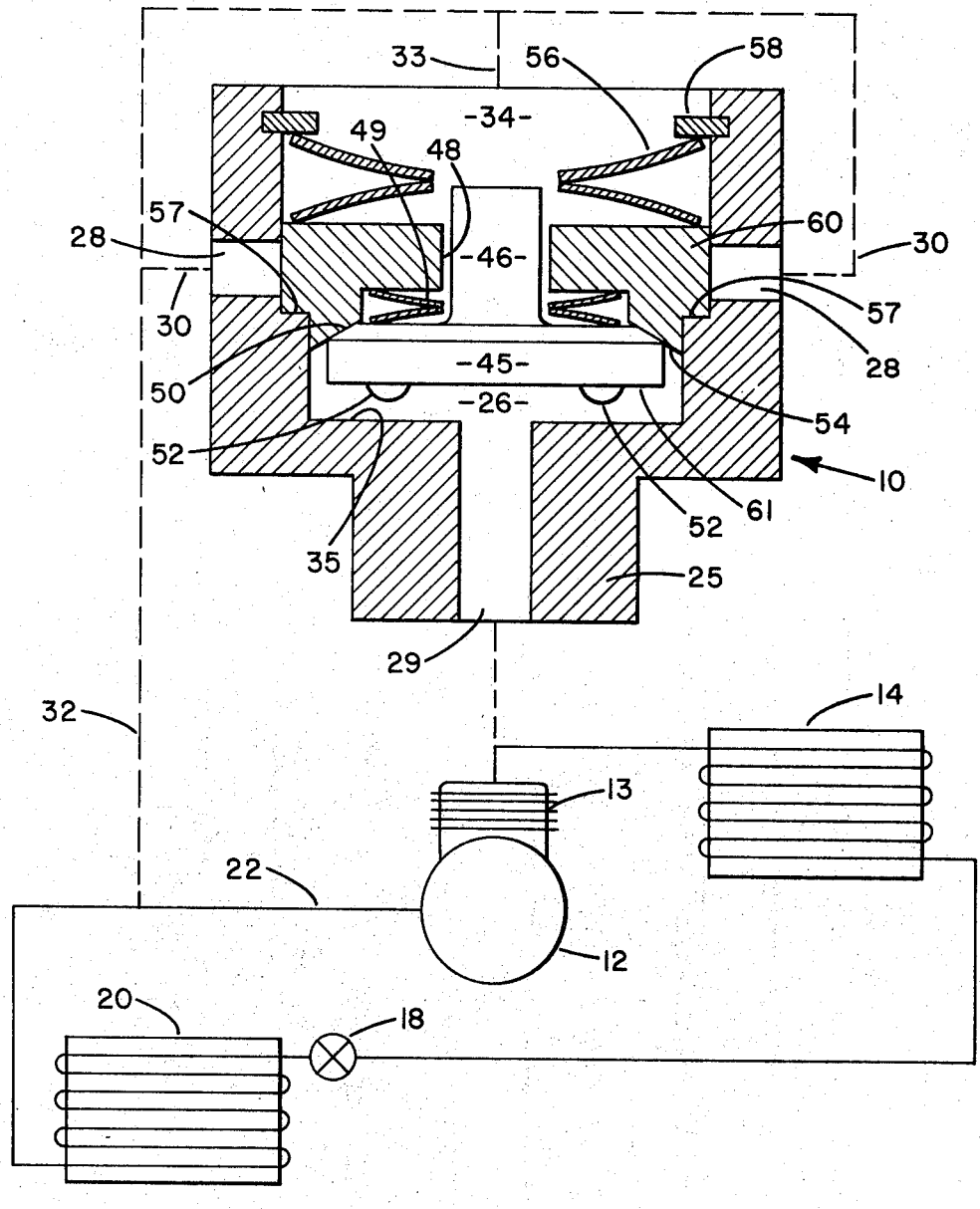

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FIG. 1

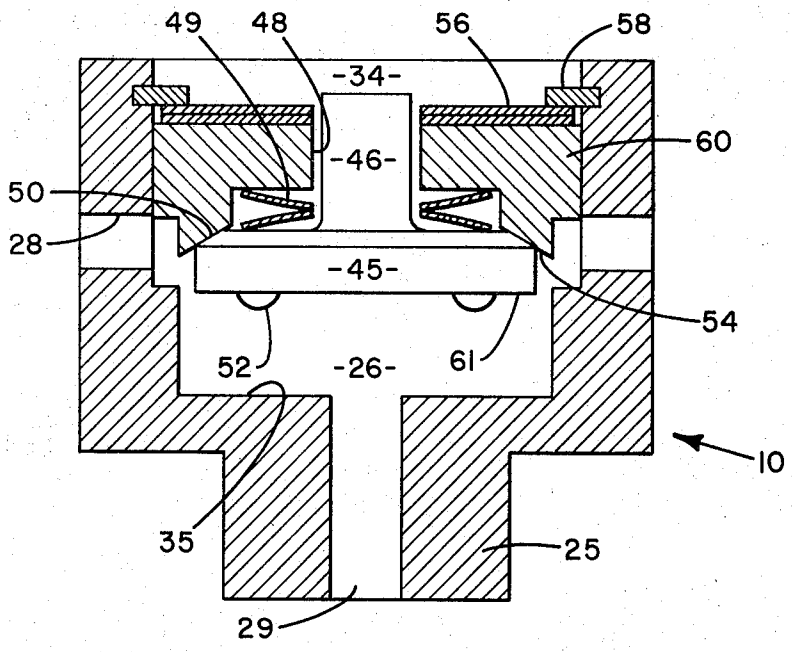

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FIG. 2

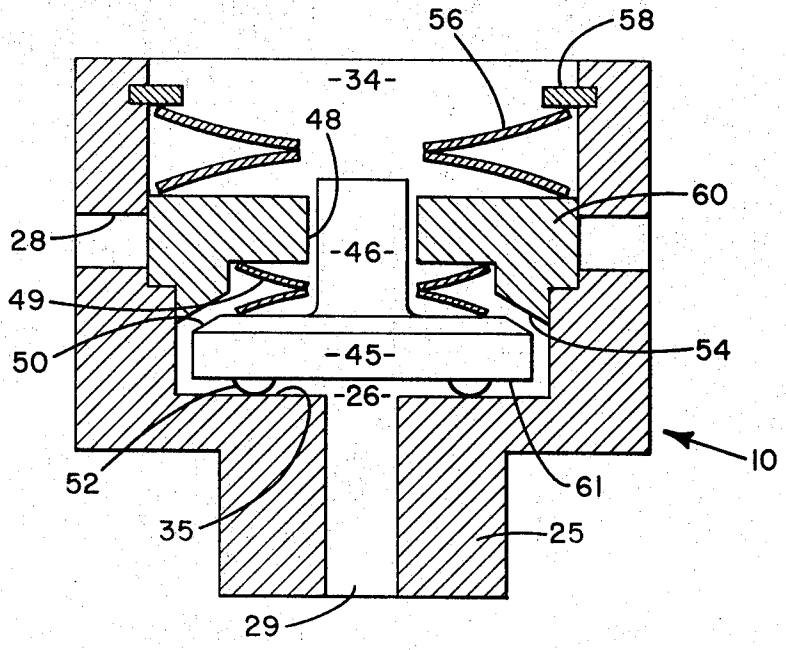

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FIG. 3

# COMPRESSOR CONTROL FOR REFRIGERATION SYSTEM

## BACKGROUND OF THE INVENTION

This invention relates to fluid compressors and more particularly to a combined pressure equalizer and overpressure control for use with fluid compressors.

Refrigeration units employing fluid compressors typify applications in which there exists a substantial pressure differential across the compressor following shutdown and normally for a number of hours thereafter. If it is desired to restart the compressor during the period of time when the pressure differential exists, the compressor motor must not only have sufficient torque to overcome the inherent inertia of the compressor parts, but it must also overcome the pressure differential in order to restart the compressor. The foregoing necessitates the utilization of either oversized motors or relatively expensive starting accessories.

In U.S. Pat. No. 3,398,551, assigned to the assignee of the instant invention, there is disclosed a compressor control which functions to rapidly equalize the pressure between the suction and discharge sides of the compressor to thereby eliminate the necessity for having starting accessories or the need for using oversized motors. In addition, the control disclosed in the aforecited patent operates to protect the fluid compressor during overpressure conditions.

Although the device disclosed in the aforementioned patent has proven to be extremely satisfactory from a functional standpoint, it has been found that certain of the parts of such control wear more rapidly than desired. In addition, equalization between the discharge and suction side of the compressor is not accomplished quite as rapidly as desired due to internal friction produced by the relative motion of the parts and in particular due to the utilization of an O-ring for sealing purposes.

## SUMMARY OF THE INVENTION

It is therefore an object of the invention to provide a compressor control which permits rapid equalization between the discharge and suction side of the compressor, as well as protects the compressor during overpressure conditions.

It is a further object of the invention to reduce movement of parts of the control to thereby decrease wear thereof.

It is a further object of this invention to eliminate the need for O-rings or similar sealing devices to thereby eliminate internal friction to increase the rate at which equalization occurs.

These and other objects of the present invention are obtained by providing a control device having a passage adapted to conduct pressure fluid. A first piston-like member includes a relief port therethrough, the member when in a first position preventing any flow of fluid through a second relief port. A second piston-like member is disposed upstream of the first piston-like member for relative movement therebetween. First force supplying means operates to maintain the second member in spaced relationship relative to the first member, the second piston-like member moving into sealing abutment with the first member to close the first relief port when fluid pressure acting on the second member exceeds a predetermined value. Second force supplying means operates to maintain the first and second members in position relative to the second relief port to prevent any fluid flow therethrough, the first and second piston-like members moving jointly at a predetermined overpressure condition to open the second relief port. The first force supplying means additionally functions to move the second member relative to the first member when the fluid compressor becomes inoperable thereby opening the first relief port. The second piston-like member includes abutment means to maintain the passage means of the control device in an open state when the first relief port is open to relatively quickly equalize pressures across the control.



## BRIEF DESCRIPTION OF THE DRAWING

FIG. **1** is a schematic sectional view showing the combination pressure equalizer and overpressure control of the present invention as used with a fluid compressor;

FIG. **2** is a schematic sectional view of the control of FIG. **1** showing the control during occurrence of a compressor overpressure condition; and

FIG. **3** is a schematic sectional view showing the control of FIG. **1** following shutdown of the compressor.

## DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. **1** of the drawings, there is shown a pressure control **10** of the present invention as used with a fluid compressor **12.** As will be more apparent hereinafter, pressure control **10** equalizes pressures across compressor **12** following shutdown of the compressor and protects the compressor against excessive internal pressures. In referring to the various Figures of the drawing, like numerals shall refer to like parts.

In the exemplary showing of the drawing, fluid compressor **12** forms part of a closed fluid pressure unit, more particularly a refrigeration unit having condenser **14,** expansion device **18** and evaporator **20.** In this type of unit, it is understood that the relatively high pressure vaporous refrigerant discharged by compressor **12** is condensed in condenser **14,** the liquid refrigerant leaving condenser **14** being expanded by device **18** and thereafter flowing through evaporator **20** where the refrigerant is vaporized. Gaseous refrigerant from evaporator **20** returns through conduit **22** to compressor **12.**

On shutdown of compressor **12,** a substantial pressure differential exists across the compressor. Although a part of the pressure differential across the compressor is relatively quickly dissipated, the pressure differential remains relatively high for a comparatively extensive period of time. Where compressor motor **13** is a single phase motor, a start accessory must be added to enable motor **13** to overcome the pressure loading on compressor **12** if it is desired to restart the compressor when a relatively high pressure differential exists. Where motor **13** is a three phase motor, it is necessary to provide a motor having sufficient starting torque to enable the compressor to be restarted when a relatively high pressure differential exists. The cost advantage in eliminating starting accessories and reducing motor size are evident, and pressure control **10** which effectively neutralizes pressure loading on a compressor in a relatively short time following shutdown of the compressor eliminates the need for motor starting accessories and/or oversized motors.

Pressure control **10** has an outer shell **25** forming a generally cylindrical valve and piston chamber **26.** A first end **29** of chamber **26** communicates with the outlet or discharge side of compressor **12.** The other end **34** of chamber **26** communicates via conduit **32** and **33** with the inlet or suction side of the compressor. Additionally, conduits **30** and **32** communicate relief ports **28** which are provided in the wall of the valve, with the suction side of the compressor.

A first piston-like member **45** is slidably arranged in chamber **26.** Spring **49,** disposed between first piston-like member **45** and a second piston-like member **60,** urges piston **45** toward end wall **35** of chamber **26.**

Piston-like member **45** has a stem-like projection **46.** Projection **46** is slidably journaled in coaxial bearing opening **48** provided in second piston-like member **60.** Piston-like members **45** and **60** are beveled respectively on opposed surfaces **50** and **54** to form a leak-tight connection when the piston-like members are brought into intimate contact as will be more apparent hereinafter.

Piston-like member **45** includes abutment members **52** projecting from surface **61** thereof. Abutment members contact wall **35** as is illustrated in FIG. **3,** upon the compressor being rendered inoperable.

A second spring **56** urges second piston-like member **60** towards wall **35** of chamber **26.** Shoulders **57** formed on the inner wall of chamber **26** limit the movement of second piston-like member **60** towards wall **35.** Stop **58** is provided to maintain spring **56** in its desired location. Preferably, springs **49** and **56** are formed of belleville washers.

With compressor **12** shutdown, and assuming the pressures between the compressor inlet and outlet to be substantially equal, spring **49** holds first piston-like member **45** against wall **35** of control chamber **26.** Inasmuch as member **45** includes abutment members **52,** face **61** of member **45** is maintained in spaced relation relative to wall **35** to thereby maintain communication between inlet **29** and outlet **34** of the control. This position is illustrated in FIG. **3** of the drawings. As is evident from FIG. **3,** relief port **48** is opened to thereby permit flow from the high pressure side of the control to the low pressure side thereof.

When the compressor is started, the difference in pressure between the inlet and outlet thereof rises. At a predetermined pressure differential, pressure acting on piston-like member **45** overcomes the force supplied by spring member **49** to move piston **45** away from wall **35** of chamber **26** towards second piston-like member **60.** Second piston-like member **60** is maintained stationary due to the force supplied by second spring **56.** The opposed beveled faces of the piston-like members engage, thereby closing off any flow through opening **48** of second piston-like member **60.** Relief ports **28** are closed by second piston-like member **60.** The position of the components of control **10** during normal operation is illustrated in FIG. **1.**

With relief port **48** closed, a rise in pressure above the normal compressor operating pressure is reflected in control **10** and at a predetermined overpressure, the force acting on members **45** and **60** overcomes the force supplied by second spring member **56** to move the members jointly towards stop **58.** This directly connects the compressor discharge and suction through relief ports **28.** The position of the elements of the control when an overpressure condition exists is illustrated in FIG. **2** of the drawings. Spring **56** urges piston-like members **45** and **60** to their normal operating position illustrated in FIG. **1** when the over-pressure condition has been eliminated.

When compressor **12** is shut down, the existing pressure differential across compressor **12** undergoes an initial decrease as pressures are dissipated due to internal leakage within the various components of the refrigeration unit. Following this initial decrease in pressure differential across the compressor, the rate of decrease of the pressure differential falls quite substantially. First spring-like member **49** urges piston-like member **45** towards wall **35** of chamber **26;** however face **61** of member **45** is maintained in spaced relation relative to wall **35** by the projecting abutment members **52.** The continued communication between the high pressure and low pressure sides of the compressor, as provided through relief port **48** results in a continuing decrease in the pressure differential across the compressor.

The present pressure control operates to rapidly equalize the pressure differential across a compressor and also safeguards the compressor from excessive internal pressures. The control of the present invention employs a limited number of parts having limited movement to thereby increase the operating life of the control. In addition, the present control eliminates the need for an O-ring or other internal seal, as exemplified by the prior art of the heretofore cited United States patent; the elimination of such O-ring reduces the internal friction of the moving parts to thereby further increase the rate at which the pressure differential is equalized.

While a preferred embodiment of the present invention has been described and illustrated, it will be understood that the invention is not limited thereto, but may be otherwise embodied with the scope of the following claims.

I claim:

**1.** In a refrigeration unit including a compressor (**12**) with a first heat exchange coil (**14**) joined to the discharge side of said compressor, expansion means (**18**) and a second heat exchange coil (**20**) joined to the suction side of said compressor, the improvement comprising:

a. a combination equalizer and over-pressure control (**10**) having passage means adapted to communicate said compressor discharge side with said compressor suction side bypassing said other components of said unit, said passage means including a first piston-like member (**60**) having a first relief port therethrough, said member when in a first position preventing any flow of fluid through a second relief port (**28**);

b. means for closing said first relief port including a second piston-like member (**45**), said second piston-like member being disposed upstream of said first piston-like member, said first and second members being movable relative to one another;

c. control means including first means (**49**) providing a force to maintain said second member in spaced relationship relative to said first member, said second member moving into sealing abutment with said first member to close said first relief port when fluid pressure acting on said second member exceeds a predetermined value, second means (**56**) providing a force to maintain said first and second members in position relative to said second relief

port to prevent any fluid flow therethrough, said first and second members moving jointly at a predetermined over-pressure condition to open said second relief port; and

d. said first force supplying means moving said second member relative to said first member when the compressor becomes inoperable thereby opening said first relief port, said second member including abutment means (**52**) to maintain said passage means in an open state when said first relief port is opened to relatively quickly equalize pressures between the discharge side and the suction side of said compressor.

**2.** A combination in accordance with claim **1** wherein said first and second force supplying means are spring washers.

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