July 26, 1938. J. KIRGAN 2,124,620

CONTROL MEANS FOR THERMO-COMPRESSORS

Filed Feb. 16, 1937

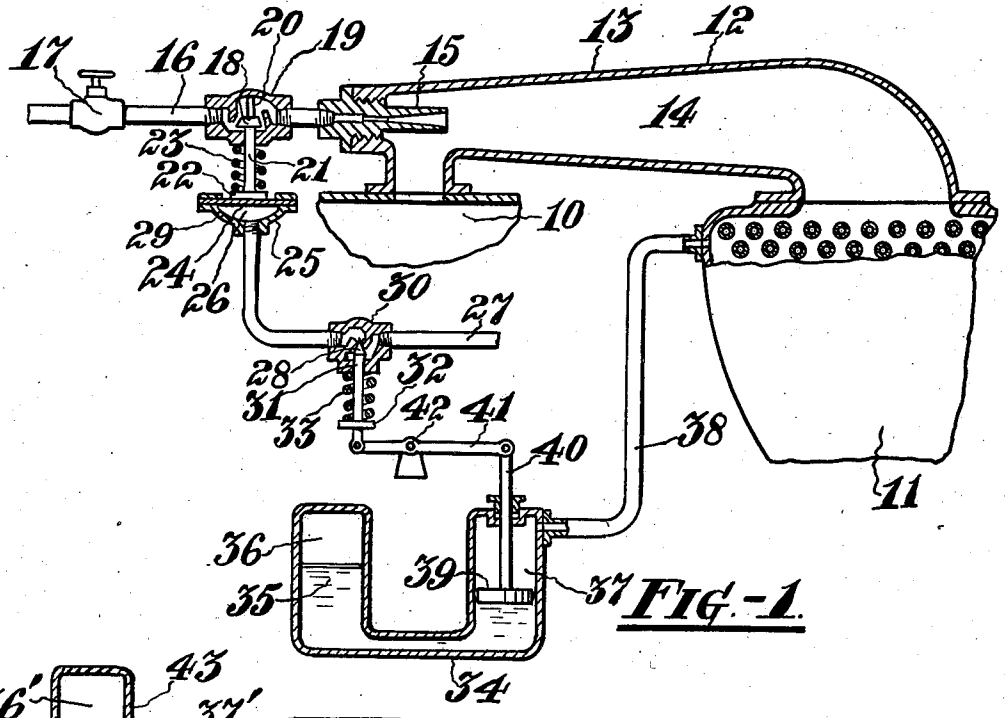


FIG.-1.

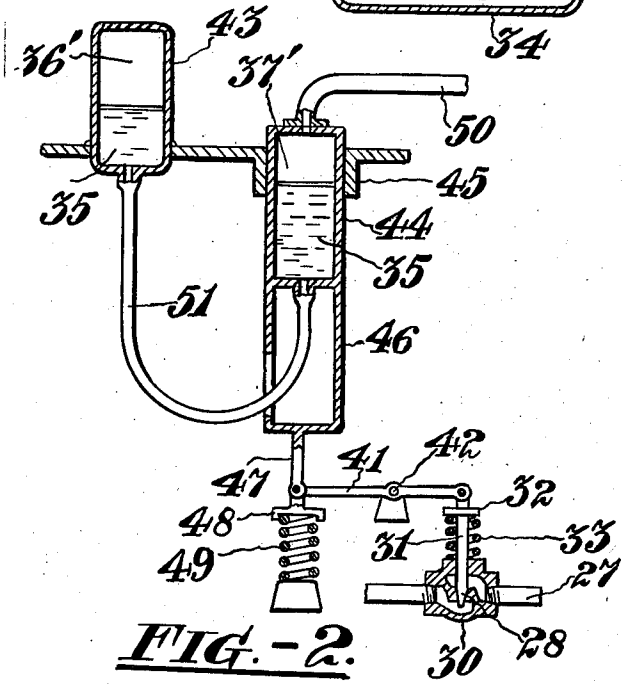


FIG.-2.

INVENTOR.
John Kirgan
BY
HIS ATTORNEY

Patented July 26, 1938 2,124,620

UNITED STATES PATENT OFFICE

2,124,620

CONTROL MEANS FOR THERMO-COMPRESSORS

John Kirgan, Easton, Pa., assignor to Ingersoll-Rand Company, Jersey City, N. J., a corporation of New Jersey

Application February 16, 1937, Serial No. 125,996

4 Claims. (Cl. 230—111)

This invention relates to thermo-compressors, and more particularly to devices acting responsively to pressure conditions in a thermo-compressor to control its operation.

A few of the objects of the invention are to prevent waste of power in a thermo-compressor, and to assure positive control of the power supply.

Other objects will be in part obvious and in part pointed out hereinafter.

In the drawing, in which similar reference characters denote similar parts,

Figure 1 is a view, in elevation and partly in section, of apparatus embodying control means constructed in accordance with the practice of the invention, and

Figure 2 is a similar view showing a modified form of the invention.

Referring more particularly to the drawing and especially to Figure 1, the invention is shown embodied in a refrigerating system comprising an evaporator, fragmentarily shown at 10, a condenser 11, and a thermo-compressor, indicated in general by 12, connected to convey vapor from the evaporator to the condenser.

The thermo-compressor may be of any desired construction, and is shown as including a casing 13 forming a passage 14 opening at one end into the evaporator 10 and at the other end into the condenser 11. Discharge nozzles for steam or other power fluid, one being shown at 15, are positioned in the passage 14 near the end which opens into the evaporator. The casing 13 may be sealed around the nozzles in any well known manner, and a pipe 16 provided with a control valve 17 will serve to convey steam to the nozzles.

In practice both the evaporator 10 and condenser 11 may be kept under high vacuum by the compressor 12 and by a condenser vacuum pump (not shown), and refrigerant exposed to the vacuum in the evaporator may be partially vaporized and chilled for refrigerating purposes.

In accordance with the practice of the invention, and to obviate waste of power in the compressor, suitable means are provided for automatically and accurately controlling the amount of steam admitted to the nozzles 15. In its preferred form, a throttle valve 18 is interposed in the steam supply pipe 16 and arranged to be automatically controlled by a power medium, the strength of which is varied in accordance with pressure conditions in the compressor.

In the construction illustrated, the valve 18 is within a casing 19 and is preferably provided with a stop 20 to prevent its complete closure. The stem 21 of the valve extends outside of the casing 19 and terminates in a head 22 to provide an abutment for a spring member 23 which bears against the casing 9 and acts to urge the valve toward open position.

The head 22 of the valve stem is in abutment with a diaphragm 24 against which pressure may be applied for moving the valve 18 in opposition to the spring 23. A casing 25 to which the diaphragm is affixed, forms a chamber 26 between itself and the diaphragm, and a pipe 27 serves to convey suitable pressure fluid, compressed air, for example, from an external source (not shown) to the chamber 26. A small vent 29 in the casing 25 serves to prevent trapping of pressure fluid in the diaphragm chamber.

A control member comprising a valve 28 and a valve casing 30, is interposed in the pipe 27 to determine the pressure of the fluid delivered to the chamber 26. This valve is shown as of the needle type, and the stem 31 of the valve extends outside of the valve casing and may be provided with a collar 32 to serve as an abutment for a spring 33. The spring also bears against the casing 30 and acts to urge the valve 28 toward open position.

A pressure-responsive device for actuating the valve 28 is illustrated in the form of a U-shaped manometer vessel 34 in which is placed a quantity of mercury 35 or other fluid medium. One arm of the manometer forms a chamber 36 which may be sealed, or if desired, placed in communication with the evaporator 10 or the inlet to the thermo-compressor passage 14. The other arm of the manometer forms a chamber 37 into which a pipe 38 leads from the condenser 11 or from a point near the outlet of the passage 14.

A piston or float member 39 is preferably positioned in the chamber 37 to be actuated by the mercury 35. A rod 40 connected to the float extends through a gland to the outside of the vessel 34, and a rod 41 is pivotally connected at one end to the float rod 40 and at its other end to the stem 31 of the valve 28. The rod 41 is also fulcrumed, as indicated by 42, intermediate the aforesaid pivotal connections to enable the motion of the float 39 to be transmitted from the rod 40 to the valve stem 31.

In operation, the inlet and discharge pressures of the thermo-compressor 12 will rise or fall as the amount af vapor formed in the evaporator 10 increases or decreases due to variations in refrigerating load, or as the pressure in the condenser varies due to changes in cooling water temperature, for example.

The mercury in the chamber 37 will be subjected to whatever pressure conditions exist at the discharge end of the compressor, and the chamber 36 may be under vacuum, as by prior filling of the manometer with mercury and inverting to the position shown. When the discharge pressure increases, the mercury will be depressed in the chamber 37 and forced into the chamber 36. The float 39 will fall and its motion will be transmitted by links 40 and 41 to move the valve 28 toward closed position. Less

pressure fluid will now be supplied to the chamber 26 and the spring 23 will act to urge the valve 18 toward open position.

Thus more steam at a pressure somewhat closer to that of the steam supplied to the valve 18, will be delivered to the nozzles 15 to enable the compressor 12 to overcome the increased discharge pressure. When the condenser pressure again decreases, the pressure on the diaphragm 22 will be increased to move the valve 18 toward closed position, and thus the steam may be regulated in accordance with the demand therefor.

If it is desired that the valve 18 be actuated in accordance with the pressure differential between the inlet and discharge ends of the passage 14, connection (not shown) may be made between the manometer chamber 36 and the evaporator 10, and the mercury will, in this instance, move from one manometer chamber to the other and actuate the float 39 as the said pressure differential varies.

In the modification illustrated in Figure 2 the manometer is formed by two separate vessels 43 and 44 connected by a flexible tube 51 and containing a quantity of mercury 35. The vessel 43 is supported in a fixed position and the other vessel 44 is movable vertically in a guideway 45. A part 46 extends from the bottom of the movable vessel and carries a rod 47 pivotally connected to the rod 41 for actuating the valve 28, and a head 48 at the end of the rod 47 forms an abutment against which a spring 49 bears to resist the downward movement of the vessel 44.

The vessel 43 encloses a chamber 36' which may be sealed, or if desired, placed in communication with the evaporator 10, and the vessel 44 encloses a chamber 37' which is connected by a flexible tube 50 with the condenser 13. The flexible tube 51 between the chambers 36' and 37' connects the bottoms thereof and serves as a passage for conveying the mercury 35 from one chamber to the other.

In operation, when condenser pressure increases the mercury is displaced from the chamber 37' into the chamber 36' and the weight of the movable vessel 44 and its contents is decreased. The spring 49 then causes the container 44 to rise and the valve 28 to move toward closed position, and this in turn decreases the pressure acting on the diaphragm 24 to cause the valve 18 to be more fully opened.

In thermo-compressors which operate at both inlet and discharge under high vacuum such as is encountered in water-vapor refrigerating systems, it has been found that the fluctuations in the inlet and discharge pressures are of such small magnitude, that they cannot be conveniently directly applied to actuate devices for controlling the flow of steam to the compressor. Accordingly, provision is made for multiplying the variations in these pressures and for using the increased variation to control a suitable power medium for actuating an automatic steam valve 18. The multiplied pressure variations give a very sensitive control, and the power medium, illustratively disclosed herein as pressure fluid, can be conveyed for substantial distances without appreciable loss of effect, thereby assuring positive control of the power supply and enabling the pressure-responsive manometers to be positioned as close to the controlling pressures as is practicable.

The evacuating capacity of a thermo-compressor is well known to be constant for a given suction pressure, and the power supplied to the compressor need only be increased if the suction pressure decreases, the discharge pressure increases, or the differential between the two pressures increases. In the present invention these pressure fluctuations are made use of to effect supply of steam to the compressor only in the amounts necessary, and waste of steam is thus prevented.

It will be apparent to those skilled in the art to which this invention appertains that other arrangements and combinations may be made for accomplishing like results. It will be understood, therefore, that the scope and spirit of the invention is not to be limited to the specific forms described, but is to be interpreted only by the terms in which the appended claims are expressed.

I claim:

1. The combination with a thermo-compressor, and means to admit power fluid to the compressor including a control member, of means to admit a power medium to the control member for actuating the same, a U-shaped vessel for a transmission medium, means actuated by the transmission medium to control the last-named means, means communicating between the vessel and the compressor to subject the transmission medium solely to the total discharge pressure of the compressor, thereby to actuate the transmission medium.

2. The combination with a thermo-compressor, and means to admit power fluid to the compressor including a control member, of means to admit a power medium to the control member for actuating the same, a U-shaped vessel containing a transmission medium, means actuated by the transmission medium to control the last-named means, means to seal one arm of the vessel, and means communicating between the other arm of the vessel and the compressor to subject the transmission medium solely to the total discharge pressure of the compressor thereby to actuate the latter medium.

3. The combination with a thermo-compressor, and means to admit power fluid to the compressor including a control member, of means to admit a power medium to the control member for actuating the same, a device to control the last-named means, separate vessels having a connection for transmitting a fluid medium therebetween, and means to subject the fluid medium in the vessels to pressure conditions in the compressor for displacing the fluid medium from one vessel to the other, one of said vessels being in fixed position, and the other vessel being movable and having connections to control said device in accordance with the amount of fluid medium present in the latter vessel.

4. The combination with a thermo-compressor, and a means to admit power fluid to the compressor including a control member, of a means to admit a power medium to said control member for actuating the same, a device comprising a pair of inter-communicating vessels containing a liquid having connections whereby the level of the liquid in the vessels fluctuates solely in accordance with the total discharge pressure of the compressor, and means acting to control the admission means in response to variations of said liquid level.

JOHN KIRGAN.