

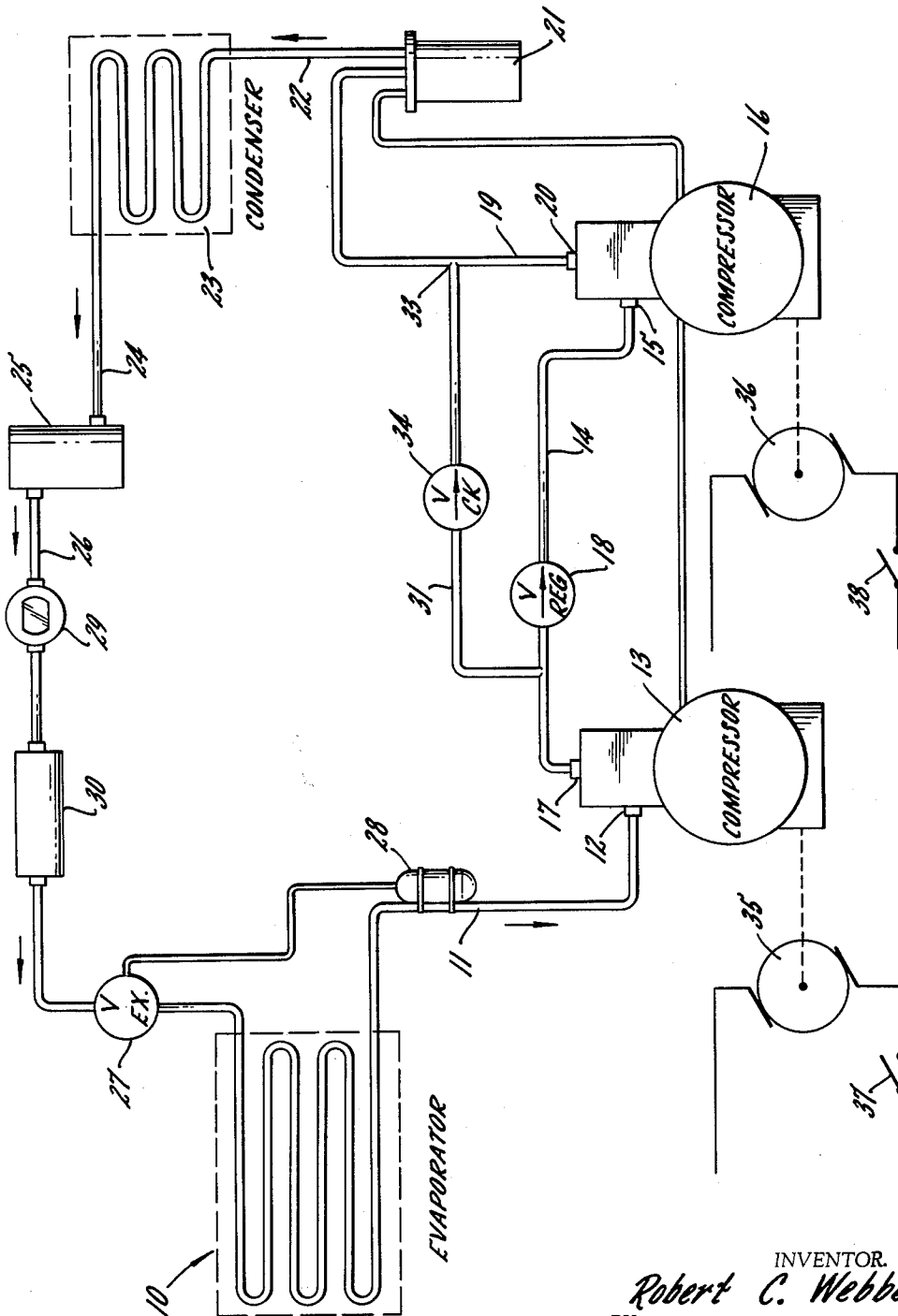
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TWO-STAGE REFRIGERATION SYSTEM WITH BY-PASS MEANS

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TWO-STAGE REFRIGERATION SYSTEM WITH BY-PASS MEANS

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The present invention relates to a two-stage refrigeration system and is particularly concerned with improving the capacity and operation of such a system while simplifying it and rendering its construction less expensive and less liable to malfunction. The primary object of the invention is to provide such a system in which the temperature of a chamber dominated by evaporator means may be very quickly reduced to a desired value and may be held effectively within a minimum range of variation from that value, by eliminating cycling of the low stage compressor within the system.

A further object of the invention is to provide, in such a system, an arrangement under which humidity conditions within a chamber dominated by one or more evaporators may be held more accurately than has been feasible heretofore with known two-stage systems.

Further objects of the invention will appear as the description proceeds.

To the accomplishment of the above and related objects, my invention may be embodied in the form illustrated in the accompanying drawing, attention being called to the fact, however, that change may be made in the specific construction illustrated and described, so long as the scope of the appended claims is not violated.

The single figure is a somewhat diagrammatic illustration of a refrigeration system embodying my present invention.

In the past, a two-stage refrigeration system generally of the character with which the present invention is concerned has comprised an evaporator, a first compressor having an input and an output, conduit means connecting the input of the first compressor to receive refrigerant from the evaporator, a second compressor, usually of lower power rating than that of the first compressor, having an input and an output, conduit means connecting the input of the second compressor to receive refrigerant from the output of the first compressor, a condenser, conduit means connecting the condenser to receive refrigerant from the output of the second compressor and conduit means connecting the evaporator to receive refrigerant from the condenser. A low pressure switch responsive to pressure conditions in the conduit means between the two compressors controlled operation of the first compressor, and a thermostatic switch responsive to temperature conditions at the evaporator or in the chamber to be refrigerated controlled operation of the second compressor. In such a system, the two compressors operated in series during pull-down condition, the first compressor cycling at rather frequent intervals; with the consequence that neither temperature nor humidity conditions could be very closely controlled within the chamber dominated by the evaporator or evaporators, and the compressors and their driving means were subjected to heavy wear and load variations.

I have discovered that, if a suction pressure regulator valve is installed in the conduit means between the two compressors, and if a check-valve-controlled by-pass is installed to connect a point between the first compressor and the suction pressure regulator valve with a point in the conduit means between the second compressor and the condenser, a much more rapid pull-down can be achieved, cycling of the low-stage, higher powered compressor will be eliminated, the higher powered compressor can be shut down completely once pull-down has been

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effected and the system as a whole will operate more efficiently than has heretofore been possible.

Referring more particularly to the drawing, it will be seen that I have illustrated an evaporator 10 which may be installed to dominate conditions in a chamber (not shown). Conduit means 11 connects the input 12 of a high powered, low-stage compressor 13 to receive refrigerant from the evaporator 10. A second conduit means 14 connects the input 15 of a lower-powered, high-stage second compressor 16 to receive refrigerant from the output 17 of the compressor 13 through a suction pressure regulator valve 18. A third conduit means 19 leads from the output 20 of the compressor 16 to and through an oil separator 21 and thence conduit means 22 leads to the input of a condenser 23. A conduit 24 carries refrigerant from the condenser 23 to and through a receiver 25 whence conduit means 26 leads through an expansion valve 27, preferably dominated by a sensing element 28 responsive to conditions in the conduit means 11, to the evaporator 10. The conduit means 26 may preferably lead through a sight glass 29 and a suitable drier 30.

A by-pass 31 is connected to the conduit means 14 at a point between the output 17 of the compressor 13 and the suction pressure regulator valve 18, and extends to a point 33 in the conduit means 19 at a point between the output 20 of the compressor 16 and, for instance, the oil separator 21. A check valve 34 is installed in the by-pass 31 to prevent back flow of refrigerant from the conduit means 19 toward the conduit means 14.

During pull-down operation of the system, compressed refrigerant from the compressor 13 will be fed to the input 15 of the compressor 16 always at a predetermined intake pressure, maintained substantially constant by the suction pressure regulator 18. In the absence of the by-pass 31, of course, the compressor 13 would have to be cut out periodically in order to avoid over-load of the compressor 16. In the disclosed system, however, the compressor 13 may operate continuously during pull-down, feeding compressed refrigerant to the conduit means 19 through the by-pass 31 to supplement the flow of refrigerant delivered by the compressor 16. As a consequence, the optimum temperature in the chamber dominated by the evaporator 10 will be reached more quickly, and with less strain upon the system than has heretofore been possible.

Once the optimum temperature has been attained, the compressor 13 may be thrown completely out of operation so long as the load upon the evaporator does not exceed the capacity of the compressor 16. The two compressors will conventionally be driven by separate electric motors 35 and 36 dominated, respectively, by separate switches 37 and 38 either or both of which may be automatic or manually manipulable.

I claim as my invention:

1. In a plural-stage refrigeration system, an evaporator, a first compressor having an intake and an output, first conduit means connecting the intake of said first compressor to receive refrigerant from said evaporator, a second compressor having an intake and an output, a suction pressure regulator valve, second conduit means connecting the intake of said second compressor to receive refrigerant from the output of said first compressor through said suction pressure regulator valve, a condenser, third conduit means connecting said condenser to receive refrigerant from the output of said second compressor, a by-pass connecting said second conduit means, at a point between said first compressor output and said suction pressure regulator valve, with said third conduit means, a check valve in said by-pass preventing refrigerant flow from said third conduit means toward said second conduit

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means, and fourth conduit means connecting said evaporator to receive refrigerant from said condenser.

2. The system of claim 1 including a separate driving means for each of said compressors, and separate control means for each driving means, said control means being operable to render either of said compressors inactive while the other of said compressors continues to operate.

3. The system of claim 1 in which the power rating of said second compressor is less than that of said first compressor.

4. The system of claim 1 in which said compressors are electrically driven and control means for said compres-

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sors comprising a manual switch controlling the driving means for said first compressor and an independently manipulable manual switch controlling the driving means for said second compressor.

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