Feb. 10, 1931. F. SCHMIDT 1,792,248

CENTRIFUGAL COMPRESSOR

Filed July 8, 1929

Fig. 1.

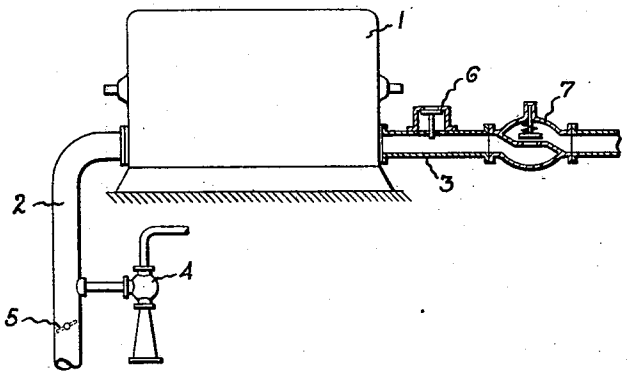
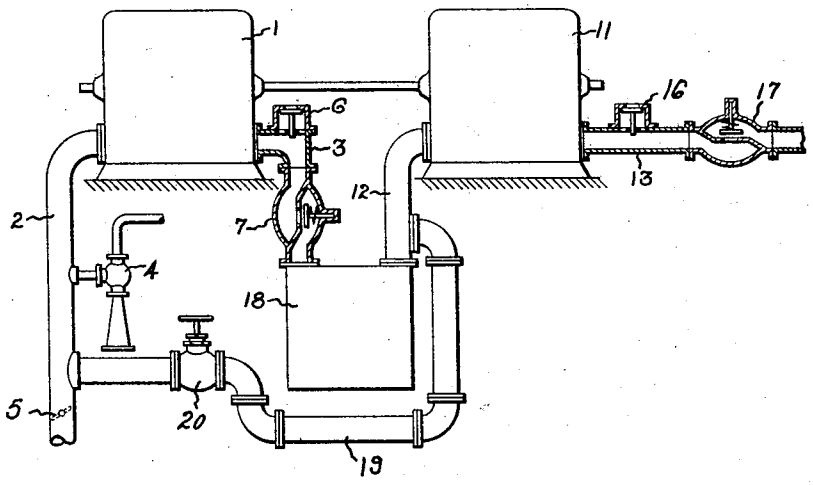


Fig. 2.



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UNITED STATES PATENT OFFICE

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CENTRIFUGAL COMPRESSOR

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It is well known in the operation of centrifugal compressors that when the output required of the compressor falls off to a predetermined low value, pulsations, or what is termed generally "pumping" occurs. Also, if the load falls off to substantially zero the rotating impellers operate in the compressed medium with the result that substantial heating of the compressor is likely to ensue and considerable energy losses will be consumed from the driving motor. Pumping in a centrifugal compressor and excessive heating have been prevented to a certain extent either by allowing a portion of the compressed fluid to flow back through the compressor or supplying a separate fluid under pressure, such as steam or compressed air, and allowing this fluid to flow back through the compressor. However, there are certain disadvantages in this method as considerable loss is involved either in extracting compressed air from the system or supplying a separate compressed fluid.

It is among the objects of my invention to overcome the above mentioned disadvantages and to provide a regulator for preventing the pumping of a centrifugal compressor at light load and this without the use of a compressed medium. According to my invention I provide an auxiliary exhausting pump which is connected to the suction of the compressor and is set into operation when no output is required of the compressor to increase the suction of the compressor to such a value that the discharge pressure will be less than atmospheric. In the discharge line of the compressor I provide a check valve adapted to admit atmospheric air into the discharge line when the pressure therein is less than atmospheric. Thus when there is no load on the compressor the auxiliary exhaust pump is set in operation; the discharge pressure drops below atmospheric, and the atmospheric air flows through the check valve and in a reverse direction through the compressor.

For a more complete understanding of my invention reference is had to the following description taken in connection with the accompanying drawing in which Fig. 1 is a schematic diagram of my improved regulator as applied to a centrifugal compressor, and Fig. 2 is a modification of my invention as applied to multiple stage compressors provided with an interstage cooler.

Referring more particularly to Figure 1, a centrifugal compressor of any well known type is represented at 1. The compressor is provided with a suction line 2 and a discharge line 3, in which is interposed the non-return valve 7. The suction line of the compressor is provided with a throttle valve 5 which is illustrated as a flap valve although any desired valve means may be employed. Connected in the suction line 2 between the throttle valve 5 and the compressor is the auxiliary exhausting pump 4. This pump may be of the water jet type or any other form of exhausting pump desired. Inserted in the discharge line 3, intermediate the compressor and the non-return valve 7, is a check valve 6 adapted to open when the pressure in the discharge line decreases below atmospheric.

Under normal operating conditions with the compressor running and delivering compressed air, the non-return valve 7 and the throttle valve 5 are open, the check valve 6 is closed, and the auxiliary pump 4 is idle. When the load on the compressor falls to a predetermined low value, for example, to zero, the non-return valve 7 automatically closes and the throttle valve 5 is closed and the auxiliary pump 4 simultaneously set into operation. The pressure in the suction line 2 is now reduced to such a value that the pressure in the discharge line 3 is less than atmospheric so that the check valve 6 opens and atmospheric air flows in a reverse direction through the compressor.

In Figure 2 is shown a modification of my invention as applied to the two-stage compressors 1 and 11 and the inter-stage cooler 18. The auxiliary pump 4 may be arranged to exhaust only the suction line 2 by closing the valve 20 in which case the pressure in the suction must be reduced to such a value that the combined pressure of the system is less than atmospheric, or the valve 20 may be opened, thus connecting the suction line 2 with the suction line 12 of compressor 11. With this latter arrangement the auxiliary

pump 4 simultaneously exhausts the suction lines of both compressors so that it is not necessary to produce as low a vacuum in the suction lines.

In accordance with the patent statutes I have described and set forth the operation of the preferred embodiment of my invention, but I do not wish to be limited thereto, but aim in the appended claims to cover all modifications thereof within the spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States, is,—

1. In combination with a centrifugal compressor, means for increasing the suction of the compressor, and valve means in the discharge of said compressor adapted to provide a reverse flow of atmospheric air through the compressor when the suction is increased below a predetermined value, whereby there is effected a flow of air from the atmosphere backwards to the compressor.

2. In combination with a centrifugal compressor, auxiliary pumping means connected to the suction of said compressor and adapted to increase the suction thereof, valve means in said suction and in front of the connection to the auxiliary pumping means adapted to shut off the normal suction of the medium to be compressed, and valve means in the discharge of said compressor adapted to provide a reverse flow of atmospheric air through the compressor upon the operation of said auxiliary pumping means and said first mentioned valve means.

3. In combination with a centrifugal compressor, a throttle valve in the suction of said compressor, a jet pump connected to the suction of the compressor intermediate the throttle valve and the compressor and adapted to exhaust said suction, and a check valve in the discharge of the compressor adapted to provide a reverse flow of atmospheric air through the compressor when the discharge pressure of the compressor falls below atmospheric.

In witness whereof, I have hereunto set my hand this 20th day of June, 1929.

FRIEDRICH SCHMIDT.