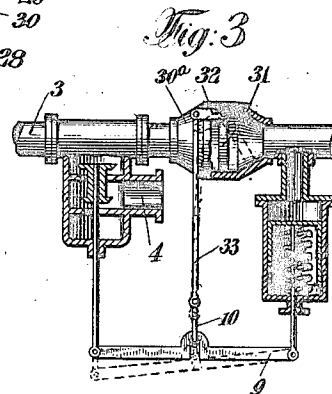
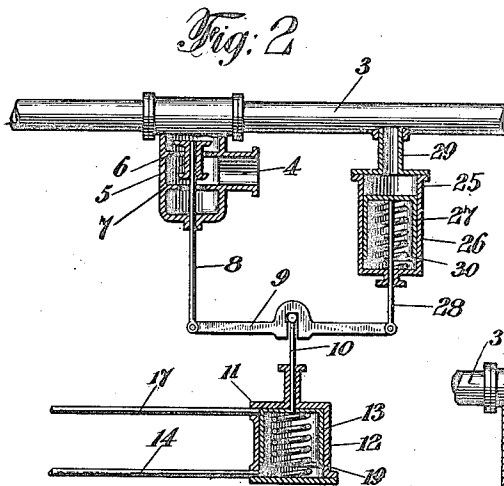
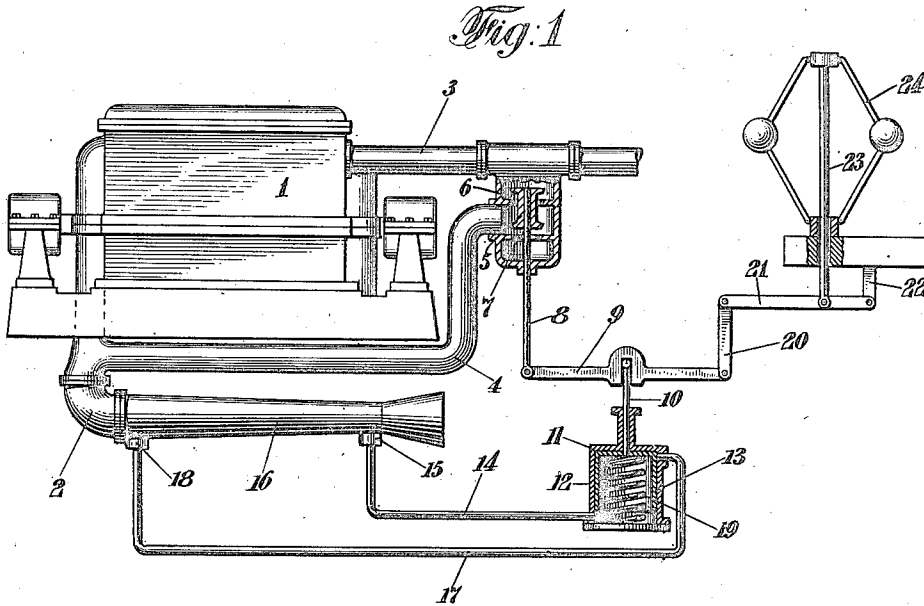


O. BANNER.
 REGULATING MECHANISM FOR CENTRIFUGAL COMPRESSORS AND PUMPS.
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1,222,352.

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REGULATING MECHANISM FOR CENTRIFUGAL COMPRESSORS AND PUMPS.

1,222,352.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, OTTO BANNER, a subject of the German Emperor, residing at Easton, in the county of Northampton and State of Pennsylvania, have invented a certain new and useful Improvement in Regulating Mechanism for Centrifugal Compressors and Pumps, of which the following is a specification.

This invention relates to centrifugal compressors and pumps and more particularly to a regulating mechanism therefor for allowing the compressor or pump to be operated at variable volume and variable pressure.

In the operation of centrifugal compressors to supply a variable volume a difficulty is encountered in that when the demand on the compressor is reduced below a certain amount which depends on the design of the compressor the air or other fluid passing through the compressor does not flow steadily but pulsates, giving an effect known as "pumping." This difficulty has been overcome by arranging a blow off valve in the discharge line which is automatically opened when the demand reaches a certain minimum allowing the same quantity of air to go through the compressor but diverting part of it so that only the desired quantity passes to the demand line. Where, however, it is desired to operate a compressor not only with variable volume but at varying pressure of discharge, a new consideration comes into effect. This is that as the pressure of the fluid in the discharge line becomes lower, the minimum volume at which pumping begins also becomes lower so that if a lower pressure is required in the demand line, the volume demanded can be lower and still pumping be prevented in the compressor. It will therefore be seen that the blow off valve in the discharge can be opened when there is a less volume of demand, if the compressor is operating at a lower pressure, and that a considerable amount of power need not be wasted in blowing off unnecessary air from the discharge line.

A further consideration to be observed in machines which are to be operated with varying pressures in the discharge, such as blowing engines for blast furnaces, is that to obtain an accurate measurement of the air passed to the furnace, the mechanism

for measuring or regulating the output of the compressor, herein called the "demand measuring device" must be put into the intake pipe of the compressor where the pressure is constant and that in order to measure the true discharge of the engine, any air blown out must be returned to the inlet of the compressor, that is, between the demand measuring device and the first wheel of the compressor.

It is the object of the present invention to devise a mechanism whereby the property of the compressor of requiring less blow off at lower pressure can be taken advantage of, and to provide a means whereby the blow off valve will be opened later when the demand falls off while the compressor is operating at a lower pressure, than at a higher pressure.

A further object is to obtain an accurate measurement of the air actually passing through the discharge line to the demand by placing the demand measuring device in the intake pipe of the compressor and returning blown off air to the compressor inlet.

With these objects in view I have devised a regulating mechanism practical embodiments of which are shown in the accompanying drawings in which—

Figure 1 shows a side elevation partly in section of a compressor provided with such a regulating means, and

Figs. 2 and 3 show sections through modified forms of the regulating device.

In the form shown in Fig. 1 the device is shown attached to a compressor 1 of ordinary construction which is provided with an intake line 2 and a discharge line 3. From the discharge line 3 an exhaust passage 4 leads to the inlet of the compressor. This exhaust passage is controlled by a balanced valve 5 which seats on valve seats 6 and 7 and is operated by a valve stem 8. The valve stem 8 is pivotally attached to a lever 9, to which in turn is loosely attached the piston rod 10 of a motor 11. This motor comprises a cylinder 12 and a piston 13 to which the rod 10 is attached. From the lower end of cylinder 12 a pipe 14 leads to the throat 15 of a Venturi tube 16 which is attached to the inlet 2 of the compressor, while from the upper end of the cylinder a pipe 17 leads to the discharge 18 of the Venturi tube. A spring 19 presses against

the lower side of piston 13 tending to raise it and open valve 5. This spring is of such strength that when the amount of air taken through the Venturi tube is above the pumping limit of the compressor at any desired speed and pressure in the compressor, the difference in pressure in the throat and discharge of the Venturi tube will hold the piston 13 at the lower end of the cylinder 12 and hold the valve 5 shut. If however the volume through the Venturi tube is decreased on account of decreased demand on the compressor, the piston 13 will rise tending to open the valve 5. As before stated the valve is designed to open at a certain minimum volume through the discharge line when the compressor is running at a certain pressure and speed. If however it is desired to run the compressor at a lower pressure a further mechanism is required to take advantage of the lower pumping limit at such lower pressure. In compressors of the type concerned, when operating above the pumping limit, that is when the amount of air passing through the compressor is above the pumping limit a decrease in pressure with constant volume is necessarily accompanied by a decrease in speed in mathematical relation thereto. It is possible therefore to use either the decrease in pressure or the decrease in speed to modify the action of the motor 11 in opening the valve 5. In the form shown in Fig. 1 the variation in speed is used. To the end of lever 9 on the opposite side of the pivoted connection of the motor piston rod 10 from the connection of the valve rod 8 is fastened a link 20 which is in turn pivotally connected to a lever 21 which is fulcrumed in a stationary lug 22. Between the fulcrum and the link connection is secured the rod 23 of a tachometer or fly ball governor 24 which is operated by connections, not shown, from the shaft of the compressor. This governor is so arranged that the rod 23 will rise as the speed of the compressor falls and vice versa.

In Fig. 2 an equivalent form is shown in which however the pressure in the discharge line is used to modify the action of the valve 5. Here a motor 25 is provided which comprises a cylinder 26 in which slides a piston 27 the rod 28 of which is attached to the lever 9. Pressure is supplied from the discharge line by a pipe 29 to keep the piston 27 down while the pressure is above the desired amount, while a spring 30 of the proper strength presses against the lower side of the piston serving to raise it when the air pressure on the other side falls below a certain value.

In Figs. 1 and 2 forms are shown in which the demand is measured by a Venturi tube. As the present invention has to do with a variable pressure in the discharge line, the

Venturi tube must be put into the inlet line, as its measurements would vary with varying pressure. But as the demand measuring device must only measure the demand, in such a case the difference between the minimum amount necessarily passed through the compressor and that blown off through valve 5, the air blown out through the valve 5 must be carried back to the inlet so that only the amount of air passing out through the discharge line to the demand shall be measured. In Fig. 3 a form is shown wherein the actual discharge is measured. This comprises a discharge pipe 30^a in which is pivoted a swinging gate or float 31 the position of which depends on the amount of air passing through the discharge pipe. This gate or float is operatively connected with the rod 10 by an arm 32 and link 33, so that a decrease in the flow of fluid through the pipe 30^a tends to open the valve 5. Where the demand is thus measured in the discharge line the blow-off pipe 4 can open to the atmosphere and need not go to the intake of the compressor.

The invention is applicable to either of the common types of compressors, either those whose motor governors are arranged to vary their speed to produce a constant pressure at all times, the volume varying with the demand, or those whose governors are arranged to drive the pump so that it takes in and compresses a constant volume of free air at all times, the discharge pressure and discharge volume varying with the resistance, as in blast furnace work. In the first case the governing mechanism of the compressor driving motor is manually adjustable so that the constant pressure produced can be varied, and in the second case, the governing mechanism is manually adjustable so that the constant volume taken in can be varied.

The forms of the invention shown in Figs. 1 and 2 are applicable to either type of compressor, while the form shown in Fig. 3 is only applicable to the first type as it is evident that with a compressor taking in a constant volume of fluid and discharging it at various pressures, the flow of fluid in the discharge line would depend on the pressure and not form a definite medium for regulation.

Considering the operation of the invention as applied to the first type of compressor mentioned above, suppose that the motor 11 and Venturi tube 16 or gate 31 are so designed that the valve 5 will be opened at a predetermined minimum volume while the compressor is running at its maximum speed and pressure. This will mean that when the volume of air passing through the Venturi tube or the discharge line falls below a certain minimum the piston 13 or

the arm 32 will rise opening the valve 5 immediately since because of the maximum speed and pressure of the compressor the rod 23 or the rod 28 will be in its lowermost position thus allowing the motion of the piston 13 to be communicated directly to the valve 5. Supposing however that it was desired to furnish air at a lower pressure and hence at lower compressor speed: In such a case the rod 23 or the rod 28 would be in a somewhat raised position and the piston rod 10 would have to move some distance before it would engage the lever 9 and open valve 5. In this way a less volume of air could pass through the Venturi tube 16 or through the discharge line before the valve 5 was opened, thus taking advantage of the property of such compressors described above.

Considering the operation of the invention as applied to the second type of compressor mentioned above, the valve connections will be so arranged that at the minimum volume and speed or pressure required of the compressor the piston 13 will be in its uppermost position and the piston 27, or the speed governor 24 will also be in its uppermost position, so that a slight increase in pressure in the discharge line will open the valve 5. If, however, the compressor is set to take in a greater volume of air the piston 13 will take a constant lower position and the pressure in the discharge line or the speed will have to increase considerably before the valve 5 will open.

Although the invention is here described in connection with a compressor for use with air or a similar gas, the general principle and some of its embodiments are equally applicable to centrifugal pumps for water and similar fluids and such application is intended to be included under the claims, moreover, it is to be understood that the present showing and description discloses only certain specified modifications of my invention and other forms and modifications are included in the spirit and scope of the invention as expressed in the claims.

What I claim is:

1. In a centrifugal compressor, an inlet and discharge line for said compressor, a demand measuring device in the inlet line

of said compressor, a blow off valve in the discharge line of said compressor and a conduit for leading the blown off air back to the inlet of said compressor between the compressor and the demand measuring device so that only the air passing out through the discharge line to the demand shall be measured by said demand measuring device.

2. In a centrifugal compressor, an inlet and discharge line for said compressor, a demand measuring device in the inlet line of said compressor, a blow off valve in the discharge line of said compressor, a conduit for conveying the blown off air back to the inlet of said compressor, between said compressor and said demand measuring device, and means for regulating the amount of air passed through said blow off valve.

3. In a centrifugal compressor, an inlet and discharge line for said compressor, a demand measuring device in the inlet line of said compressor, a blow off valve in the discharge line of said compressor, a conduit for conveying the blown off air back to the inlet of said compressor, between said compressor and said demand measuring device, and means for regulating the amount of air passed through said blow off valve in accordance with the amount of fluid passing through said demand measuring device.

4. In a centrifugal compressor, an inlet and discharge line for said compressor, a demand measuring device in the inlet line of said compressor, a blow off valve in the discharge line of said compressor, a conduit for conveying the blown off air back to the inlet of said compressor, between said compressor and said demand measuring device, and means for regulating the amount of air passed through said blow off valve in accordance with the amount of fluid passing through said demand measuring device and the pressure of the fluid in said discharge line.

In testimony whereof I have hereunto set my hand.

OTTO BANNER.

Witnesses:

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PAUL HOFFMAN.