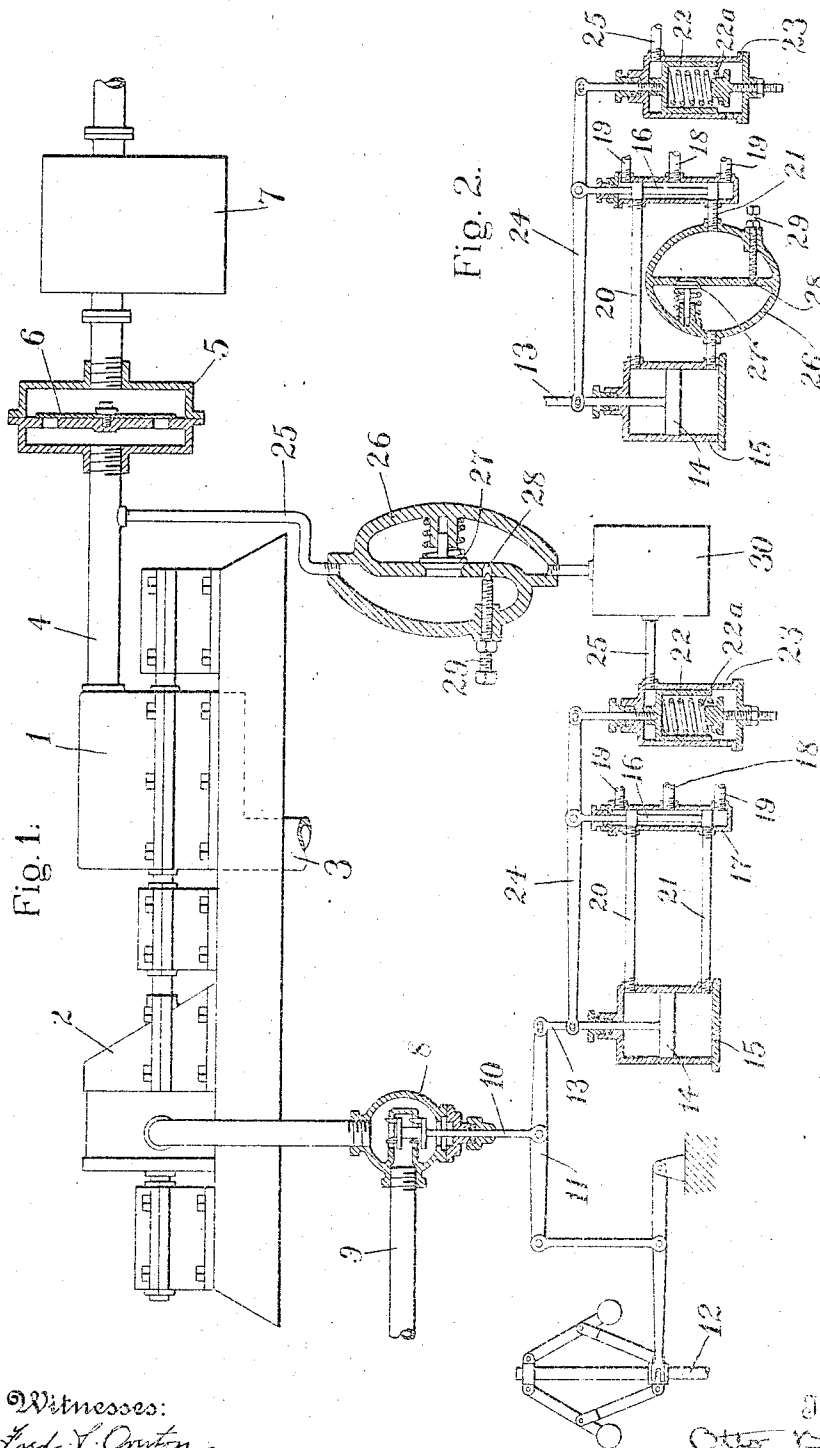


O. BANNER.
 REGULATING MECHANISM FOR CENTRIFUGAL COMPRESSORS.
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1,240,531.

Patented Sept. 18, 1917.



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UNITED STATES PATENT OFFICE.

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REGULATING MECHANISM FOR CENTRIFUGAL COMPRESSORS.

1,240,531.

Specification of Letters Patent.

Patented Sept. 18, 1917.

Application filed June 30, 1914. Serial No. 343,147.

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, Case "B", of which the following is a specification.

10 This invention relates to regulating mechanism for centrifugal compressors and blowers, and more particularly to mechanism for regulating the operation of such compressors below their normal capacity.

15 When the air or other fluid delivered by a centrifugal compressor or pump falls below a certain amount, which is determined by the size and design of the compressor or pump, the fluid in the compressor begins to pulsate back and forth through the impellers giving the effect known as "pumping".

20 It is often necessary, however, to operate such a compressor to deliver an amount of fluid below the so-called pumping limit. To do this various methods have been devised, the most common being to allow enough fluid to pass through the compressor to prevent pumping, but to blow off whatever excess there is over the demand to the atmosphere from the compressor discharge line. This, of course, involves considerable waste of energy.

25 The object of this invention is to provide a means whereby a compressor can be safely operated below the pumping limit without any waste of the pumped fluid.

30 With this object in view, a regulator has been devised, practical embodiments of which are shown in the accompanying drawings, in which,

35 Figure 1 shows a partially diagrammatic side elevation of a compressor system embodying the invention, the important features being in section, and

40 Fig. 2 shows a detail of a modified form.

45 In the drawings is shown a centrifugal compressor 1, of ordinary construction, driven by a steam turbine 2, also of ordinary construction. Air or other fluid is taken into the compressor through an inlet pipe 3 and passed out through the discharge line 4. Situated in the discharge line 4 near the compressor is a valve chest 5 in which is situated a spring plate check valve 6 which is preferably of very light construction and

allows free flow of the compressed fluid to the work but prevents any return flow to the compressor.

50 When the compressor is operated below its pumping limit the pressure in the discharge line fluctuates between the pressure which the compressor is designed to normally produce and a very much lower pressure, the pressure alternately rising and falling as the machine pumps. The addition of the check valve 6 in the discharge line prevents any fall in pressure on its farther side so that when the compressor operates normally a quantity of air or fluid at the required pressure passes through the valve and can not return, while when the compressor is pumping, no air passes by the valve except at the height of the pressure of each of the pumping pulsations. If the air from the compressor is to be used directly it is necessary to provide an auxiliary receiver 7, to prevent undue variation in the pressure of the fluid delivered.

55 As the regulation of the driving motor of a compressor is usually effected by the pressure of the discharged fluid, the effect of the pumping on the regulating mechanism must also be considered.

60 In the drawing is shown an ordinary mechanism for regulating the steam admission to the turbine 2 in accordance with the speed and the discharge pressure of the compressor, this mechanism comprising a throttle valve 8, controlling the admission of steam to the turbine 2 through the pipe 9. The valve 8 is provided with a stem 10 which is attached to the center of a lever 11 operatively connected with a ball governor 12 driven by connections, (not shown), from the main shaft of the turbine. The other end of the lever 11 is attached to the piston rod 13 of a piston 14 sliding in a cylinder 15. The piston 14 is moved through a relay mechanism which consists of a pilot valve 16 sliding in a chest 17 to which oil is admitted by a pipe 18 from a source of oil under pressure, (not shown), and from which oil is exhausted by pipes 19. Oil is admitted and exhausted from the upper and lower sides of the piston 14 by pipes 20 and 21, the movement of valve 16 upward causing admission to the upper side of piston 14, moving it downwardly and the movement of valve 16 downwardly admitting fluid to the lower side of piston 14 moving it upwardly.

This pilot valve is moved by a piston 22 sliding in a cylinder 23, the piston 22, valve 16, and piston 14 being connected to each other by a follow up lever 24, this whole relay mechanism being of well known construction. The piston 22 has an adjustable spring 22^a tending to move it upwardly, while the upper end of the cylinder 23 is connected by means of a pipe 25 to the discharge line 4 of the compressor between the compressor and the check valve 6. As the pressure in the pipe 25 varies the piston 14 and hence the valve 8 are moved to vary the admission of steam to the turbine. If fluid were able to pass freely through the pipe 25 in both directions when the compressor was pumping the valve 8 would be moved up and down with the pulsations of the compressor, alternately closing off the steam and allowing it to enter the turbine, the alternations being of considerable rapidity.

It is obvious that the sharp blows resulting from the impact of the steam on the blades of the turbine would result in wear and breakage. To prevent this pulsation of the valve 8 a valve chest 26 is provided in the pipe 25 in which is situated a check valve 27, which allows free movement of the fluid through the pipe 25 to the cylinder 23 but which cuts off the flow in the other direction. A limited flow in the other direction is allowed, however, through a leak port 28 which can be adjusted by means of a screw 29.

When the compressor is operating under normal conditions above the pumping limit, the pressure changes in the discharge line 4 and hence in the pipe 25 are small, the pressure rising slightly when the demand falls off causing the piston 22 to move downwardly, the piston 14 upwardly, and the valve 8 to shut off the admission of the steam to the turbine to a slight extent. Any fall in pressure is also gradual and the fluid can easily escape through the port 28.

When the compressor is pumping, however, it is necessary for there to be a free flow of the fluid through the pipe 25 in a direction to close the valve 8, but the flow in the other direction must be restricted so that when the pressure in the discharge line 4 falls, the fall cannot be communicated suddenly to the cylinder 23 and hence to the valve 8. This fall must be gradual, and if the capacity of the pipe 25 between the cylinder 23 and the valve chest 26 is not sufficient an auxiliary receiver 30 must be added.

Fig. 2 shows a modification of the device in which the valve chest 26, check valve 27 and port 28 are placed in the pipe 21, this having the same effect as placing them in the pipe 25. The port 28 might be omitted in either case by allowing the check valve 27 to leak slightly.

In my copending application Serial Number 848,146 filed June 30th, 1914, I have shown and described a regulating mechanism accomplishing the same purpose as the present, in which the pipe corresponding to pipe 25 is led from the discharge line beyond the check valve, the mechanism for preventing the rapid communication of the fall in pressure in the discharge line to the pressure regulating mechanism not being necessary in such a case.

With this invention a steam driven centrifugal compressor can be successfully operated below its pumping limit without the loss of energy entailed in blowing off excess fluid from the discharge line, and it is to be understood that while the present showing and description discloses only certain specified modifications of the invention, 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 combination, a centrifugal compressor, a driving engine therefor, a compressor discharge line, a check valve in said discharge line, a controlling valve for said engine, and means to operate said controlling valve by discharge line pressure and the speed of the engine comprising a fluid conduit leading from said discharge line between said compressor and said check valve.

2. The combination with a centrifugal compressor having a discharge line, and an engine for said compressor, of a check valve in said discharge line, a controlling valve for said engine, a speed governor and a motor for operating said controlling valve, a fluid conduit for transmitting the pressure of said discharge line to operate said motor, means in said conduit for allowing free passage of the fluid through said conduit in a direction to close said valve and means for restricting the flow in the opposite direction.

In testimony whereof, I have hereunto set my hand.

OTTO BANNER.

Witnesses:

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