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REGULATING MECHANISM FOR CENTRIFUGAL COMPRESSORS.

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1,268,079. Patented June 4, 1918.

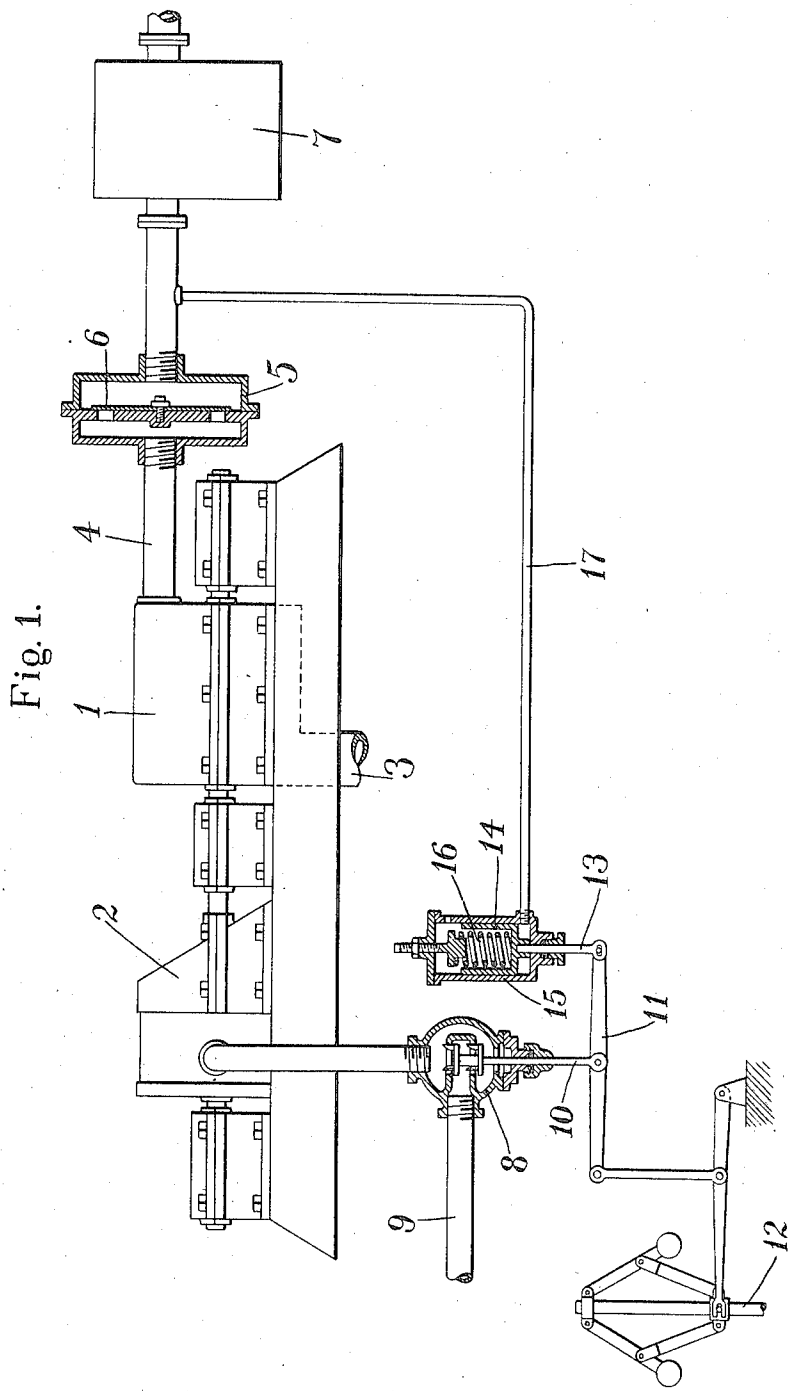


Fig. 1.

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UNITED STATES PATENT OFFICE.

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REGULATING MECHANISM FOR CENTRIFUGAL COMPRESSORS.

1,268,079. Specification of Letters Patent. Patented June 4, 1918.

Application filed June 30, 1914. Serial No. 848,146.

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 "A",) of which the following is a specification.

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.

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".

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.

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.

With this object in view, a regulator has been devised, a practical embodiment of which is shown in the accompanying drawing, which shows a diagrammatic side elevation of a compressor system embodying the invention, the important features being in section.

In the drawing 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.

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 each time 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.

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

In the drawing is shown an ordinary mechanism for regulating the steam admission to the turbine 2 in accordance with 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.

Pressing on the upper side of the piston 14 in a direction tending to open the valve 8 is an adjustable spring 16. The lower end of the cylinder is connected with the

discharge line 4 beyond the check valve 6 by a pipe 17.

It is obvious that any desired relay mechanism may be employed in connection with the transmission of the movement of the piston 14, and the governor 12 to the valve 8.

In operation, when the demand falls below the pumping limit, the rise in pressure in the discharge line relatively to the normal delivery pressure of the compressor, together with the decrease in the volume of fluid flowing through the machine, will cause the compressor to begin to pump. This pumping will result in a large decrease in the pressure in the compressor itself, and in the discharge line on the compressor side of the check valve, the fluid surging back and forth in the compressor and only producing the normal pressure momentarily when the forward surges of the fluid reach their maximum. During such a period of pumping the check valve will remain closed, except at the height of the forward pulsations, and as the compressor is doing practically no work, the fluid merely surging back and forth without entering the discharge line, the whole system will be running practically unloaded, and, as a consequence, the engine will speed up to its maximum speed, the speed governor almost closing the engine valve 8. The compressor and engine will thus run practically unloaded until the pressure in the discharge line beyond the check valve drops far enough to allow the compressor to pick up the air again, the engine valve 8 meanwhile being gradually opened by the fall of the piston 14 due to the drop in pressure in the discharge line beyond the check valve. After the compressor has again picked up the load and the speed of the engine has decreased to normal, the compressor will work normally until the pressure in the discharge line rises to a point where the cycle will be repeated, this pumping circle being repeated at regular intervals when the demand of the compressor is below its pumping limit, the frequency of the cycles depending on the deficiency of the demand below the pumping limit. The check valve thus prevents any material sudden fluctuation in the discharge line beyond it and hence prevents any sudden movement in the pressure controlling mechanism of the valve 8, in a direction to open it, such a movement resulting in a sudden admission of steam to the turbine which would place it under dangerous stress.

With this arrangement 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 one specified modification 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, a speed governor operatively connected to said controlling valve, and means for transmitting the compressor discharge pressure to coöperate with said speed governor in the operation of said controlling valve comprising a fluid conduit leading from said discharge line beyond said check valve.

2. In combination, a centrifugal compressor, its engine, a governing mechanism for the engine comprising a speed governor and a fluid operated motor for varying the admission of motive fluid in accordance with the speed of the engine and the compressor discharge line pressure, a check valve in the discharge line of the compressor, and a fluid connection from the discharge line of the compressor beyond said check valve to said motor.

3. In combination, a compressor, its discharge line, a receiver in said discharge line, a driving engine for said compressor, a valve mechanism for controlling said engine, a speed governor and a fluid operated motor for operating said valve mechanism, a check valve in said compressor discharge line, and a fluid conduit for conveying fluid from said discharge line beyond said check valve to said motor.

4. In combination, a centrifugal compressor, a driving engine therefor, a discharge line for said compressor, a check valve in said discharge line, a combined speed and discharge line pressure governor for said engine, said governor being arranged to regulate said engine and compressor when operating below the pumping limit of said compressor.

5. In combination, a centrifugal compressor, a driving engine therefor, a discharge line for said compressor, a check valve in said discharge line, and means for regulating said engine to drive said compressor at a total capacity below its pumping limit.

6. In combination, a centrifugal compressor, a driving engine therefor, a discharge line for said compressor, a check valve in said discharge line, said discharge line beyond said check valve receiving at all times the total output of compressed fluid from said compressor, and a governing means for regulating the driving engine in accordance with the demand both above and below the pumping limit of the compressor.

7. In combination, a centrifugal compressor a driving engine therefor, a discharge line for said compressor, a check valve in

said discharge line, a combined speed and discharge line pressure governor for said engine, said governor being arranged to regulate said engine while said compressor is operating below the pumping limit and during the pumping period of said compressor.

In testimony whereof, I have hereunto set my hand.

OTTO BANNER.

Witnesses:
F. G. RAUBER,
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