C. P. CRISSEY.

AIR REGULATING DEVICE FOR CENTRIFUGAL COMPRESSORS.

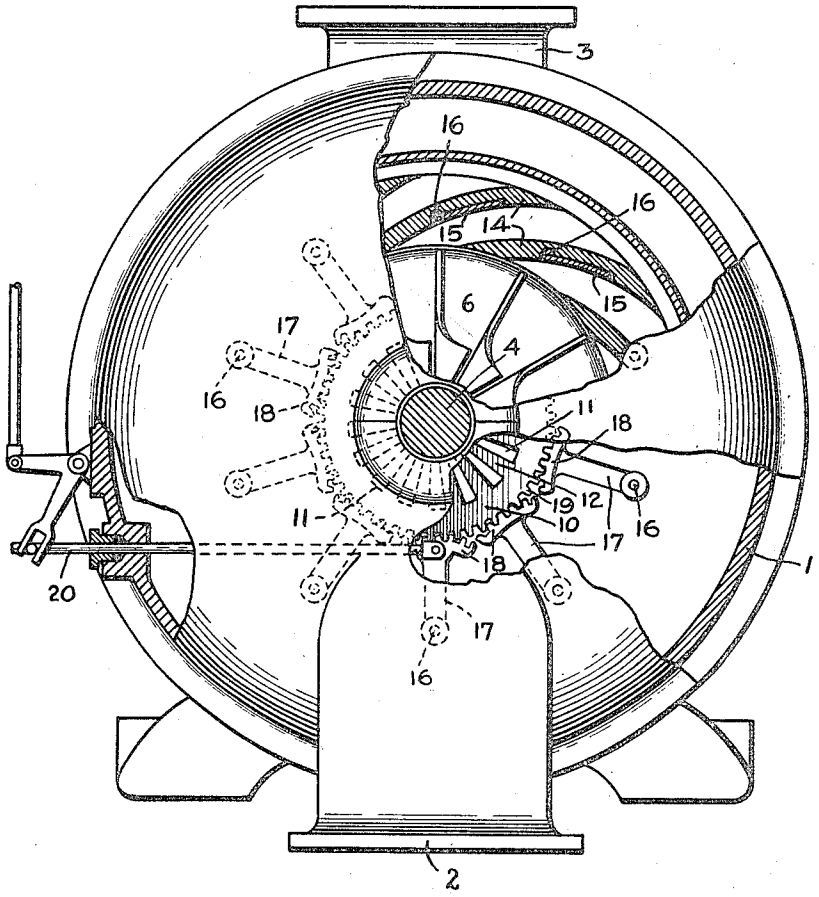
APPLICATION FILED JAN. 17, 1913.

1,141,938.

Patented June 8, 1915.

2 SHEETS—SHEET 1.

Fig. 1.



Witnesses:

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J. Ellis Glen

Inventor,

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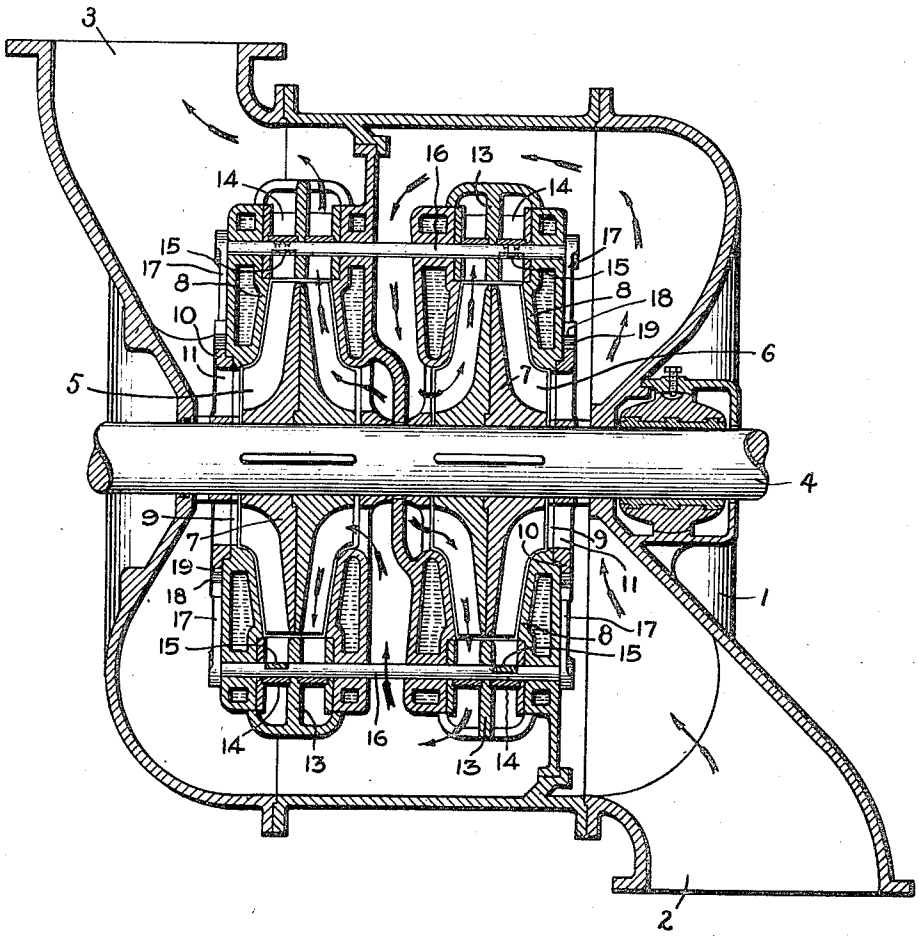
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2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

CLARENCE P. CRISSEY, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

AIR-REGULATING DEVICE FOR CENTRIFUGAL COMPRESSORS.

1,141,938. Specification of Letters Patent. Patented June 8, 1915.

Application filed January 17, 1913. Serial No. 742,614.

To all whom it may concern:

Be it known that I, CLARENCE P. CRISSEY, a citizen of the United States, residing at East Orange, in the county of Essex, State of New Jersey, have invented certain new and useful Improvements in Air-Regulating Devices for Centrifugal Compressors, of which the following is a specification.

This invention relates to centrifugal machines for compressing air, and its object is to retard or prevent the breakdown which is liable to occur when a critical point is reached in the ratio between the speed of the machine and the volume of air delivered. If this critical point is passed, surging of the air column and violent pulsations in pressure are liable to be set up, which endanger the machine and interfere with its usefulness. Each speed has its own breakdown point, and so long as the volume of air delivered remains on the safe side of the curve thus established, no trouble will be experienced. But when the machine is running at a constant number of revolutions per minute, the lessening of the volume delivered means also that the velocity of the air column is lessened. If the velocity can be maintained in spite of the lessened volume, the danger of a breakdown is greatly reduced. My invention, therefore, concerns a particular construction of the compressor by which the velocity diagram can be kept approximately correct even at light loads and thus a correct functioning of the fluid will be secured. I accomplish this by making the impeller, or each impeller, if more than one is used, capable of taking air from both sides; controlling by a suitable valve the air admitted to one side; dividing the discharge chamber by a partition in line with the impeller, so that each half of the impeller will deliver its air to its own set of discharge vanes, and providing, if desired, auxiliary vanes to regulate the delivery of the fluid. The special construction of these parts and the particular functions of each will appear from the following detailed description, reference being had to the accompanying drawings, in which—

Figure 1 is an end elevation of a centrifugal air compressor partly broken away to show some of the mechanism embodying my invention, and Fig. 2 is a longitudinal section of the same machine.

The casing 1 has an intake 2 and an outlet 3. Mounted on the shaft 4 are two impellers 5 and 6, each of which is double, that is to say, it has driving blades on each side of a central web 7. The air entering through the intake is admitted to the housing 8 of each impeller through ports 9 adjacent to the hub. On one side of each impeller, these ports are controlled by a rotary valve 10, having ports 11 to register with the ports 9, and intermediate solid portions 12 to close said ports 9 when the valve is turned. By suitably adjusting the position of this valve, the amount of air admitted to that side of the impeller can be accurately regulated,

The discharge chamber surrounding each impeller is divided into two compartments by a partition 13, lying in the same plane as the web of the impeller and making a close running fit with its periphery. In each of the compartments thus formed is a set of main discharge vanes 14 of the usual shape and arrangement. In order to control the effective area of the discharge channels between the vanes, I provide in each channel an auxiliary vane 15 mounted on a shaft 16 which extends through the housing of the impeller and is provided on one or both ends with a lever arm 17. Inasmuch as it is desirable to adjust all these auxiliary vanes simultaneously and to the same degree, each lever carries a segment gear 18 meshing with a spur gear 19 formed integral with one of the valves 10. A rod 20 pivoted to one of the levers enables the valves and all the auxiliary vanes to be adjusted at the same time; the vanes being gradually closed when the ports 9 are gradually closed, and vice versa. The rod 20 can be actuated by hand, or automatically by a speed governor (not shown), as may be desired.

It will be observed that the two valves 10 are on opposite sides of the two impellers. The object of this is to balance the end thrust when the valves are partially or wholly closed, due to the greater quantity of fluid entering one side of the impeller than the other.

In the operation of this compressor, as the quantity at which breakdown occurs is approached, both sides of the impellers being open to the fluid, the governor or other means will cause the valves 10 to close. The velocity of the fluid passing into the active side of the impellers will, therefore, be such

as to form a velocity diagram which is more nearly correct, and thus breakdown will not take place until the quantity is again greatly reduced. This latter quantity can be made so small a percentage of the rated capacity of the machine that breakdown is eliminated to all intents and purposes, because outside of the range of operating conditions. When the valves 10 are closed, there is a tendency for the fluid discharged from the active side of the impeller to flow into the discharge compartment of the other side. This is prevented, or at least greatly limited, by the small clearance between the partition and the periphery of the impeller web.

I deem it better to use both the valves 10 and the auxiliary vanes 15 in the same machine; but it is evident that one or the other device may be omitted; or, if desired, the valve 10 may be used on one side of an impeller and the auxiliary vanes on the other side thereof.

The effect of my invention is to convert a machine having double inlet impellers into the equivalent of one having single inlet impellers, for use at fractional quantities of the rated load.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative, and that the invention can be carried out by other means.

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

1. In a centrifugal air compressor, the combination of a casing having an inlet opening and an outlet opening, a shaft, a plurality of double inlet impellers mounted on said shaft, and a valve associated with each impeller to control the admission of fluid to one side thereof, said valves being arranged on opposite sides of adjacent impellers whereby the end thrust is balanced.

2. The combination with a centrifugal air compressor having a double inlet impeller, of a discharge chamber provided with a partition in line with the web of said impeller, discharge vanes in each compartment of said chamber, and means located between the discharge vanes and operable to change the contour of the channels therebetween for controlling the effective area of such discharge channels.

3. The combination with a centrifugal air compressor having a double inlet impeller, of a discharge chamber provided with a partition in line with the web of said impeller, main discharge vanes in each compartment of said chamber, and auxiliary vanes for controlling the effective area of the discharge channels between the main vanes.

4. The combination with a centrifugal air compressor having a double inlet impeller and walls forming stationary discharge channels at the periphery thereof, of means for regulating the admission of fluid to one side of said impeller, and means for regulating the effective area of the discharge channels.

5. The combination with a centrifugal air compressor having a double inlet impeller, of means for regulating the admission of fluid to one side of said impeller, means for regulating the effective area of the discharge channels, and means for effecting said regulations simultaneously.

6. In a centrifugal air compressor, the combination of an impeller, stationary discharge vanes surrounding it and defining passages for directing the fluid discharged from the periphery of the impeller, and auxiliary discharge vanes carried by the first named vanes, and adapted to be adjusted to vary the effective area of said passages.

7. In a centrifugal air compressor, the combination of an impeller, stationary discharge vanes surrounding it and defining passages for directing the fluid discharged from the periphery of the impeller, auxiliary discharge vanes carried by the first named vanes, and means for simultaneously adjusting them to vary the effective area of said passages.

In witness whereof, I have hereunto set my hand this 13th day of January, 1913.

CLARENCE P. CRISSEY.

Witnesses:

R. T. FROST,

H. V. ALLEN.