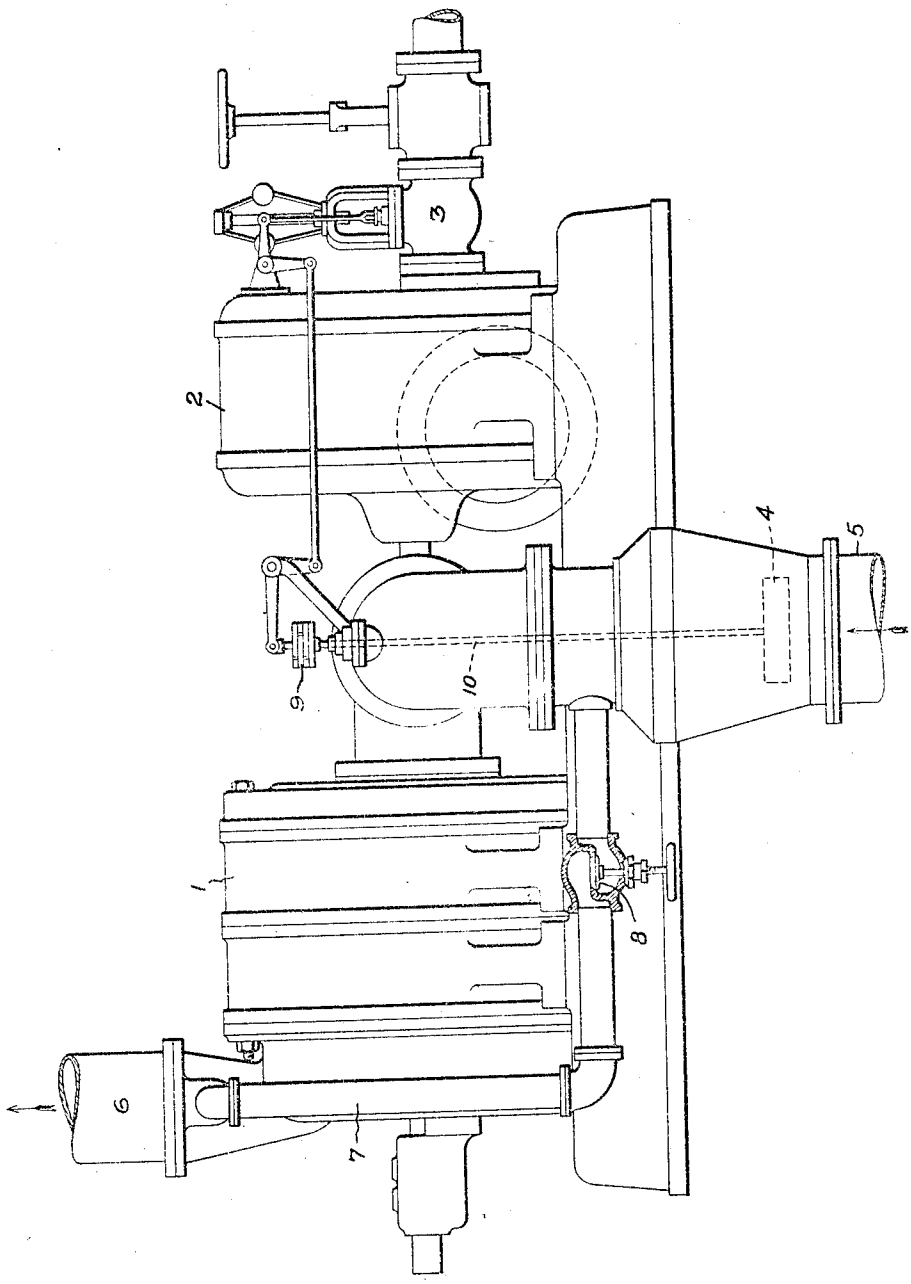
S. A. MOSS.

MEANS FOR PREVENTING SURGING IN CENTRIFUGAL COMPRESSORS.

APPLICATION FILED JAN. 11, 1913.

1,085,286.

Patented Jan. 27, 1914.



Witnesses:

Marcus L. Byng.

Anthony Mark.

Inventor:

Sanford A. Moss,

by Albert G. Davis

His Attorney.

UNITED STATES PATENT OFFICE.

SANFORD A. MOSS, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

MEANS FOR PREVENTING SURGING IN CENTRIFUGAL COMPRESSORS.

1,085,286. Specification of Letters Patent. Patented Jan. 27, 1914.

Application filed January 11, 1913. Serial No. 741,473.

To all whom it may concern:

Be it known that I, SANFORD A. MOSS, a citizen of the United States, residing at Lynn, in the county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Means for Preventing Surging in Centrifugal Compressors, of which the following is a specification.

This invention relates to centrifugal machines for compressing air or other fluids, and its object is to prevent surging or pulsations at light loads. The phenomenon of surging is one which occurs when the load on a centrifugal compressor becomes so light that the volume taken by the blast furnace or other apparatus falls below a certain critical point known as the break-down point, there being such a point for every speed of the machine. In other words, there is a certain relation between speed and volume at break-down and a greater volume must be maintained if the machine is to operate without pressure fluctuation. For less volume there is liable to be a backward rush of fluid which temporarily relieves the pressure at the discharge, and is quickly overcome by the inward flow of air into the machine, so that a to-and-fro surging of the air column is set up. My invention aims to prevent this occurrence by providing a bypass for the excess of air or other fluid, so that a portion of the discharge is wasted by returning it to the intake pipe. Where the machine is provided with a constant volume governor, this bypass must be led back into the intake at a point between said governor and the rotor of the machine, so that the action of the governor shall not be interfered with. By means of a suitable valve in this bypass, it can be adjusted to take care of any given excess of discharge. The valve can be regulated by hand or automatically, as desired.

In the accompanying drawing, is shown in elevation a centrifugal air compressor provided with my invention, the valve being adjusted by hand.

The compressor shown is a horizontal multi-stage machine 1, the impeller shaft of which is directly connected to a motor, such as a steam turbine 2. The regulator 3 of the motor, in this case a valve, is controlled by a constant volume governor of the type shown in the patent to Rice, No. 919,953, dated April 27, 1909, and has a float 4 located in an enlargement of the intake pipe 5. This float rides on the incoming volume of fluid, and by its movement up and down as the volume of the air column changes slightly varies the speed of the motor to cause the compressor to deliver the proper volume of fluid to the blast furnace or other apparatus served by the machine.

From the delivery pipe 6 a bypass pipe 7 runs back to the intake pipe, entering it at a point between the float and the rotor of the machine. Said bypass pipe is controlled by a valve 8 adjusted by hand to give the desired opening when the constant volume governor is set for a volume below break-down, and completely closed for greater volumes. In order to adjust the constant volume governing mechanism for different outputs, a means, such as the weights 9 is provided and mounted on the rod 10 connected to the float 4 and to the parts connected to the controlling mechanism of the motor 2. An automatic mechanism could also be used. Inasmuch as the returned air enters the intake above the float it does not influence said float and so does not prevent the latter from continuing to perform its office of properly regulating the speed of the motor.

To state the invention in another way, when the volume of air which it is decided to pass through the furnace, and for which the constant volume governor is set, is less than the break-down volume, the bypass is opened partially so that the volume of fluid which actually circulates through the compressor is greater than the break-down volume, thereby eliminating pulsations which would otherwise occur. Taking a concrete case as an example, and supposing the break-down volume is 12,000 cubic feet per unit of time at normal speed and pressure and it is desired to supply 10,000 cubic feet of air per unit of time. The constant volume governor will be set for 10,000 cubic feet by changing the weights or otherwise suitably adjusting the mechanism and the bypass valve will be adjusted so as to bypass about 3,000 cubic feet of fluid. The compressor will then be working on a load of 13,000 cubic feet and will therefore work above the break-down point and the furnace will receive only 10,000 cubic feet of air. I have indicated a suitable place for connecting the bypass conduit to the discharge pipe of the compressor but the invention is not so limited

since said conduit can be connected to a point in the discharge pipe somewhat remote from the compressor if it be found more convenient to do so, as for example in applying my invention to existing apparatus.

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 combination, a centrifugal compressor which is subject to surging at light loads, a constant volume governor therefor, and a bypass for returning fluid to the intake pipe at a point between the governor and compressor whereby the compressor is always loaded to a value above the breakdown point, and all of the fluid entering the compressor acts on said governor.

2. In combination, a centrifugal compressor which is subject to surging at light loads, a constant volume float governor therefor, and a bypass for returning fluid to the intake pipe at a point above the float of said governor whereby the work performed by the compressor is always maintained above the breakdown point.

3. In combination, a centrifugal compressor which is subject to surging at light loads, a constant volume governor, a bypass for returning fluid to the intake pipe at a point between the governor and compressor, and means for regulating the flow through said bypass to prevent the load on the compressor from falling below the breakdown point.

4. In combination, a centrifugal compressor which is subject to surging at light loads, an inlet and a discharge conduit therefor, a constant volume governor therefor located in the inlet, a bypass which is connected at one end to the discharge conduit and at the other end to the inlet conduit at a point between said governor and the impeller of the compressor, and means for controlling the effective discharge area of the bypass.

5. The combination of a centrifugal compressor which is subject to surging at light loads, a motor for driving it, a governing mechanism therefor responsive to a change in condition of the fluid passing through the compressor, and a conduit which at light loads returns a portion of the fluid discharged by the compressor to a point in its inlet between the governing mechanism and the compressor to prevent surging.

6. The combination of a centrifugal compressor which is subject to surging at light loads, an inlet and a discharge conduit therefor, a motor for driving the compressor, a regulator for the motor, means responsive to a change in condition of the fluid passing through the compressor for adjusting the regulator, and a conduit that receives fluid of higher pressure from the discharge side of the compressor and returns it to the inlet at a point between said adjusting means and the compressor where said fluid mixes with the fresh air and again passes through the compressor whereby a minimum load on the compressor is maintained irrespective of the demand for compressed fluid.

In witness whereof, I have hereunto set my hand this 9th day of January 1913.

SANFORD A. MOSS.

Witnesses:
JOHN A. McMANUS, Jr.,
HENRY O. WESTENDORF.