July 9, 1957 J. E. McDONALD 2,798,658

VOLUME CONTROLS FOR CENTRIFUGAL FANS

Filed March 1, 1955

Fig. 1.

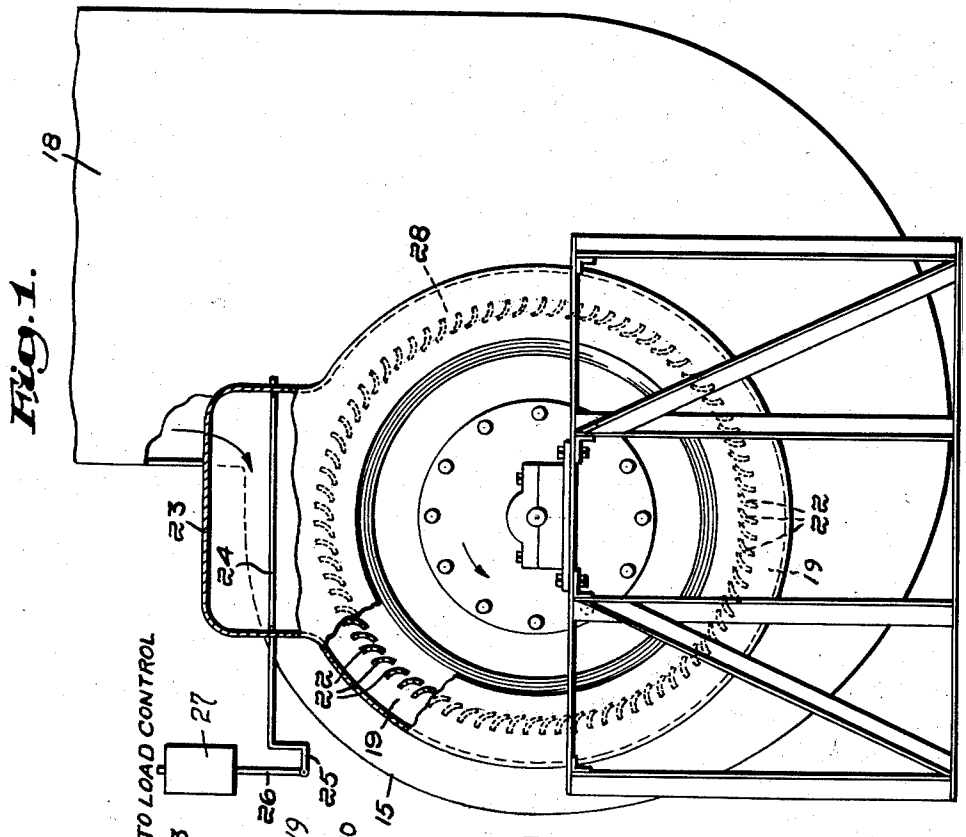
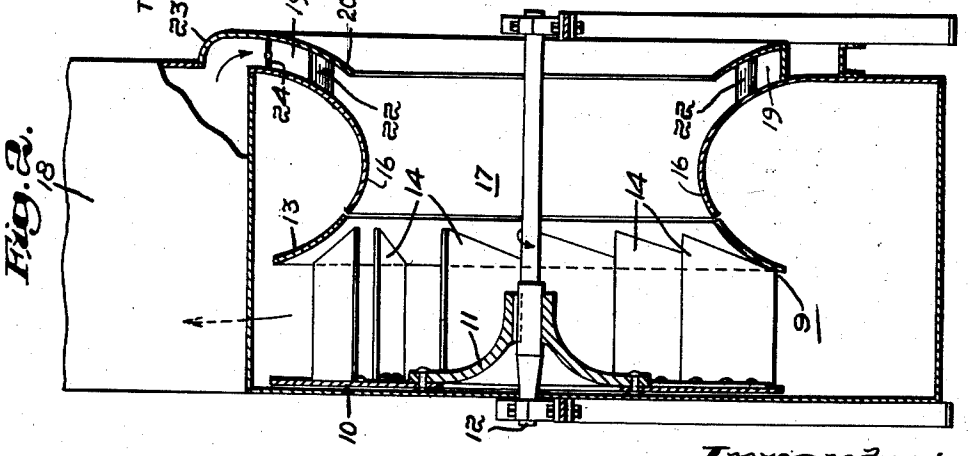


Fig. 2.



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United States Patent Office 2,798,658 Patented July 9, 1957

2,798,658

VOLUME CONTROLS FOR CENTRIFUGAL FANS

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Application March 1, 1955, Serial No. 491,271
7 Claims. (Cl. 230—114)

This invention relates to centrifugal fans, and relates more particularly to volume controls for such fans.

Centrifugal fans are usually driven by constant speed induction motors. Loads on such fans vary from time to time so that some means of varying the volumes of gas handled by the fans must be provided. Dampers may be used for adjusting gas volume, but with dampers, a reduction in gas volume does not result in a corresponding reduction in fan power consumption. The H. F. Hagen Patent No. 1,846,863 discloses a control which reduces the gas volume of a fan with a conformal reduction in power consumption, using adjustable spin vanes for spinning the gas entering a fan in the direction of rotation of the wheel of the fan. Such spin vanes and their adjusting mechanisms are relatively expensive and complicated since they must be pivoted around a fan inlet, and rotated by complicated linkage.

For many duties it is not required that the output of a fan be adjusted over a wide range, and I have found that a relatively simple and inexpensive, yet effective and efficient control can be provided by recirculating excess gas over that required by a load through a fan, and by recovering energy from the recirculated gas by passing it through fixed spin vanes which spin the recirculated gas in the direction of wheel rotation at a rate greater than the rate of wheel rotation, adjustment of the gas volume being provided by a simple damper in the recirculated gas connection.

Objects of this invention are to provide a simple and inexpensive yet effective and efficient volume control for a centrifugal fan.

This invention will now be described with reference to the annexed drawings, of which:

Fig. 1 is a side section of a centrifugal fan embodying this invention, and

Fig. 2 is an end elevation looking into the inlet of the fan, with a portion in section.

The fan has a rotor or wheel **9** consisting of a backplate **10** secured by a hub **11** to a rotary shaft **12**, a sideplate **13** and a plurality of backwardly inclined blades **14** secured to the back and side plates. The fan has a scroll-shaped casing **15** with a curved, inwardly converging inlet sheet **16** forming an axial, gas inlet passage into the wheel **9**. The casing has a tangential gas outlet **18**.

The construction described so far with reference to the drawings is conventional. This invention adds a recirculated gas passage **19** around the outer portion of the axial passage **17**, and formed by a curved sheet **20** spaced outwardly of the outer portion of the inlet sheet **16**. Spin vanes **22** are fixedly attached to and between the sheets **16** and **20** adjacent the inner end of the sheet **20**.

A recirculation duct **23** connects the fan outlet **18** to the inlet of the passage **19**, and has a damper **24** therein. The damper has a rotary shaft journalled in the sides of the duct **23** which is connected by a crank-arm **25** to the piston rod **26** of a hydraulic cylinder **27** which forms a part of a conventional load control. Upon a load reduction as indicated, for example, by a rise in steam pressure where the fan is used as a forced draft fan in a steam plant, the piston rod **26** would adjust the damper **24** towards open position. Upon a load increase, the damper would be adjusted towards closed position.

The spin vanes **22** are so shaped and placed that they spin the recirculated gas in the passage **19** in the direction of rotation of the fan wheel **9**, at a speed greater than the speed of rotation of the wheel, whereby the recirculated gas aids in the rotation of the wheel so that energy is recovered by the wheel from the recirculated gas.

The passage **19** is so located that the spinning gas emerging from it moves in a high velocity, annular stream contacting the outer positions of the fan blades **14**, and blocking off such outer blade portions from contact with the primary gas stream which enters the fan wheel axially. This aids in reducing the gas volume handled by the fan since, in effect, it reduces the active blade area.

Under full load condition where the maximum volume of gas provided by the fan is required by its load, the damper **24** would be closed so that there would be no flow of recirculated gas. Under a part load condition, the damper would be opened in proportion to the reduction in load, permitting high pressure gas from the fan outlet to flow through the passage **19** into the inlet of the fan. The fan wheel recovers energy from the recirculated gas resulting in efficient operation at reduced loads.

While one embodiment of this invention has been described for the purpose of illustration, it should be understood that the invention is not limited to the exact apparatus and arrangement of apparatus illustrated, since modifications thereof may be suggested by those skilled in the art, without departure from the essence of the invention.

What is claimed is:

1. In combination with a centrifugal fan having a fan wheel, an axial, primary gas inlet passage to the wheel, and a gas outlet, means forming a secondary gas passage extending around said inlet passage and having an outlet discharging into said inlet passage, means forming a gas recirculation passage connecting said first mentioned outlet with the inlet of said secondary passage, and spin vanes in said secondary passage adjacent said second mentioned outlet for spinning the gas entering the inlet passage therethrough in the direction of wheel rotation.

2. The combination claimed in claim 1 in which an adjustable damper is provided in the recirculation passage between the first mentioned outlet and the spin vanes.

3. The combination claimed in claim 1 in which a pair of spaced-apart, inwardly converging sheets form said secondary passage therebetween, the innermost of said sheets forming said axial passage, the outermost of said sheets extending into said inlet passage.

4. The combination claimed in claim 3 in which an adjustable damper is provided in the recirculation passage between the first mentioned outlet and the spin vanes.

5. The combination claimed in claim 4 in which the inner end of the outermost sheet terminates outwardly of the inner end of the innermost sheet, and in which the spin vanes are arranged in the secondary passage adjacent the inner end of the innermost sheet.

6. The combination claimed in claim 1 in which the inner end of the secondary passage terminates outwardly of the inner end of the axial passage, and in which the spin vanes are in the secondary passage adjacent its inner end.

7. The combination claimed in claim 6 in which an adjustable damper is provided in the recirculation passage between the first mentioned outlet and the spin vanes.

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