Aug. 24, 1943. H. F. HAGEN 2,327,841

PROPELLER FAN

Original Filed June 12, 1940

Fig. 1.

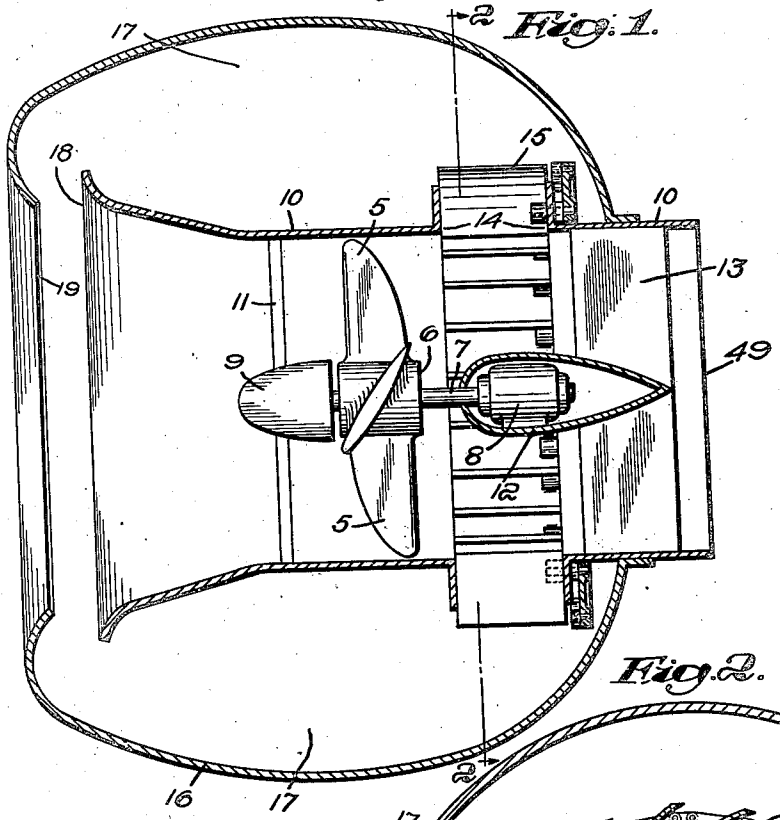
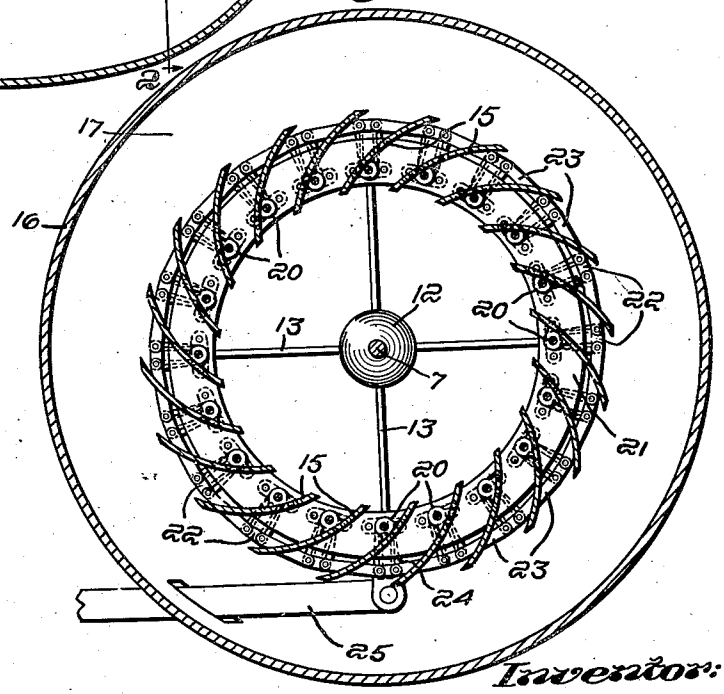


Fig. 2.



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PROPELLER FAN

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Original application June 12, 1940, Serial No. 340,126. Divided and this application November 29, 1941, Serial No. 420,930

6 Claims. (Cl. 230—114)

This invention relates to propeller fans, and relates more particularly to methods of and apparatus for, varying the air pressure and the air volume in propeller fan systems.

This application is a division of my co-pending application, Serial No. 340,126, which was filed June 12, 1940.

In many systems utilizing fans, such for example, as steam power plant systems, it is desirable to vary the air quantities from a fan. For example, in a steam power plant, it is usual to vary the volume of air supplied by a forced draft fan conformably with changes in the load upon the plant. Heretofore, it has been customary to utilize centrifugal fans for such duties requiring the fans to work against substantial static resistance and to vary the volumes of air delivered to the systems by means for example, of dampers in the fan inlets or outlets, or change of speed.

I propose to utilize propeller fans for moving air against substantial static resistance, in the field heretofore served by centrifugal fans, and to vary the air quantities as required. The characteristics of propeller fans are such that they require less horse power at substantially reduced loads when they are operated substantially at or to move larger volumes of air or other gases than are required by the loads. This invention provides for operating propeller fans to maintain relatively large total volumes of air flowing through the impellers at all times, and for varying the volumes of air supplied to the loads by recirculating through the impellers and by spinning the recirculated air.

A feature of the invention resides in combining the recirculation of air through propeller fans with the spinning of the air for supplying desired air quantities with minimum power.

Another feature of the invention resides in recirculating air through the impeller of a propeller fan, in spinning the recirculated air, and in controlling the spin, and in providing that at reduced fan outputs, a greater volume of air is recirculated through the impeller than is delivered to the load.

An object of the invention is to reduce the power required to operate propeller fans under different loads.

The invention will now be described with reference to the drawing, of which:

Fig. 1 is an elevation view in section, of a propeller fan embodying this invention, and

Fig. 2 is a sectional view along the lines 2—2 of Fig. 1.

In the embodiment of Figs. 1 and 2, air for recirculation through the fan, is taken through a circumferentially extending opening between the fan wheel and the spin straightening vanes, and recirculated through the fan inlet, and the spin of the recirculated air is adjusted by vanes in the circumferentially extending opening.

Referring now to Figs. 1 and 2, the propeller blades 5 are formed on the hub 6 which in turn is keyed to the shaft 7. The shaft 7 is supported at one end by the bearings of the electric motor 8 and at the other end by a bearing in the stream-lined cover 9. The cover 9 is supported from the casing 10 by the struts 11 which are preferably cylindrical so as to avoid their having any effect upon the spin of the air. The motor 8 is attached to the stream-lined cover 12 which in turn is supported from the casing 10 by the stationary vanes 13. The vanes 13 serve to straighten out the spin in the air from the blades 5 and are positioned to accomplish this most effectively.

The casing 10 has a circumferential air outlet opening at 14 between the fan blades 5 and the spin straightening vanes 13, in which opening are supported the spin adjusting vanes 15. The vanes 15 are fixedly secured to the studs 20 which are pivoted in the annular ring 21. The cranks 22 are attached to the ends of the studs 20 and are interconnected by the links 23 which are pivoted at their ends to the cranks. The links 23 form a polygon around the fan casing, each link connecting parallel pivot radii. The lever 24 movable by the arm 25 adjusts the lowermost vane 15 at its pivot point and simultaneously through the cranks 22 and the links 23 adjusts the other vanes 15. This mechanism is similar to that disclosed in my Patent No. 1,846,863 which issued Feb. 23, 1932.

With the vanes 15 positioned as illustrated by Fig. 2, the blades 5 are intended to rotate in a clock-wise direction and therefore to produce a spin in a clock-wise direction. A portion of the spinning air proceeds axially through the casing 10; its spin is eliminated by the vanes 13 and it passes out the outlet connection 19 to the load to which the fan is connected. Another portion of the spinning air passes outwardly between the vanes 15 and the spin in this air portion is adjusted by adjustment of the vanes 15. When the vanes 15 are adjusted towards closed position, the spin is increased and when the vanes 15 are adjusted towards open position, the spin is reduced.

The wall 16 with the casing 10 forms an air guiding passage 17 for directing the air passing

between the vanes 15 into the inlet 18 of the fan. The wall 16 is connected to the casing 10 at the back or air outlet side of the opening 14.

Varying the spin of the air entering the inlet 18 varies conformably the pressure imparted to the air by the fan. This action is explained in detail in my patents, No. Re. 20,408 which was reissued June 15, 1937, and in my said Patent No. 1,846,863 and in my Patent No. 1,989,413 which issued Jan. 29, 1935.

In operation at reduced outputs, a relatively large volume of air consisting of direct air through the inlet 19 into the inlet 18 and of recirculated air through the passage 17 into the inlet 18 passes through the impeller. Adjustment of the vanes 15 varies the proportion of recirculated air to direct air and accordingly the volume of air delivered to the load through the outlet 19. By maintaining relatively large volumes of air through the fan even though the volume of air delivered at the outlet may be relatively small, the power requirements are at a minimum.

The circumferentially extending outlet opening 14 may extend through an angle of 360° or through a much smaller angle.

It is preferred that recirculation of the air and spinning of the air are combined. Through recirculation relatively large volumes of air pass through the impeller at all times, thus enabling the fan to operate with resulting minimum power requirements, and the controlled spinning of the air results in the desired pressure changes also with minimum power requirements.

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

What is claimed is:

1. In a propeller fan having a casing with an air inlet and an outlet and having propeller blades mounted therein between said inlet and outlet, means forming a recirculated air outlet in said casing between said blades and said first mentioned outlet, means comprising an extension from said casing and forming an air guiding passage for air from said recirculated air outlet to said inlet, and means for spinning the air in said passage.

2. In a propeller fan having a casing with an air inlet and an air outlet and having propeller blades mounted therein and having spin straightening vanes between said blades and said outlet, means forming a recirculated air outlet in said casing between said blades and said vanes, means comprising an extension from said casing and forming an air guiding passage for air from said recirculated air outlet to said inlet, and spin adjusting means in said recirculated air outlet.

3. In a propeller fan having a casing with an air inlet and an axial, air outlet and having propeller blades mounted therein and having spin straightening vanes between said blades and said outlet, means forming a circumferentially extending, recirculated air outlet slot in said casing between said blades and said vanes, means comprising an extension from said casing and forming an air guiding passage for air from said recirculated air outlet to said inlet, and spin adjusting vanes in said circumferential outlet slot.

4. In a propeller fan having a casing with an air inlet and an outlet and having propeller blades mounted therein between said inlet and outlet, means forming a recirculated air outlet in said casing between said blades and said first mentioned outlet, means forming an air guiding passage for air from said recirculated air outlet to said inlet, and means for spinning the air in said passage.

5. In a propeller fan having a casing with an air inlet and an air outlet and having propeller blades mounted therein and having spin straightening vanes between said blades and said outlet, means forming a recirculated air outlet in said casing between said blades and said vanes, means forming an air guiding passage for air from said recirculated air outlet to said inlet, and spin adjusting means in said recirculated air outlet.

6. In a propeller fan having a casing with an air inlet and an air axial outlet and having propeller blades mounted therein and having spin straightening vanes between said blades and said outlet, means forming a circumferentially extending, recirculated air outlet slot in said casing between said blades and said vanes, means forming an air guiding passage for air from said recirculated air outlet to said inlet, and spin adjusting vanes in said slot.

HAROLD F. HAGEN.