July 23, 1929. M. R. ROBINSON 1,722,112

DISK FAN

Filed June 5, 1924

Fig. 1

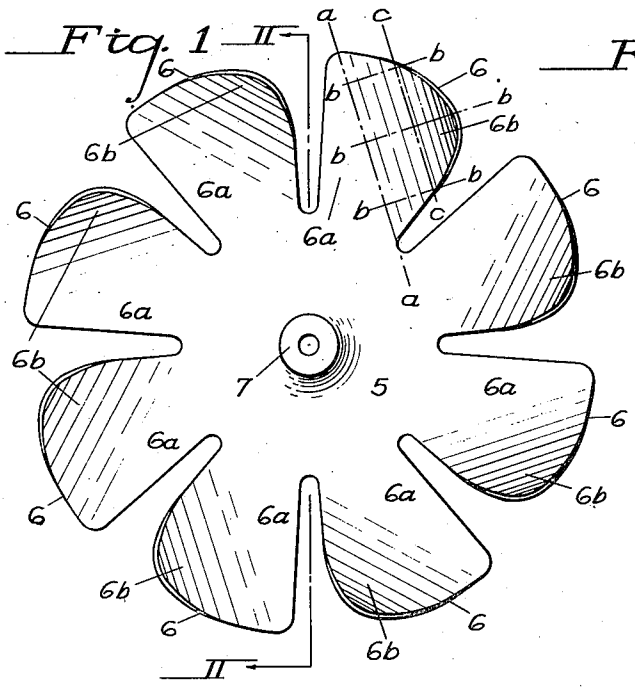


Fig. 2

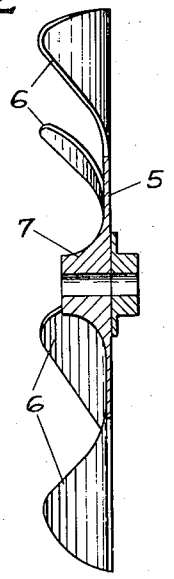


Fig. 3

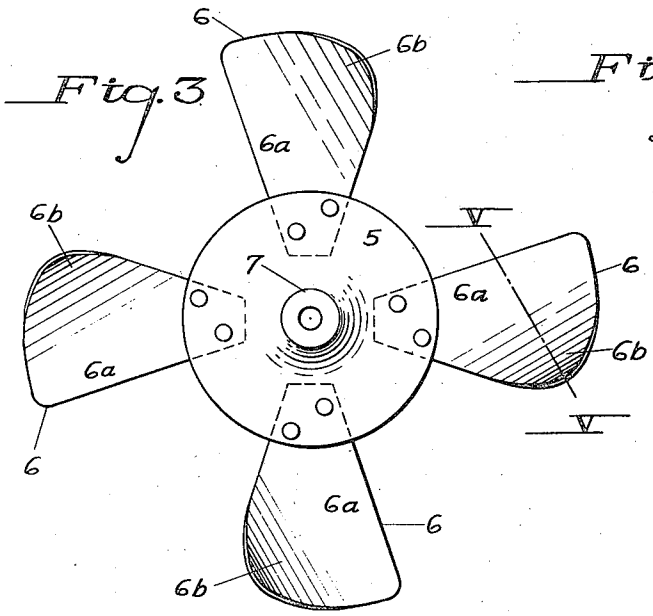


Fig. 4

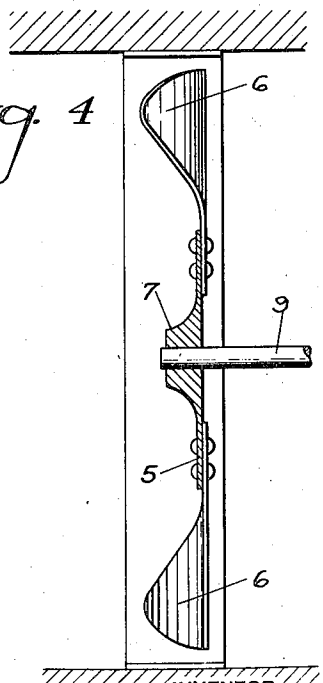
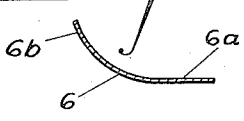


Fig. 5



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Patented July 23, 1929. 1,722,112

UNITED STATES PATENT OFFICE.

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DISK FAN.

Application filed June 5, 1924. Serial No. 717,990.

This invention is for a disk fan of a new and improved construction.

It is customary in the manufacture of disk fans designed to work against an air pressure to overlap the blades to prevent back flow. This does not efficiently effect the purpose and unnecessarily restricts the air space between the blades of the fan, cutting down the maximum volume of air which the fan may handle, and necessitating such disposition of the blades as to cause power losses by the blades or a portion of them hitting the air with a full flat surface.

Furthermore, disk fans as now generally constructed have blades of such design that the air is forced away from the fan in divergent paths, so that the air strikes the casing or conduit immediately at a point in close proximity to the fan, causing power losses and decrease of the mechanical efficiency of the fan.

Fans of this type are largely used in mining operations and in forced draft boiler installations. It has heretofore been considered impractical to develop a disk or propeller fan that will consistently establish and work against a pressure exceeding one inch of water without the fan soon being torn to pieces, and without low mechanical efficiency.

In the disk type of fan, it is true that the velocity of the air approaches zero as it nears the center of the wheel, while the maximum velocity is attained at the periphery. Consequently, there is a tendency of the air, when being forced through the casing against any appreciable resistance, to establish a back flow in and around the central part of the fan. As before stated, attempts have been made to avoid this by overlapping the fan blades, but, due to the low velocities maintaining or produced at the center portion of the fan, this overlapping of the blades does not avoid the difficulty.

I have found, from extensive experiments, that the central area of a disk fan covering about one-fifth or twenty percent of the area of the circle described by the periphery of the fan, is practically non-productive, and it is through this portion of the area of the wheel that back flow ordinarily occurs. Substantially this percentage holds true irrespective of the diameter of the fan.

According to the present invention, this non-productive central area of the fan comprising substantially one-fifth of the area of the circle described by the radius of the fan is made in the form of a solid disk, from the periphery of which the vanes radiate. This solid disk effectually prevents back flow, and any air that should flow in the reverse direction is deflected by said central portion into the zone of air currents of high velocity.

A further object of the invention is to provide a fan having the blades thereof so shaped as to cut through the air and project it forwardly with as little shock and friction as possible, and which will direct the air straight forward or in convergent paths, instead of in divergent paths, so that the air does not impinge against the casing close to the fan. The blades, furthermore, are so shaped as to impart a centrifugal or spiral motion to the current of air which it produces, further reducing frictional losses and increasing the efficiency of the fan.

The invention may be understood by reference to the accompanying drawings, in which:

Fig. 1 shows a front view of an eight-blade fan involving my invention;

Fig. 2 is a transverse section in the plane of line II—II of Fig. 1;

Fig. 3 is a front view of a four-blade fan;

Fig. 4 is a side view, showing the fan positioned in a casing; and

Fig. 5 is a section on line V—V of Fig. 3, showing the true curvature of the blades.

The fan may be made as an integral casting, as shown in Fig. 1, or it can have separate blades riveted or otherwise attached in place, as shown in Fig. 3.

In the drawing, 5 designates a central disk having blades 6 carried thereby. In the center of the disk is a conical hub member 7, the center of the disk and the hub being perforated for mounting on a suitable shaft, as shaft 9 in Fig. 4.

The area of the central disk is in all cases equal to substantially one-fifth or twenty percent of the area of the circle described by the radius of the fan.

Each blade 6 is wider at its outer end than at its point of juncture with the disk. Each blade is separated from the other, so that there is no overlapping of the blades

at any point. One surface of the fan wheel is substantially flat, the rear surfaces of the blades lying as closely as possible in the same plane as the disk. The entering or forward edge of each blade, therefore, lies in the same plane as the disk throughout its length, presenting a thin edge to the air as it rotates. That portion of the forward part of the blade which is disposed in front of a diagonal line drawn from the forward tip of the blade to the rearmost edge at its point of juncture with the disk, is substantially flat. Such a line is indicated in Fig. 1 as *a*—*a*, and the flat area is designated 6^a. The remaining area 6^b of each blade is gradually and uniformly curved, the pitch or the radii of curvature at any point being at substantially right angles to the line *a*—*a*, as indicated by lines *b*—*b* of Fig. 1, and line V—V of Fig. 3. In other words, the curvature is such that any line, such as *c*—*c*, drawn parallel to any axis of curvature will be substantially parallel with line *a*—*a*; and substantially any part of the curved portion of the blade has a slight pitch toward the center of the wheel.

The shape of the blades is important, and has been determined after a careful observation and experiments based on fans heretofore made.

Presenting, as they do, a thin edge to the air, the blades "slice" the air instead of "slapping" it, as do fans having the entire area of the blade presented at an angle to the direction of rotation. The gradual curvature of the blades converts the direction of flow of the air easily forward, with minimum friction. The slight pitch toward the center tends to force the air forward in slightly convergent lines, rather than at divergent lines. That is, the current of air from the fan is formed into a cone. The same pitch toward the center imparts a centripetal motion to the blast of air, so that the current of air leaving the fan has a spiral movement in the direction of rotation of the fan.

The central disk closes the non-productive area of the fan, and any back flow of air is easily diverted by the central cone with a minimum friction out into an air current of sufficiently high velocity to prevent the air from flowing back through the fan.

The mechanical efficiency and the volumetric capacity of the fan are greatly increased by the shape of the blade, and the fan can work against higher pressures by reason of the successful elimination of back flow.

There is an additional mechanical advantage provided by the construction, and that is that, due to the relatively large diameter of the disk 5, the length of the blade projecting beyond the point of support is greatly reduced, and the blade is supported where the high peripheral speed puts a strain upon the blade. The wheels are thus much stronger and the blades are capable of withstanding high speeds and a relatively great back pressure without any risk of the wheel being torn to pieces.

In commercial installations, it has been found that the fan will have a much greater volumetric capacity than other fans now on the market, and will successfully develop and maintain a pressure of more than two inches of water gauge, as compared with one inch, heretofore considered the limit. In actual commercial operations, applicant's fan has produced fifty percent more air than the standard fans of the same size which it replaced, and while running at the same speed, with only an increase of about thirty-three percent in applied horsepower, with the water gauge showing more than twice as much pressure, all other conditions being the same.

In the drawings, I have shown both an eight-blade and a four-blade fan, the latter to be used, of course, where greater volume at higher fan speeds is desired, the fewer number of blades increasing the orificial area of the fan, that is, the space between blades, thereby allowing for a greater volume of flow with the higher fan speeds.

I do not confine myself, however, to any particular number of blades or to any particular manner of mounting them on the disk 5.

I claim as my invention:

1. A disk fan comprising a central disk, a plurality of blades carried by the disk and extending radially therefrom, each blade having a uniformly curved portion with the radii of curvature at any point being substantially at right angles to a line drawn from the forward tip of the blade to the rearmost edge of its point of juncture with the disk, the area of the disk being equal to substantially twenty percent of the area of a circle whose radius is the over-all radius of the wheel.

2. A disk fan comprising a central disk, a plurality of blades carried by the disk and radiating therefrom, each blade having a uniformly curved portion with the radii of curvature at any point being substantially at right angles to a line drawn from the forward tip of the blade to the rearmost edge of its point of juncture with the disk, said disk having an area substantially equal to but not substantially exceeding twenty percent of the area of the circle described by the outer ends of the blades when the fan is rotated.

3. A disk fan comprising a central disk, a plurality of blades carried by the disk and radiating therefrom, each blade having a uniformly curved portion with the radii of curvature at any point being substantially at

right angles to a line drawn from the forward tip of the blade to the rearmost edge of its point of juncture with the disk, said disk having an area substantially equal to but not substantially exceeding twenty percent of the area of the circle described by the outer ends of the blades when the fan is rotated, said disk having a central deflecting cone on the pressure side of the fan, said blades being so spaced that they are free of overlapping portions.

4. A disk fan comprising a central disk, a plurality of blades carried thereby having spaced apart unconnected outer ends, each blade having its forward edge disposed edgewise to the direction of rotation of the wheel, each blade having a flat surface which increases in width from the forward tip of the blade to its point of attachment with the disk, the remaining area of the blade being uniformly curved, with the radii of curvature at any point being at substantially right angles to a line drawn from the forward tip of the blade to the rearmost edge of its point of juncture with the disk.

5. A disk fan comprising a central disk, a plurality of blades carried thereby, each blade being wider at its outer end than at its point of juncture with the disk, the forward edge of each blade being disposed edgewise to the direction of rotation of the fan, the area of each blade disposed forwardly of a diagonal line drawn from the forward outer tip of the blade to the rear edge at substantially the point of attachment with the disk being flat, the remaining larger area of the blade being curved, the curvature being such that any line drawn through the curved part substantially parallel with said diagonal line between the flat and curved parts will be parallel with the axis of curvature of the blade, whereby the curved portion of each blade has a slight pitch toward the center of the wheel.

6. A disk fan comprising a central supporting disk member, a plurality of blades carried thereby, each blade wider at its outer end than at its point of juncture with the disk, the forward edge of each blade being turned toward the direction of rotation of the wheel, the rear portion of each blade being forwardly curved, the curvature being such that the radius of curvature at any point will be at an angle other than a right angle with the forward edge of the blade, the axis of curvature along any point of the curved area of the blade being substantially parallel with any other axis.

7. A disk fan comprising a central disk, a plurality of blades carried thereby, each blade having its forward edge disposed in the direction of rotation of the disk, each blade being curved, with the curvature having a slight pitch toward the center of the wheel to direct the air in convergent lines forwardly from the wheel.

8. A disk fan comprising a central disk, a plurality of blades carried thereby and projecting outwardly therefrom, each blade having its forward edge disposed in the direction of rotation of the wheel, the blades being wider at their outer ends than at their point of juncture with the disk, the portion of the blade disposed forwardly of a diagonal line extending from the forward tip of the blade to the rear edge at substantially its point of juncture with the disk being flat, substantially the entire remaining area of each blade being curved about an axis of curvature lying parallel with said diagonal line, whereby air currents are directed in convergent lines to the front of the fan, said disk having an area equal to substantially twenty percent of the area of a circle described by the wheel.

In testimony whereof I affix my signature.

MAYES R. ROBINSON.