H. F. HAGEN.

FAN.

APPLICATION FILED JULY 30, 1915.

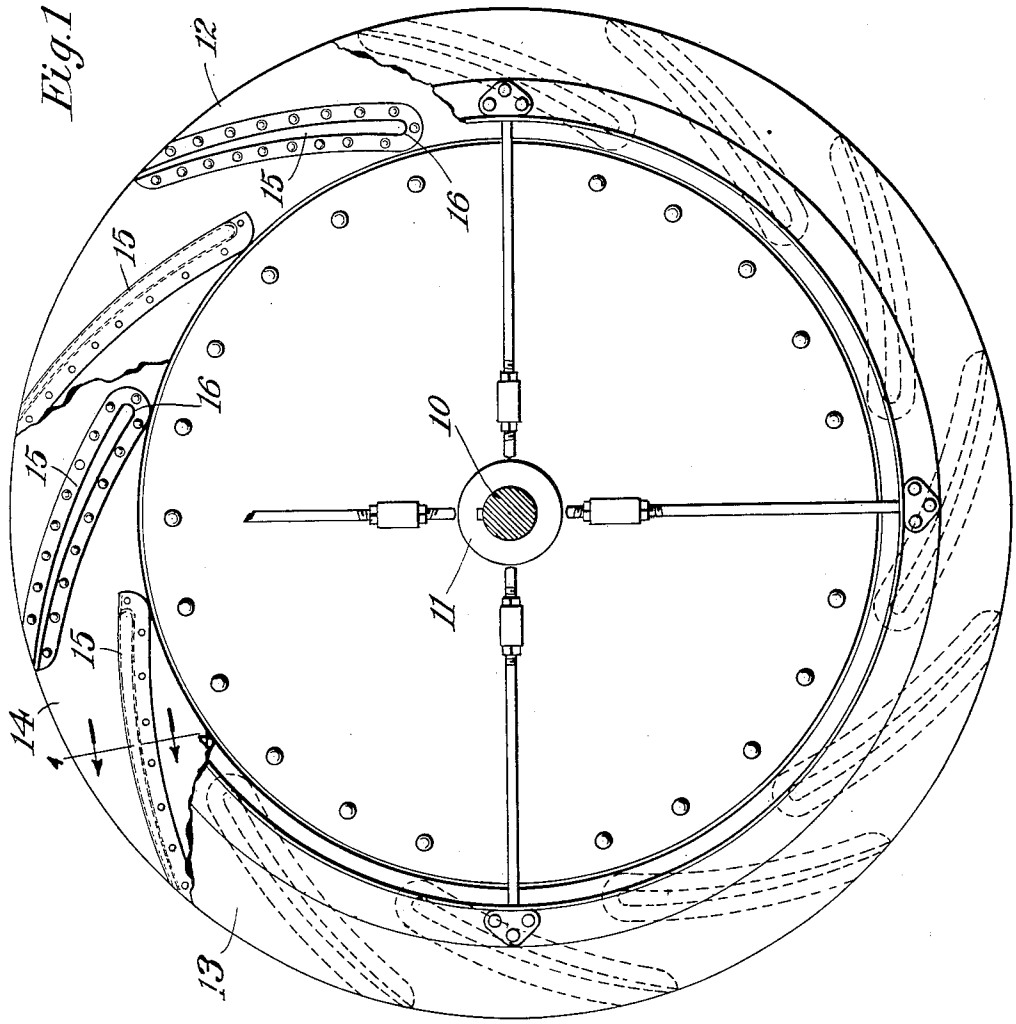
1,246,090.

Patented Nov. 13, 1917.

2 SHEETS—SHEET 1.

Direction of Rotation

Fig. 1




INVENTOR

Harold F. Hagen

BY

Kerr Page Coopers & Hayward

ATTORNEYS

H. F. HAGEN.

FAN.

APPLICATION FILED JULY 30, 1915.

1,246,090.

Patented Nov. 13, 1917.

2 SHEETS—SHEET 2.

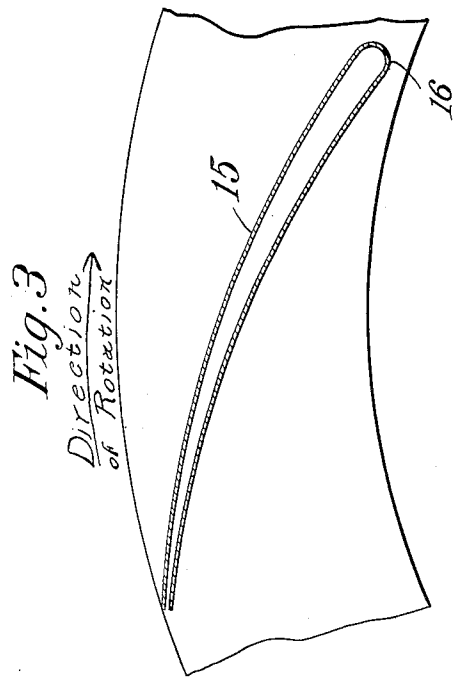



Fig. 3

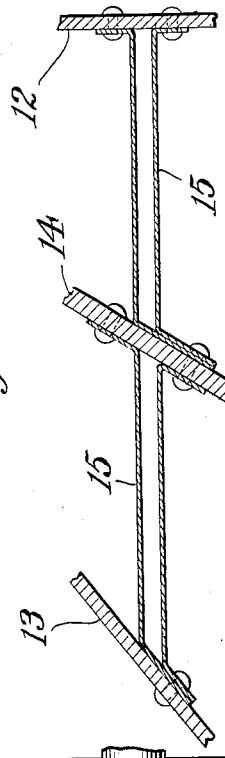



Fig. 4

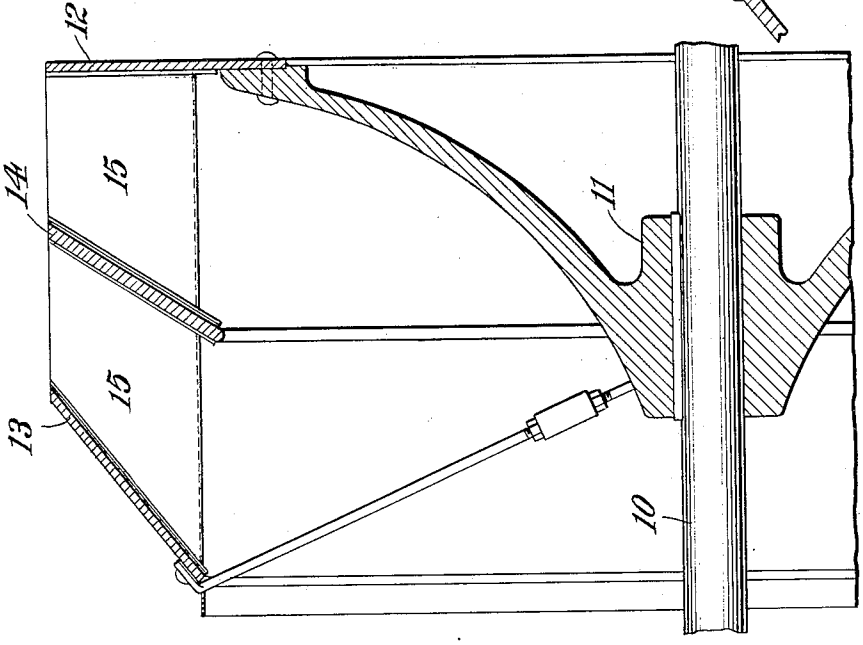



Fig. 2

Inventor
Harold F. Hagen

By his Attorneys
Kerr Page Cooper & Hayward

# UNITED STATES PATENT OFFICE.

HAROLD F. HAGEN, OF BEACON, NEW YORK, ASSIGNOR TO THE GREEN FUEL ECONOMIZER COMPANY, OF BEACON, NEW YORK, A CORPORATION OF NEW YORK.

## FAN.

1,246,090. Specification of Letters Patent. Patented Nov. 13, 1917.

Application filed July 30, 1915. Serial No. 42,705.

*To all whom it may concern:*

Be it known that I, HAROLD F. HAGEN, a citizen of the United States, residing at Beacon, in the county of Dutchess and State of New York, have invented certain new and useful Improvements in Fans, of which the following is a full, clear, and exact description.

The invention which constitutes the subject matter of this application relates to centrifugal fans. In adapting these fans to the high speeds demanded for economical operation directly connected to steam turbines a very serious objection is encountered in the noise of these fans resulting from such high speeds. In numerous installations this noise has been so objectionable that it was necessary to pipe the fan inlet to the etxerior space. In other installations it is either impossible to construct this piping or the piping itself tends to aggravate the very objection which it is intended to overcome.

The noise produced by these high speed fans is a very penetrating one, and is somewhat painful and disagreeable to the organs of hearing. These high speed fans are installed, among other places, upon torpedo boat destroyers for forced draft purposes. The noise produced by these fans upon destroyers is so intense as to impair the efficiency of the destroyers, since the noise is capable of being heard at a distance sufficient to warn the enemy of impending attack.

It is well known to those familiar with aero-dynamics and hydrodynamics that theoretically an inviscid fluid will attain an infinite velocity when forced to pass over a sharp edge. It is further known that air and water, although they have viscosity, tend to act in a manner similar to the action of an ideal fluid. In other words, air forced to pass over a sharp edge cannot reach an infinite velocity, but it tends to do so and will attempt to attain a very high velocity. In so doing, it will cease to flow smoothly and break up into a turbulent discontinuous mass. This turbulence at the very high velocities induced by forcing the air over a sharp edge is responsible at least for some of the noise produced by a fan. This condition exists at the entrance edge of the fan blade, and to overcome the noise the said entrance edge must be formed so as to avoid the setting up of a kinetic discontinuity as the air encounters the fan blades.

Theory would indicate and experiment proves that a fluid forced to pass over a large rounded edge, does not attain such excessive velocity. This fact elimniates, to a large extent, the turbulence or discontinuity experienced in passing over a sharp edge. It is also known from experience that a fluid free from whirls and eddies flows very quietly, as for example water flowing smoothly over the crest of a dam where very little sound is ordinarily produced, but a decided roar is produced when the water strikes at the foot of the dam and is dashed into spray.

In experimenting with various forms which represented blades of a fan, I found that all shapes presenting a sharp edge produced more noise than shapes presenting a blunt edge to the current of air. I also found that shapes which presented a blunt edge to the current and tapered off to a thin edge, were quieter than those having the same shaped blunt edge at both ends.

With the above considerations in mind, and with a view to overcome the objections pointed out, I have devised a new form of fan which I will now proceed to describe in detail.

Referring to the drawings,

Figure 1 is a front view of an impeller provided with blades embodying the principle of my invention, with parts broken away to illustrate the method of attaching the blades.

Fig. 2 is a longitudinal section of a centrifugal fan showing an advantageous form of air passages for securing a high efficiency with my novel form of blade.

Fig. 3 is a cross section of the novel form of blade employed to decrease the noise.

Fig. 4 is a section taken on line 4—4 of Fig. 1.

In detail, the reference character 10 designates the shaft of a typical radial flow fan to which the hub 11 is secured by any suitable means. To the outer portion of the hub 11 is secured a back plate 12 which is arranged substantially at right angles to the axis of the shaft 10 and forwardly is secured a shroud 13. This shroud, in conjunction with hub 11 and back plate 12, constitutes the walls of the fan and defines a passage through which the fluid is adapted

to pass in stream lines, as will be understood to those skilled in the art. At an intermediate portion is located an annular stiffening ring 14 arranged parallel to the mean stream line flow of the fluid through the fan.

Secured to the back plate 12, shroud 13, and stiffening ring 14 are blades 15 designed to avoid the discontinuity pointed out above. The entrance edges 16 of these blades are rounded, as clearly shown in Fig. 3, and preferably taper gradually from the entrance edge to the trailing edges of the same. The rounded entrance portion of the blade may be of various sizes, but I find that a rounded portion of one fourth of an inch radius is best adapted for ordinary forms of centrifugal fans. Any further increase in the size of the entrance edge of the blade correspondingly decreases the area of the fluid passage in the fan and consequently the capacity of the same.

Most high speed fans have backwardly curved blades and consequently the fan shown in the drawings accompanying this application has been shown with blades curved back from the direction of rotation. The principles of the invention, however, are equally applicable to fans having blades with a radial tip and to those having blades with the tips curved forwardly in the direction of rotation. It is understood that I do not limit the scope of my invention to any specific form of delivery edge or tip, either in direction of curvature or in thickness.

There are many forms which the blade can have without departing from the principle of my invention. The actual form of the entrance portion is not so important as is the thickness of this entrance portion, and by entrance portion I mean the inner or entrance portion to about one fourth of the length of the blade. This entrance portion of the blade, specifically speaking, is preferably made from sheet metal bent to form a substantially rounded entrance surface having a resultant thickness greater than twice the gage of the metal of which it is made. Various methods of securing this thick entrance portion will suggest themselves to those familiar with this art, the actual methods adopted being determined by considerations of good engineering, economy, and ease of manufacture. Blades made according to my invention may also be used in fans having air passages different from those shown in the drawings and from those mentioned herein.

What I claim is:

1. A centrifugal flow fan, comprising means for forming a passage for the flow of fluid therethrough, in combination with impeller blades, the entrance edges of which are rounded so as to avoid harsh and severe noises emanating therefrom.

2. A centrifugal flow fan, comprising forward and rear walls for forming a passage for the flow of fluid therethrough, and a stiffening ring between said walls, in combination with impeller blades secured to said walls and to said stiffening ring, the entrance edges of which are rounded so as to avoid harsh and severe noises emanating from said blade.

3. A centrifugal flow fan comprising means for forming a passage for the flow of fluid therethrough, in combination with impeller blades, the entrance edges of which are rounded and the body of the blade tapered from the rounded portion to the trailing edges of the same so as to avoid harsh and severe noises emanating therefrom.

4. An impeller blade for a centrifugal flow fan, the entrance edge of which is substantially rounded to avoid harsh and severe noises emanating therefrom.

5. A centrifugal flow fan comprising a means for forming a passage for the flow of fluid therethrough in combination with impeller blades with rounded entrance edges, sections of which blades made by planes passing through the blades and through the axis of the shaft are of uniform width from the forward to the rear wall of the wheel, the entrance edges of said blades being rounded so as to avoid the production of harsh and severe noises.

6. A centrifugal flow fan, comprising forward and rear walls for forming a passage for the flow of fluid therethrough, and a stiffening ring between said walls, in combination with impeller blades secured to said walls and to said stiffening ring, the entrance edges of said stiffening ring and said blades being rounded so as to avoid the production of harsh and severe noises.

7. A centrifugal flow fan, comprising means for forming a passage for the flow of fluid therethrough, in combination with impeller blades, the entrance edges of which are rounded and relatively thick so as to avoid harsh and severe noises emanating therefrom.

8. A centrifugal flow fan, comprising a shaft, a hub mounted upon the shaft, a back plate secured to the hub and arranged substantially at right angles to the axis of said shaft, and a shroud at the inlet in combination with impeller blades supported between said back plate and shroud, the entrance edges of which blades are relatively thick and rounded so as to avoid harsh and severe noises emanating therefrom.

9. A centrifugal flow fan, comprising a shaft, a hub mounted upon the shaft, a back plate secured to the hub and arranged substantially at right angles to the axis of said shaft, and a rearwardly inclined shroud at the inlet, in combination with

impeller blades supported between said back plate and shroud, the entrance edges of which blades are relatively thick and rounded so as to avoid harsh and severe noises emanating therefrom.

10. A centrifugal flow fan, comprising a shaft, a hub mounted upon the shaft, a back plate secured to the hub and arranged substantially at right angles to the axis of said shaft, and a shroud at the inlet, in combination with impeller blades supported between said back plate and shroud, the entrance edges of which blades are relatively thick and rounded so as to avoid harsh and severe noises emanating therefrom, and a stiffening ring for said blades interposed between the back plate and shroud and arranged substantially parallel to the stream line flow of the fluid through the fan.

In testimony whereof I affix my signature in the presence of two subscribing witnesses.

HAROLD F. HAGEN.

Witnesses:
A. VAN NOSTRAND,
JAS. W. TERRY.