G. M. CAPELL.

CENTRIFUGAL FAN AND PUMP.

APPLICATION FILED APR. 23, 1907.

912,362. Patented Feb. 16, 1909.

Fig. 1.

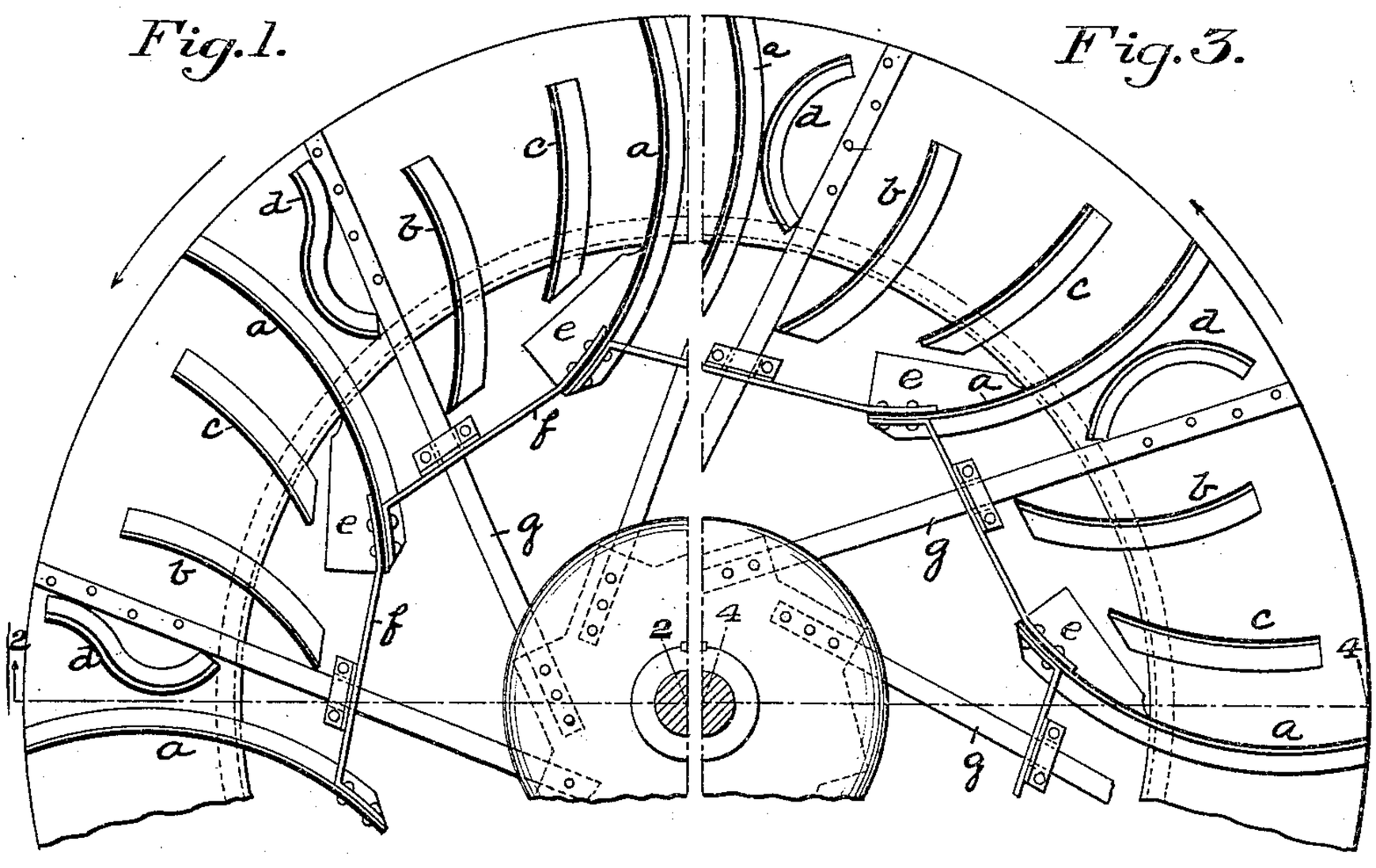


Fig. 3.

Fig. 2.

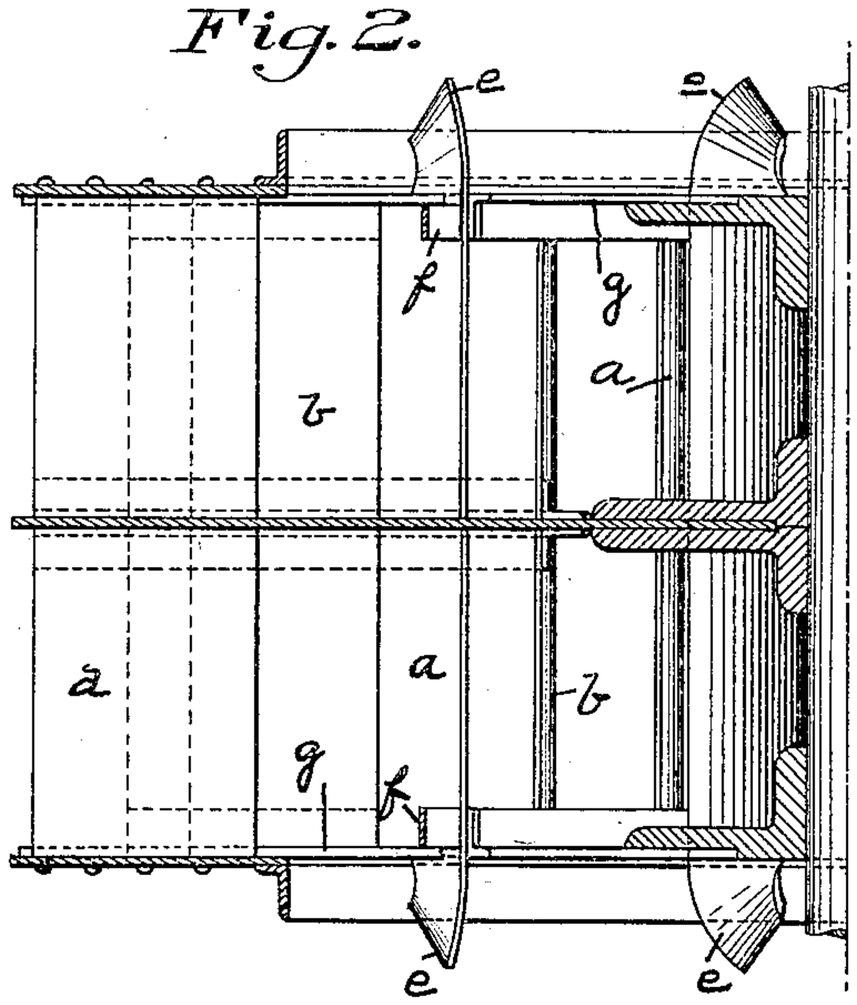
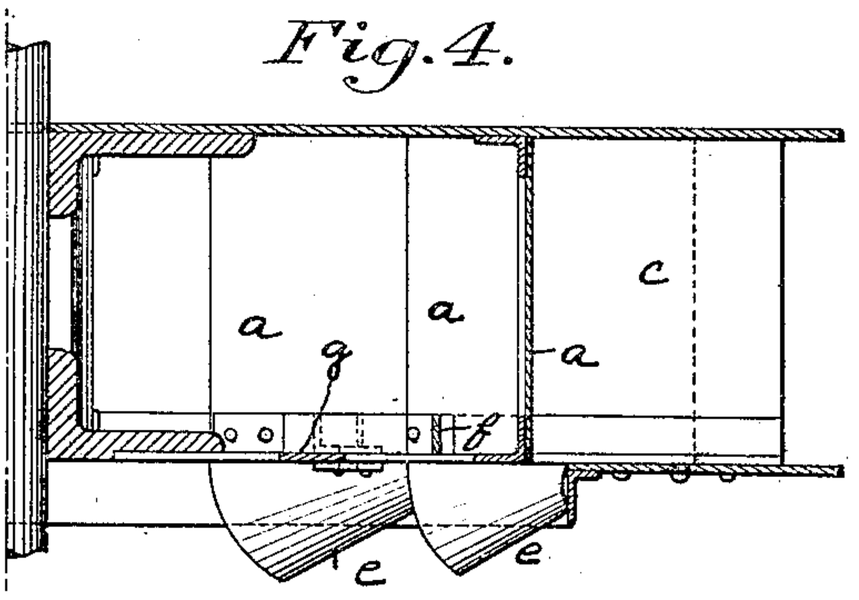


Fig. 4.



WITNESSES

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CENTRIFUGAL FAN AND PUMP.

No. 912,362. Specification of Letters Patent. Patented Feb. 16, 1909.

Application filed April 23, 1907. Serial No. 369,855.

To all whom it may concern:

Be it known that I, GEORGE MARIE CAPELL, a resident of Passenham Rectory, Stony Stratford, Buckingham, England, have invented a new and useful Improvement in Centrifugal Fans and Pumps; and I do hereby declare the following to be a full, clear, and exact description thereof.

This invention relates to improvements in centrifugal fans and pump wheels for circulating fluids and has special reference to the type of fans shown in my Patent No. 867,874 granted October 8, 1907, wherein is shown, described and claimed broadly a tail-blade back of the main vanes, a series of radially stepped vanes, and a series of vanes between the main vanes. Hitherto in such fans and wheels, centrifugal force has almost entirely been relied on as the urging force compelling the fluid to flow, though in some cases this has been supplemented by a scooping effect derived by bending in a forward direction lateral extensions of the inner portions of the vanes, the gathering effect of the scoops augmenting the quantity of fluid which enters the zone of action in front of the revolving vanes. Over and above these two impelling forces there is a third which, although well known in relation to other matters, its utilization for promoting the output of fans and centrifugal pumps has not hitherto been proposed.

It is well known that at the rear of a linearly moving vane there is created a partial vacuum, the action being conveniently called "cavitation" towards which, fluid in the neighborhood will flow by reason of the higher pressure to which it is there subjected. Under ordinary circumstances no useful effect is derivable from this cavitation inasmuch as fluid will flow to the vacated space behind the vane equally from the space outside the exterior edge of the vane as from that within the interior edge. Now according to this invention I provide means for augmenting cavitation at the rear of the inner portions of the vanes and at the same time suppressing cavitation at the rear of the outer portions and thereby fill up the cavity entirely from the interior of the fan or wheel. The effect will be great of even a small addition to the inducement of fluid to enter the zone of action of the vanes because its evacuation by centrifugal force must be accompanied by replenishment from the interior apart from the inducing effect of further cavitation. It is to the cumulative effect derived thereby that I attribute the very greatly enhanced manometric and volumetric effect which I have derived from a fan constructed in accordance with the principle of this invention.

The means for augmenting cavitation at the rear of the inner portions of the vanes and suppressing it at the rear of the outer portions, can best be explained by reference to a representative example as shown in the accompanying drawing which is that of a double inlet mine ventilating fan.

In the drawing:—Figure 1 is a transverse section of a portion of a fan showing my invention applied thereto. Fig. 2 is a sectional view of the same taken at right angles to that shown in Fig. 1, on the line 2—2 Fig. 1, and showing a double inlet construction. Fig. 3 is a transverse section of the fan showing another form of the invention. Fig. 4 is another view of the section, taken at right angles to that shown in Fig. 3, on the line 4—4 Fig. 3, and showing an inlet construction.

Referring to Fig. 1 it will be observed that the fan wheel is formed with a number of principal vanes *a.a* between which are interposed a number of secondary vanes *b.b* and *c.c* and, for a purpose to be presently explained, tail-blades *d.d* at the rear of the exterior portions of the principal vanes *a.a*. The portions of the principal vanes which extend within the periphery of the inlet orifice have scoop-shaped lateral extensions *e.e* projecting outwards and forwards and constitute a well known addition to a fan for augmenting the volume of delivery of the fan.

The fan shown is designed to take advantage of the fact that a partial vacuum is produced at the rear of an advancing vane by utilizing that vacuum as an additional force inducing air to flow into the zone of action of the vanes. For this purpose the inner edge of the secondary vane *b* is stepped outwards relatively to the inner edge of the preceding principal vane *a* and the inner edge of the vane *c* is stepped outwards relatively to that of the vane *b*. The result of such relative positions of the inner edges of the series of vanes *a*, *b* and *c*, is to cause, by the relative remoteness from *a* of the next succeeding vane *a*, a great tendency to the production of a vacuum in the rear of the inner portion of *a*. Also on account of

the outward stepping of *c* there will be a pronounced tendency to the production of a vacuum at the rear of the inner portion of *b* while at the rear of *c* the vacuum produced will be no more than in fans of normal construction.

To realize the inducing effect on the flow due to the above described vacuum production, it will be necessary to provide conditions which will prevent a counteracting effect at the outer portions of the vanes and so avoid as completely as possible a tendency to a back flow from the casing into the spaces vacated by the advancing vanes. For this purpose the outer edge of the vane *c* is at a greater radial distance than the edge of *b* but less than that of the outer edge of the succeeding vane *a*. Thus at the rear of the outer portions of the vanes *b* and *c* there will be little or no tendency to the production of a vacuum on account of the proximity of the vanes of greater radius which follow. But all this will be of no avail unless the production of a vacuum at the rear of the outer portion of *a* is prevented. I have discovered an effectual means of attaining this desired result by the use of the tail-blade *d*. In Fig. 1 this blade *d* is positioned with its outer edge short of the periphery of the wheel and divergent from the back of the vane as compared with the inner edge which is relatively close to the vane while leaving a space for the outward flow of the fluid between the vane and tail-blade, and the inner edge of the said blade is caused to diverge from the vane to a small degree. The double effect of fluid passing between the vane and tail-blade and the proximity of the tail-blade will preclude to any appreciable degree the tendency to the production of a vacuum at the rear of the outer portion of the vane *a* and the backward slope of the outward extremity of the tail-blade will minimize any tendency to the production of a vacuum at the rear of the outward portion of that blade. The diverging of the inner edge of such blade *d* will assist in gathering fluid to pass between the vane and blade by avoiding the contraction of stream which results from a sharp edged entrance and thus augmenting the flow.

In Fig. 3 the tail-blade is entirely convex to the vane, whereas in Fig. 1 the outer portion is concave and both are efficient forms of the general form of tail-blade shown in said patent.

It has been found that by placing the contracted portion of the opening between the vane and blade at about twice the distance from the periphery as it is from the air inlet or inner circle it will give the best results.

The figures show details of construction in respect to which no claim is made in this application. To strengthen the support of the portions of the principal vanes *a.a* which extend within the air-inlet orifice, circumferentially disposed stay rods *f.f* are provided and these are secured to arms *g.a* somewhat tangentially inclined, whereby a portion of the turning effort is transmitted from the shaft to the vanes of the wheel.

The drawing shows wheels adapted for operating on air. If water or other fluid is required to be circulated or pumped, the design will require some modification of detail, but such detail forms no portion of the present invention.

The different improvements may be employed separately from each other, as for example, the main vanes extending inwardly from the periphery together with the tail-blades located at the back of them, as described, may be employed without intermediate vanes.

In fans of ordinary construction in which the outer edges of all the vanes are at equal radii and are equally spaced and also the inner edges, the greater spacing of the outer edges relatively to the inner edges consequent on the greater circumference of the circle along which they are disposed has the result of causing the cavitation effect of onward motion to be more pronounced at the rear of the outward portions of the vanes than at the rear of the inward portions so that, in ordinary fans, the principle of action, which by the present invention is sought to be utilized for promoting the flow, has hitherto operated in a contrary manner and I claim by the present invention to have converted a feeble opponent into a potent ally whereby I have been able to obtain a greater volumetric and manometric discharge than has hitherto been possible with a given diameter and speed of revolution of fan.

I claim:

1. A centrifugal wheel for circulating fluids, having a series of vanes, and blades at the back of the vanes, each such blade extending inwardly in a direction to first converge towards its vane and afterwards to diverge therefrom, leaving a space between the blade and vane for the passage of fluid.

2. A centrifugal wheel for circulating fluids, having a series of vanes, and blades at the back of the vanes, each such blade extending inwardly in a direction to first converge towards its vane and afterwards to diverge therefrom, leaving a space between the blade and vane for the passage of fluid, the amount of the subsequent divergence being less than that of the preceding convergence.

3. A centrifugal wheel for circulating fluids having a series of vanes extending inwardly from the periphery to a short distance within the air-inlet circle and a single blade at the back of each vane, the nearest point of blade to vane being located about

twice the distance from the periphery as it is from the air inlet or inner circle, such blade first converging towards its vane and afterwards diverging therefrom leaving a space between the vane and blade for the passage of fluid.

4. A centrifugal wheel for circulating fluids having a series of vanes and a single blade at the back of each vane, the nearest point of blade to vane being located about twice the distance from the periphery as it is from the air inlet or inner circle, such blade first converging towards its vane and afterwards diverging therefrom leaving a space between the vane and blade for the passage of fluid, the amount of the subsequent divergence being less than that of the preceding convergence.

5. A centrifugal wheel for circulating fluids having a series of vanes and a single blade at the back of each vane, the nearest point of blade to vane being located about twice the distance from the periphery as it is from the air inlet or inner circle, such blade first converging towards its vane and afterwards diverging therefrom leaving a space between the vane and blade for the passage of fluid, the vane being convex relatively to the blade at the back thereof.

6. A centrifugal wheel for circulating fluids having a series of vanes and a single blade at the back of each vane, the nearest point of blade to vane being located about twice the distance from the periphery as it is from the air inlet or inner circle, such blade first converging toward its vane and afterwards diverging therefrom leaving a space between the vane and blade for the passage of fluid, the vane being convex relatively to the blade at the back thereof, and the blade at its outer portion concave, and at its inner portion convex relatively to the vane.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

GEORGE MARIE CAPELL.

Witnesses:

H. D. JAMESON,

F. L. RAND.