J. W. A. ELLING.

CENTRIFUGAL FAN AND PUMP.

APPLICATION FILED JULY 16, 1904.

908,227.

Patented Dec. 29, 1908.

3 SHEETS—SHEET 1.

Fig. 2.

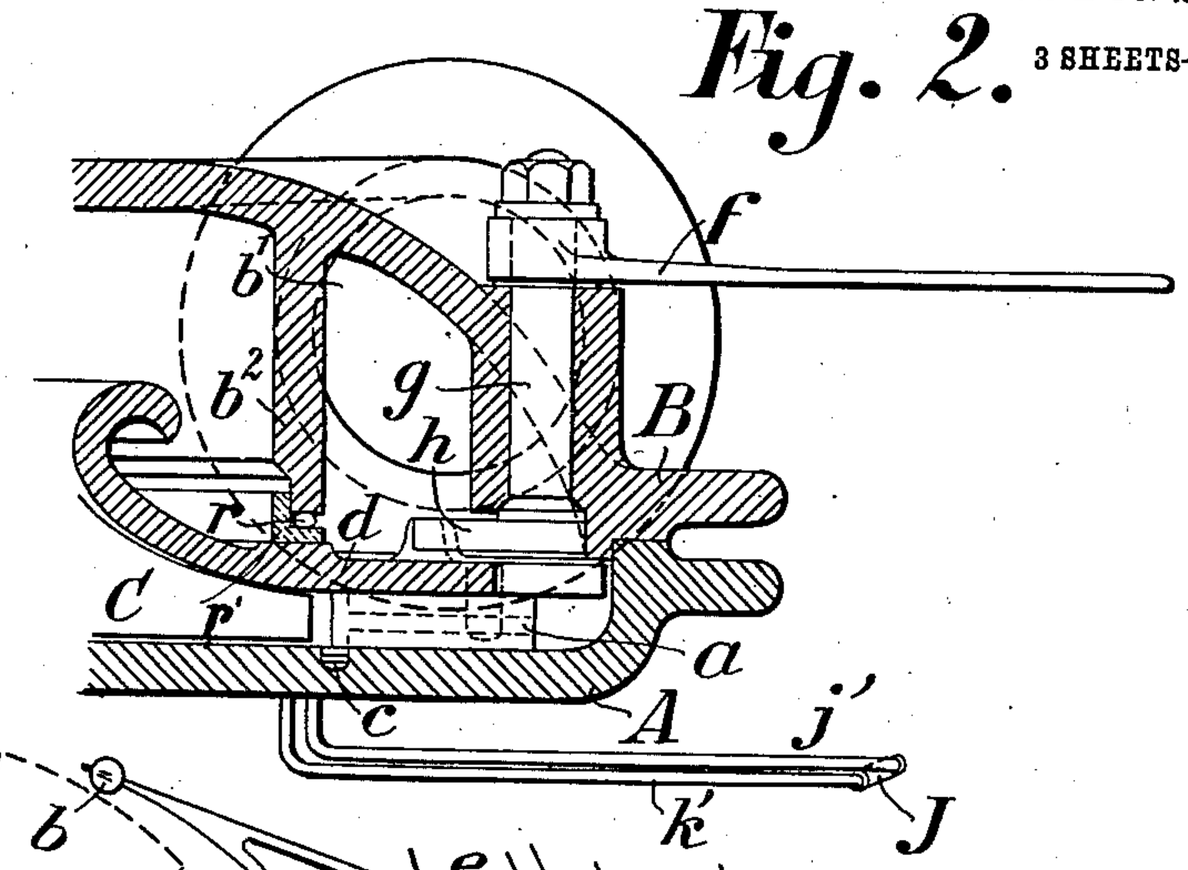
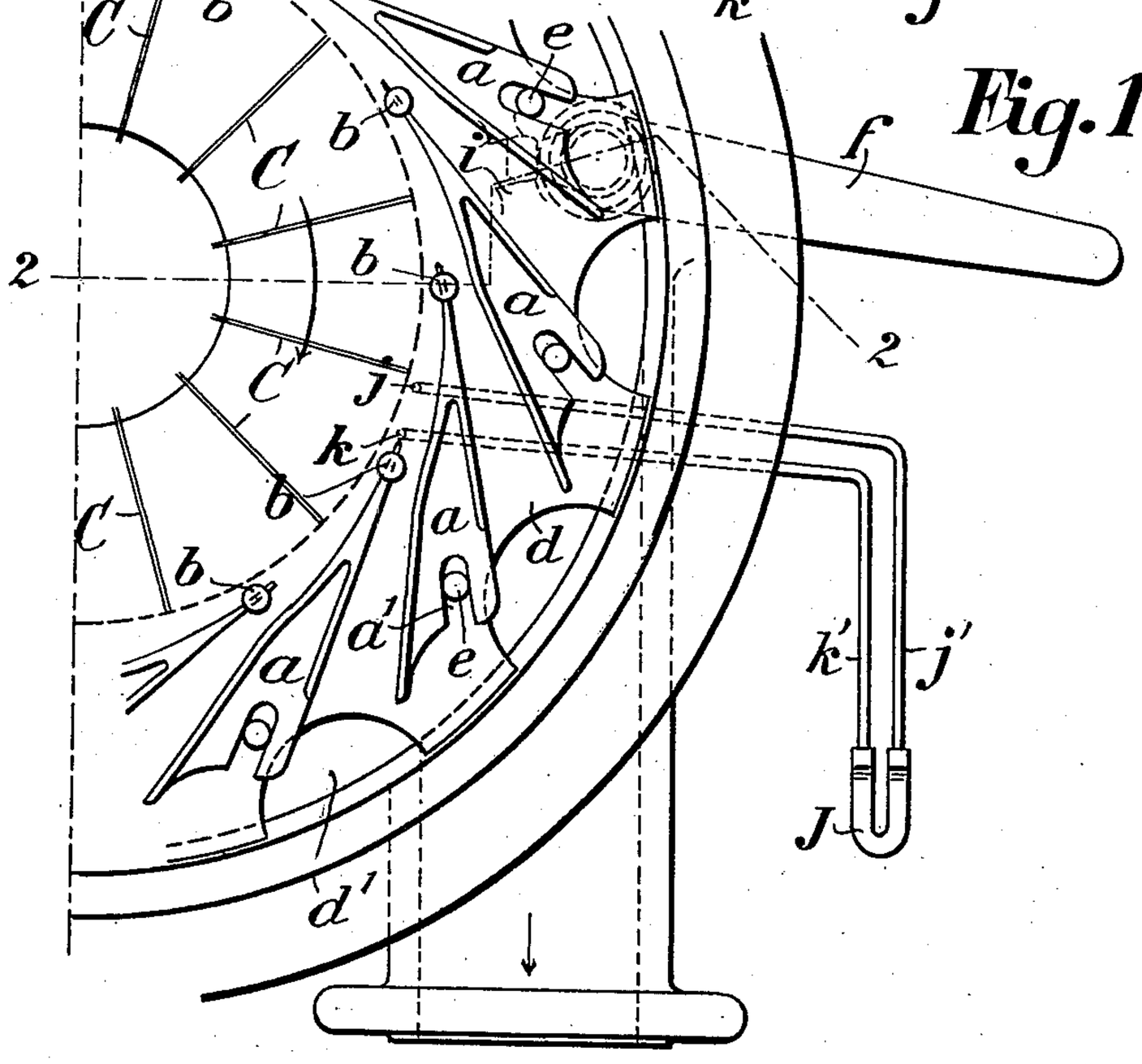


Fig. 1.



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3 SHEETS—SHEET 2.

Fig. 4.

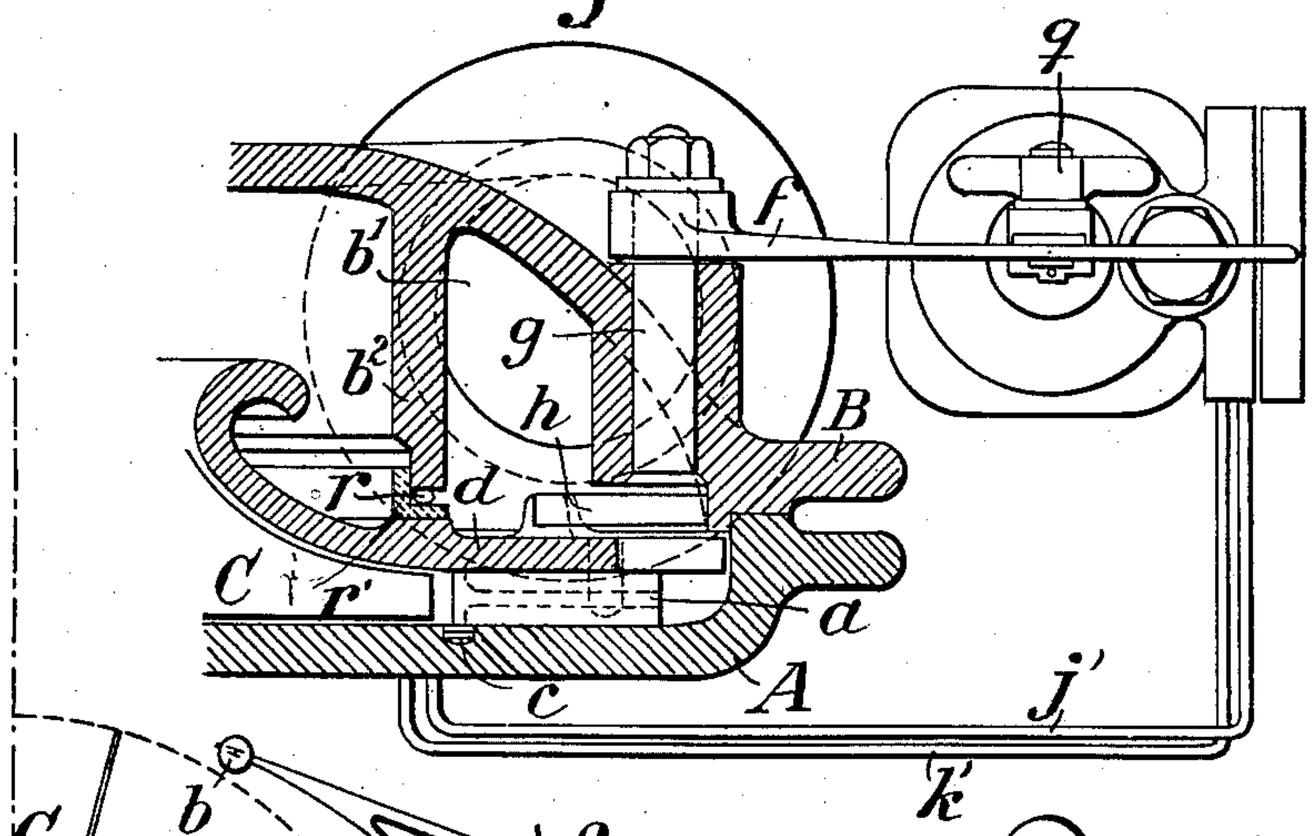
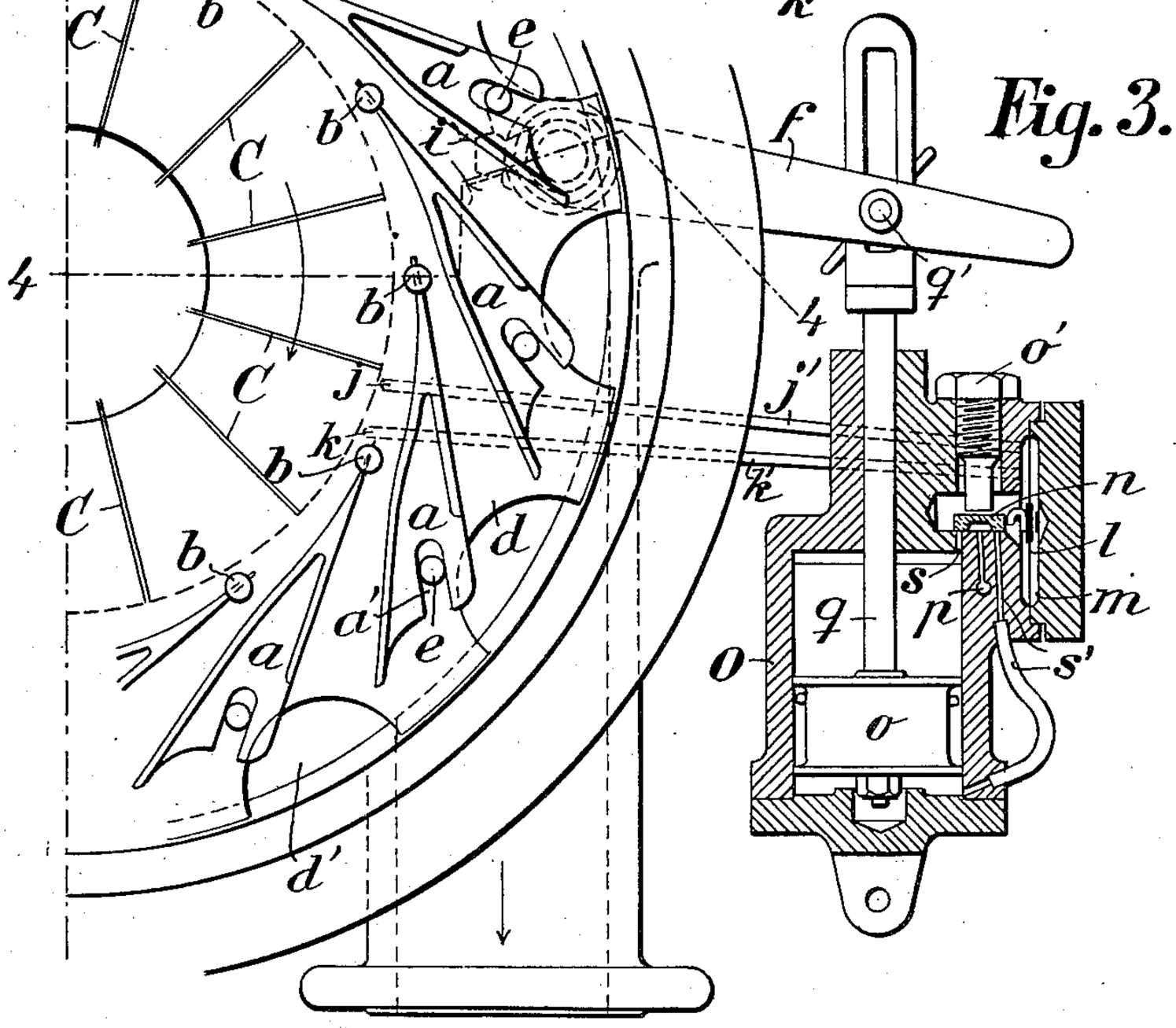


Fig. 3.



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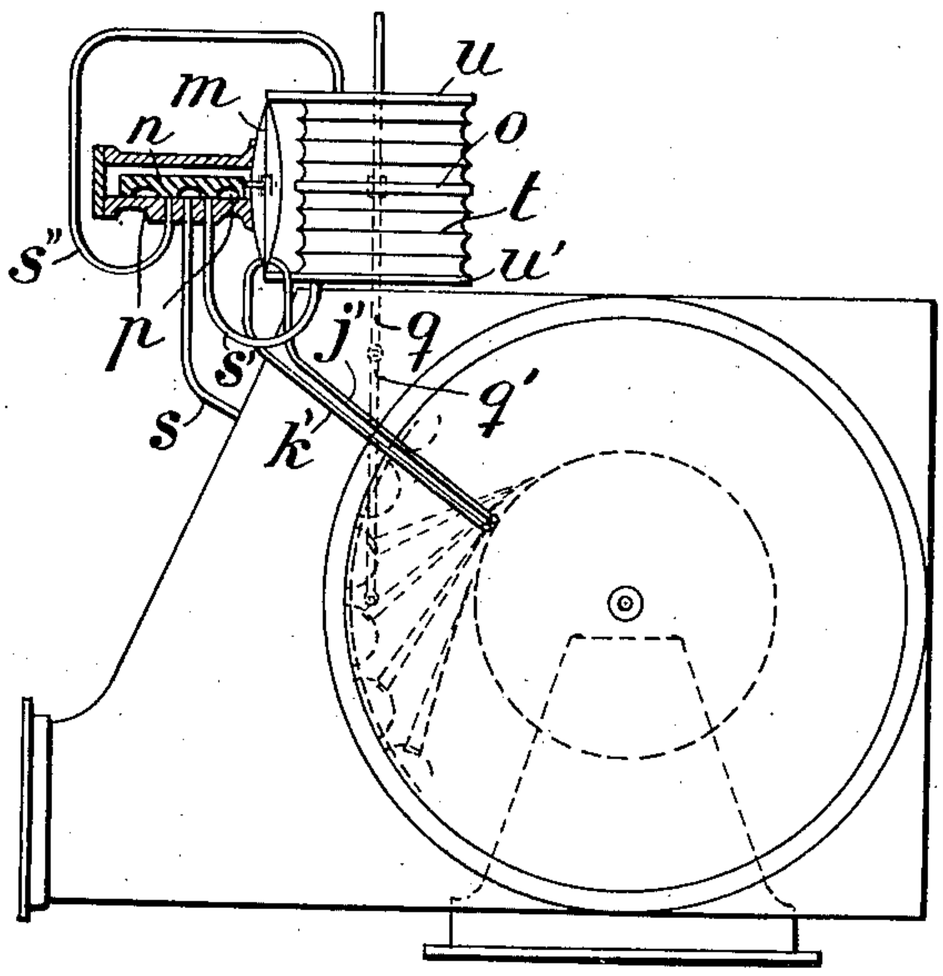
3 SHEETS—SHEET 3.

Fig. 5.



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UNITED STATES PATENT OFFICE.

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CENTRIFUGAL FAN AND PUMP.

No. 908,227. Specification of Letters Patent. Patented Dec. 29, 1908.

Application filed July 16, 1904. Serial No. 216,821.

To all whom it may concern:

Be it known that I, JENS WILLIAM AEGIDIUS ELLING, a subject of the King of Norway, residing in the city of Christiania, in the Kingdom of Norway, have invented certain new and useful Improvements in Centrifugal Fans and Centrifugal Pumps, of which the following is a specification.

The invention relates to improvements in centrifugal fans and pumps provided with adjustable diffuser vanes located at the periphery of the fan or pump blades, the invention having for its object the provision of means whereby adjustment of the diffuser vanes is effected to permit efficient discharge of the fluid under constant number of revolutions of the wheel. In centrifugal fans or pumps of this character, when driven at a constant speed, the fluid issues from the wheel at a certain angle to the tangent of the periphery, and the highest efficiency is attained, when the diffuser vanes are set to the abovenamed angle. By such adjustment of the vanes the flow of the fluid will not be disturbed by impact against any side of the vanes, the fluid being merely guided towards the diverging part of the canal formed by the vanes. In the clearance space between the wheel and the diffuser vanes the pressures of the fluid will in such a normal case theoretically be equal all around the periphery at points equi-distant from the axis of the wheel. If now the discharge of the fan or pump is changed to a larger or smaller quantity, the mean direction of the fluid issuing from the wheel will be correspondingly changed to a larger or smaller angle to the tangent of the periphery and the pressure in the said clearance space will now be unequal at different points of the periphery of the same radial distance from the axis of the wheel, if the diffuser vanes are not correspondingly adjusted, such change in pressure being due to the different angle at which the air discharged by the wheel strikes the diffuser vanes, it being obvious that the more acute such angle is, the greater will be the pressure at the point of direct impact and the less will be the pressure at the same time at a point adjacent such point of direct impact. In the first case the area between the diffuser vanes is too small necessitating a high velocity of the fluid at the entrance of the passage between the vanes and thereby reducing the pressure here as compared with the pressure prevailing at a place behind the tip of the vane, where no contraction of the current takes place. In the second case the area between the diffuser vanes is too large to correspond to the proper velocity of the discharge from the wheel, and consequently the pressure will be higher before the entrance opening between the diffuser vanes than behind the tips of the vanes, where moreover an eddy will arise. Such action will take place at every diffuser vane, and the values of the pressures will correspond to a stationary waveline the crest of which will shift according to the discharge quantity. The consequence of these unequal or abnormal pressures will of course be that power is consumed and the monometric efficiency is reduced, which evils may be nullified by adjusting the diffuser vanes in the manner that the above named normal state of things as indicated above may take place for any discharge quantity of the fan or pumps. The said unequal pressures may now by certain means be made to indicate if and in what manner the adjustment of the diffuser vanes is to be done, and the difference in pressure may be employed directly or indirectly by suitable mechanism to change the openings between the diffuser vanes to correspond to the change in the discharge quantity of the fan or pump.

The invention will be more fully described in connection with the accompanying drawing and will be more particularly pointed out and ascertained in and by the appended claims.

In the drawings:—Figure 1 is a fragmentary view of a portion of a centrifugal fan or pump with cover of casing removed showing the means for operating the diffuser vanes by hand. Fig. 2 is a sectional view on line 2—2 of Fig. 1. Fig. 3 is similar view as Fig. 1 but showing the means for connecting the diffuser vanes to an automatic adjusting device. Fig. 4 is a sectional view on line 4—4 in Fig. 3. Fig. 5 represents a modified automatic adjusting device.

Like characters of reference designate similar parts throughout the different figures of the drawing.

As shown, my invention consists generally of a two-part shell or casing comprising members A and B, respectively, which may be bolted or secured together in any desired manner. The fan blades which are indicated by C are, at their outer peripheries,

in close proximity to the receiving ends of the diffuser vanes *a*. The casing formed by the parts A and B is divided by a movable partition *d* provided at its periphery with recesses *d'* for the outgoing fluid currents. Between the movable partition *d* and the part A are interposed the diffuser vanes *a* provided at their receiving ends with journals *b*, which find bearings in cavities *c* in the part A. The opposite or delivery ends of said vanes are secured to the partition *d* upon pins *e* which engage slots *a'* in said vanes. Each of said vanes completely fills the space laterally between the movable partition *d* and the stationary casing A forming a passage which delivers direct to the openings *d'*. The said openings *d'* deliver to a chamber *b'* formed in the part B by means of a circular partition b^2 which extends up to and has a bearing engagement with the movable partition *d*. Such engagement consists desirably of a packing ring *r* lodged between the partition b^2 and a ring *r'* tightening on the partition *d*, affording free movement for the partition *d*. It will be seen from the figures that all of the vanes *a* are connected at their receiving ends with the stationary part A and at their delivery ends with the movable partition *d* thereby permitting adjustment of all the vanes in unison, upon movement of the partition *d*.

As shown the partition *d* is connected with and operated by mechanism in the following manner. In the casing B is mounted a shaft *g* which carries on its outer end an operating lever *f* and on its inner end a lever *h*, the latter engaging on its opposite faces lugs *i* formed on the partition *d*. As the lever *f* is raised and lowered the lever *h* engaging the lugs *i*, serves to swing the partition *d* in opposite directions.

According to Figs. 1 and 2 the operation of the lever *f* is done by hand, and the device for indicating in which way the said lever is to be worked consists of a U-shaped tube J, the branches of which are through pipes *j'* and *k'* communicating with the diffuser at the points *j* and *k*. The tube J of transparent material, for instance glass, is partly filled with liquid, for instance water, and as long as the diffuser vanes are properly set in conformity with the delivery of fluid the columns of liquid in the branches of the tube *f* are level, but as soon as the delivery of fluid changes the equilibrium of pressure in the diffuser is disturbed, which causes the columns in the tube J to come out of level either the one way or the other and thereby indicating how the handle *f* is to be worked, until the two columns again are level, which indicates that the diffuser vanes are properly adjusted.

The means for actuating the lever *f* automatically, Figs. 3 and 4 consists of the following parts. A cylinder O is provided having a reciprocating piston *o* and a piston rod *q* which is slotted at its upper end. The lever *f* is adjustably secured to the slotted end of the piston rod *q* by means of a thumb nut clamp *q'*. The cylinder O, as shown, is provided with a valve chest which communicates by means of ports *s s'* with the cylinder O and with an exhaust *p* common to said ports. A slide valve *n* operates to alternately connect the opposite ends of the cylinder O with the valve chest and exhaust through the ports *s* and *s'*. The valve *n* is normally held upon its seat in the valve chest by means of an adjustable bolt *o'*, the walls of the valve chest desirably constituting lateral guides. The valve *n* is operated upon its seat by a diaphragm *l*, which is located in a diaphragm chamber *m*. Said chamber is connected with the fan or pump casing by pipes *j'* and *k'* which communicate with said chamber at points on opposite sides of the diaphragm *l*. Said pipes communicate with the casing at points indicated by *j* and *k*. The opening *k* is located closely adjacent the receiving end of one of the diffuser vanes *a* and preferably at a point intersected by a radial line passing through the center of the fan or pump and touching the end of the vane *a*. The opening *j* is located at the same radial distance from the center of the fan as is opening *k*, but a slight distance beyond the receiving end of the vane.

The adjustment shown in Figs. 3 and 4 is such that the fluid discharging from the fan or pump travels in a plane coincident with an axial line of the space between the vanes *a* when the fan or pump operates at a given speed. In this adjustment the pressure at *j* and *k* will be equal and the pressure communicated on opposite sides of the diaphragm will likewise be equal thereby maintaining the valve *n* in a position to close ports *s* and *s'* so that the piston *o* and the vanes *a* will remain stationary. Assuming that the delivery of the fan or pump is decreased and the fluid is discharged at a smaller angle to the periphery necessitating a corresponding inward adjustment of the vanes, the pressure at *j* will suddenly increase with respect to the pressure at *k* moving the valve *n* to the left and opening port *s'*, raising the piston *o* and swinging the vanes *a* inwardly until the medial or axial lines between said vanes coincide with the angle of discharge of the fluid passing from the wheel.

The driving medium for the piston *o* may be taken from any source producing sufficient pressure, it may thus very conveniently be taken from the delivery pipe of the fan or pump.

In the device shown in Fig. 5 the cylinder and piston are substituted by a bellows, which is provided with a movable middle-bottom. *o* is the movable bottom, which through a rod *q* and link *q'* is connected with

the movable partition *d*, the said bottom *o* being interposed in the middle of a bellows *t*, having fixed bottoms *u* and *u'*. The said rod *q* is located in the middle of the said bottom *u* and *u'* and moves in packing boxes. The pipes *j'* and *k'* lead into spaces on either side of diaphragm *m*, which is connected to a slide valve *n*. The medium for operating the said bottom *o* is through a pipe *s* conducted either into the pipe *s'* or into the pipe *s''*, all according to the action of the pressure difference in the pipes *j'* and *k'*, so as to either lift or lower the bottom *o*, said motion being transmitted to the diffuser vanes through the rod *q*. *p* are the exhaust ports of the two chambers of the bellows *t*.

Claims:—

1. In a centrifugal fan or pump the combination of a diffuser having movable vanes and automatically operating means for adjusting said vanes in accordance with the delivery of the fan or pump.

2. In a centrifugal fan or pump the combination of a casing, a wheel revolving therein, adjustable diffuser vanes, mechanism for adjusting said vanes in unison, said vanes creating unequal pressures as described and automatically operating means controlled by the said unequal pressures to cause the adjustment of the said vanes in accordance with the varying delivery of the fan or pump.

3. In a centrifugal fan or pump the combination of a casing, a wheel revolving therein, adjustable diffuser vanes, mechanism for adjusting said vanes in unison, an auxiliary motor connected with said mechanism and governed by the mechanism, connected with the interior space of the casing between the wheel and the diffuser vanes at two points of equal radial distance from the center of the wheel for the purpose of operating the said governing mechanism by the said unequal pressures so as to obtain automatic adjustment of the vanes.

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

JENS WILLIAM AEGIDIUS ELLING.

Witnesses:

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