PATENT SPECIFICATION

Application Date: May 14, 1935. No. 14171/35. **456,761**

(Patent of Addition to No. 395,874: dated July 14, 1932.)

Complete Specification Left: Feb. 14, 1936.

Complete Specification Accepted: Nov. 16, 1936.

PROVISIONAL SPECIFICATION

Improvements in Apparatus for Controlling the Volumetric Output and Discharge Pressure of Fans, Blowers, Pumps and the like

We, DAVIDSON & COMPANY LIMITED, of Sirocco Engineering Works, Belfast, Ireland, a Company organised under the laws of Great Britain and Northern Ireland, and THOMAS BOSANKO COLLINS, of "Lisheen," Cultra, County Down, Ireland, a British Subject, do hereby declare the nature of this invention to be as follows:—

Our invention relates to apparatus for controlling the volumetric output and discharge pressure of fans, blowers, pumps and the like of either the centrifugal or propeller type, by suitably modifying the intake conditions.

The invention is more particularly applicable to units driven at a constant speed.

According to a prior arrangement described in British Specification No. 395,874, a valve formed of a semi-cylindrical plate is mounted for controlled rotation within the relatively fixed semi-cylindrical end of a casing forming an intake channel or entrance chamber to the fan, blower or the like, and which is preferably concentric with the eye of the fan and with the axis of the impeller. A trailing plate substantially equal in width to the intake passage is pivotally connected to the lower edge of the valve, whereby the said channel is modified to define a convergent nozzle for the passage of the fluid as the valve is moved from the fully open towards the closed position. By this means, in addition to varying the intake to the fan eye, the fluid stream is caused to flow tangentially to a circle concentric to the axis of the impeller, thus imparting a vortical movement to the fluid stream as it enters the impeller eye. Thus at outputs less than the desired maximum output the incoming fluid is given an initial velocity in the direction of rotation of the impeller or rotor, so that the change in velocity of the fluid when passing through an impeller driven at constant speed is reduced, with a consequent diminution of the delivery pressure and in the horse power absorbed.

While the results achieved with the foregoing apparatus are highly satisfactory such apparatus is, however, somewhat at a commercial disadvantage due to the necessity of providing a relatively long side inlet trunk to accommodate the trailing plate; and furthermore, the apparatus is not balanced about the points of support so that robust operating gear is required.

We have found that the above apparatus can be considerably simplified without materially affecting its efficiency, and the present invention accordingly consists in an apparatus of the type first above referred to and comprising a simple valve in the form of a partially cylindrical plate mounted for rotation within the relatively fixed semi-cylindrical end of a casing forming the intake channel or suction box to the fan or the like.

The valve should preferably carry weights or be otherwise provided so that the whole is balanced or nearly so about its axis of rotation. Where weights are used, these may be conveniently attached to circular stiffening members for the partially cylindrical valve.

The valve may be in one piece or comprise a plurality of plates hinged or otherwise connected together, and is preferably of approximately semi-cylindrical form.

The semi-cylindrical valve may be so mounted as to be operable by means external to the suction box to give the desired degree of rotary movement to the valve.

That side of the valve remote from the fan eye may be closed with a back plate or by the plate forming the outer wall of the intake channel or suction box. In the former case the back plate may conveniently carry the balance weights for the valve.

The suction box should preferably be extended at right angles to the axis of rotation of the impeller and parallel to the plane of rotation of the impeller disc. The semi-cylindrical portion of the suction box forming the valve casing may be

joined to trunking or fitted with a flared outlet for drawing fluid from its own immediate neighbourhood, in which latter case any extension of the suction box may be relatively short.

The valve should preferably operate in association with transversely disposed seals to prevent leakage between the said valve and the suction box end, these seals being substantially equal in width to the width of the semi-cylindrical valve and the end of the suction box.

The sealing plates are preferably secured at one end only and sufficiently resilient so as to give a wiping action to the cylindrical wall of the valve passing thereover. The sealing plates are preferably secured at opposite ends.

The valve and its back plate may be carried on a stub shaft passing through the side of the suction box and supported in suitable bearings, or the valve may be fixed to circular rings preferably formed of angle irons, which rings are supported on a system of rollers fixed in or to the sides of the suction box such that the valve can be readily rotated about its axis.

The rotation of the valve may conveniently be effected by external means which may comprise a worm wheel secured to the stub shaft aforesaid and supported in a suitable bracket and adapted to engage a worm mounted on an external spindle and between thrust bearings, which spindle may be operated by means of a hand wheel or by a flexible shaft or gearing from a remote position. The external proximate end of the stub shaft may also carry a pointer, the outer end of which is associated with a dial showing thereon percentage volume or other indicia, whereby the valve may be suitably positioned to give a predetermined output.

The control of the fan output is performed by rotating the movable curved plate in the direction of rotation of the impeller and when so located an edge of the curved plate partly covers the trunk leading to the suction box, constraining the air or gas to pass through the inlet so formed in a direction tangential to a circle round the axis of rotation of the impeller or rotor, while the valve forms with the semi-cylindrical portion of the suction box a substantially cylindrical chamber, in which the air or gas rotates vortically, and from which it is drawn into the eye of the impeller.

While the foregoing description is more particularly applicable to units where the intake is on the outer side of the impeller casing, it will be obvious that the invention can be employed with equal effect to units where a central inlet is placed between two impeller casings and that various consequential and other modifications in the construction hereinbefore described may be made within the scope of the invention.

Dated this 14th day of May, 1935.

MEWBURN, ELLIS & CO.,
70 & 72, Chancery Lane, London, W.C.2.
Chartered Patent Agents.

COMPLETE SPECIFICATION

Improvements in Apparatus for Controlling the Volumetric Output and Discharge Pressure of Fans, Blowers, Pumps and the like

We, DAVIDSON & COMPANY LIMITED, of Sirocco Engineering Works, Belfast, Ireland, a Company organised under the laws of Great Britain and Northern Ireland, and THOMAS BOSANKO COLLINS, of "Lisheen," Cultra, County Down, Ireland, a British Subject, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement:—

This invention relates to apparatus for controlling the volumetric output and discharge pressure of fans, blowers, pumps and the like of either the centrifugal or propeller type, by suitably modifying the intake conditions, and is an improvement in or modification of the invention described in prior patent specification No. 395,874.

The controlling means described in the said prior patent specification 395,874 are of the kind in which a deflector provided in an entrance chamber to the casing, from which the fluid enters the eye of the fan, is adapted to be adjusted to vary the throat of the entrance chamber in such a manner that the delivery of the fluid into the said casing shall be in a direction tangential to circles concentric with the axis of rotation of the impeller, or propeller.

Controlling means of this kind forming the subject of the said prior patent specification comprises an intake of rectangular cross-section terminating in a substantially half-cylindrical wall surrounding the eye of the fan casing or the like at the farther end of the intake, in combina-

tion with two movable hinged plates, of which one is adapted to be moved along the said half-cylindrical wall at the farther end of the intake and be brought around the remainder of the eye of the fan casing or the like, thereby closing more or less the throat of the intake and the other plate (hereinafter referred to as the flat guide plate) being adapted to be displaced during the said movement within the intake and form a nozzle of smaller or greater convergence. The plate which is moved along the said half-cylindrical wall is of arcuate formation and constitutes a valve which can be variably adjusted in the intake. The flat guide plate is hingeably connected to the arcuate plate and is adapted to be displaced during the movement of the arcuate plate within the intake to form, together with the upper and side walls of the intake, a nozzle of smaller or greater convergence whereby the fluid stream is caused to flow tangentially to a circle concentric with the axis of the impeller.

The provision of the said flat guide plate necessitates a relatively long intake passage involving an undesirably large overall dimension of the apparatus, thereby limiting its use, and the main object of the present invention is to remedy this disadvantage.

According to the present invention the flat guide plate is dispensed with and the peripheral wall of the movable arcuate plate, which forms the valve serves to guide the incoming fluid into the chamber so that the fluid rotates in the same direction as the impeller, after which it travels into the eye of the impeller.

The term "impeller" in the present specification and claims refers to a propeller or like rotating element of a fan, pump, or the like. Further, the term "eye" refers to the so-called "throat" of the casing for the propeller of the fan, pump or the like.

The invention will now be described with reference to the accompanying drawings, in which:—

Fig. 1 is a side elevation of one form of single inlet fan to which our invention has been applied;

Fig. 2 is an end elevation of the fan shown in Fig. 1;

Fig. 3 is an end elevation of the rotatable partially cylindrical valve;

Fig. 4 is a side elevation of a double inlet fan to which a modified form of our invention has been applied;

Fig. 5 is an end elevation thereof, and

Fig. 6 is a sectional elevation of an inlet box in which a rotatable partially cylindrical valve is fitted.

Referring to Figs. 1, 2 and 3, the fan casing 1 is associated with a suction box or side intake duct 2 of rectangular cross-section having a semi-cylindrical end 3 substantially concentric with the inlet eye 4 of the fan. The suction box or side intake duct 2 is provided with a flared inlet 5 when the fan draws air or gasses from its own immediate neighbourhood, or the inlet may be connected to a suitable system of trunking. Resilient seals 6, 7 (Figs. 1 and 6) are disposed transversely within the rectangular side intake duct 2, such that seal 6 makes continual contact with the rotatable partially cylindrical valve, and seal 7 makes contact at the full open and full shut positions of the valve.

The valve, the essential configuration of which is best shown in Fig. 6, comprises a curved sheet 10 forming the main component, which sheet 10 subtends more than two right angles and is of substantially the same width as the inlet box, the curvature of the sheet being concentric with the semi-cylindrical end 3 of the suction box. Welded to the curved sheet 10 at the side adjacent to the fan eye 4 is an annulus 11 of heavy cross-section, and welded to the annulus 11 is the conical seal 12 made of light material and disposed within the entrance to the fan eye 4. To the side of the curved plate 10, remote from the fan, is welded a steel or other backplate 13 which may be constructed with a centre hub 14 of heavy section. The backplate 13 carries a balance weight 15 on the sector opposite to that subtended by the curved plate 10, and is keyed to a stub-shaft 16 passing through its centre.

The stub-shaft 16 passes through, and is supported in, bearings 17 and 20 formed on a bracket 21 external to the suction box 2. The bracket 21 may be replaced by a pedestal support. In the example shown in the drawings, the bracket 21 is so designed that the stub-shaft 16 carries between bearings 17 and 20 a worm-wheel 22 keyed thereto and driven by a worm 23, which latter may be operated by a hand-wheel 24 or by other suitable means such as through gearing from an electric motor. The bearings 17 and 20 may be combined to form a single, relatively long bearing, the worm-wheel 22 then being keyed to an external extension of the stub-shaft 16. Again, where the unit is small, the worm-wheel 22 and worm 23 may be replaced by a simple lever suitably fixed to the stub-shaft extension.

A pointer 25 may be rigidly fixed either to the stub-shaft 16 or to the worm-wheel 22 to provide an indicator showing the position of the leading edge of the curved plate 10 and the approximate pro-

portional relation of the volume of air or gas flowing to the maximum volume with which the installation is designed to deal when the control valve is fully open. The apex of the pointer operates in association with a graduated arc 26.

Figs. 4 and 5 show a construction of the invention particularly adapted for use in a double inlet fan, though the construction is not restricted solely to such a use. The fan casing 1 is again provided with a suction box or side intake duct 2 of rectangular cross section, and having a semi-cylindrical end 3 substantially concentric with the inlet eye 4 of the fan. The valve is again formed by a curved sheet 10 having welded to its curved edge adjacent the inlet eye an annulus 11 of heavy cross section. In this construction the annulus 11 makes contact with, and is carried on, a set of rollers 27, the centre pins 28 of which are mounted in the vertical side of the suction box 2 adjacent to the fan eye. In this construction the backsheet is also in the form of an annulus 30 of heavy-gauge material which, on its inner circumference 31, makes contact with, and is carried on, a set of rollers 32, the centre pins 33 of which are mounted in the vertical side of the suction box 2 remote from the fan eye 4. Alternatively the rollers 27 and 32 may be replaced by rollers 50 (Fig. 6) fixed in the sides of the suction box and bearing externally on the ring 11. Both arrangements permit of the passage of the fan rotor shaft 34 through the centre of the backsheet 30 to the pedestal bearing 35 by which it is carried. Around the outer circumference of the curved plate 10 is rigidly fixed a toothed segment 36 which may be formed in one or several parts, and the valve is rotated by operation of a worm 37 engaging the toothed segment or circular toothed rack 36. The worm 37 may be replaced by a gear wheel serving the same purpose, and in either case the operation may be by a hand-wheel or through suitable gearing from an electric motor or similar driving means.

The operating mechanism of the two valves on the two inlets or suction boxes of a double inlet fan are conveniently interconnected to drive equally and simultaneously the valves with which the two suction boxes are equipped.

Although the drawings illustrate the application of the invention to fans, it will be understood that the invention can be similarly applied to blowers and pumps without in any way departing from the principles of operation or construction.

In operation the curved sheet 10 forming the valve is rotated by the mechanism provided to a position in which it restricts to the desired extent the passage of fluid through the inlet box. At greater closure positions the delivery of the fluid into the chamber is substantially in a direction tangential to circles concentric with the axis of rotation of the impeller. At the smaller closure positions however, say from full open to substantially beyond half closure positions, the fluid is not delivered into the casing in a direction strictly tangential to circles concentric with the axis of rotation of the impeller. At such smaller closure positions the central axis of the inflow is varied with varying closure positions around the axis of the impeller. The action in all cases is such that a vortical flow is set up, (increasing in magnitude as the valve is progressively closed), within a chamber of which the valve forms part of the wall, the vortex thus set up being maintained during the flow of the fluid into the eye of the impeller.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. The improvement in or modification of the invention of prior patent specification No. 395,874, the said improvement consisting in dispensing with the flat guide plate whereby the peripheral wall of the movable arcuate plate which forms the valve serves to guide the incoming fluid into the chamber so that the fluid rotates in the same direction as the impeller, after which it travels into the eye of the impeller.

2. The improvement in or modification of the invention of prior patent specification No. 395,874, the said improvement consisting in dispensing with the flat guide plate whereby the peripheral wall of the movable arcuate plate which forms the valve serves to guide the incoming fluid into the chamber in such a way that a vortical flow is set up in the direction of rotation of the impeller within a chamber of which the valve forms part of the wall, the vortex thus set up being maintained during the flow of the fluid into the eye of the impeller.

3. A fan, blower, pump, or the like according to claim 1 or 2 wherein the valve is mounted at its curved edge remote from the inlet eye on a circular disc or plate carrying balance weights on the sector opposite to the partially cylindrical plate.

4. A fan, blower, pump, or the like according to claim 3, wherein the circular disc or plate is mounted on a stub shaft carried in bearings external to the inlet box of the fan, the said bearings carry-

ing the entire weight of the valve.

5. A fan, blower, pump or the like according to any one of claims 1 to 4 wherein the valve is stiffened by one or more complete rings.

6. A fan, blower, pump, or the like according to claim 5 wherein stiffening rings or annuli are provided on both edges of the partially cylindrical plate, the valve being supported by sets of rollers mounted on the walls of the inlet box and engaging the edges of the said rings or annuli, or the peripheral wall of the partially cylindrical plate.

7. A fan, blower, pump, or the like according to claim 4, wherein the stub shaft carries a worm wheel keyed thereto and operating in conjunction with a worm to effect the rotation of the valve.

8. A fan, blower, pump, or the like according to any of claims 1, 2 or 6 wherein the partially cylindrical sheet forming the valve carries on its outer surface a toothed segment or segments meshing with a worm or gear wheel operated externally of the suction box to control the movements of the valve.

9. A fan, blower, pump, or the like according to any preceding claim, wherein resilient seals are provided in the intake duct to co-operate with the transverse edges of the valve.

10. A fan, blower, pump or the like according to any preceding claim, wherein an indicator is provided externally of the inlet casing to show the position of the leading edge of the valve.

11. A fan, blower, pump or the like according to any preceding claim, wherein an inlet box is provided on each side of the fan, each of said inlet boxes being provided with a valve and the said valves being operated by external interconnected mechanism.

12. A fan, blower, pump or the like constructed, arranged and adapted to operate substantially as described with reference to Figs. 1 to 3, or Figs. 4 to 6 of the accompanying drawings.

Dated this 14th day of February, 1936.

MEWBURN, ELLIS & CO.,
70 & 72, Chancery Lane, London, W.C.2.
Chartered Patent Agents.

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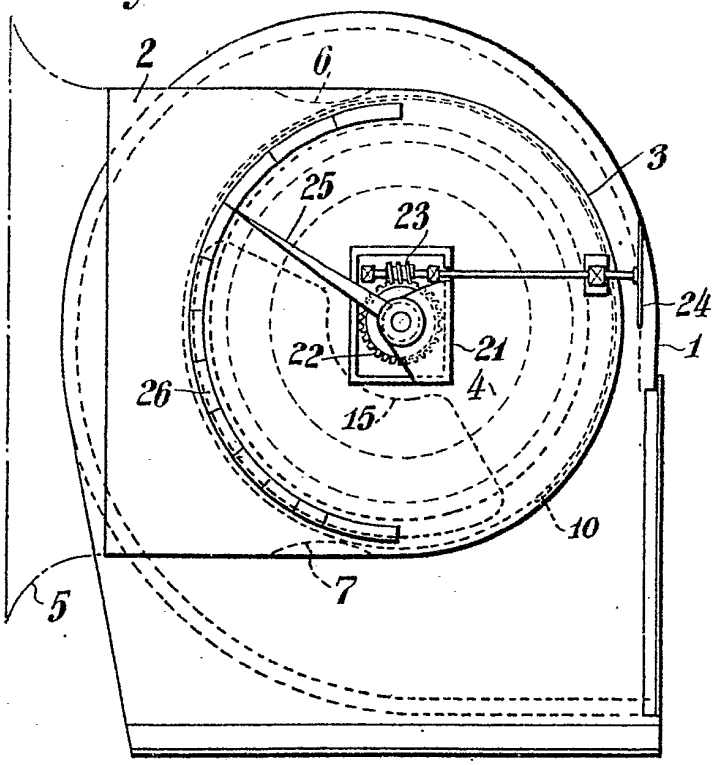
Fig.1.



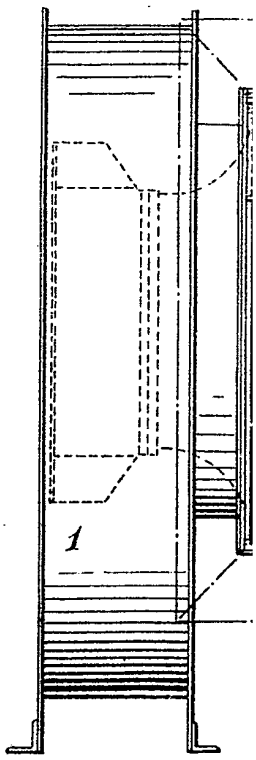


Fig.4.

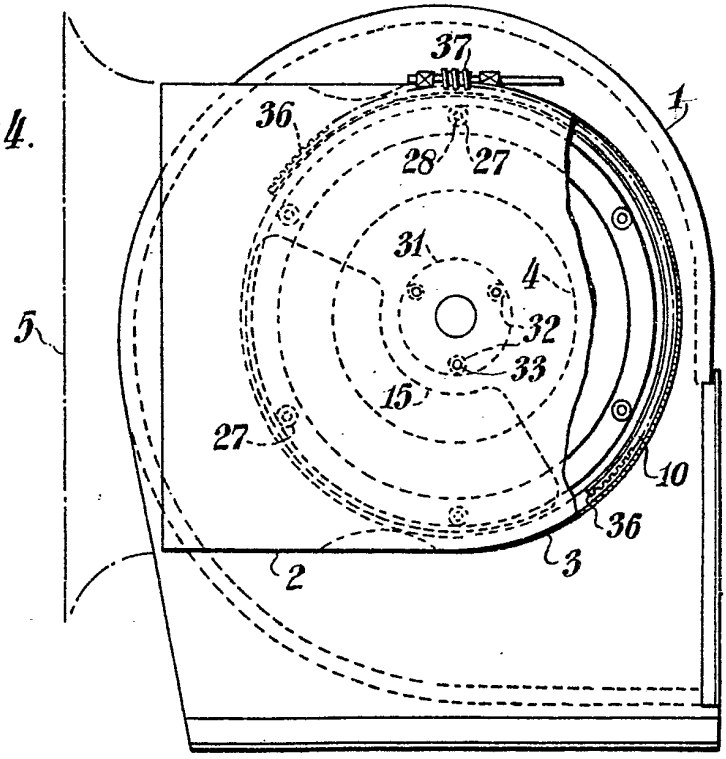


Fig.5.

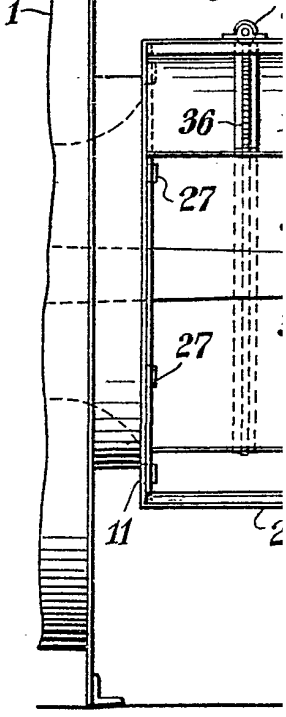
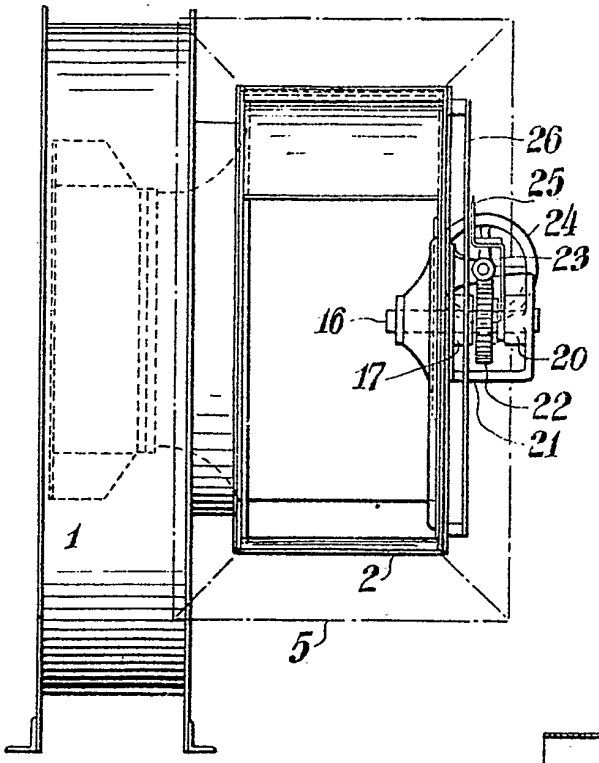


Fig. 2.



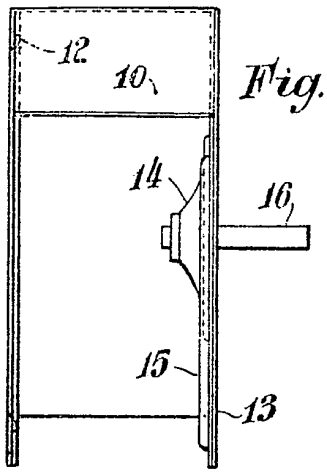


Fig. 3.

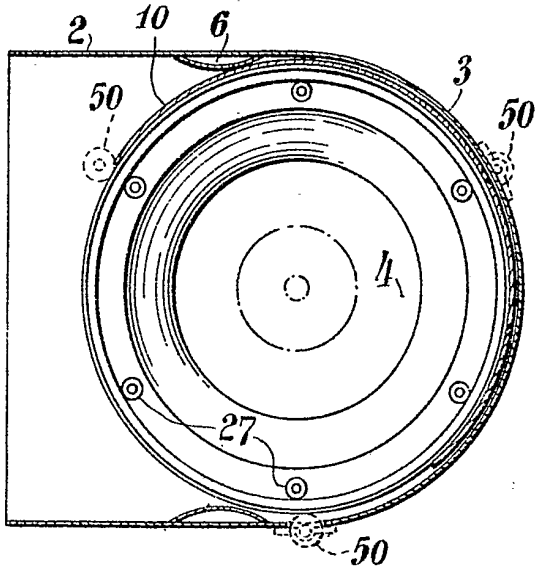


Fig. 6.

Fig. 5.

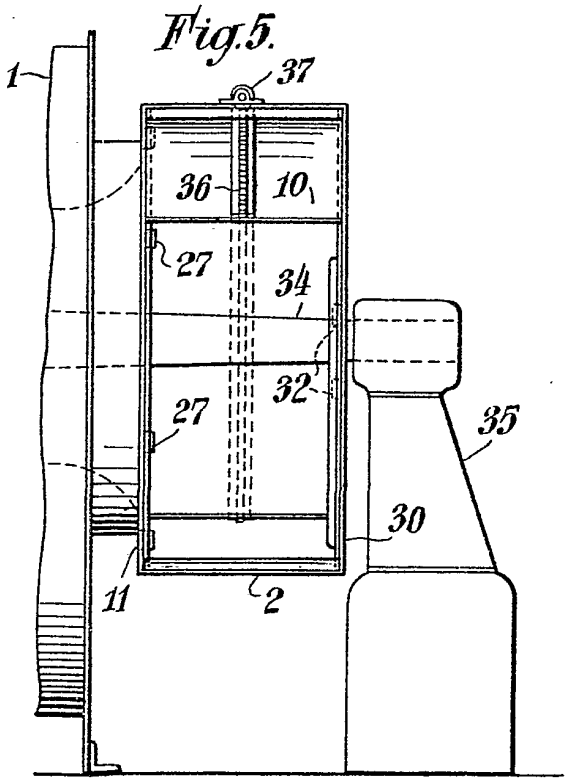


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Fig. 1.

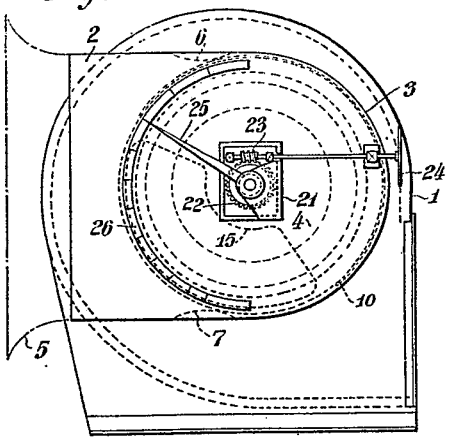


Fig. 2.

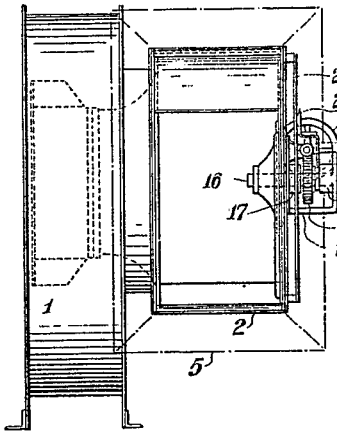


Fig. 3.

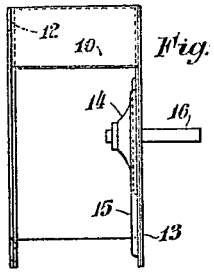


Fig. 4.

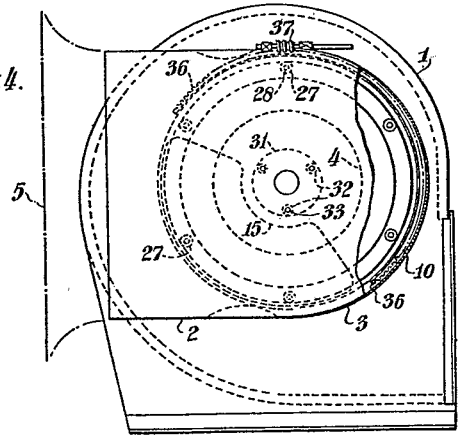


Fig. 5.

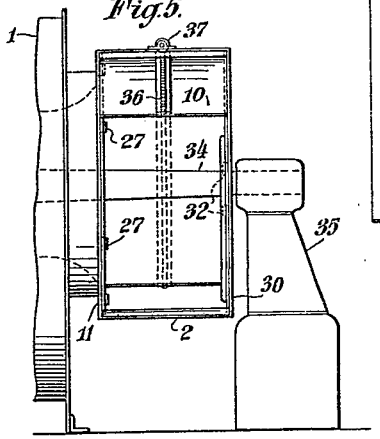
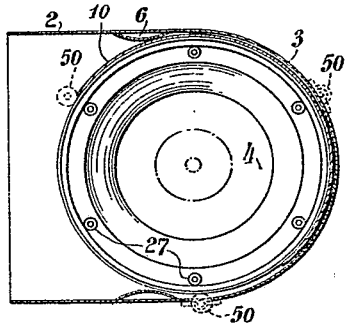


Fig. 6.



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