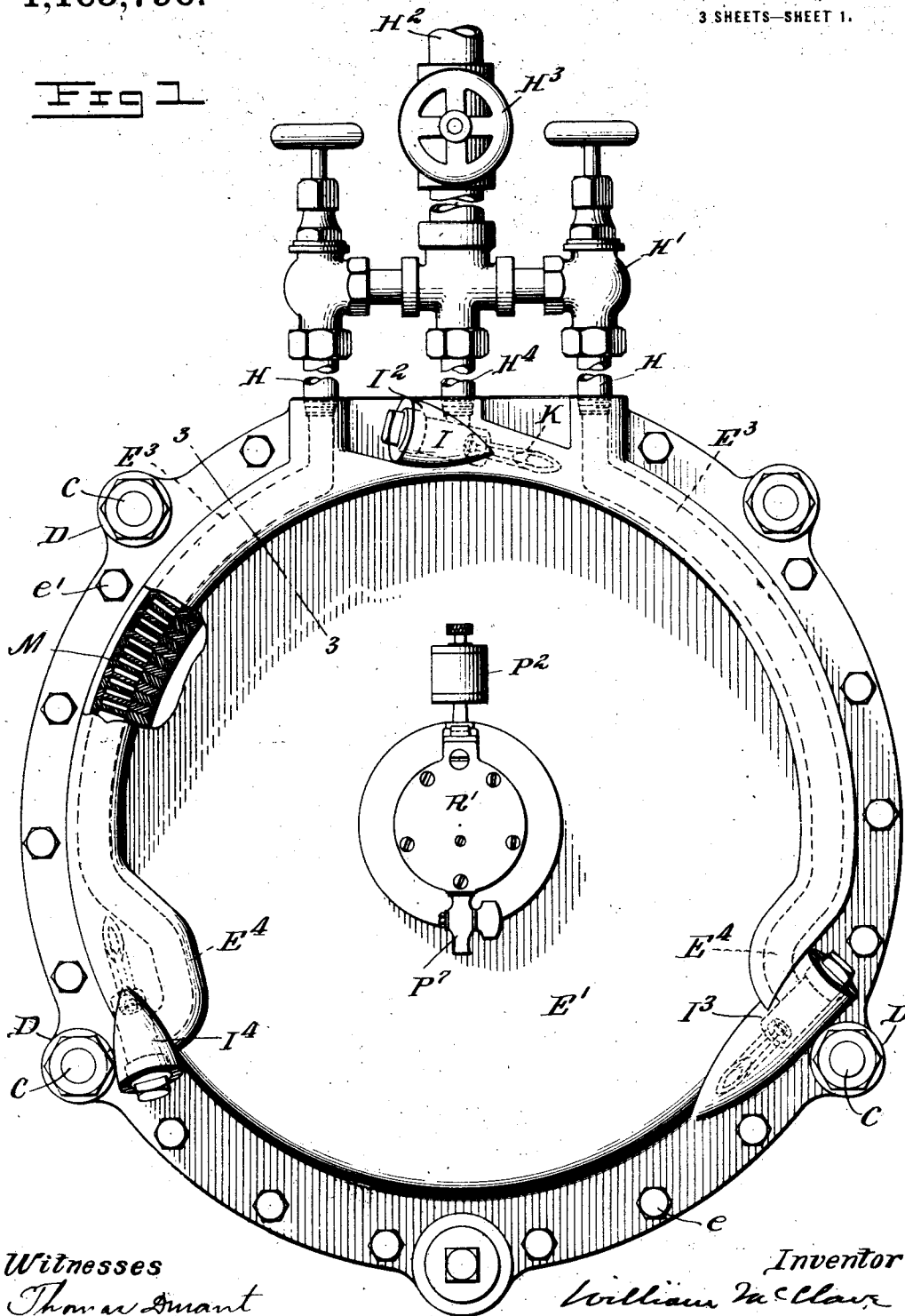


W. McCLAVE,
STEAM TURBINE BLOWER.
APPLICATION FILED NOV. 18, 1914.

1,165,796.

Patented Dec. 28, 1915.
3 SHEETS—SHEET 1.

Fig 1



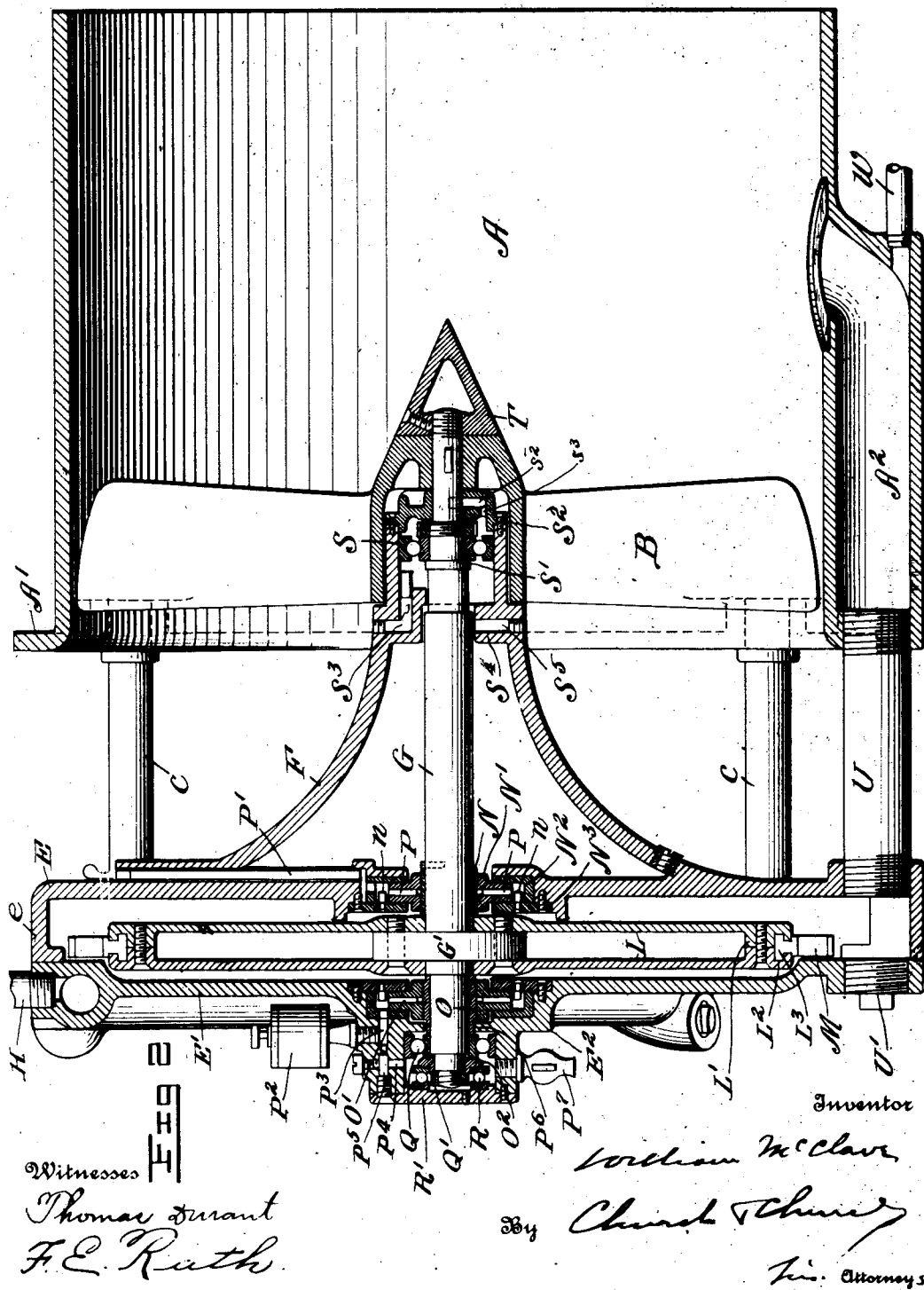
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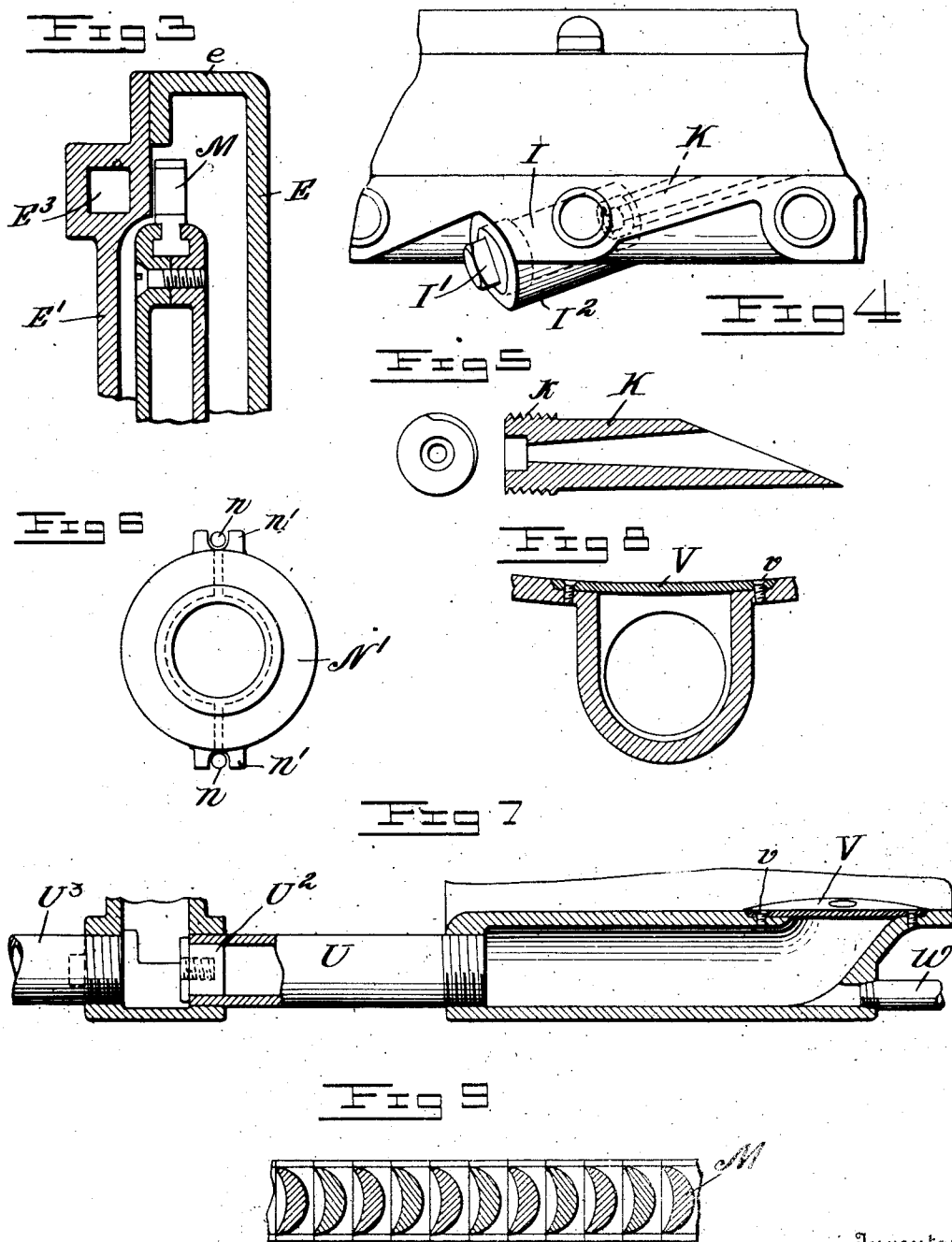


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STEAM-TURBINE BLOWER.

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Specification of Letters Patent.

Patented Dec. 28, 1915.

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To all whom it may concern:

Be it known that I, WILLIAM McCLAVE, a citizen of the United States, residing at Scranton, in the county of Lackawanna and State of Pennsylvania, have invented certain new and useful Improvements in Steam-Turbine Blowers; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification, and to the figures and letters of reference marked thereon.

This invention relates to turbine blowers of that type wherein the rotor of the turbine is rigidly connected with the impeller of the blower and rotates in unison therewith, the objects of the invention being to provide a structure in which the air will be afforded an easy and free entry to the impeller whereby noise incident to the movement of the air at high speed or its contact with the parts of the apparatus will be largely eliminated and at the same time the rotor chamber and steam ducts protected from the cooling action of the air passing to the impeller, other objects of the invention being to simplify and improve the construction in such wise as to prevent or overcome the injurious effects of wear, cheapen the cost of production and prevent water of condensation from the rotor chamber reaching or injuriously affecting the bearings which support the combined rotor and impeller shaft.

The invention consists in certain novel details of construction and combinations and arrangements of parts, all as will be hereinafter described and pointed out particularly in the appended claims.

Referring to the accompanying drawings, Figure 1 is a front elevation of a steam turbine blower embodying the present improvements. Fig. 2 is a section of the same in a vertical plane longitudinally of the axis of the shaft. Fig. 3 is a section of the peripheral portion of the rotor chamber substantially on the line 3—3 of Fig. 1. Fig. 4 is a plan view of the top central portion of the rotor chamber. Fig. 5 is an end elevation and a longitudinal section of one of the nozzles. Fig. 6 is an elevation of one of the self-adjustable collars for preventing the water of condensation or steam from escaping from the rotor chamber or reaching the supporting bearings of the shaft. Fig.

7 is a sectional view corresponding to the lower portion of the section in Fig. 2, but showing the connections arranged for discharging the exhaust at a distant point. Fig. 8 is a detail cross section of the exhaust duct shown in Fig. 7. Fig. 9 is a detail section showing the preferred form of rotor vanes.

Like letters of reference in the several figures indicate the same parts.

As is usual in devices of the character to which the present invention relates, the structure embodies a flue or casing A adapted to be built into the wall of a steam boiler furnace, usually that portion of the wall forming the ashpit. In the present instance the casing A is preferably of substantially cylindrical form having at its front edge an outwardly extending flange A', and at the bottom a duct A² through which the exhaust from the impeller chamber may be conducted into the flue formed by the casing A so as to be discharged into the ashpit with the inflowing air, the exit of the duct A², however, being located beyond the impeller, whereby the exhaust steam is prevented from exerting any injurious influence on the impeller itself or by any chance escaping into the atmosphere.

The flange A' before referred to is preferably employed as the means whereby the casing A is connected with and adapted to rigidly support a rotor casing or housing, and the latter constitutes the sole support for the rotor and the impeller B which latter is located at a suitable point in the entrance end of the casing. The mechanical construction preferably adopted embodies a plurality of posts C secured at one end to the flange A' and at the opposite end to flange like portions or ears D of a two-part rotor casing or housing, one part E of which is opposite the entrance opening of the casing A and removed therefrom a sufficient distance to afford free access of air to the casing around the entire circumference. The part E is provided with an inwardly and forwardly tapering projection F, the walls of which curve toward the center or axis of the casing and terminate in a construction which will be hereinafter described for supporting the bearing of the rotor and impeller shaft G. The other or front portion E' of the rotor casing or hous-

ing is substantially in the form of a plate member which is adapted to be secured to the edges or peripheral flange *e* of the member E by bolts or fastenings *e'* to form a steam tight joint between the two members. At the center the front member E' of the rotor housing is provided with a hub E² adapted to support the bearings for the outer end of the rotor shaft and certain other parts which will be presently referred to.

Extending around the peripheral portion of the front member E' or from the upper portion thereof down on each side are ducts E³ best shown in dotted lines in Fig. 1, which ducts at their upper ends terminate in threaded openings for the reception of pipe connections H. The pipe connections H are each provided with a valve H' and constitute branches of a main steam supply pipe H² also provided with a valve H². Intermediate the pipe connections H is a third pipe connection H⁴ which leads from the steam supply into a diagonally arranged cylindrical nozzle chamber I formed in a boss I² on the front member E', as shown in Figs. 1 and 4. The inner end of said nozzle chamber I is provided with a seat for a steam nozzle K adapted to be driven into place and the rear or outer end of the nozzle is provided with a screw thread *k* for the reception of a threaded socket wrench, whereby the nozzle may be withdrawn, should repair be necessary. The outer end of the nozzle chamber I is closed by a screw plug I', the removal of which gives direct access to the screw-threaded end of the nozzle, the said nozzle chamber and plug opening all being in direct alinement. Nozzles and nozzle chambers I³, I⁴ corresponding to that just described are provided at the lower ends of the ducts F³, the arrangement being such that the nozzles are equally distributed around the periphery of the rotor chamber and the nozzle chambers being all on the front face of the rotor chamber are in position to be readily accessible should cleaning or repair be necessary. In connection with the nozzles at the lower ends of the ducts E³ it will be noted that said ducts are curved inwardly and then outwardly as at E⁴, so as to enter the nozzle chambers at substantially right angles to the axis of the chambers and so as to avoid any interference with the removal of the plugs or nozzles.

The shaft G within the rotor chamber is provided with an integral disk-like portion G' which serves as the means whereby the rotor itself is rigidly attached to the shaft, and in the preferred construction, the rotor is formed by two oppositely disposed circular plates L clamped to opposite faces of the disk G' by screws or appro-

priate fastenings, the contacting faces of the parts being accurately machined, to form a rotor which will be in accurate balance and may be rotated at high velocity without vibration. At their peripheries the rotor plates L are formed with spacing lugs L', and on the outer sides of said lugs are opposite disposed under cut channels L² adapted to receive the heads L³ of the rotor vanes M. The rotor vanes M are of the well known concavo convex form as indicated in cross section in Fig. 9. They may be cast in individual units or in blocks made to conform to the curvature of the periphery of the rotor. The side edges of the vanes travel in close proximity to the front plate E' of the rotor housing and therefore in close proximity to the exits of the nozzles K. The curvature of the vanes and direction of the nozzles is such as to give the highest efficiency from the momentum of the steam issuing from the nozzles and tending to impart rotary movement to the rotor and at the same time the pressure of the steam tends to advance the rotor longitudinally of its shaft or axis in a direction contrary to the thrust of the impeller B which drives the air through the casing A.

The rotor and impeller shaft G is preferably made of several diameters at different points in its length, the successive diameters toward the ends being reduced for the application of the bearings and self-adjusting collars. As illustrated, for example, in Fig. 2, it will be seen that on the largest diameter of the shaft which is on the inner side of the rotor there is mounted a steel bushing N adapted to form the bearing or contacting surface for a self-adjusting collar N', shown in elevation in Fig. 6. This collar makes a steam and water tight joint with the bushing, and its peripheral flange-like portion is confined between radial bearing surfaces in the rotor housing. Said radial bearing surfaces are preferably formed by an annular cupped bushing N² seated in a corresponding recess in the housing and a cup cover plate N³ secured in place by suitable screws or fastenings, whereby the self-adjusting collar N' may be permitted a limited movement or self-centering adjustment radially of the shaft, but it is held from rotation in unison with the shaft by pins *n* on the cup cover located loosely between lugs *n'*, Fig. 6, on the collar. On the opposite side of the rotor the shaft is provided with a bushing O corresponding to the bushing N' save that it is of somewhat smaller internal diameter to fit the smaller diameter of the shaft, and a correspondingly constructed self-adjusting collar with cup bushing and cup cover, as at O', are provided for preventing the leakage of steam or water at the front of the rotor chamber. In both instances the self-

adjusting collars are provided with radial openings P at top and bottom for the admission and escape of lubricant, said lubricant being supplied to the inner collar through a duct P' which extends radially up to a point near the periphery of the rotor housing, and the lubricant is supplied to the front collar from a lubricant cup P² through a duct P³, all as clearly shown in Fig. 2.

The bearings forming the radial supports for the shaft are preferably annular ball bearings, that lettered Q for the front end of the shaft being held in position against the collar O, as an abutment, by a clamping nut Q' threaded on the end of the shaft and preferably acting against the said bearing through an intermediate washer O² which serves as the seat for a thrust ball bearing R. The latter is sustained in position by the said washer O² and by a cap or cover plate R' secured to the hub E² of the housing by set screws or bolts of ordinary construction. The lubricant passage or duct P³ at one end communicates with the ducts in the self-adjusting collar O', and at the other end communicates with a passage P⁴ leading to the ball bearings, the flow of lubricant through the latter passage being regulated by a valve screw P⁵ and the chamber for the reception of the lubricant being defined by the cap or cover R' and the wall P⁶, thus providing for the retention of a body of lubricant in which the lower portion of the ball bearings will travel, excess lubricant may be drained away when so desired through a drain cock P⁷ of ordinary construction.

At the inner end of the shaft, a ball bearing S of the usual annular type is seated against a shoulder S' on the shaft, and longitudinal movement is prevented in an inward direction, by an end piece S² surrounding the shaft and secured to the inwardly extending projection of the rotor housing. The end piece S² is provided at the lower side of the shaft with a double wall forming an oil well s² in communication with the bottom of the bearing chamber through a port s³ whereby oil tending to creep along the shaft and escape to the exterior will be deposited in the well and flow back into the bearing chamber. Lubricant is supplied to this bearing through a duct S³ and wall S⁴ in connection with the end piece S² serves to retain a body of the lubricant at the bottom of the bearing, whereby effective lubrication is insured, but at the same time provision is made whereby any excess of lubricant will not find its way along the shaft, but will overflow from the chamber through an opening S⁵ located at the lowest point of the wall S⁴, and if desired having a screw plug which may be removed when lubricant is being supplied to the bearing. In other words, it

is the design of the structure to provide for retaining a body of lubricant into which the balls of the bearings will dip in their travel, but to prevent the accumulation of lubricant in the large spaces formed within the walls of the forwardly extending projection F, inasmuch as one of the objects of this projection is to form a clear air space spreading out over the inner face of the rotor housing to overcome or prevent the tendency to excessive condensation by reason of the cooling action of the rapidly flowing current of air toward the impeller. The impeller B before referred to is mounted on the inner end of the shaft which latter projects through the end plate S² and it is preferably provided with a tapering nut or cap piece T for permitting the air to close in gradually around the hub so as to prevent as far as possible any whistling or screaming action when the air currents attain a high velocity.

The steam entering the rotor housing and passing through the vanes of the rotor finds its way around and along the faces of the rotor to the bottom of the chamber and at this point provision is made whereby the exhaust steam may be led into the casing A for discharge into the ashpit with the entering air or, without changing the connections, other than to insert and remove suitable plugs to be presently explained and providing appropriate pipe connections, the exhaust steam may be led away to a point remote from the blower. As shown in Figs. 2, 7 and 8, it will be noted that, at the bottom of the housing, oppositely disposed threaded openings are provided, one of said openings being in communication through a short section of pipe U with the duct A² formed at the bottom of the casing A. This pipe U and duct A² form a direct exhaust duct leading into the casing and when it is to be utilized exclusively a plug U' such as ordinarily employed in pipe fitting work, serves to close the threaded opening in the front wall of the housing. In case the exhaust steam is to be led away to a distant point, however, the pipe connection U is closed by a driven plug U², Fig. 7, provided with an internal threaded cavity or socket for the reception of a wrench, whereby it may be inserted or removed. Likewise the plug U' of Fig. 1 is removed and a pipe U³ substituted, leading off to the desired distant point for the discharge of the exhaust. In connection with or as a substitute for the plug U², the inner end of the duct A² is preferably closed by a plate V, which plate is held in place by screws adapted to be readily inserted by reaching in through the casing A.

The exhaust duct A² is provided at the bottom with a drain duct W for carrying off water of condensation, which might tend to accumulate therein, and this insures the chambers and passages being left entirely

free from water so that no injury can result from freezing while the apparatus is shut down.

From the foregoing description it will be noted that the entire rotor housing may be removed from the casing or the front plate of the rotor housing may be removed as a unit, and when the impeller is disconnected from the shaft the rotor itself, together with its shaft, may be withdrawn without breaking the connection between the casing and inner portion of the housing. Provision is thus made whereby any of the parts may be reached for renewal or repair with the utmost freedom, and in addition to the advantages thus attained, the structure is one in which there is a minimum condensation effect of the inflowing air on the steam ducts and chamber.

While the thrust of the impeller is taken by the thrust bearing at the front end of the shaft, it is in a measure also resisted by the action of the steam which enters the rotor housing axially in a direction contrary to the direction of the thrust of the impeller. Furthermore it will be noted that by the provision of equally spaced nozzles the pressure on the rotor is equalized when under full load and at the same time by cutting off one or more of the nozzles it is possible to regulate the speed and power of the rotor and the volume of air driven into the boiler furnace by the impeller.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is,—

1. In an apparatus such as described, the combination with a shaft forming the support for an impeller and having an integral disk-like projection thereon, of a rotor embodying oppositely disposed disks secured to opposite faces of the disk-like projection on the shaft, said disks having at their peripheries under-cut channels and rotor vanes held in said channels, with means whereby the disks are separately held together for clamping the vanes.

2. In an apparatus such as described, the combination with a shaft forming a support for an impeller and having a disk-like projection thereon with parallel oppositely disposed faces, disks removably clamped to said oppositely disposed faces and mounted in parallelism in planes at right angles to the axis of the shaft, said disks having at their peripheral portions spacing lugs for maintaining them in parallelism and oppositely disposed undercut channels, impeller vanes mounted in said channels and projecting beyond the peripheries of the disks, and means for clamping the peripheral portions of the disks together.

3. In an apparatus such as described, the combination with a rotor housing embodying inner and front sections adapted to be

connected together to form between them a rotor chamber, hub-like projections on the oppositely disposed faces of said sections, and having shaft bearings therein, a shaft mounted in said bearing, and a rotor mounted on the shaft within the rotor chamber, of an impeller mounted on one end of said shaft beyond the hub-like projection, nozzles for supplying motive fluid to the rotor, and motive fluid ducts for supplying motive fluid to the nozzles located on the side of the rotor housing opposite that on which the impeller is located, whereby said ducts are located at a point remote from the current of air flowing to the impeller.

4. In an apparatus of the class described, the combination of a shaft, a rotor mounted on the shaft at one end, an impeller mounted on the shaft beyond the rotor, a housing for the rotor including inner and front sections, a steam chamber formed entirely within and integral with the front section whereby the steam will be free from refrigerating effects of air flowing to the impeller, and a plurality of nozzles for admitting the motive fluid to the rotor from different points in the periphery of the housing.

5. In an apparatus of the class described, the combination of a shaft, a rotor mounted on the shaft at one end, an impeller mounted on the shaft beyond the rotor, a sectional housing for the rotor, means for admitting steam to the rotor from the side of the housing away from the impeller, said steam admitting means being formed entirely within one section of the housing, and an insulating chamber arranged between the impeller and rotor.

6. In an apparatus such as described, the combination with a rotor housing embodying inner and front sections adapted to be connected together, to form a rotor chamber, said housing being provided with nozzles for the admission of motive fluid to the rotor, and said inner and front sections being provided at the bottom with oppositely disposed threaded openings for the exhaust of motive fluid, means for closing at will either one of said openings, whereby the exhaust may be directed through the inner or front of the housing, of a rotor shaft journaled in the housing, a rotor mounted on said shaft in the rotor chamber, means for preventing access of motive fluid to the bearings of the shaft, and means mounted on said shaft for inducing a current of air in a direction away from the center of the housing.

7. In an apparatus such as described, the combination with a casing forming an air duct, a rotor housing mounted in line with but removed from said casing whereby a peripheral space is left for the admission

of air to said casing, an exhaust duct leading from the bottom of the rotor housing into the bottom of the casing, means for closing said duct, whereby access of exhaust
5 from the housing to the casing may be prevented, a second exhaust duct leading from the housing, a rotor shaft journaled in the housing, an impeller mounted on said shaft within the casing, and a rotor mounted
10 on said shaft within the housing.

8. In an apparatus such as described, the combination with a casing forming an air duct, a rotor housing rigidly connected with but spaced from said casing to form an air

entrance space between the casing and hous- 15
ing, an exhaust pipe connection extending from the bottom of the housing to the bottom of the casing, a threaded opening in the housing located opposite the said pipe connection, and a plug for closing said opening, 20
of a rotor shaft journaled in the housing, an impeller mounted on said shaft within the casing, and a rotor mounted on said shaft within the housing.

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