March 17. 1925. 1,529,925

J. SAY

TURBO BLOWER

Filed June 19, 1922 2 Sheets-Sheet 1

Fig. 1.

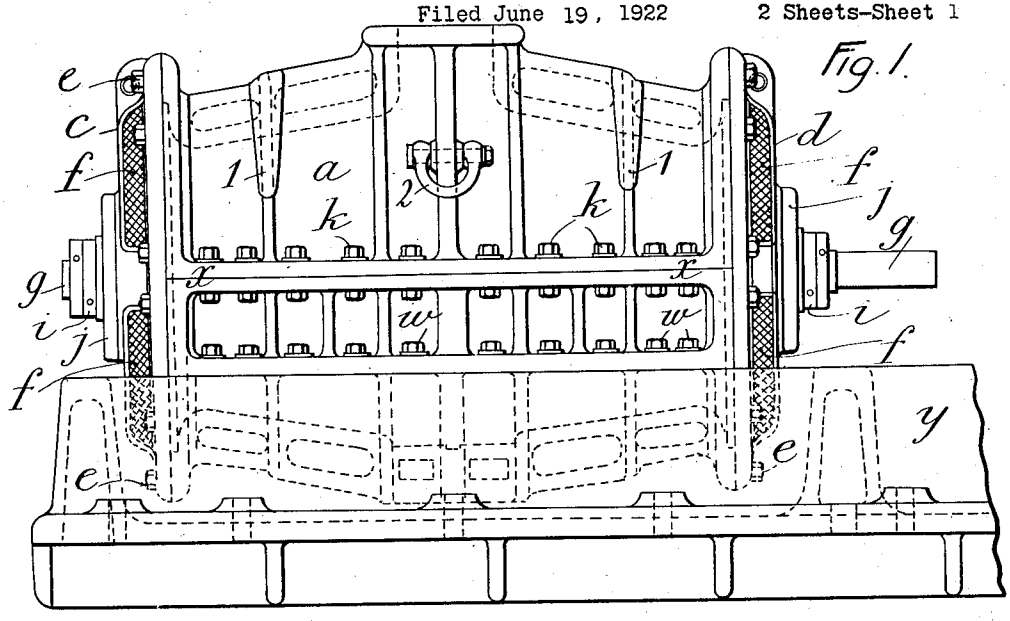
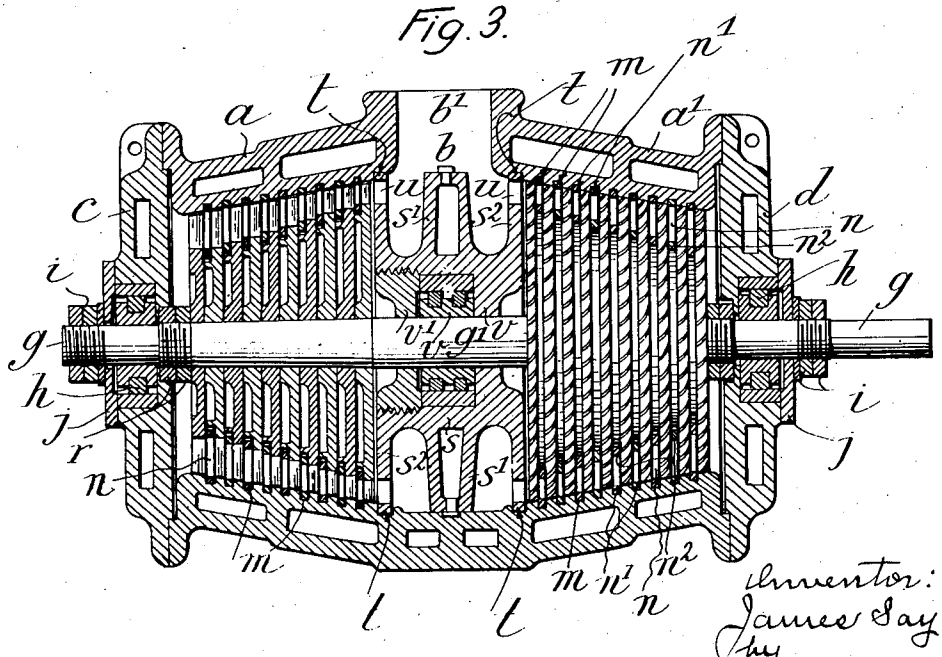


Fig. 3.



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Fig. 2.

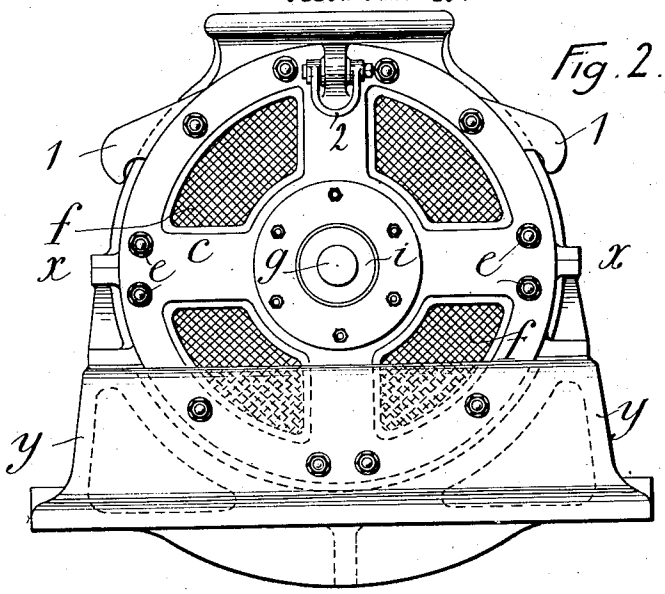


Fig. 8.

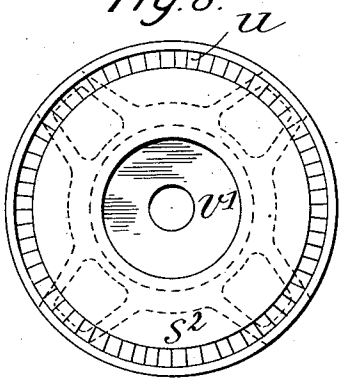


Fig. 6.

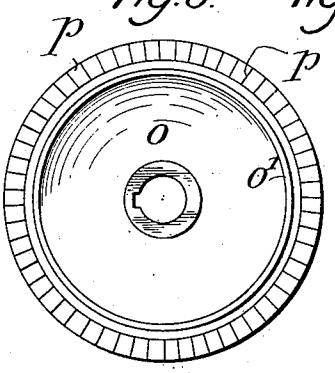


Fig. 7.

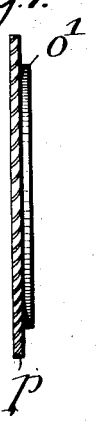


Fig. 4.

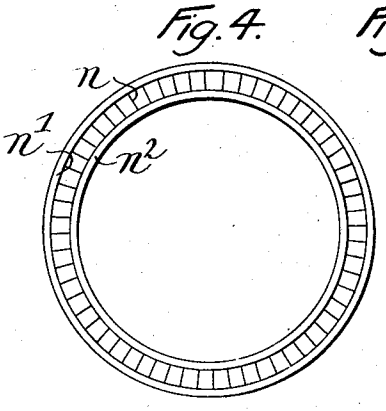
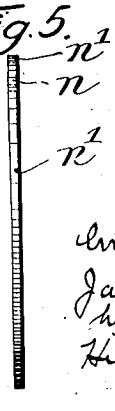


Fig. 5.



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Patented Mar. 17, 1925. 1,529,925

UNITED STATES PATENT OFFICE.

JAMES SAY, OF MANCHESTER, ENGLAND.

TURBO BLOWER.

Application filed June 19, 1922. Serial No. 569,314.

To all whom it may concern:

Be it known that I, JAMES SAY, a subject of the King of Great Britain and Ireland, residing at Manchester, in the county of Lancaster, England, have invented Improvements in or Relating to Turbo Blowers, of which the following is a specification.

This invention relates to that type of turbo-blower in which two sets of multi-stage impellers and stators are mounted in co-axially arranged truncated conical air compressing chambers provided at their opposite smaller ends with air inlet openings and having their larger ends facing one another and communicating with a delivery chamber or chambers having a compressed air outlet or outlets between them, the two sets of impellers being fixed upon a shaft common to them and extending co-axially through the two chambers. A turbo-blower of this type is described in the specification of British Letters Patent No. 3740 of 1911, granted to me, the two truncated conical chambers with an intermediate compressed air delivery chamber common to them, being, in the example described and shown in such specification, constituted as a single structure or casing that is divided horizontally in such a manner as to admit of the upper part being readily removed from the lower part and from separate air inlet covers or heads fixed to the lower part, in order to admit of the stators and impellers being easily assembled, and of ready access being gained to the interior of the casing for inspection thereof when this may becomes necessary or desirable.

Now the present invention has for its object to improve the construction and working of turbo-blowers of the kind referred to.

For this purpose, according thereto the stators are constituted by rings of blades of gradually increasing diameter externally, towards the compressed air delivery chamber, and the impellers are constituted by metal discs, also of gradually increasing diameter towards the delivery chamber, and having central solid portions fixed to the impeller shaft and outer rings of blades that are arranged to rotate between and opposite the rings of stator blades. The central solid portions of the successive impellers in each set thereof may be held firmly one against the other and to the impeller shaft, as by nuts screwed on the impeller shaft, to form a solid central core extending through the corresponding set of stator rings so that air that is being compressed is constrained to flow through the rings of impeller and stator blades to the delivery chamber and outlet and cannot return through the central portions of the chambers to the inlet ends thereof. The impeller shaft may be held in position endways relatively to the casing, by adjustable nuts on the shaft bearing against the outer sides of the end covers or heads of the casing, so that the rings of impeller blades can readily be adjusted endways in relation to the rings of stator blades to suit requirement.

The bearing located within the compressed air delivery chamber of a single structure blower such as that described in the said former specification, for supporting the central portions of the impeller shaft, may advantageously have its opposite end portions provided with outer peripheral rings of blades to form additional stators opposite which the innermost rings of impeller blades rotate.

In the accompanying illustrative drawings, Fig.s 1, 2 and 3 show respectively in side elevation, end elevation and longitudinal section, a turbo-blower embodying the present invention, the impellers being shown in vertical section in the left hand portion of Fig. 3 and in elevation in the right hand portion of the said figure. Figs. 4 and 5 show one of the stator rings in end and side view respectively. Figs. 6 and 7 show one of the impellers in end and side view respectively. Fig. 8 shows in end view, a central stationary bearing for the impeller shaft adapted to form additional stator.

In the example shown, a and a^1 are the two truncated portions of the casing arranged with their larger ends adjacent to each other and adapted to form between them an air delivery chamber b provided with a compressed air delivery outlet b^1 and c and d are the end covers detachably secured to the smaller ends of the casing by bolts e and each provided with air inlet apertures f. g is the impeller shaft mounted at its outer

end portions in antifriction bearings h in the end covers c and d and held in place longitudinally by nuts i screwed on the shaft and bearing, through interposed cover plates j, against the outer sides of the end covers c and d. The casing a a^1 is divided horizontally at the line x x in the plane of the axis of the propeller shaft, the upper and lower parts thus formed being secured together by bolts k so that the upper part can, as heretofore, be removed from the lower part and from the end covers c and d when desired. Within a series of annular parallel grooves m in each of the two conical end portions a a^1 of the casing are firmly held, as in my former construction of turbo-blower, a series of stators. Each of these stators, however, according to the present invention, is constituted, as shown more clearly in Figs. 4 and 5, by a ring of blades n carried by outer and inner rings n^1 and n^2 respectively, the outer ring n^1 being located in its corresponding groove m in the casing when the upper and lower parts thereof are fixed together. The impellers for co-acting with the stators, each consist as shown more clearly in Figs. 6 and 7, of a solid central portion o provided at its outer periphery with a ring of impeller blades p of an axial thickness to fit between the annular stators with suitable clearance between them, the central solid portion of the impeller being of greater thickness than the ring of blades p, as shown at o^1 (Fig. 7), so as to extend through the adjacent stator ring n n^1 n^2 and bear against the solid portion of the next adjacent impeller. The successive impellers in each set thereof, are held firmly one against the other and upon the impeller shaft g by nuts r screwed on the shaft. For this purpose, the portion of the shaft upon which the impellers are mounted, may, as shown, be made of taper shape, or the central portion g^1 of the impeller shaft may be made of greater diameter than the remaining portions so as to form annular shoulders against which the impellers can be forced and secured in place by the nuts r. The successive rings of stator blades n and impeller blades p are, as shown, made of gradually decreasing radius and with the blades therein of gradually increasing pitch, so that the air entering the two opposite outer ends of the casing a, a^1 through the apertures f will be constrained to pass through the rings of blades, and be gradually increased in pressure as it flows towards the compressed air delivery chamber b whence it will wholly be compelled to pass through the outlet b^1. By making each of the air compressing chambers of truncated conical shape as shown, the peripheral velocity of the successive impeller rings increases towards the outlet chamber as the pressure of the air increases, which is important.

As will be understood, as the reaction of the air pressure upon the two opposite coaxial sets of impellers is exerted in opposite directions, the two portions of the impeller shaft at opposite sides of the central portion will be subjected to tensile stresses exerted in opposite directions so that whipping of the shaft will be avoided.

The first or outermost impeller ring p, in each set of impeller rings is preferably made radially wider in the axial direction than the remainder of the impeller rings, as shown in Fig. 3, so that it may take the maximum amount of free air necessary to fill the first or outermost stator ring n, n^1, n^2. The remaining impeller rings may be of the same width in the axial direction though of increasing diameter. The first or outermost impeller in each set of impellers is preferably thicker or stiffer than the others so that when fixed to the shaft, it can act as a buttress for the other impellers when the turbo-blower is in action.

The cross sectional area of the airway from each of the innermost stators to the outlet chambers b is considerably less than that of the air inlet to each of the outermost stators, say for example about 50% less.

The stationary bearing s for the central portions g^1 of the impeller shaft is provided with radial arms s^1 that bear against the inner surface of the delivery chamber b and with opposite disc-like end portions s^2 the outer peripheral portion of each of which is fixed in a groove t in the corresponding truncated conical portion a or a^1 of the casing and is provided with a ring of blades u to form a stator opposite which the innermost ring of impeller blades p rotates. The bearing s may, as shown, be centrally recessed to contain the races and antifriction rollers or balls of an antifriction bearing arrangement v that directly supports the said central portion of the shaft and is held in place endways by a ring v^1 screwed into the boss of the stationary bearing s.

Each of the rings of stator blades and of the impeller blades may be cast in one piece with the parts carrying them. Each stator ring may however be made in one piece or in halves, as may be desired.

The casing a a^1 and the end covers or heads c and d may, as shown, be made hollow to permit of the circulation therethrough of a cooling fluid, for instance water, to keep them cool and also to enable cool compressed air to be delivered from the blower.

The blower casing a a^1 with end covers c and d may, as shown, be fixed, as by bolts w, to a bed plate y adapted to carry a motor, for instance an electric motor, or a steam turbine, for rotating the impeller shaft and impellers.

The upper part of the casing a a^1 may be

provided with hooks 1 and jointed links 2 to facilitate its being lifted from the lower part of the casing.

What I claim is:—

1. A turbo-blower of the kind herein referred to, comprising a stationary casing having inlets for fluid at its opposite ends and a central delivery chamber for compressed fluid, a driving shaft extending centrally through said casing and carried by bearings in the end walls of said casing, two co-acting sets of rings of stator and impeller blades of gradually increasing diameter and decreasing radial width arranged within said casing at opposite sides of said delivery chamber so that the passages for fluid from the inlets to the delivery chamber are of decreasing cross sectional area, and two sets of rotary discs fixed to said shaft, at opposite sides of said delivery chamber and carrying said rings of impeller blades, each set of said discs extending through the corresponding set of rings of stator blades and bearing one against the other.

2. A turbo-blower of the kind herein referred to, comprising a stationary casing having inlets for fluid at its opposite ends and a central delivery chamber for compressed fluid, two sets of rings of stator blades fixed within said casing and arranged at opposite sides of said chamber, said rings of stator blades being of increasing diameter toward said chamber but of decreasing radial width, a driving shaft extending through said casing and co-axial with said rings of stator blades, two sets of rings of impeller blades also arranged at opposite sides of said chamber and of gradually increasing diameter towards said chamber but of decreasing radial width, arranged to revolve past the stator blades, the rings of stator blades and impeller blades in each set being alternately arranged and near together throughout the set, and discs carrying the sets of impeller blades, fixed to said shaft, extending through the rings of the stator blades and bearing directly one against the other.

3. A turbo-blower of the kind herein referred to, comprising a stationary casing shaped internally to form oppositely arranged truncated conical chambers having their smaller ends remote from each other and provided with inlets for fluid and their larger ends facing one another and a compressed fluid delivery chamber between the larger ends of said conical chambers, two sets of stators secured in said conical chamber at opposite sides of said delivery chamber, each set being constituted by rings or blades of increasing diameter but of decreasing radial width towards said delivery chamber, a driving shaft extending through and coaxial with said conical chamber and two sets of impellers fixed to said shaft at opposite sides of said delivery chamber, each set of impellers comprising a set of solid discs of increasing diameter towards said delivery chamber and peripheral rings or blades carried by said discs, the rings of impeller blades being arranged alternately with the rings of stator blades and near thereto throughout the set and of increasing diameter but of decreasing radial width towards said delivery chamber, and the impeller discs being held firmly one against the other to form practically a solid core extending through the corresponding set of rings of stator blades.

4. A turbo-blower of the kind herein referred to, comprising a stationary casing with air inlets at its opposite ends and a central compressed air delivery chamber, rings of stator blades of increasing diameter and decreasing radial width fixed within said casing at opposite sides of said delivery chamber, rings of impeller blades, also of increasing diameter and decreasing radial width, arranged at opposite sides of said delivery chamber, a driving shaft coaxial with said rings of stator and impeller blades, two sets of impeller discs carrying the impeller blades and means within said casing for holding the discs in each set firmly on said shaft and one against the other to form a solid core extending through the corresponding rings of stator blades, the discs in each set being of gradually increasing diameter towards the delivery chamber so that the passage way through the rings of stator and impeller blades and between the casing and impeller discs is of decreasing cross sectional area towards the said delivery chamber, substantially as described for the purpose set forth.

5. A turbo-blower of the kind herein referred to, comprising a stationary casing having end covers with inlets for fluid and a central compressed air delivery chamber, two sets of multi-stage impellers and stators arranged within said casing at opposite sides of said delivery chamber, bearings carried by said end covers, a shaft extending through said casing and bearings and carrying said impellers and nuts adjustable on said shaft and bearing against the outer side of said end covers whereby the shaft and impellers can be adjusted endways relatively to said stators.

6. A turbo-blower of the kind herein referred to, comprising a stationary casing having end covers with inlets for fluids and a central compressed air delivery chamber, two sets of multi-stage impellers and stators arranged within said casing at opposite sides of said delivery chamber, bearings carried by said end covers, a shaft extending through said casing and bearings and carrying the impellers, and a stationary bearing fixed in

said delivery chamber and serving to support the central portion of said shaft, the last mentioned bearing being provided at its opposite sides with outer peripheral rings of blades to form additional stators opposite the innermost rings of impellers, substantially as described.

7. A turbo-blower comprising a divided casing shaped internally to form two oppositely arranged truncated conical chambers and between such chambers a delivery chamber having an outlet for compressed fluid, end covers secured to the casing and provided with inlets for fluid, an endways adjustable driving shaft extending through said casing and end covers and mounted in bearings carried by said end covers, a bearing located in said delivery chamber and adapted to support the central portion of said shaft, a series of annular sets of stator blades fixed in each truncated conical chamber, a series of annular sets of impeller blades arranged to rotate opposite the stator blades, the rings of stator and impeller blades being arranged alternately and near together throughout the series and solid rings or discs fixed to the driving shaft and carrying the impeller blades, said rings or discs extending through the rings of stator and impeller blades and bearing directly against one another substantially as described.

Signed at Manchester, England, this second day of June 1922.

JAMES SAY.