E. S. G. REES.

CENTRIFUGAL PUMP, TURBINE, AND COMPRESSOR.

APPLICATION FILED NOV. 22, 1907.

1,068,365. Patented July 22, 1913.

4 SHEETS—SHEET 1

Fig. 1.

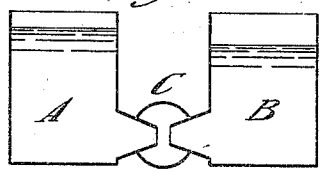


Fig. 2.

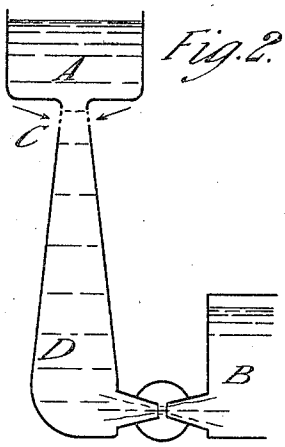


Fig. 3.

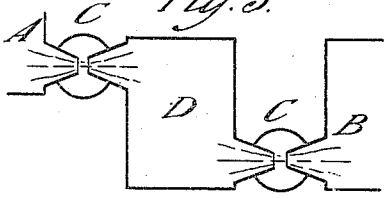


Fig. 4.

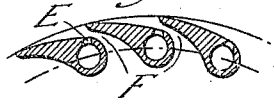


Fig. 5.

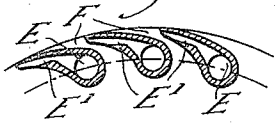


Fig. 4a.



Fig. 5a.



Fig. 6.

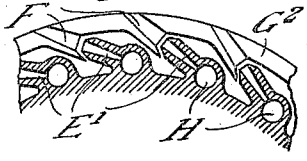
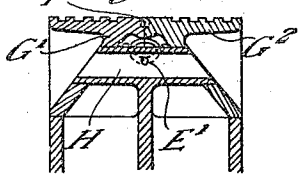


Fig. 6a.



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4 SHEETS—SHEET 2.

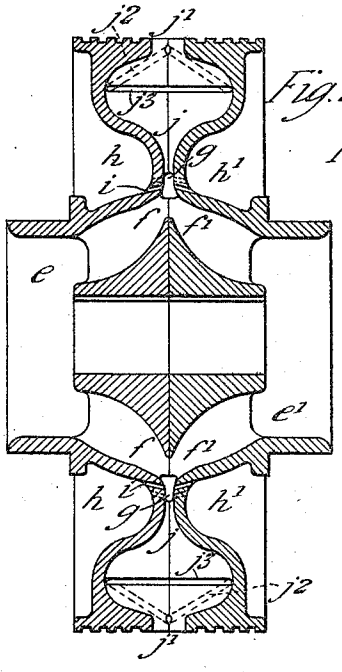


Fig. 7.

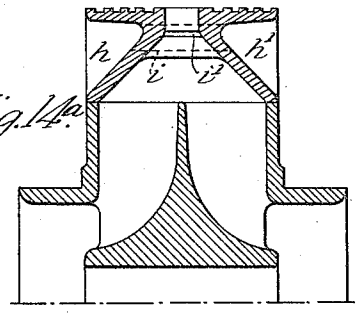


Fig. 14a.

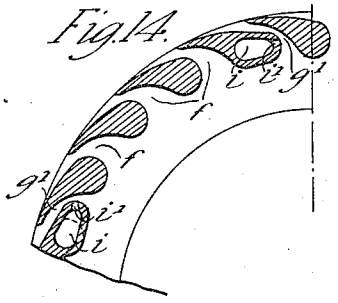


Fig. 14.

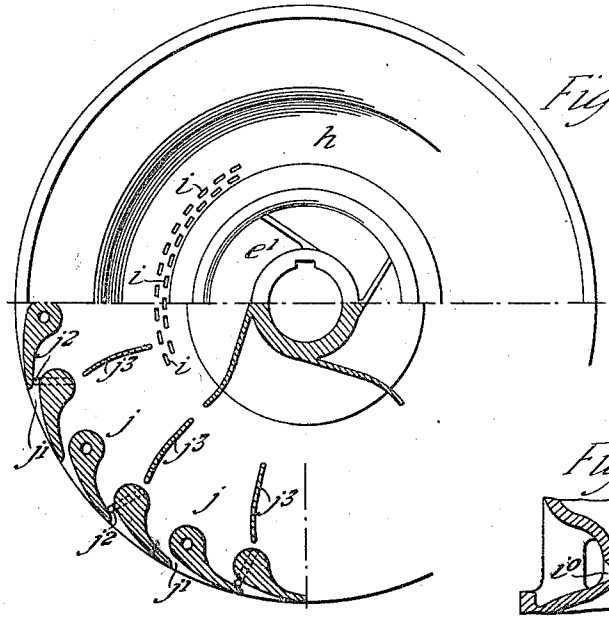


Fig. 8.

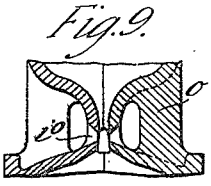


Fig. 9.

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4 SHEETS—SHEET 3.

Fig. 11.

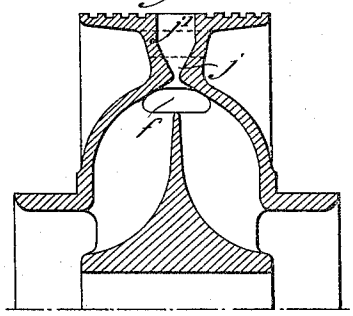


Fig. 10.

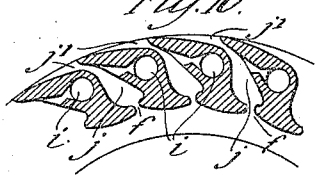


Fig. 13.

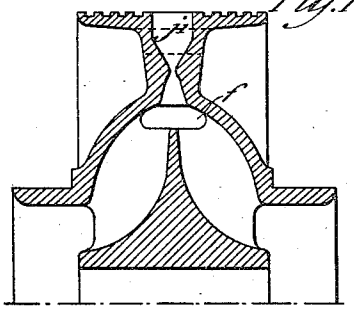


Fig. 12.

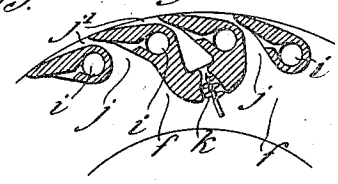


Fig. 15.

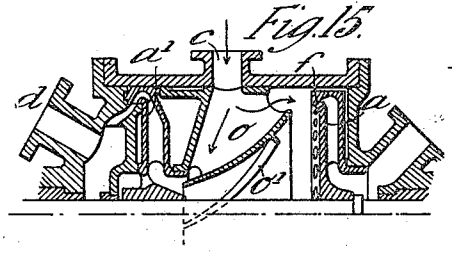
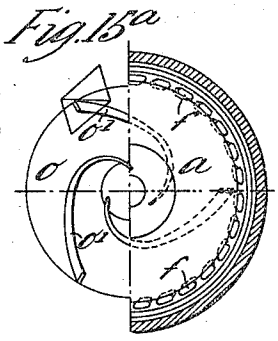


Fig. 15a



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4 SHEETS—SHEET 4.

Fig. 16a.

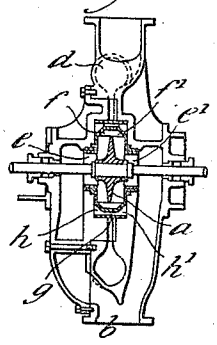


Fig. 16.

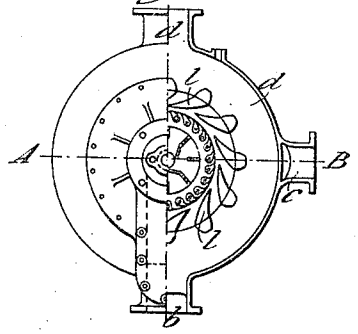


Fig. 16b.

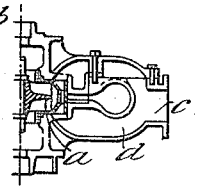
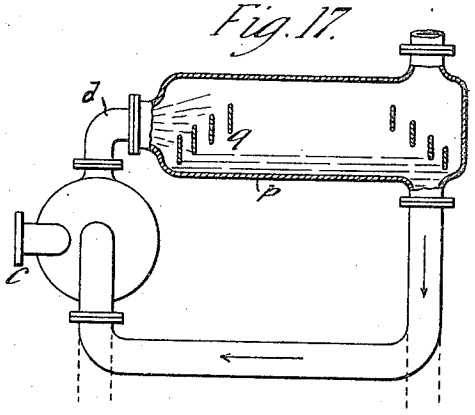


Fig. 17.



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UNITED STATES PATENT OFFICE.

EDMUND SCOTT GUSTAVE REES, OF DUNSCAR, OAKEN, NEAR WOLVERHAMPTON, ENGLAND.

CENTRIFUGAL PUMP, TURBINE, AND COMPRESSOR.

1,068,365. Specification of Letters Patent. Patented July 22, 1913.

Application filed November 22, 1907. Serial No. 403,408.

To all whom it may concern:

Be it known that I, EDMUND SCOTT GUSTAVE REES, a subject of the King of Great Britain, residing at Dunscar, Oaken, near Wolverhampton, in the county of Stafford, England, have invented certain new and useful Improvements in Centrifugal Pumps, Turbines, and Compressors, of which the following is a specification.

This invention relates primarily to the application of apparatus such as described in the specifications of my pending applications of 13 September 1906 Serial No. 334,456 and of 22 June 1907 Serial No. 380347 to the extraction of air and other non-condensable gases, and their delivery, if desired, under pressure so that such apparatus may be adapted to be used, for example as an air compressor.

The essential feature of such apparatus consists in a rotary chamber in which a considerable body of liquid is stored and maintained at a high pressure and from which it is discharged at a high velocity through a constricted peripheral outlet or outlets into an expanding passage or passages or chamber in a fixed casing surrounding the rotary reservoir so that there will be produced at the constriction of the discharge passage or passages, that is to say at or within the point at which the liquid leaves the rotary member, a considerable vacuum which is utilized for the exhaustion of air or other non-condensable gases from inclosed spaces, or for the delivery of such gases under pressure to a receiver, the velocity at which the gases are ejected from the rotary member being converted into pressure by any suitable known means.

The space to be exhausted or the source of air or other gas or gases may be connected with the interior of the discharge outlet or outlets of the rotor which for this purpose may consist of one or more peripheral constrictions from which the fluid is discharged in an annular sheet or sheets or may alternatively be place in communication with the passage or passages within the rotor casing into which the fluid is discharged from the rotor.

The apparatus may also be applied to extract energy from air or other gas or gases under pressure, in which case the source of the gas or gases may be placed in communication with the interior of the discharge outlet of the rotor or of the passage within the casing, and the gases mixed with the water before or after being discharged from the rotor. In the former case the energy or part of the energy derivable from the pressure of the gases is given up to the rotor, and in the latter case the mixed gases and water are led to a second rotor of the same or other suitable character and their energy given up thereto. In both cases the temperature of the gases, which initially may be very great, for example in the case of a gas turbine in which the pressure gases are derived from the explosion of a combustible mixture, is reduced at an early stage to such a value as will practically eliminate the destructive effects of such hot gases on the apparatus.

In the accompanying drawings: Figures 1, 2, 3, are diagrammatic illustrations of the principles underlying the invention; Figs. 4, 4ª show diagrammatically forms of gas and water nozzles, the former with contracting outlets; Figs. 5, 5ª, 6 and 6ª show gas nozzles with expanding outlets; Figs. 7 and 8 are respectively a longitudinal section and side sectional elevation of an impeller; Fig. 9 is a modified annular duct for the impeller shown in Figs. 7 and 8; Figs. 10, 11, 12 and 13 are modified gas and water nozzles; Figs. 14, 14ª, 15 and 15ª modified portions of an impeller; Figs. 16, 16ª and 16ᵇ are respectively a transverse sectional elevation, a longitudinal section and a part section on line A B of Fig. 16 of a gas turbine or extractor; and Fig. 17 shows diagrammatically the application of the invention to an air compressor.

The principles underlying the invention can be illustrated by reference to Figs. 1, 2 and 3 of the accompanying drawings in which Fig. 1 shows a reservoir A containing liquid under pressure due to gravity, which pressure is partially converted into velocity at the interrupted nozzle C and the velocity

re-converted into pressure in the chamber B. The air or gas, being usually at higher pressure than the liquid at the interrupted nozzle, is drawn into the liquid stream at that point, or it may be admitted thereto through suitable nozzles which impart a velocity to the gas so that it impinges on the liquid stream and mixes with it, increasing its velocity.

In Fig. 2 the liquid passage is not completely interrupted at the point C where the gas is admitted, and the velocity of the mixed stream is converted into pressure by being led through an expanding passage to a lower part D of the same reservoir. This pressure is converted into velocity and the velocity reconverted into pressure in the discharge reservoir B by means of the discharge nozzle and expanding passage leading to the said reservoir as in the case of Fig. 1.

In Fig. 3 the increased flow of liquid through the nozzle C and the consequently increased vacuum at that point is obtained by means of a second chamber D having a discharge nozzle C at a lower level than the chamber A, directed toward an expanding passage leading into the discharge reservoir B.

According to the present invention, instead of producing the pressure in the liquid by gravitation as in the above illustration, the pressure is created by means of a rotary pressure producing chamber or impeller of the character described in the specification of 13 Sept. 1906 S. No. 334456 in which the discharge outlet of the impeller may consist of a series of peripheral nozzles, or it may be of a continuous peripheral slot.

In the case of a gas extractor or air compressor in which the gas is admitted to the liquid stream at a pressure which does not greatly exceed that of the liquid at that point, the gas inlet passage or passages E would contract to the point of junction with the liquid passage F, as shown in Figs. 4, 4ª, while in the case of a gas turbine in which the pressure of the gas is considerable, its potential energy is extracted by conversion into kinetic energy on its passage through the discharge nozzles, and for this purpose the gas inlet passages are made after the well known Delaval type of expansion nozzle and are directed with the liquid stream against the direction of rotation of the pressure producing chamber as shown in Figs. 5, 5ª, 6 and 6ª. Fitting a nozzle of this character into the water discharge nozzles of the impeller, it will be seen that for an exhausting pump the passage through which the gas is discharged into the liquid stream will be cut off at the point of maximum constriction as shown at E in the single duct nozzle of Fig. 4 and in the multiple duct nozzle of Fig. 4ª, and will be directed substantially toward the point of maximum constriction of the water discharge nozzle F. In the case of a gas turbine, on the other hand, the gas expansion nozzle will include a greater or less length of outwardly flaring passage E′ which is directed rearwardly into the water stream as shown in Figs. 5 and 5ª.

In Figs. 6 and 6ª, a constructional form of gas and water nozzles is shown which may be applied either to gas extractors or gas turbines, and the advantage of which is that, being circular in cross section, both the water nozzles F and the gas nozzles E′ may be drilled out, the water nozzles being formed in two half rings G′, G², which are afterward bolted together and are arranged to be held in position partly by the laterally extending gas branches H in which the gas nozzles are formed. As shown in the drawings the gas nozzles E′ are expansion nozzles adapted for a turbine and are co-axial with the water nozzles F, but obviously the same construction may be applied to gas extractors having nozzles such as shown in Figs. 4, 4ª.

The above mentioned or other suitable arrangements of nozzles may be applied to any of the forms of apparatus hereinafter described, the drawings illustrating which are for the most part to be regarded merely as diagrammatic and not as exhibiting the actual constructional details.

Figs. 7 and 8 show an impeller of the kind described in the specification of 13 Sept. 1906 S. No. 334456 showing one way in which the said impeller may be adapted for the purposes of the present invention. This particular form of impeller is not only balanced by making both the water and the air or other gas or gases to enter at both sides of the impeller but is also duplicated in another respect by the addition of an impeller of larger diameter on the same plane as the first impeller, in the manner indicated diagrammatically in Fig. 2 in the case of gravitationally produced pressures, so as to maintain or increase the vacuum at the discharge nozzles of the inner impeller by the suction of the outer impeller, the issuing stream of mixed water and gas being rearwardly directed on leaving the outer impeller so as to utilize the speed energy of the stream in turbine effect by reaction on the revolving wheel.

The water enters the impeller at the two opposite eyes e, e', into the two sets of water passages f, f', which converge into a central annular duct g or alternatively to a series of peripheral nozzles, on either side of which duct or nozzles are annular gas chambers h, h', into which the air or gas is admitted by any suitable connection from the space to be exhausted of such air or gas.

The walls of the duct g are perforated at intervals by a series of gas ducts i connecting the chambers h, h', with the water duct g at or near the point of maximum constriction of the latter. Alternatively the walls of the inner and outer impellers may be interrupted by a continuous annular duct i^0 as shown in Fig. 9, the two impellers being connected by ties or webs such as o. The duct g expands into the outer pressure producing chamber j into which the mixed stream is discharged, this chamber forming an external pump impeller having preferably rearwardly directed discharge nozzles j' at its periphery such as described in the specification already referred to.

To prevent any possibility of aggregation of gas in the chamber j in the region of minimum pressure, this region is connected by ducts j^2 with the discharge nozzles j' so as to extract such uncondensed gases. To check any such tendency to an aggregation of gas, and to cause the water to revolve with the chamber, the external chamber j is also preferably subdivided by vanes j^3 as shown.

The entraining or admixture of the air or gases with the liquid stream may be effected or facilitated if the water is projected in jets or sprayed into the various compartments j into which the gas nozzles i deliver, as shown in Figs. 10 and 11, and 12 and 13, the mixed stream of gas and water being discharged through common peripheral discharge nozzles j' into the expanding ducts of the outer casing not shown in these figures. In Figs. 12 and 13 the water passages f are fitted with spiral distributers k to give a rotatory motion to the issuing jets of water in the known manner so as to facilitate the admixture of the water with the gas in the compartments j.

In the impeller illustrated in Figs. 14 and 14^a, only a proportion of the water nozzles are used for the extraction of gases and these nozzles g', may be designed as shown with a greater constriction than the remainder of the nozzles, followed by an expansion so as to give a high vacuum in the chambers h h', gas ducts i, and gas nozzles i'.

Figs. 15 and 15^a, show a modification of the construction of Figs. 10 and 11, in which the discharge nozzles f of the impeller a are inwardly directed as described in specification of 13 Sept. 1906 S. No. 334456, with reference to Fig. 6 of the drawings of that specification. The streams of water issuing from the nozzles f are directed at a high velocity into a fixed casing o, which is in communication with the gas inlet pipe c, and which is preferably designed as shown to give a rotary movement to the mixed stream of water and the gas entrained therewith by means of the internal spiral guides or ribs o'. The casing o has a contracting channel which delivers the mixed stream into an expanding pipe or into the eye of a second impeller a' mounted on the same shaft as the impeller a and discharging into expanding ducts in the fixed casing leading to the delivery pipe d. As shown in the drawing the gas or air may in part be drawn in with the stream entering the eye of the second impeller.

The complete machine which is represented in Figs. 16, 16^a and 16^b may be adapted either as a gas extractor or as a gas turbine, the gas nozzles in the latter case being of the character illustrated in Fig. 5. The water and gas are in this case both admitted to the two sides of the central partition of the impeller a, the water by the pipe b and the gas by the pipe c, so as to balance end thrust on the shaft bearings, and the joint stream is discharged from the peripheral nozzles g into expanding ducts in the fixed casing formed by the cut-waters l. The same reference letters are applied to these figures as have been used for corresponding parts in the constructions hereinbefore described.

In an air compressor as represented in Fig. 17, both the suction pipe b and delivery pipe d of an apparatus such as illustrated in Fig. 16 are connected with the air receiver p into which the mixed stream of air and water are delivered under pressure from the impeller casing, the air being sucked in by the action of the impeller as already described through the air inlet pipe c. Baffles q may be provided in the receiver to aid the separation of the air and water.

In each of the constructions above described whether in the case of a vacuum pump, compressor, or gas turbine it will be noted that a mass of liquid is raised to a considerable pressure by rotation of a containing reservoir, and this pressure is in part converted into velocity by means of a suitably formed constricted outlet or outlets from the pressure producing chamber or reservoir thereby reducing the pressure locally and entraining the air or other gas or gases by what may be called the "Venturi" effect, the speed energy of the mixed stream being afterward converted into pressure or utilized in a suitable turbine as hereinbefore described.

Having thus described the nature of this invention and the best means I know of carrying the same into practical effect, I claim:—

A rotary vacuum pump compressor or gas turbine comprising a rotor which is constructed with a reservoir of large capacity wherein liquid is stored under pressure due to centrifugal force, passages lead-

ing from said reservoir to the periphery of the rotor, said passages comprising compartments connected by ducts with a supply of gas and short constricted discharge nozzles, and means for projecting the liquid in the reservoir into the said compartments in a sub-divided condition.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EDMUND SCOTT GUSTAVE REES.

Witnesses:

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JOSEPH MILLARD.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."