No. 888,192. PATENTED MAY 19, 1908.

E. S. G. REES.

CENTRIFUGAL PUMP AND TURBINE.

APPLICATION FILED NOV. 22, 1907.

2 SHEETS—SHEET 1.

Fig. 1.

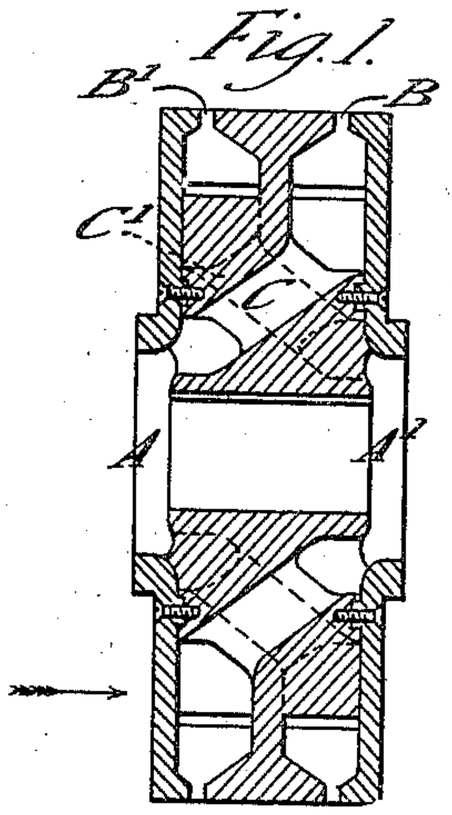


Fig. 2.

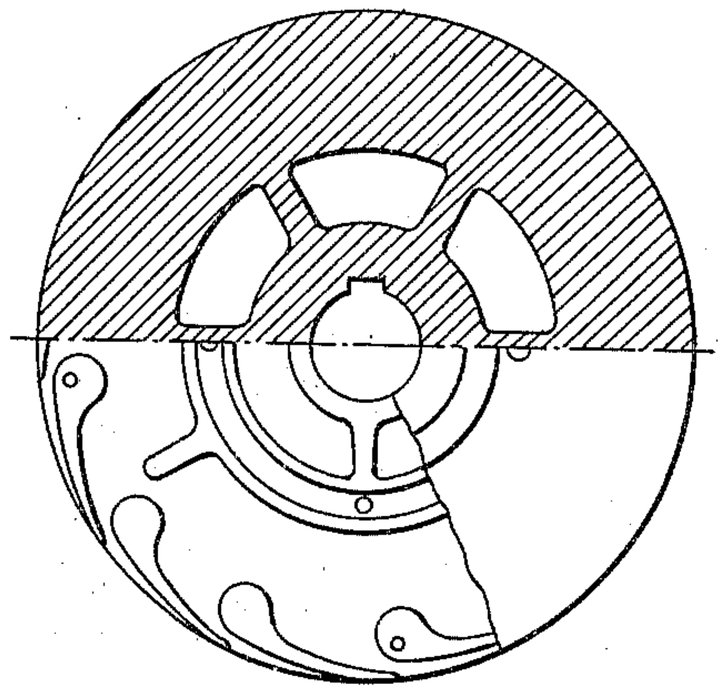


Fig. 3.

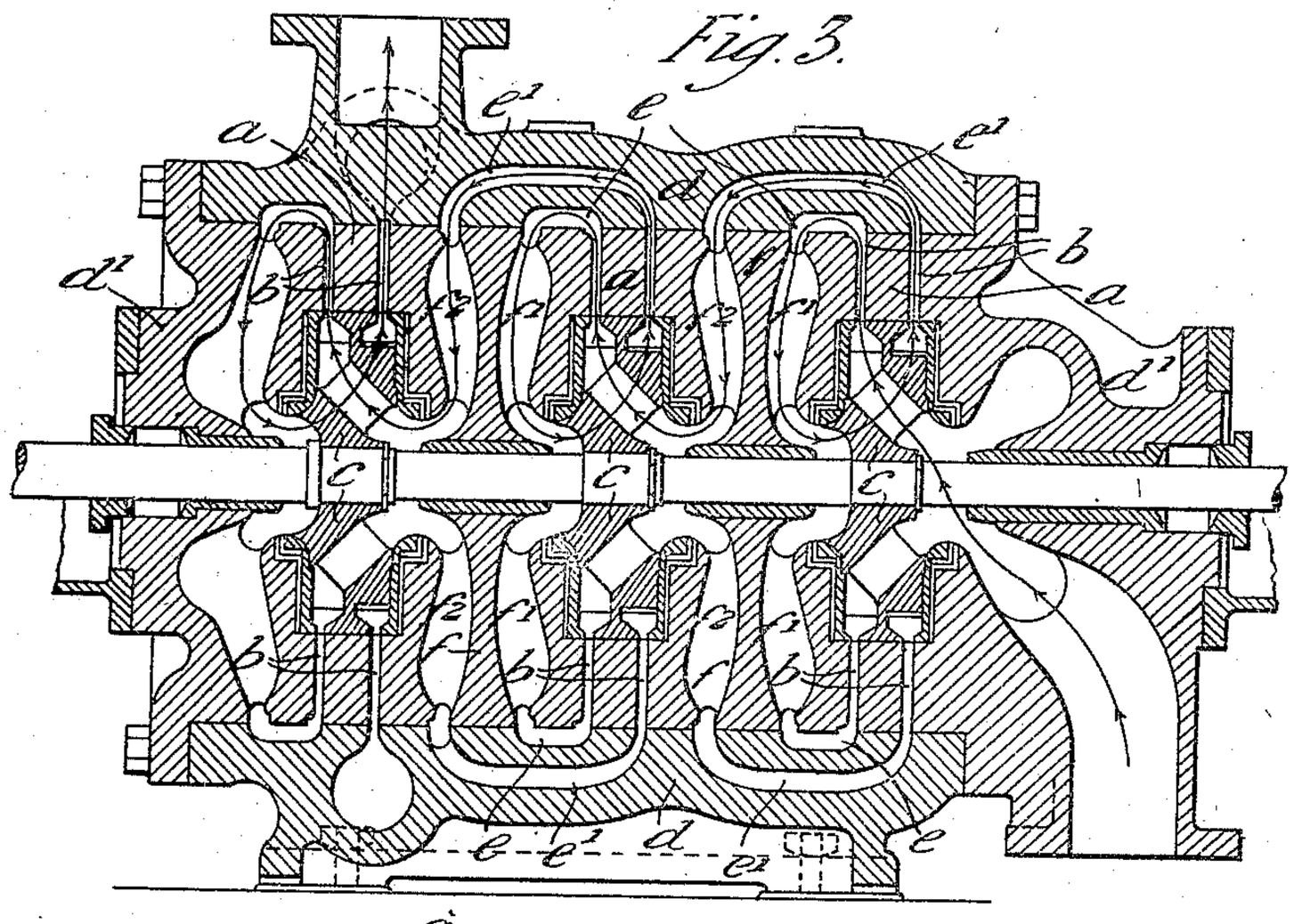
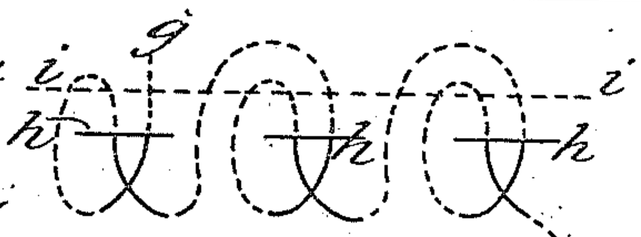


Fig. 3a



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2 SHEETS—SHEET 2.

Fig. 5.

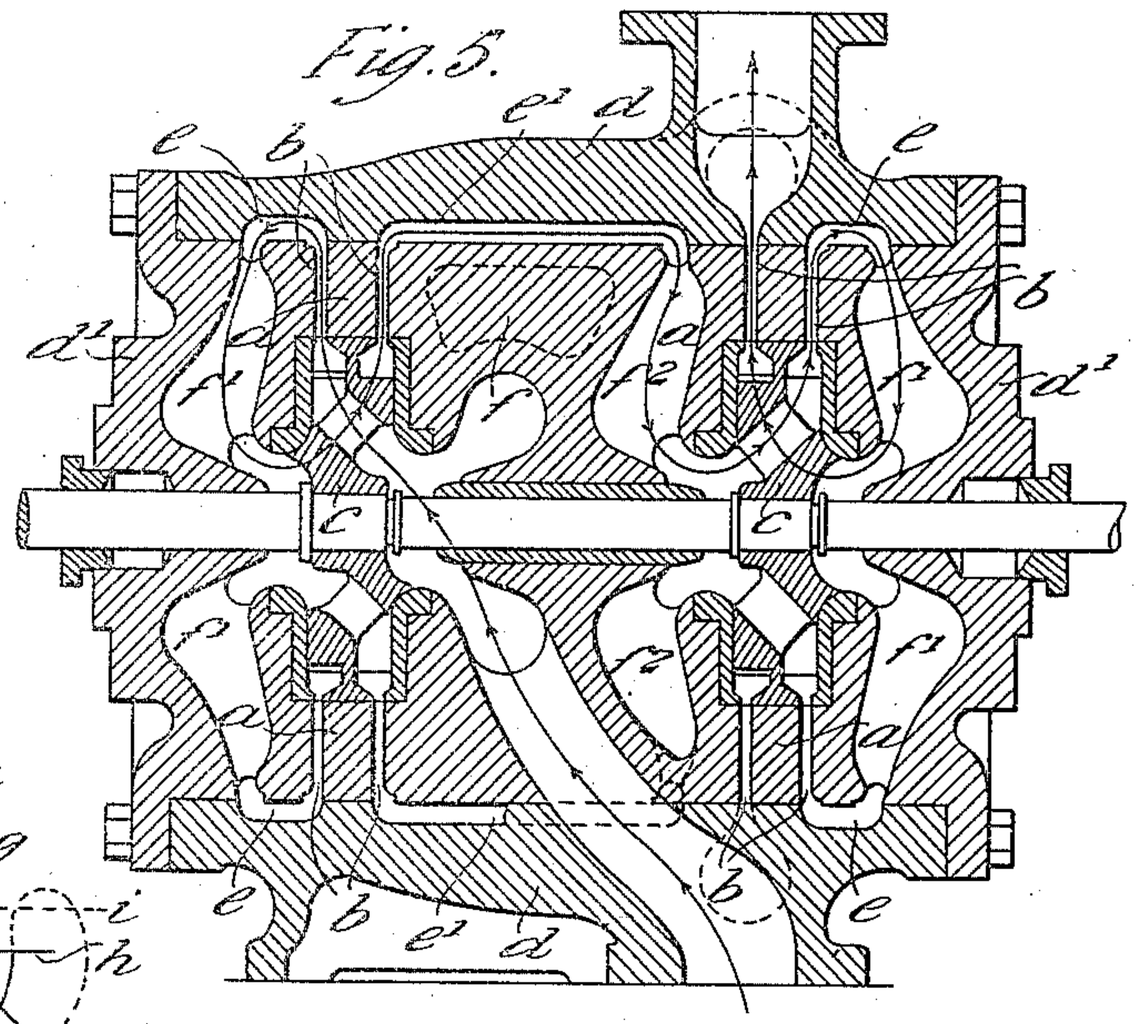


Fig. 5a

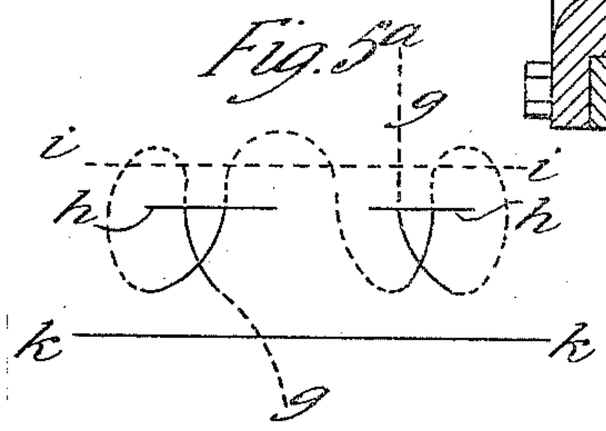


Fig. 4.

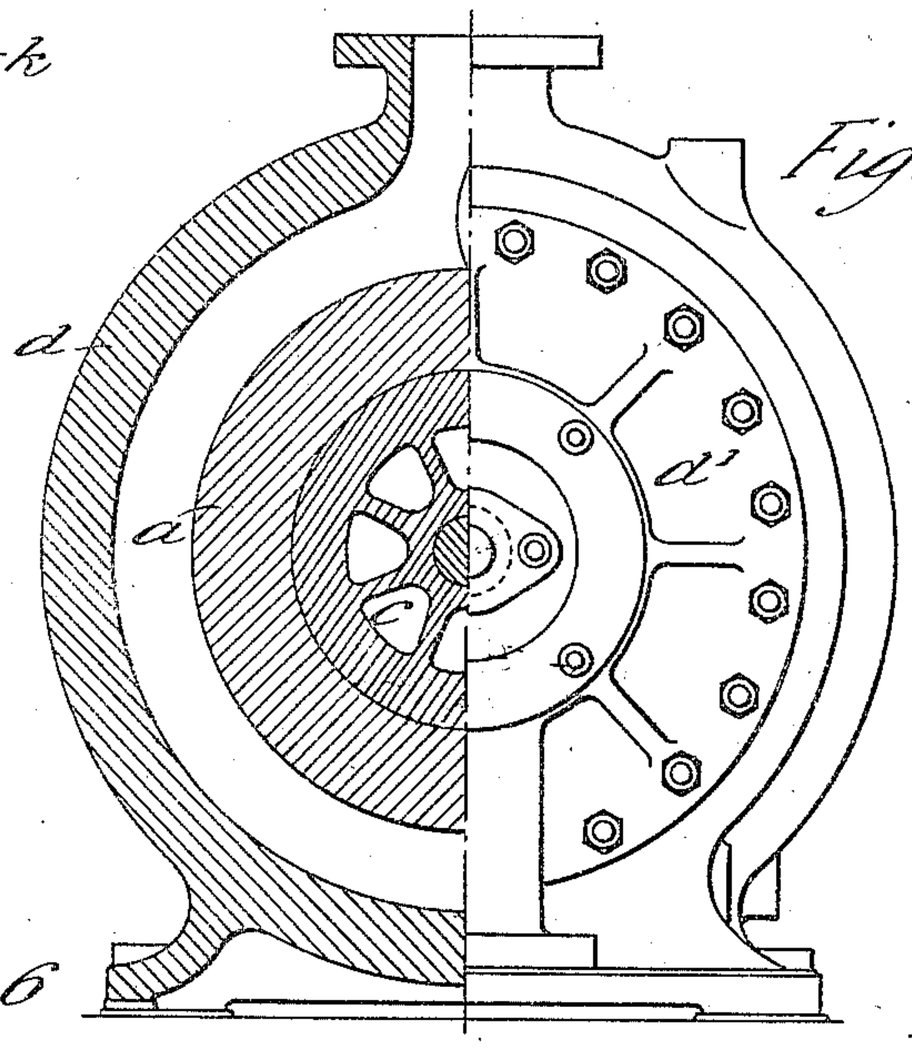


Fig. 6

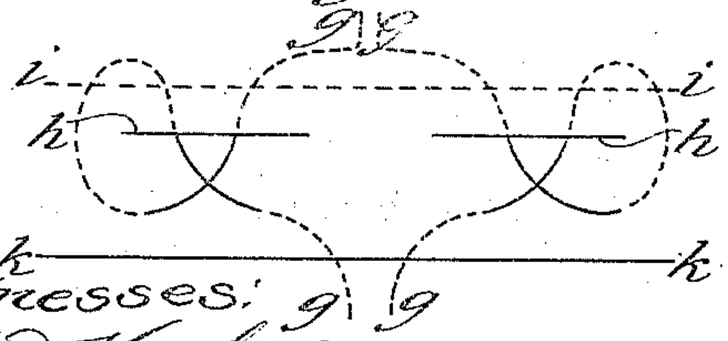
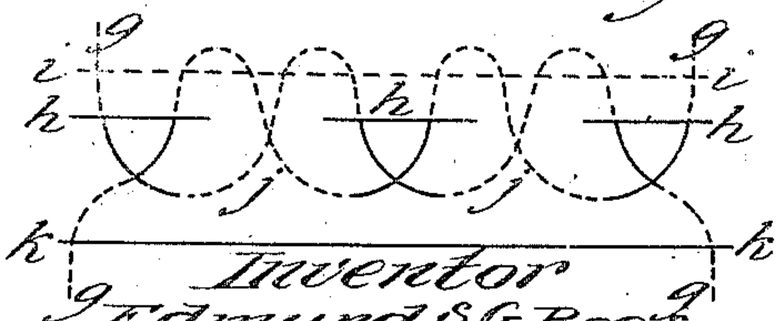


Fig. 7.



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UNITED STATES PATENT OFFICE.

EDMUND SCOTT GUSTAVE REES, OF DUNSEAR, OKEN, NEAR WOLVERHAMPTON, ENGLAND.

CENTRIFUGAL PUMP AND TURBINE.

No. 888,192. Specification of Letters Patent. Patented May 19, 1908.

Application filed November 22, 1907. Serial No. 403,409.

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 Dunsear, Oken, near Wolverhampton, in the county of Stafford, England, have invented certain new and useful Improvements in and Relating to Centrifugal Pumps and Turbines, of which the following is a specification.

This invention relates to multi-stage centrifugal pumps and turbines and has for its main objects to simplify the construction of such pumps and turbines, and to afford a smooth flow for the fluid throughout its passage from the inlet to the discharge pipe. These objects are attained by using one or more rotors of the kind characterized by a central fluid pressure reservoir of large capacity compared with the total cross section of the peripheral outlet, such as the impeller or rotor described in my pending application of 13 Sept. 1906, S. No. 334,456, in which the fluid under pressure in such a reservoir is discharged through a series of peripheral nozzles or orifices, and by dividing such rotor or rotors by a central web into two separate fluid pressure reservoirs each having a constricted peripheral outlet or series of nozzles discharging into separate sets of expanding channels or other suitable chamber or chambers in the cutwater ring or casing. The dividing web is so formed that the fluid which enters on the left is discharged from the right hand outlet and the fluid which enters at the right eye is discharged from the left hand outlet.

The invention is illustrated in the accompanying drawings, in which

Figure 1 is a central longitudinal section and Fig. 2 a sectional elevation looking in the direction of the arrow in Fig. 1 and with part of the end plate removed of an impeller or rotor such as referred to; Fig. 3 is a longitudinal section, and Fig. 4 a transverse sectional elevation of a multiple stage pump with three double impellers; Fig. 5 is a longitudinal section of a series of balanced pumps; Figs. 3^a, 5^a, 6 and 7 show diagrammatically the paths referred to below, of the fluid through the various machines.

As shown in Fig. 1 the left eye A and the right eye A′ of the impeller are connected with the right hand peripheral outlet B and left hand outlet B′ respectively by interlaced passages C C′ in the body of the impeller or rotor.

With such a construction of rotor, a two stage centrifugal pump or turbine is obtained by connecting the expanding channels into which one of the fluid pressure reservoirs discharges with the eye or inlet on the same side by means of a simple unlooped passage formed in the cover or casing or partly in the cover and partly in the casing.

The complete multi-stage pump constructed according to this invention and as illustrated has three double impellers with interlaced fluid passages as shown in Figs. 1 and 2 are mounted on the same shaft within symmetrically formed cutwater rings *a* having suitable expanding channels *b* which rings are held in place around the rotor members *c* by the pump casing *d* which is bolted to the end covers *d′*. Annular grooves *e* in the inner periphery of the casing connect the left hand channels *b* of each double impeller with a duct *f′* formed in the stationary separating ring *f* between successive impellers and leading to the left hand eye of each double impeller.

Ducts *e′* formed in the casing *d* connect the right hand channels *b* with ducts f^2 on the opposite side of the dividing ring *f* leading to the right hand eye of the succeeding impeller. In this case the partition ring *f* is made symmetrical about its medial plane, the two ducts *f′* f^2 curving outwardly on each side, and the pump casing *d* is a simple cylindrical casting bored to the external diameter of the cutwater and partition rings *a*, *f* and chambered or cored to connect up the fluid passages as described.

In Fig. 5 is shown a balanced multi-stage pump or turbine having two double rotors mounted on one shaft and connected in series with each other but with the fluid path arranged so as to be symmetrical on the two sides of the medial transverse plane, whereby the various pressures which would separately produce end thrust are equilibrated. It will also be noted that the pressures in each of the rotors are also balanced or approximately so because the sum of the pressures of the fluid entering and leaving on one side of the rotor is equal to the sum of the pressures of the fluid entering and leaving on the other side of the rotor.

The same balancing result may be obtained by the parallel arrangement of a multi-stage machine having two double rotors which is illustrated diagrammatically

in Fig. 6, in which two streams of fluid entering the inner edges of the two double rotors and passing twice through their respective rotors are discharged into the cutwater passages corresponding with the two outer edges of the rotor and leading to the delivery pipe. The path of the fluid in each half of the machine is indicated by the full and broken lines *g*, *g*, the full part being that portion of the path within the rotor and the broken part that portion of the path in the stationary parts of the machine. The full lines *h*, *h*, represent the periphery of the rotor and the dotted line *i i* the periphery of the cutwater ring. The full line *k k* represents the center line of the shaft. Alternately the inlet may be connected with the two outer eyes and the delivery with the cutwater passages corresponding with the two inner eyes of the rotor.

The path of the fluid in the multi-stage pump of Fig. 3 and in the series balanced pump illustrated in Fig. 5 may be exemplified in the same manner, as shown in Figs. 3^a, 5^a, respectively, in which the reference letters have the same significations as in Fig. 6.

In an alternative arrangement of multiple series balanced pump or turbine illustrated diagrammatically in the same manner in Fig. 7, the inlet is connected with the outer eyes of the two outside rotors of the series, and the cutwater and partition ring passages are arranged to lead the fluid which enters at the left hand rotor of the series successively into the left hand eye of each succeeding double rotor, while the fluid which enters at the right hand rotor is led successively into the right eye of each rotor of the series. In this case the cutwater ring or casing passages are also crossed or interlaced as shown at *j*, *j*, but the path of each stream of fluid has a simple wave shape with no loops. It will be obvious, however, that the interconnections of the rotors in a multi-stage centrifugal pump or turbine such as described may be varied in a number of ways, thereby involving constructional modifications in the cutwater and partition rings and casing, and the present invention is not restricted to the particular constructions of these parts hereinbefore described, the essential feature of the invention being the double internal pressure reservoir having fluid passages which cross each other within the body of the rotor.

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

1. In multi-stage centrifugal pumps and turbines, a rotor comprising two fluid pressure reservoirs separated by a central partition having fluid passages which cross each other within the body of the rotor to connect the left hand reservoir with the right hand inlet or eye, and the right hand reservoir with the left hand inlet, and means for leading the fluid from the delivery side of one reservoir to the inlet or eye of the other reservoir.

2. In multi-stage centrifugal pumps and turbines, a rotor having two fluid pressure reservoirs separated by a central partition, fluid passages in said partition which cross each other within the body of the rotor and connect the left hand reservoir with the right hand eye or inlet and the right hand reservoir with the left hand inlet, a cutwater ring having duplicate sets of expanding channels into which the two reservoirs respectively discharge, a partition ring between successive rotors having ducts on each side of the dividing partition, and a casing chambered or cored to connect the two sets of cutwater ducts respectively with the two partition ring ducts, substantially as described.

3. In centrifugal pumps and turbines, a plurality of rotors mounted on one shaft, each rotor having a pair of fluid reservoirs separated by a central partition and acting as centrifugal pressure accumulators and having fluid passages across each other within the body of said rotor, and a fixed casing having expanding ducts connecting the discharge and inlet openings of different reservoirs in pairs, said connections being so arranged that end thrust on the shaft is annulled, substantially as described.

4. In centrifugal pumps and turbines, a plurality of rotors mounted on one shaft, each rotor having a pair of fluid reservoirs separated by a central partition and acting as centrifugal pressure accumulators, and a fixed casing having expanding ducts connecting the inlet and discharge openings of different reservoirs, said connections being arranged to lead the fluid through one reservoir in each of the rotors, substantially as described.

5. In centrifugal pumps and turbines, a plurality of rotors mounted on one shaft, each rotor having a pair of fluid reservoirs separated by a central partition and acting as centrifugal pressure accumulators, and a fixed casing having expanding ducts connecting the inlet and discharge openings of the said reservoirs, said connections being arranged to lead the fluid through both reservoirs in each of the rotors in succession, substantially as described.

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

EDMUND SCOTT GUSTAVE REES.

Witnesses:
OLIVER IMRAY,
JOSEPH MILLARD.