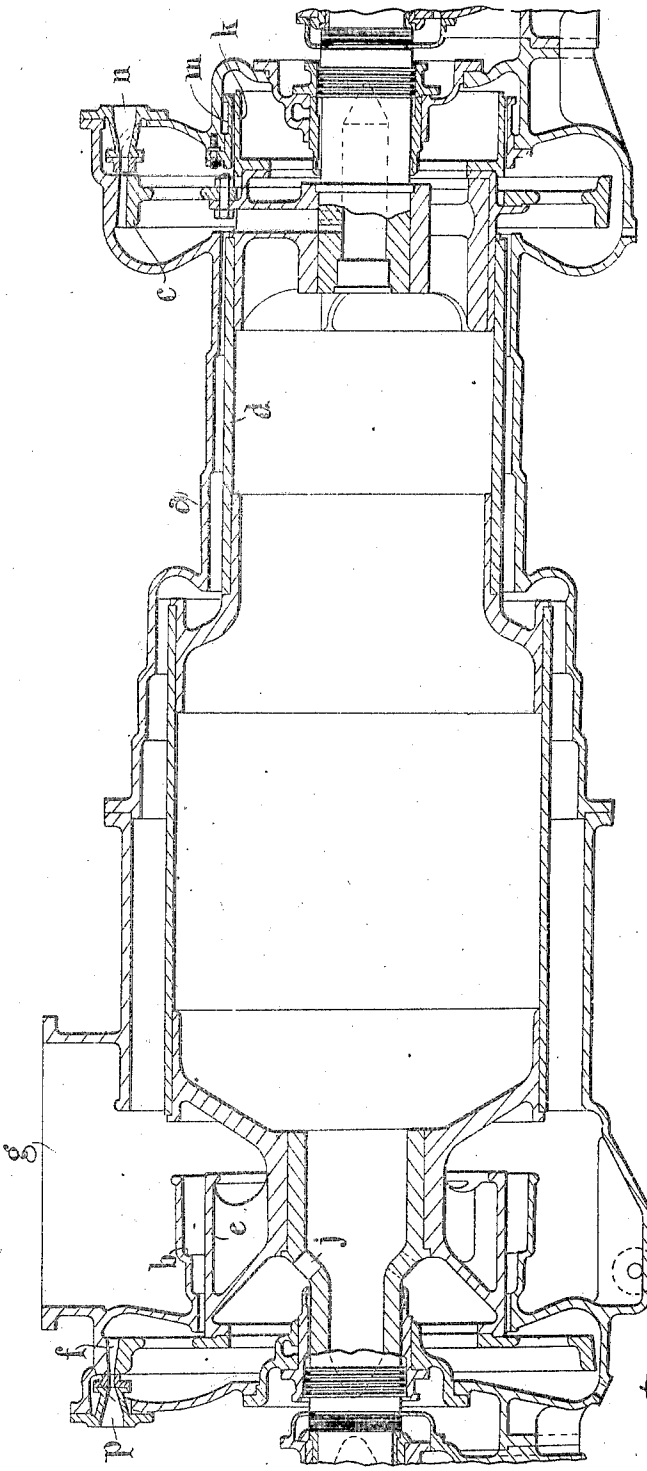
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COMBINED AHEAD AND ASTERN TURBINE.

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COMBINED AHEAD AND ASTERN TURBINE.

1,009,789. Specification of Letters Patent. Patented Nov. 28, 1911.

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To all whom it may concern:

Be it known that we, HERBERT WHEATLEY RIDSDALE, a subject of the King of Great Britain and Ireland, and residing at Capel House, 62 New Broad street, London, E. C., England, and STANLEY SMITH COOK, a subject of the King of Great Britain and Ireland, and residing at Turbinia Works, Wallsend-on-Tyne, in the county of Northumberland, England, have invented certain new and useful Improvements in and Relating to Combined Ahead and Astern Turbines, of which the following is a specification.

This invention relates to improvements in the combination of an ahead and an astern turbine, each of which may form an entire or a portion only of the ahead and astern turbine systems. In such constructions of combined ahead and astern turbines as have hitherto been proposed, it has been usual to provide separate balancing pistons for the ahead and the astern turbines, the steam leaking past such balancing pistons being carried to the common exhaust of the two turbines either through the interior of the rotors or by special pipes provided for that purpose.

The object of the present invention is to provide an improved and simplified arrangement for effecting the balancing of such combined ahead and astern turbine.

The invention consists in an arrangement of combined ahead and astern turbines in which fluid from a stage of one of the turbines is admitted to the interior of a hollow rotor common to both turbines, while a packing separates the rotor interior from the other turbine and thereby enables the required balancing thrust to be obtained with either turbine in operation.

The invention also consists in the improved balancing arrangement of combined ahead and astern turbines as hereinafter described.

Referring now to the accompanying drawing which illustrates one method of carrying the present invention into effect, there is shown in section a combined ahead and astern turbine in which the ahead turbine part comprises an impulse wheel, *c*, followed by a reaction stage, *a*, while the astern turbine comprises an impulse wheel, *f*, followed by a reaction stage, *b*. The rotor, *e*, of the astern turbine reaction stage is supported on an extension of the rotor, *d*, while the impulse wheels *c* and *f* are suitably attached at opposite ends of the rotor, *d*, which is common to both the ahead and astern turbine parts. The reaction stages of both the ahead and astern turbine parts being thus adjacent are arranged to exhaust into a common eduction pipe, *g*, and thus it will be seen that the inactive turbine part always rotates idly in the low pressure steam exhausted from the turbine part in action.

In the arrangement of the combined ahead and astern turbines according to the present invention, the axial thrust produced when the turbine drives a propeller in either direction is balanced by the steam pressure on a balancing piston which is subjected to the fluid pressure in one of the turbine parts only. Such a piston as shown at, *k*, is conveniently placed at the ahead turbine end of the rotor, which, for the purpose of enabling the piston to be subjected to the pressure of the fluid in a stage of the astern turbine, is hollow and open at both ends. The fluid thus passing from the chamber containing the impulse wheel, *f*, through holes *j* enters the rotor interior and thence passes by axial passages, *i*, into the chamber containing the piston, *k*. By providing a packing *m* between the balancing piston, *k*, and the turbine casing, no high pressure working fluid (with the exception of that which may leak through the packing *m*), can pass from the ahead turbine directly into the chamber containing the balancing piston, *k*. It will thus be seen that when the ahead turbine is in action, the rotor interior is filled with low pressure steam, but is filled with higher pressure steam when the astern turbine is in action.

It is sometimes desirable to form the ahead turbine part of the rotor in two parts, *d* and *h*, which are of different diameters and thus provide an annular surface, *q*, at

the place where the two parts meet. As such an annular surface is subjected to a difference of pressure, it can be used as a balancing surface when the ahead turbine is in action. In all cases however, it will be seen that the diameter of the balancing piston, *k*, is determined by arranging that the annular area between it and the mean diameter of the ahead turbine will give with the prevailing pressure the thrust required to balance or the requisite amount in excess of or in defect of the thrust of the propeller when being driven ahead.

During ahead running the working fluid such as steam is admitted to the ahead turbine by means of nozzles, *n*, from which it passes through the blading of the impulse wheel, *c*, and is further expanded in the subsequent reaction stages. The exhaust steam then passes through the reaction blading of the astern turbine, *b*, and enters the rotor interior by means of the holes, *j*, thereby producing a difference of pressure on the opposite sides of the balancing surface, *q*, which, together with the thrust produced on the piston, *k*, is sufficient to produce the required balancing thrust. Similarly when the astern turbine is in action, steam is admitted thereto by nozzles, *p*, and after having passed through the blading of the impulse wheel, *f*, is further expanded in a subsequent reaction stage, the rotor interior being now filled with steam at the pressure of that in the chamber containing the impulse wheel, *f*.

In order to obtain the required balancing thrust, the mean diameter of the astern reaction blading and the balancing piston, *k*, are chosen so that the annular area between the diameter of the balancing piston, *k*, and the mean diameter of the reaction blading, *b*, will give with the prevailing steam pressure, the required balancing thrust.

In some cases a step or annular surface is formed in the astern reaction stage in a manner similar to that shown in the reaction stage of the ahead turbine.

It will be seen that the steam leaking past the labyrinth packing, *m*, between the balancing piston, *k*, and turbine casing, whichever turbine is in operation, passes through the blading of the other turbine, but as the amount of such leakage steam is usually small, no appreciable resistance to rotation will be produced thereby. If desired, however, suitable valves may be provided to connect the admission space of the ahead or astern turbine to the exhaust pipe, which valves may be designed to close when the pressure in this admission space has risen to a given amount, or they may be designed to be so coupled with the ahead and astern admission valves as to be actuated simultaneously and by the same means, or they may be separately hand operated. By this means leakage steam from either turbine can flow directly to the exhaust space without passing through the blading of the other turbine.

As is usual in such turbines, suitable means are provided in order to maintain a constant clearance between the packings, *r*, at the place where the rotor shaft passes through the turbine casing. Such means may consist, as shown, in forming within the rotor shaft, *s*, a chamber, *t*, to which steam is admitted by radial passages, *u*, in the rotor supporting the framework, and in communication with the chamber containing the impulse wheel, *c*.

Instead of arranging the single dummy or balancing piston at the admission end of the ahead turbine, it can be placed at the corresponding end of the astern turbine. With this arrangement the interior of the rotor, when the ahead turbine is in operation will be filled with steam at a pressure corresponding to the pressure of the steam admitted to the ahead reaction blading. The pressure on the gland packings where the rotor shaft passes through the casing will correspond to that obtaining in the interior of the rotor and therefore that in the admission space of either the ahead or astern reaction blading. The hollow rotor may however if preferred be closed by a transverse partition at any point or be closed at both ends. In the latter case the spaces between the ends of the rotor and the turbine casing are placed in open communication with one another by means of a pressure equalizing pipe or pipes external to the turbine casing, or by means of one or more passages formed in the casing itself.

This invention is also particularly applicable to the case in which either the ahead or the astern turbine or both are low pressure turbines of the reaction type; also, it is preferable that the single dummy or balancing piston should be placed at the ahead or astern end of the rotor according to whether the ahead or astern turbine is adapted to work with the high pressure admission steam. By this means the pressure difference on the before mentioned gland packings is reduced to a minimum. The invention can however be also applied to cases in which high pressure admission steam is used for either or both the ahead and astern turbines, the gland packings being suitably designed to withstand the high internal pressures. The invention is also particularly applicable to cases as shown in which one or other of the turbines or both are of the mixed type, viz., consisting in one or more impulse wheels followed by reaction blading.

It will be seen that the actual mechanical

constructions by which the invention can be carried into effect are capable of very considerable modifications without in any way departing from the spirit of the same.

Having now described our invention what we claim as new and desire to secure by Letters Patent is:—

1. A fluid operated turbine having in combination an ahead and an astern turbine part, a hollow rotor common to said parts, working fluid from a stage of one of the turbine parts being admitted to the interior of said rotor, packing means separating the rotor interior from the other turbine part, thereby enabling the required balancing thrust to be obtained with either turbine part in action.

2. A fluid operated turbine having in combination an ahead turbine part and an astern turbine part, a hollow rotor common to said parts, communicating means between the interior of said rotor and a stage of one of the turbine parts, packing means separating said interior from the other turbine part whereby the required balancing thrust is obtained with either turbine part in operation.

3. A fluid operated turbine having in combination an ahead and an astern turbine part, a hollow rotor open at both ends and common to both turbine parts, working fluid from a stage of one of the turbine parts being admitted to the interior of said rotor through one end thereof, packing means near the other end of said rotor, said means separating the rotor interior from the other turbine part, whereby the required balancing thrust is obtained with either turbine part in operation.

4. A fluid operated turbine having in combination an ahead and an astern turbine part, a hollow rotor open at both ends and common to both turbine parts, working fluid from a stage of one of the turbine parts being admitted to the interior of the rotor through one end thereof, a balancing piston attached to the other end of said rotor and subjected to the fluid pressure in said interior, packing means surrounding said piston and separating the other turbine from the rotor interior whereby the required balancing thrust is obtained with either turbine part in operation.

5. A fluid operated turbine having in combination an ahead and an astern turbine part, a hollow rotor common to said parts, means for admitting working fluid from a stage of the astern turbine part into the interior of said rotor, packing means separating said interior from the ahead turbine part whereby the required balancing thrust is obtained with either turbine part in action.

6. A fluid operated turbine having in combination an ahead and an astern turbine part, a hollow rotor common to said parts, fluid from a stage of the astern turbine part being admitted to the interior of said rotor, a balancing piston attached to said rotor at the ahead turbine end thereof, packing means surrounding said piston and separating the rotor interior from the ahead turbine part, the dimensions of said piston being determined with respect to the mean diameter of the ahead and astern turbine parts respectively to give with the prevailing steam pressure the required balancing thrust with either turbine part in action.

7. A fluid operated turbine having in combination an ahead and an astern turbine part, an impulse stage followed by a reaction stage in each of said turbine parts, a hollow rotor common to both turbine parts, working fluid being admitted to the interior of the rotor from the impulse stage of one of the turbine parts, and packing means separating the rotor interior from the other turbine part, whereby the required balancing thrust is obtained with either turbine part in action.

8. A fluid operated turbine having in combination an ahead and an astern turbine part, an impulse stage followed by a reaction stage in each of said parts, a hollow rotor common to said parts and open at both ends, working fluid from the impulse stage of the astern turbine being admitted to the interior of the rotor through one end thereof, a balancing piston attached to the rotor at the head turbine end, packing means surrounding said piston and separating the rotor interior from the ahead turbine part, whereby the required balancing thrust is obtained with either turbine part in action.

9. A fluid operated turbine having in combination an ahead and an astern turbine part within a common casing, a hollow rotor common to both of said parts, means for admitting fluid from a stage of the astern turbine part to the rotor interior, a balancing piston placed at the ahead turbine end of said rotor and subjected to the fluid pressure in the astern turbine part, a packing between said piston and the turbine casing, an annular balancing surface formed on the rotor of one or both of the turbine parts, the dimensions of the balancing piston being chosen with regard to the mean diameter of both turbine parts to give with the prevailing fluid pressure the required balancing thrust with either turbine part in action.

10. A fluid operated turbine having in combination an ahead and an astern turbine part within the same casing, a hollow rotor common to both of said parts and open at both ends, working fluid from a stage of the astern turbine part being admitted to the rotor through one end thereof, a balancing piston carried by said rotor at the ahead

turbine end thereof and subjected to the pressure in the rotor interior, a packing between said piston and the turbine casing, an annular balancing surface formed on the ahead turbine part of the common rotor whereby the dimensions of the balancing piston can be chosen with respect to the mean diameter of the ahead turbine part and of the astern turbine part to give with the prevailing fluid pressure the required balancing thrust with either turbine part in action.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

HERBERT WHEATLEY RIDSDALE.
STANLEY SMITH COOK.

Witnesses to the signature of Herbert Wheatley Ridsdale:
A. E. TAYLOR,
P. A. OUTTWAITE.

Witnesses to the signature of Stanley Smith Cook:
FREDERICK GORDON HAY BEDFORD,
ALBERT WILLIAM PARR.