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No. 871,526. PATENTED NOV. 19, 1907.

M. H. P. R. SANKEY.

REVERSIBLE TURBINE.

APPLICATION FILED SEPT. 4, 1906.

2 SHEETS—SHEET 1.

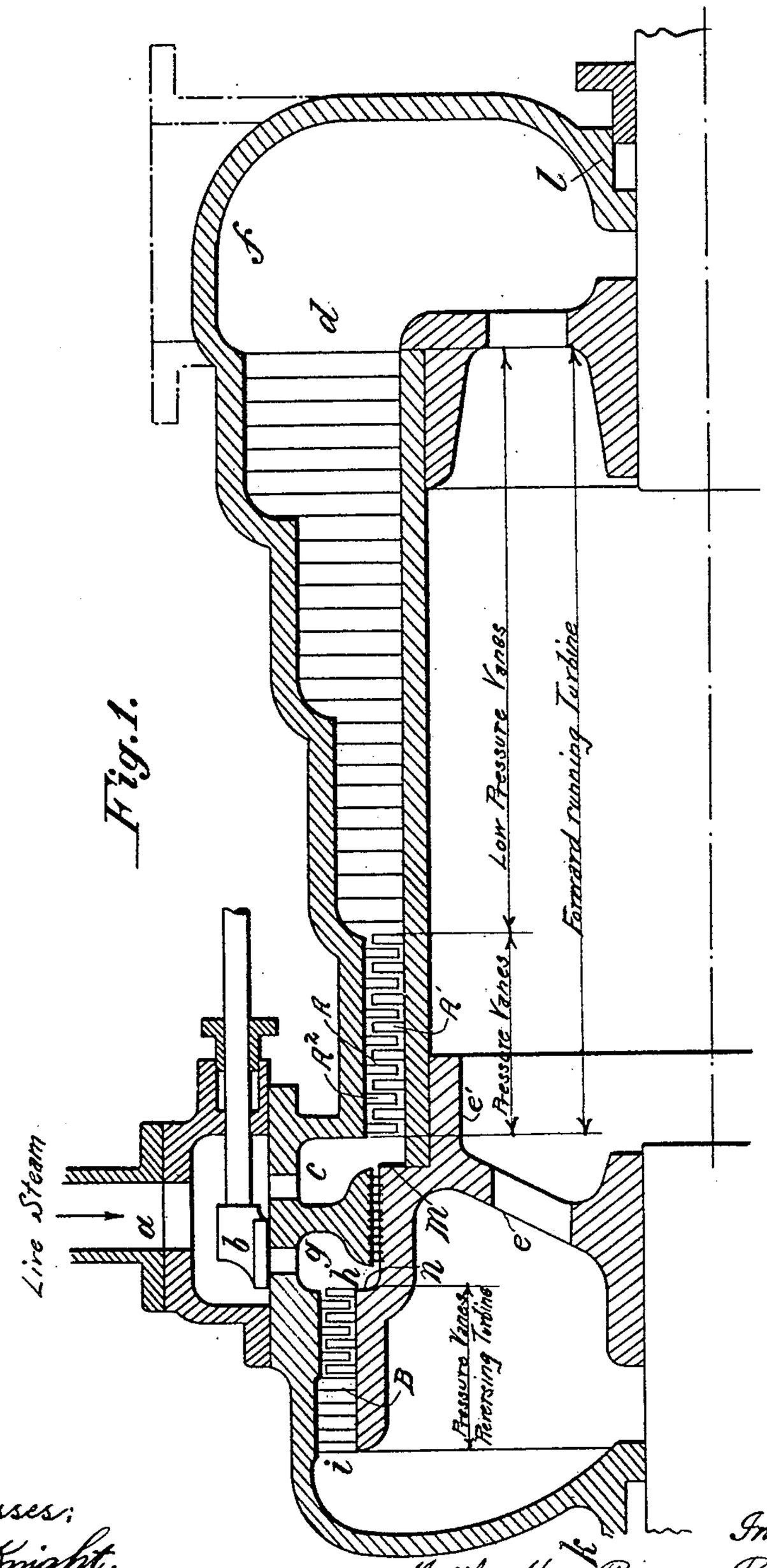

Fig. 1.

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H. W. Simmons

Inventor;
Matthew Henry Phineas Riall Sankey
By Knight Bros. Attys.

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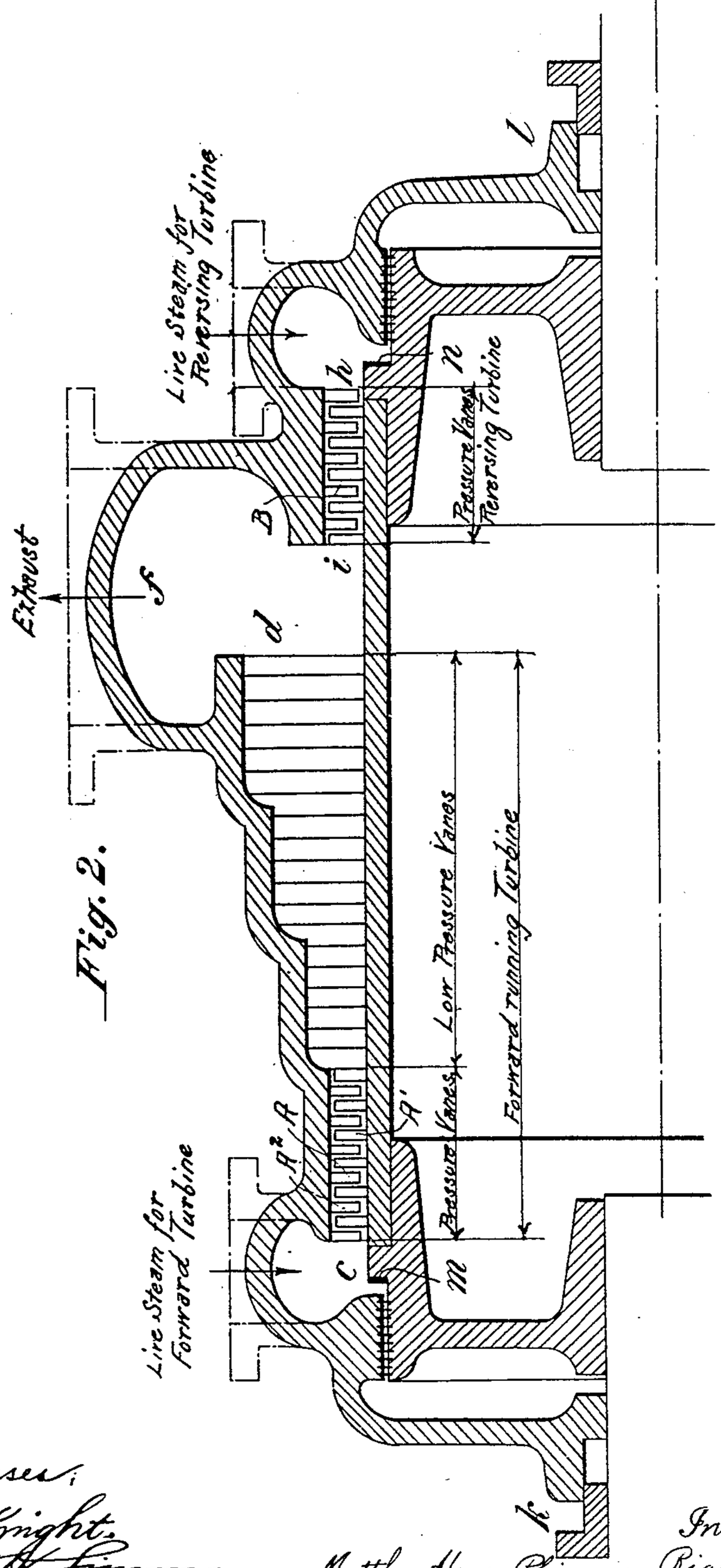

Fig. 2.

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UNITED STATES PATENT OFFICE.

MATTHEW HENRY PHINEAS RIALL SANKEY, OF LONDON, ENGLAND, ASSIGNOR TO MELMS, PFENNINGER AND SANKEY LIMITED, OF LONDON, ENGLAND, A CORPORATION.

REVERSIBLE TURBINE.

No. 871,526. Specification of Letters Patent. Patented Nov. 19, 1907.

Application filed September 4, 1906. Serial No. 333,143.

To all whom it may concern:

Be it known that I, MATTHEW HENRY PHINEAS RIALL SANKEY, a subject of His Majesty the King of Great Britain, and a resident of London, England, have invented a certain new and useful Improvement in Reversible Elastic-Fluid Turbines, of which the following is a specification.

My invention relates to reversible elastic fluid turbines in which the main turbine and the reversing turbine are arranged within the same casing.

The invention is applicable to turbines having their blades of any type or combination of types and arranged in any way within the said casing. Preference however is given to turbines of the kind in which the main turbine, and in some cases also the reversing turbine, is composed of vanes of the impulse type in conjunction with vanes of the reaction type, as it has been found that by combining these types in one turbine an exceedingly compact and solid construction is provided which is very materially reduced in length as compared with existing types of axial flow turbines and is also in other ways particularly advantageous in marine propulsion.

Turbines are sometimes provided with one or more series of impulse blades and, successively, with one or more series of reaction blades, and it has further been proposed to provide within the casing an annular surface or abutment for the steam pressure, the intention of such an arrangement being to enable the steam to counterbalance or equilibrate any axial thrust it may exert upon the shaft.

One object of the present invention is to supplement the said counterbalancing effect by including in it the axial thrust of the propeller, and causing all the axial forces acting on the shaft to be in equilibrium.

Another object of the invention is to make similar provision for taking the axial thrust in the reversing part of the turbine in a combined ahead and reversing turbine of this character which has not to my knowledge hitherto been done. The aforesaid annulus or abutment would of course be designed with due regard to the particular requirements or conditions of the various series of blades employed, the area and radial direction of its face being in each individual instance determined by a calculation of the combined effect of the several series of blades.

The invention will now be described with reference to certain examples illustrated in the accompanying drawings, in which:—

Figure 1 is a longitudinal section of a reversible turbine in which the inlet for the elastic fluid is arranged between the main and the reversing blades, and Fig. 2 is a similar view of a modified form of turbine in which the steam is admitted to the main and reversing blades from opposite ends.

Like letters of reference indicate similar parts throughout the views.

A is the main or forward driving turbine, of which A′ indicates the impulse blades and A^2 the reaction blades; and B is the reversing turbine, the blades of which are of the impulse type. The series A′ and A^2 of the main turbine are arranged upon a straight or cylindrical drum in such order that the steam passes first through the impulse blades and then through the reaction blades, the casing around said drum being constructed with steps or stages, in the well known way.

Referring to the example shown in Fig. 1, the elastic fluid is admitted through a slide valve *b* either to a steam chest *c* from which it is directed to the main turbine A, or to a steam chest *g* from which it is directed to the reversing turbine B. As above stated, the blades of the turbine A are partly of the impulse type and partly of the reaction type, but, where the diameter of the rotor is comparatively small, the blades may if desired be all of the reaction type.

m is the annulus or shoulder for the main turbine, said shoulder being in this instance positive in character, that is to say it projects outwardly from the drum, and thus receives the rearward pressure of the fluid entering the vanes A′.

n is the annulus or shoulder for the reversing turbine, and it will be noticed that it is negative in character, or in other words sunken or depressed as compared with the drum carrying the reversing blades. In this case the axial pressure is balanced by the forward pressure of the fluid passing into the vanes B acting against the annulus *n* the rearward pressure acting against the division wall between the steam chests *g* and *c*.

The drum carrying the blades B together

with both the shoulders *m* and *n* is carried by and integral with a spider *e* keyed upon the shaft. A prolongation or longitudinal extension *e'* upon said spider serves to carry one end of the drum upon which the blades of the main turbine are secured, the other end of said drum being carried by a spider of any suitable kind. It will be noticed that both the aforesaid drums are cylindrical and of uniform diameter throughout, a considerable economy in the cost of construction being thereby attained. After imparting its energy to the vanes, the motive fluid escapes through the exhaust chamber from which it may be conducted—in the case of steam—to a condenser.

In order to reverse the above described turbine, the valve *b* is moved towards the right of Fig. 1, so as to close the inlet aperture of the chest *c* and open the inlet aperture of the chest *g* whereby the motive fluid will be directed against the blades of the turbine B. These blades, like those of the turbine A, may either be all of the impact type (as shown) or of the impact and reaction types combined. The exhaust from the reversing turbine can be conducted through the hollow shaft to the exhaust chamber *f*.

k is the closing member of the stuffing box *l* of the well known kind.

In the modified example illustrated in Fig. 2, the blades of both the main and the reversing turbine are arranged upon a common drum which extends from the steam chest *c* of the main turbine at one end of the machine to the steam chest *g* of the reversing turbine at the other end thereof, the exhaust chamber *f* being located between the two turbines. It will be observed that in this instance both the annuli or shoulders *m*, *n* are negative, that is to say they extend from the periphery of the drum towards the axis thereof; and they are formed upon separate spiders or castings which carry the opposite ends of the drum. It will be evident, however, that in either of the examples the annuli or shoulders may be either positive or negative according to the character or disposition of the bladings.

What I claim is:—

1. In an elastic fluid turbine having a forward driving turbine and a reversing turbine mounted upon a common shaft within the same casing, the combination of an action and reaction forward driving turbine with a combined action-reaction reversing turbine of the drum type having a diameter substantially equal to that of the said forward driving turbine.

2. In a turbine rotor the combination of a spider, a plurality of sets of blades supported thereby, and an annulus adjacent to each set, and carried by said spider.

3. In a turbine rotor the combination of a spider, a drum supported at one of its ends by said spider, blades for forward driving carried by said drum, a reversing set of blades also supported by the spider and a plurality of annuli formed on the spider and adapted to counterbalance the axial thrusts for both directions running.

In testimony that I claim the foregoing as my invention, I have signed my name in presence of two subscribing witnesses.

MATTHEW HENRY PHINEAS RIALL SANKEY.

Witnesses:

FREDK. L. RAND,

HENRY COKE POWEL.