No. 751,316. PATENTED FEB. 2, 1904.

T. G. E. LINDMARK.

COMPOUND STEAM TURBINE.

APPLICATION FILED JUNE 2, 1903.

NO MODEL. 2 SHEETS—SHEET 1.

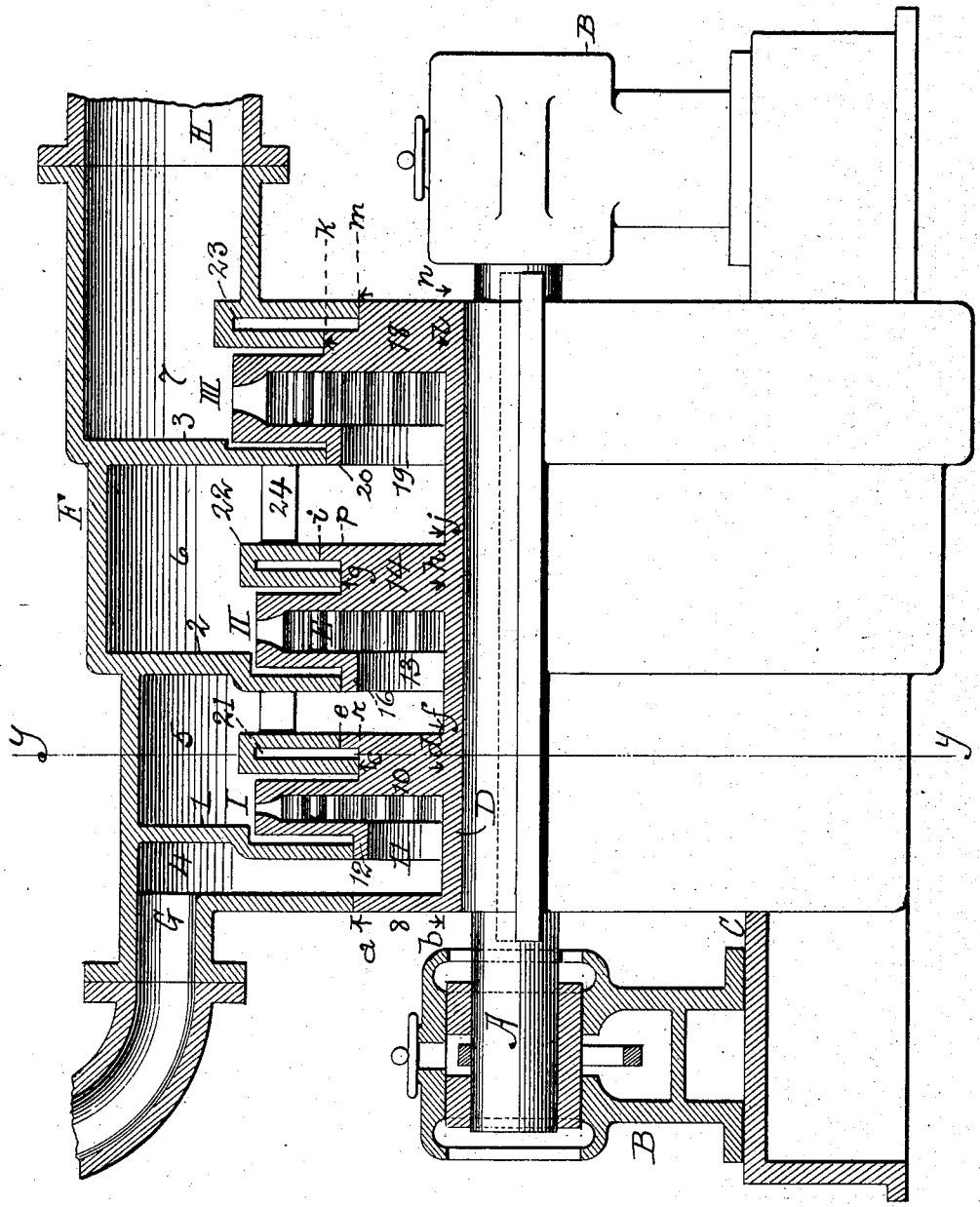


Fig. 1.

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Fig. 2.

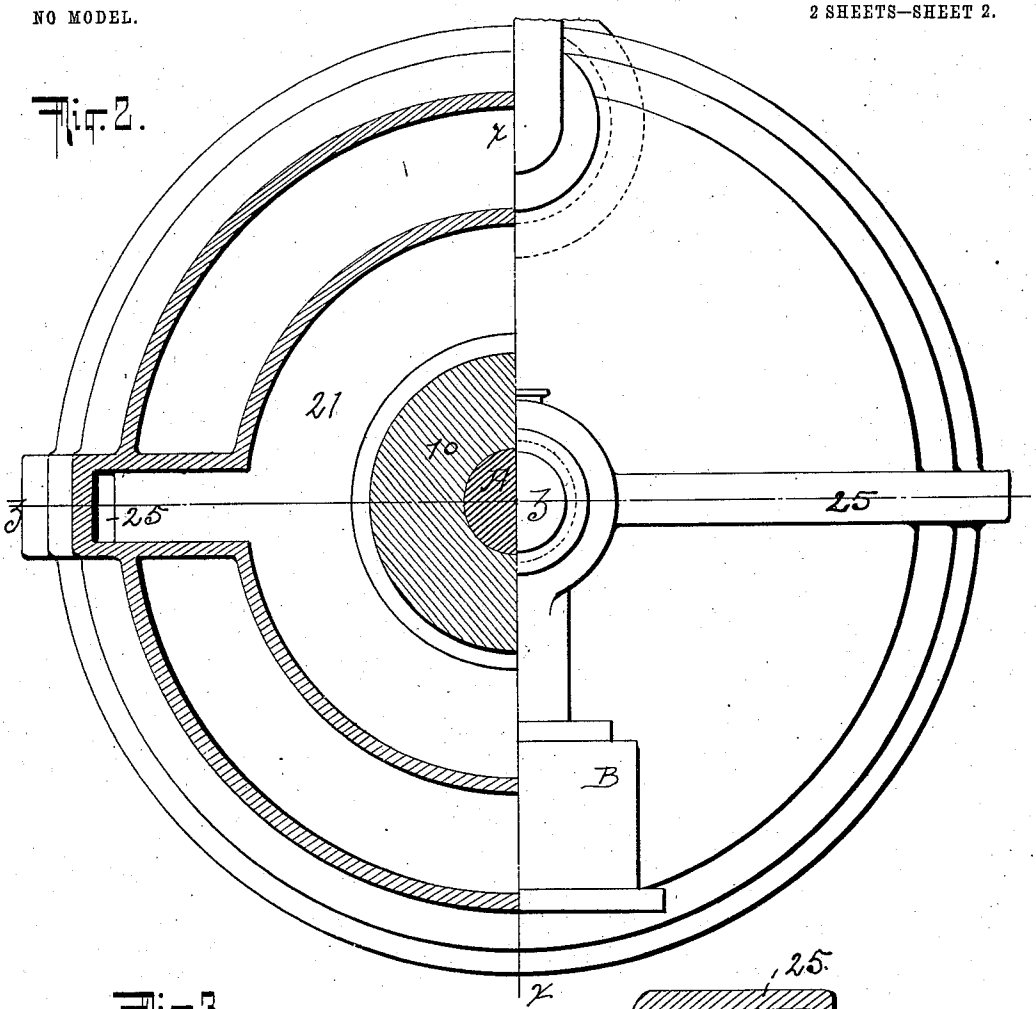
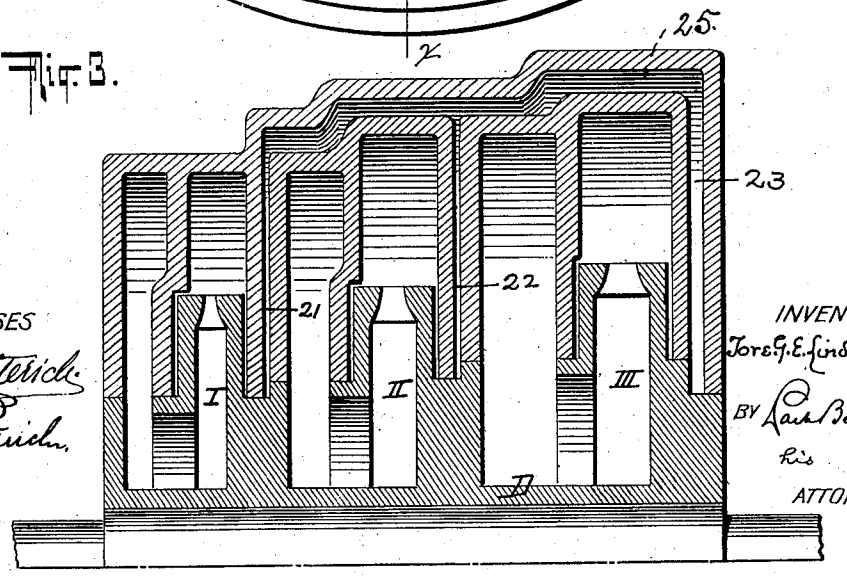


Fig. 3.



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No. 751,316. Patented February 2, 1904.

UNITED STATES PATENT OFFICE.

TORE GUSTAF EMANUEL LINDMARK, OF STOCKHOLM, SWEDEN.

COMPOUND STEAM-TURBINE.

SPECIFICATION forming part of Letters Patent No. 751,316, dated February 2, 1904.

Application filed June 2, 1903. Serial No. 159,724. (No model.)

To all whom it may concern:

Be it known that I, TORE GUSTAF EMANUEL LINDMARK, a subject of the King of Sweden and Norway, and a resident of Stockholm, Sweden, have invented a new and useful Improvement in Compound Steam-Turbines, of which the following is a specification.

The invention relates to compound steam-turbines; and it consists in the means set forth whereby the axial pressure exerted by the working medium on the wheels is balanced.

In the accompanying drawings, Figure 1 is a vertical longitudinal section on the line *x x* of Fig. 2. Fig. 2 on the left-hand side is a partial transverse section on the line *y y* of Fig. 1 and on the right-hand side shows a partial end elevation. Fig. 3 is a partial horizontal section on the line *z z* of Fig. 2.

Similar letters and numbers of reference indicate like parts.

A is the wheel-shaft journaled in standards B on bed C. Fast on said shaft are a plurality of turbine-wheels I II III. The turbines here represented are of the outward-flow type. One side and the hub of each wheel may be formed integrally with the sleeve D, which surrounds shaft A. The other side is formed separately and secured by stay-bolts, as shown at E. The wheels are inclosed in a casing F, provided with a steam-inlet G, exhaust-outlet H, and divided by the annular partitions 1 2 3 into chambers 4 5 6 7. Chamber 4 communicates with steam-inlet and wheel I. Chamber 5 conducts the exhaust from wheel I to wheel II. Chamber 6 conducts the exhaust from wheel II to wheel III, and chamber 7 communicates with the exhaust-outlet H. The steam-passages in the several chambers and wheels are progressively enlarged to accommodate the increasing volume of steam and to secure from said wheels same speed at the diminishing pressures.

In order to balance the axial pressure exerted by the working medium on the wheels, the following construction is employed: Sleeve D has a flange 8, received in an opening in end wall of casing F. The radial width of this flange between the points *a b* equals the width of hub 10 between the points *c d*. The width of the steam-inlet 11 to wheel 1 is normally the same, but is diminished by the thickness of the flange 12, which is on the wheel I, which flange is received in an opening in partition 1. Hub 10 has a flange *e r*. The radial width of said hub, including said flange, between the points *e f* is equal to that of hub 14 of wheel II between the points *g h*. The inlet 13 of wheel II is normally of the same width as between the points *e f*, but is diminished by the flange 16 on wheel II, which is received in an opening in partition 2. Hub 14 has a flange *i p*. The radial width of said hub, including said flange between the points *i j*, is equal to that of hub 18 between the points *k l*. The width of the steam-inlet 19 to wheel III is normally the same, but is diminished by the flange 20 on wheel III, which is received in an opening in partition 3. The width of the outer portion of hub 18 between the points *m n* is less than *k l* by a distance *k m* and equals the width of hub 10 between the points *c d*.

Within the casing are three circumferentially-closed annular chambers—namely, the chamber 21, receiving the hub 10, the chamber 22, receiving hub 14, and the chamber 23, receiving the hub 18. Chamber 23 is formed with the casing, as shown. Chambers 22 and 21 are held by supports 24 from the partitions 2 and 3. All three chambers, as shown in Fig. 3, connect with a passage 25 on each side of the casing. It will be obvious that in chamber 23 the pressure of steam which leaks into it at the joint with hub 18 is from right to left and is exerted upon the portion of hub 18 between the points *k m*. On the other hand, the pressure in the chamber 22, due to steam similarly leaking into it, is from left to right and is exerted on the flange *i p* of hub 14, while the pressure in chamber 21 is in the same direction and is exerted on the flange *e r* of hub 10; but the sum of the widths of flange *i p* of hub 14 and flange *e r* of hub 10 equals the total width between points *k m* of hub 18. Hence the pressures in chambers 21 and 22 will be equalized by the pressure

in chamber 23, and as their opposite and equal pressures are exerted axially the shaft the desired balance is secured.

I claim—

1. In a compound elastic-fluid turbine having a plurality of wheels, a plurality of communicating steam-chambers associated with said wheels; the said chambers being constructed and arranged so that the pressure of the working medium axially exerted in one direction in one of said chambers balances the pressure of said medium exerted in the opposite direction in the remaining chambers.

2. In a compound elastic-fluid turbine having a plurality of wheels disposed in successive compartments, a steam-chamber associated with each wheel and in the compartment thereof and receiving steam from said compartment; the said steam-chambers communicating and being constructed and arranged so that the pressure of the working medium axially exerted in one direction in one of said chambers balances the pressure of said medium exerted in the opposite direction in the remaining chambers.

3. In a compound elastic-fluid turbine having a plurality of wheels provided with hubs, a plurality of communicating steam-chambers associated with said wheels and each having a part of one wall formed by a flange on a wheel-hub; the said flanges being constructed so that the pressure of the working medium axially exerted on the hub-flange in one of said chambers balances the pressure of said medium exerted in the opposite direction on the hub-flanges in the remaining chambers.

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

TORE GUSTAF EMANUEL LINDMARK.

Witnesses:
HERM. FORSSBERG,
K. GUST. ALMÉUF.