E. BROWN.

FLUID OPERATED TURBINE.

APPLICATION FILED JUNE 25, 1910.

986,901. Patented Mar. 14, 1911.

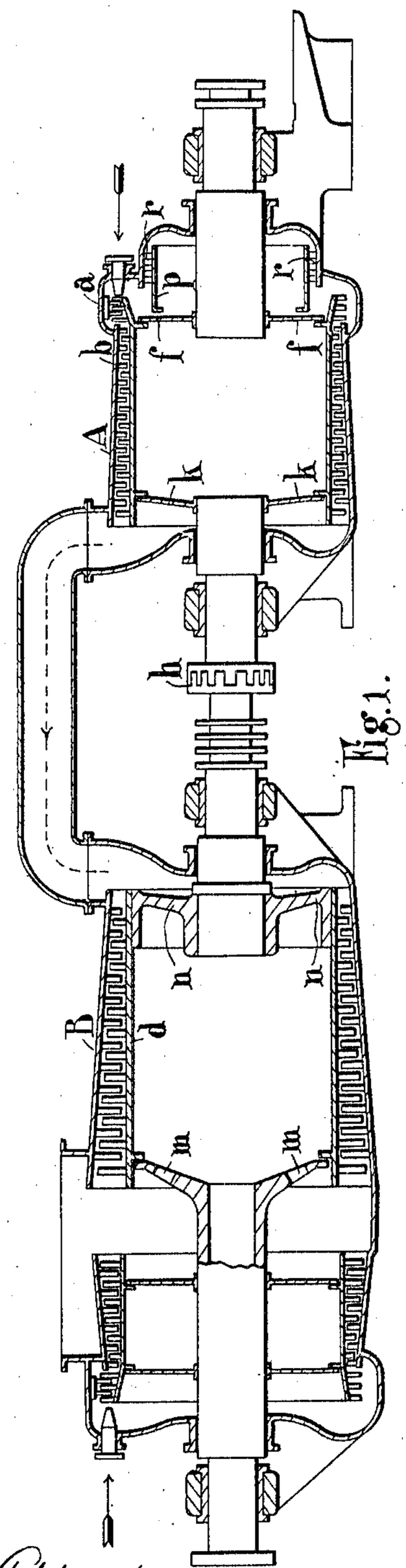

Fig. 1.

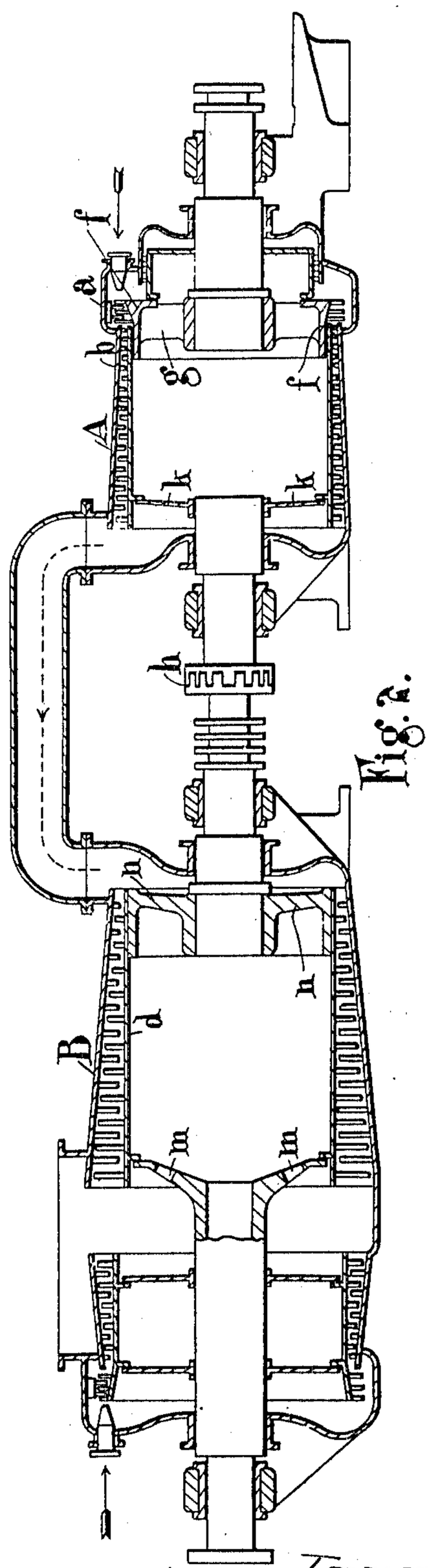

Fig. 2.

Attest.
Bent. Wm. Stahl.
Edward N. Slater

Inventor
Eric Brown.
by Speer, Middleton, Duncanson & Speer
Attys.

UNITED STATES PATENT OFFICE.

ERIC BROWN, OF BADEN, SWITZERLAND.

FLUID-OPERATED TURBINE.

986,901.

Specification of Letters Patent. **Patented Mar. 14, 1911.**

Application filed June 25, 1910. Serial No. 568,836.

To all whom it may concern:

Be it known that I, ERIC BROWN, a subject of the King of Great Britain and Ireland, residing at Bahnhofweg, Baden, Switzerland, have invented certain new and useful Improvements in Fluid-Operated Turbines, of which the following is a specification.

This invention relates to a turbine arrangement of the type in which a reaction turbine is divided up into two elements which are in series with one another and connected by a rigid shaft coupling while the adjacent ends of each rotor are provided with balancing surfaces of equal area and subjected to the same steam pressure, the axial thrusts produced thereby acting in opposite directions to neutralize one another so that the balancing of the system is unaffected by the dividing up of said reaction turbine.

The object of the present invention is to enable the above arrangement of balancing surfaces to be used for balancing in a similar arrangement in which the two turbine elements are connected by a flexible coupling and are subjected to a varying load.

The invention consists for this purpose in providing in the high pressure element, an impulse or action stage which is placed in front of the reaction part, and effecting the balancing of each element independently, the high pressure element by means of an additional balancing surface placed at the inlet to said reaction part and subjected to the fluid pressure in the impulse stage.

The invention also consists in the turbine arrangement of the above type in which the impulse stage is carried by a member which at the same time forms the inlet end of the succeeding reaction stage and carries the additional balancing surface.

Referring now to the accompanying drawings: Figure 1 shows an arrangement in which the turbine elements are connected by a flexible coupling, and Fig. 2 shows an arrangement in which the impulse stage is carried by a member which forms the end of the rotor of the reaction part and at the same time carries the impulse stage and forms the additional balancing surface.

In carrying the invention into effect according to the arrangement shown in Figs. 1 and 2, one turbine, A, has a reaction part, *b*, preceded by an impulse stage, *a*, while the other turbine, B, is purely of the reaction type. The two reaction parts, *b* and *d*, of the turbines, A and B, are placed in separate casings while the shafts are connected together by a flexible coupling, *h*, adapted to allow the shafts to move longitudinally relatively to one another. As before the adjacent ends of the two rotors of the parts, *b* and *d*, are of the same area and the turbines being in series with one another these end surfaces are subjected to the same fluid pressure. Owing, however, to the flexible connection, *h*, between the two turbines each turbine is now independent of the other as regards balancing and further, on account of the impulse stage, *a*, in the turbine, A, an additional balancing surface is now required, since the impulse stage, *a*, produces practically no steam thrust which could be utilized to balance a part of the propeller thrust. This additional balancing surface is placed conveniently at the exhaust end of the impulse stage, *a*, and forms the end of the rotor for the succeeding reaction stages, *b*, so that the surface, *f*, will be subjected to the higher pressure steam. The area of this surface, *f*, is arranged so that the thrust on the surface *f* together with the steam thrust on the reaction stage, *b*, will exactly balance the thrust in the opposite direction on the surface, *k*, at the end of the reaction stage rotor. The correct amount of balancing surface for this purpose is obtained by allowing the steam pressure to act upon an annular portion only of the end surface of the combined rotor, the rest of this surface being partitioned off by the piston, *p*, attached to the rotor end and provided with a packing, *r*, of any suitable type placed between it and the turbine casing to prevent the access of high pressure steam into the rotor interior. The turbine, B, is then independently balanced by arranging the area of the surface, *n*, at the steam inlet end of the rotor to balance the propeller thrust and if the surface, *n*, is insufficient the inner surface thereof is subjected to the exhaust pressure of the turbine by admitting the exhaust into the interior of the rotor, *d*, by openings, *m*, at the exhaust end thereof.

It will be seen that the provision of a balancing surface in the high pressure part as well as in the low pressure part allows of balancing the propeller thrust under widely varying loads while the utilization of the front end of the rotor is the low pressure part for balancing purposes enables a com-

plete piston and its necessary packings to be dispensed with. Further, since only one action or impulse stage is used in the improved installation it is possible to adopt a rotor drum for the reaction part which shall be of very rigid construction. Such a construction is shown in Fig. 3 in which the balancing surface, *f*, already described with reference to Fig. 1 forms the end of the rotor of the reaction part, *b*, but is formed in a member, *g*, which also carries the rotating blades of the action stage, *a*. It will be seen that by these improved arrangements it is now possible since the turbine is divided up into two elements which are each within a separate casing to arrange each part within a separate compartment on board ship. Further, all inconvenient partitions are dispensed with while the steam pressure available can be efficiently utilized within greatly varying limits as several sets of nozzles can be used in the high pressure action stage. Such constructions and arrangements of the turbines may be equally serviceable when applied to either land or marine installations, the particular feature being the elimination of a number of dummy pistons while the lightness and simplicity of the parts make the arrangement advantageous on account of the easy handling of the turbines both during construction and when installed.

Having now particularly described my invention what I claim as new and desire to secure by Letters Patent is:—

1. In a turbine installation having two turbine elements of the reaction type in series on the same shaft, a flexible shaft connection between said elements, an impulse stage at the inlet end of the high pressure element, and means for balancing each of said elements independently of one another.

2. In a turbine installation having two turbine elements of the reaction type in series on the same shaft, a flexible shaft connection between said elements, an impulse stage at the inlet end of the high pressure element, a balancing surface at the exhaust end of said impulse stage subjected to the fluid pressure of the impulse stage, and means for independently balancing the second turbine element.

3. In a fluid operated turbine installation, two turbine elements connected in series, a flexible shaft connection between said elements, a rotor in each of said elements, a balancing surface on the adjacent ends of said rotors, an impulse stage at the inlet to the high pressure element, and a balancing surface at the exhaust end of said impulse stage and subjected to the pressure of the fluid in said impulse stage.

4. In a fluid operated turbine installation having two reaction turbine elements in series in the same shaft line, a flexible shaft connection between said elements, a rotor in each of said elements, a balancing surface on each adjacent end of the elements each surface having the same area, an impulse turbine stage at the inlet end of the high pressure turbine element, a balancing surface at the end of the reaction turbine adjacent to the impulse stage subjected to the fluid pressure in the latter, a member forming the end of the rotor of the reaction part in the high pressure element and at the same time carrying the said balancing surface and impulse stage.

In testimony whereof, I affix my signature in presence of two witnesses.

ERIC BROWN.

Witnesses:
H. LYNCH,
J. SPÖRRI.