No. 656,208. Patented Aug. 21, 1900.

C. A. PARSONS & A. A. C. SWINTON.

REVERSING STEAM TURBINE.

(Application filed Nov. 19, 1897.)

(No Model.) 2 Sheets—Sheet 1.

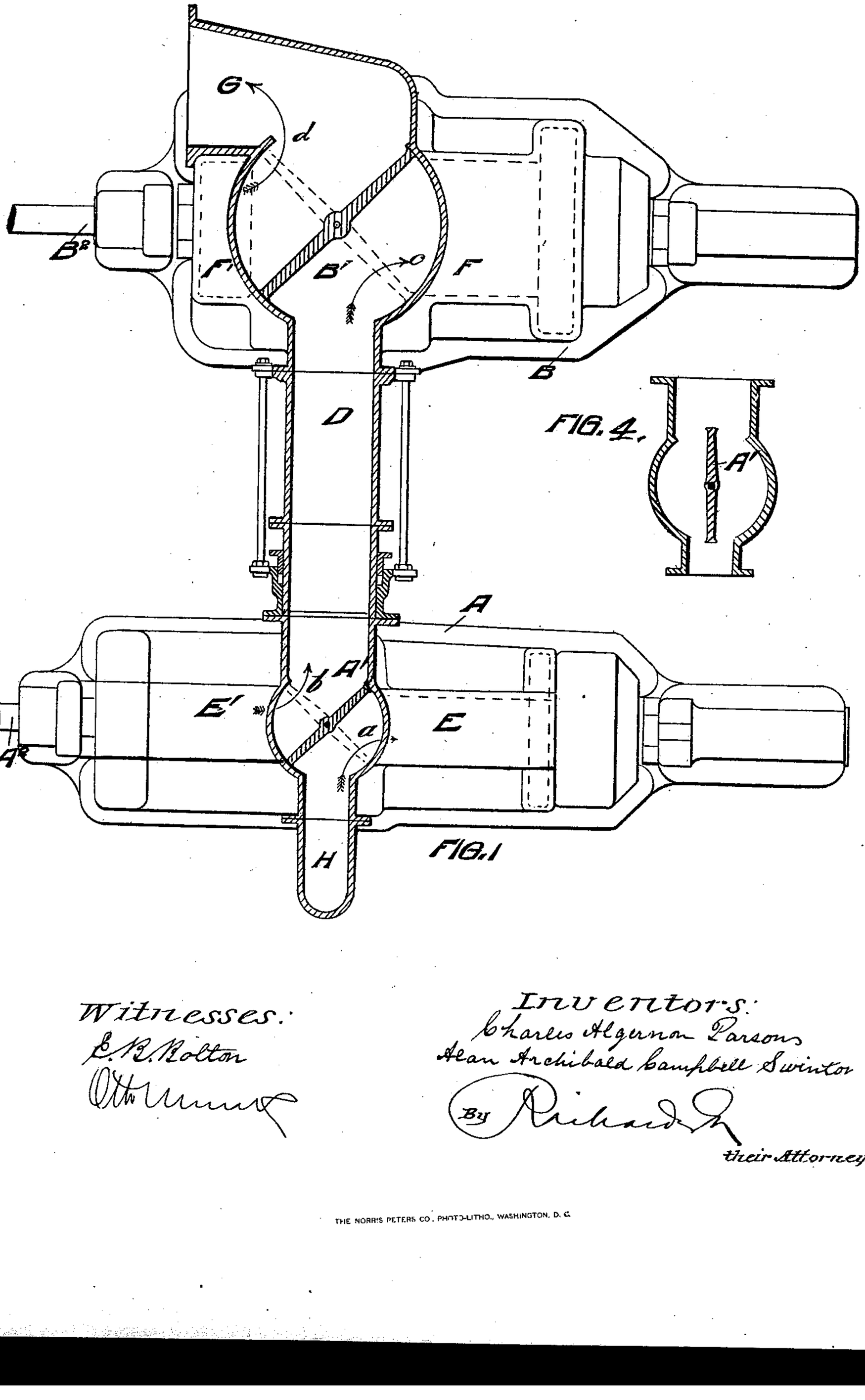

FIG. 1.

FIG. 4.

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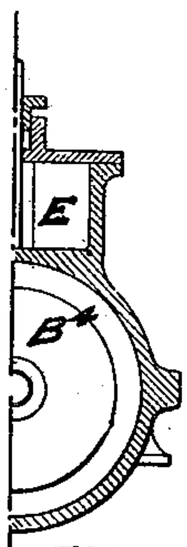

FIG. 3.

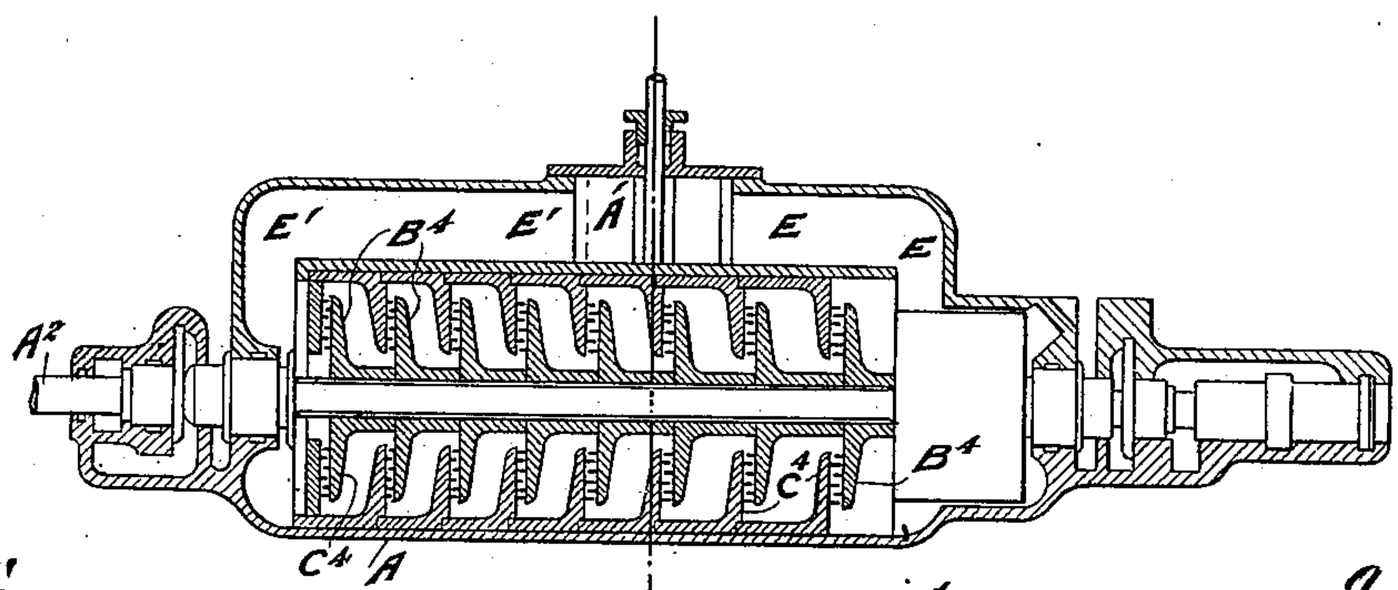

FIG. 2.

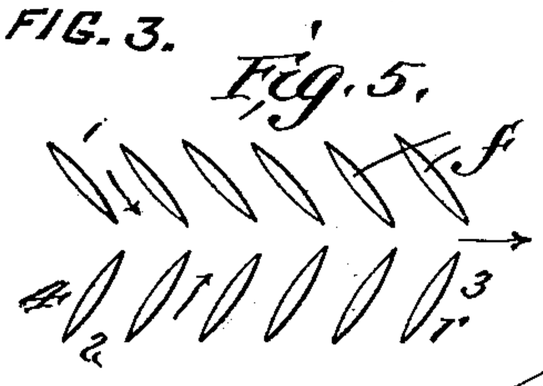

Fig. 5.

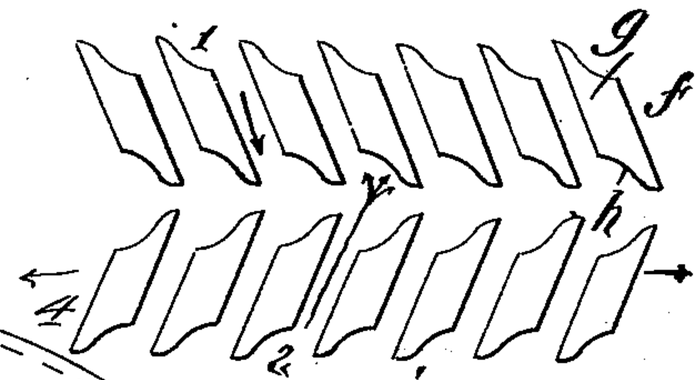

Fig. 6.

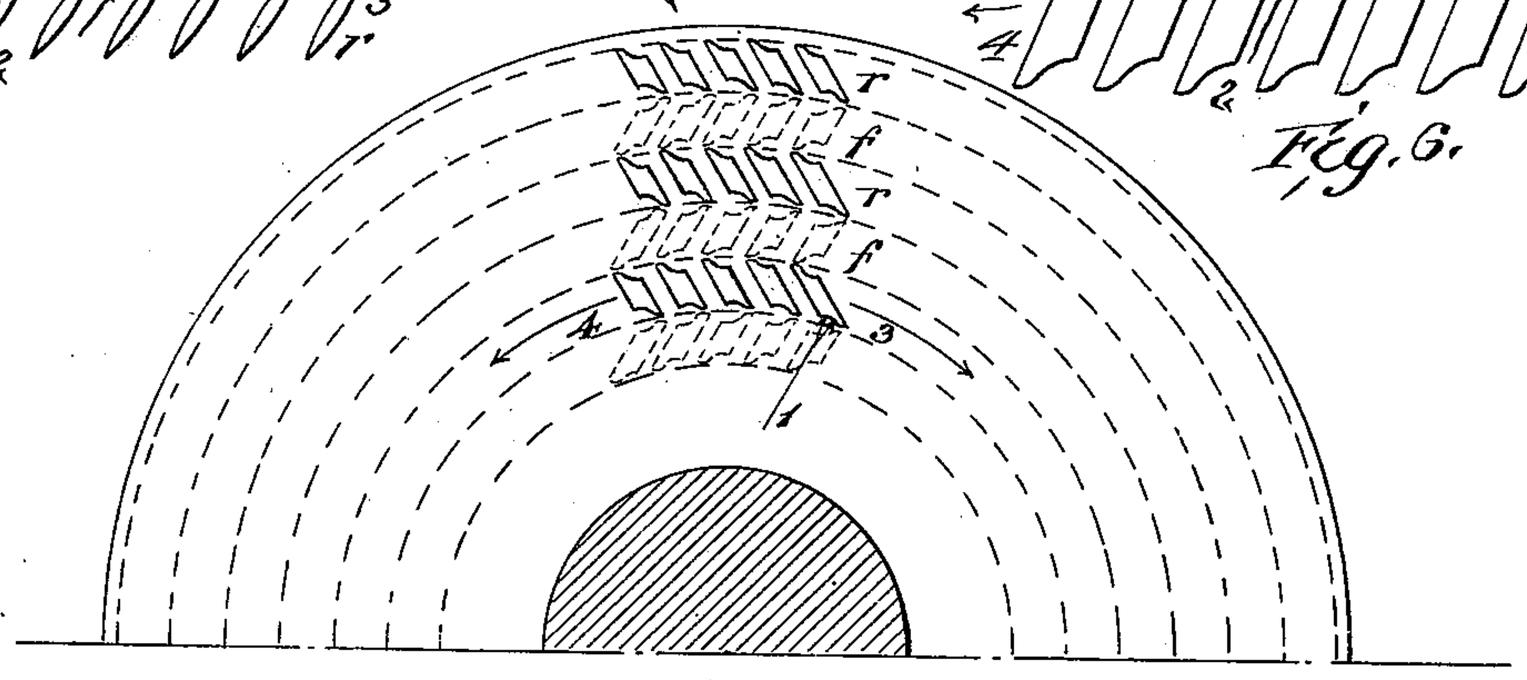

FIG. 7.

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UNITED STATES PATENT OFFICE.

CHARLES ALGERNON PARSONS, OF NEWCASTLE-UPON-TYNE, AND ALAN ARCHIBALD CAMPBELL SWINTON, OF LONDON, ENGLAND.

REVERSING STEAM-TURBINE.

SPECIFICATION forming part of Letters Patent No. 656,208, dated August 21, 1900.

Application filed November 19, 1897. Serial No. 659,141. (No model.)

To all whom it may concern:

Be it known that we, CHARLES ALGERNON PARSONS, engineer, residing at Heaton Works, Newcastle-upon-Tyne, in the county of Northumberland, and ALAN ARCHIBALD CAMPBELL SWINTON, engineer, residing at 66 Victoria street, Westminster, London, S. W., England, subjects of the Queen of Great Britain and Ireland, have invented certain new and useful Improvements in Reversing Steam-Turbines, of which the following is a specification.

Our invention relates to steam-turbines which require to be reversed, such as turbines for marine propulsion, locomotives, and autocars, and it is applicable to other purposes where a reversing turbine is required.

In steam-turbines as at present constructed certain difficulties are found in effectively reversing the direction of the rotation. In one method of reversing already adopted by one of the present applicants a special set of reversing jets and blades is applied to a marine steam-turbine, and when it is desired to reverse the engine the steam-supply is cut off from the main turbine and sent through the reversing blades or jets only. This device enables the turbine to be reversed; but the reversing power is not great, as it is impossible to use any great number or series of reversing turbines without increasing complexity and diminishing the efficiency of the turbine when running in its normal direction.

The object of our invention is to overcome the difficulties and complexities of the ordinary method and to obtain a powerful reversal of a steam-turbine without appreciable complication of its mechanical construction.

Our invention consists in an improved form of turbine-blade by the use of which a turbine can be run efficiently in both directions.

Referring to the accompanying drawings, which illustrate our invention, Figure 1 is a plan, partly in section, illustrating the working of the steam and exhaust valves in reversing turbines. Figs. 2 and 3 are respectively sectional side and end elevations of a turbine such as that shown in Fig. 1. Fig. 4 shows a reversing-valve in middle position. Fig. 5 is a diagram illustrating ordinary turbine-blades, showing the path of the steam while the turbine is going ahead and while it is reversing. Fig. 6 is a similar diagram illustrating turbine-blades formed according to our invention. Fig. 7 shows the application of our improved blades to a radial-flow turbine.

In Figs. 1 and 2, A is the high-pressure turbine, and B the low-pressure. A^2 and B^2 are the propeller-shafts driven by the turbines. The high-pressure steam from the boiler is admitted to the turbine A by way of the pipe H, and for going ahead the steam passes on one side of the reversing-valve A′, which is of the butterfly type, to the end of the steam-turbine by way of the passage E, as shown by the arrow *a*. The steam then passes through the various sets of moving and fixed turbine-blades B^4 and C^4, Fig. 2, to the opposite end of the turbine, and thence it discharges to the passage E′ and passes on the other side of the reversing-valve A′, as shown by the arrow *b*, to the pipe D, communicating with the low-pressure turbine B. The steam enters that turbine by one side of the reversing-valve B′ and the passage F, as indicated by the arrow *c*, and discharges by the passage F′ and the other side of the reversing-valve B′ to the exhaust-pipe G, as indicated by the arrow *d*. When it is desired to reverse both turbines, the reversing-valves A′ B′ are placed in the positions indicated in dotted lines in Fig. 1, and then the steam passes to the low-pressure end of each turbine and discharges from each high-pressure end. When one of the turbines is required to go ahead while the other reverses, one reversing-valve is operated for that purpose. When it is desired to cut one turbine out of action, the reversing-valve of that turbine is moved to its middle position, as shown in Fig. 4.

Fig. 5 shows a series of fixed blades *f* and rotating blades *r* of ordinary construction. These blades are moderately curved and converge in the direction in which steam flows when the turbine is going ahead. When so rotating, the steam passes between the fixed blades *f* in the direction of the arrow 1, impinges upon the concave sides of the rotating blades *r*, and discharges from them, continuing the direction of flow. The moving blades then rotate in the direction of the arrow 3. This form of blade gives very good results

when the steam passes as just described; but when the steam is caused to flow in the direction of the arrow 2, so as to reverse the motion of the turbine, it then impinges on the convex sides of the blades and travels in the direction in which the blades diverge. Under these conditions the efficiency is lowered considerably.

In order to get turbines to work efficiently in both directions, I construct the blades as shown in Figs. 6 and 7. Here the fixed blades *f* and rotating blades *r* are made with flat parallel sides, which have concavities *g h*, one at each end of the blade, so that the steam whichever way it flows impinges on a concavity. When the steam flows as indicated by the arrow 1, the jet splits up when impinging on the concave surfaces *g g*, and the turbine rotates as shown by the arrow 3. When the flow of steam is reversed to the direction shown by the arrow 2, the fluid then impinges on the concavities *h h*, and the turbine rotates as shown by the arrow 4. By this construction the efficiency is equally good in both directions of running.

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

Turbine-blades formed with flat parallel sides and concavities at both ends to enable them to work efficiently in both directions, substantially as hereinbefore set forth.

In witness whereof we have hereunto set our hands in the presence of witnesses.

CHARLES ALGERNON PARSONS.
ALAN ARCHIBALD CAMPBELL SWINTON.

Witnesses to the signature of the said Charles Algernon Parsons:

ABRAHAM BEWICK GOLDSBROUGH,
WILLIAM GILLIESPY.

Witnesses to the signature of the said Alan Archibald Campbell Swinton:

ALBERT EDWARD PARKER,
GEO. W. B. FRANKLIN.