S. Z. DE FERRANTI.

ELASTIC FLUID TURBINE.

APPLICATION FILED AUG. 9, 1907.

907,981. Patented Dec. 29, 1908.

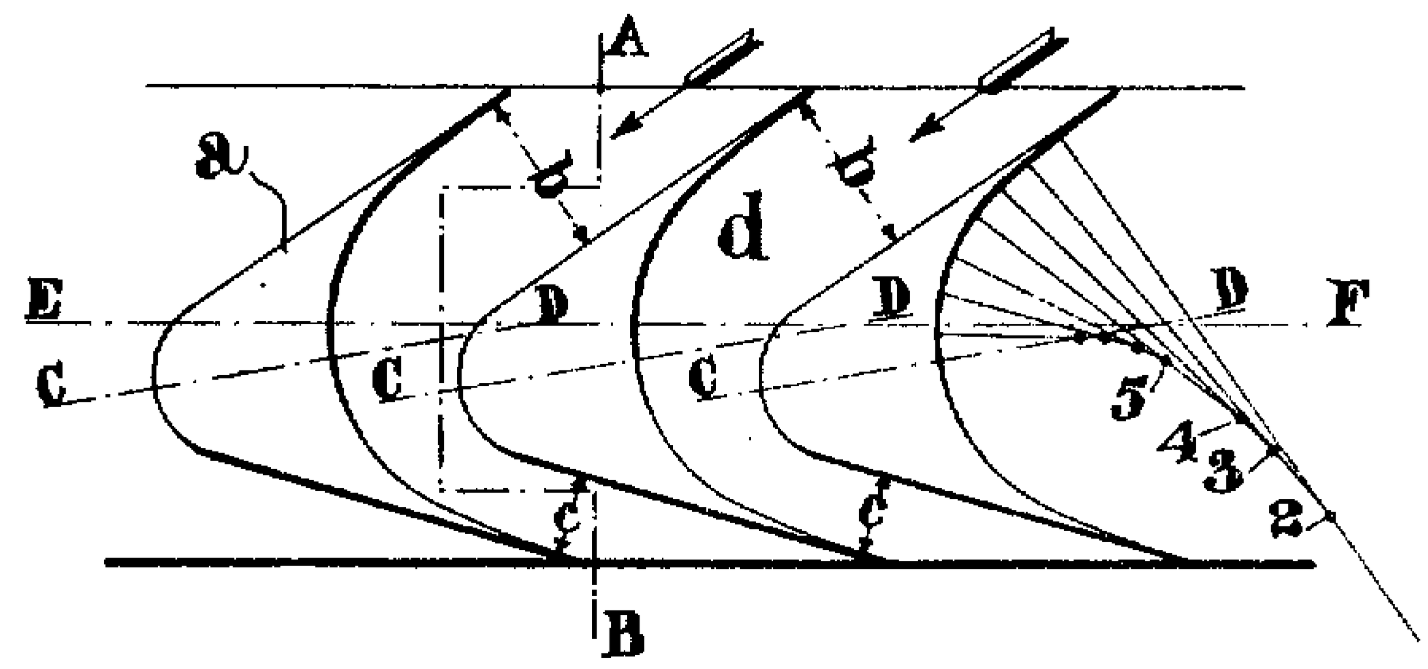

Fig. 1.

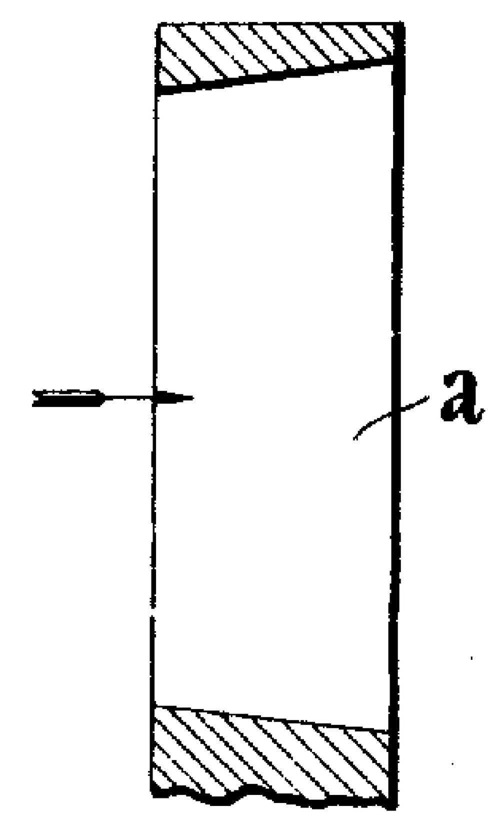

Fig. 2.

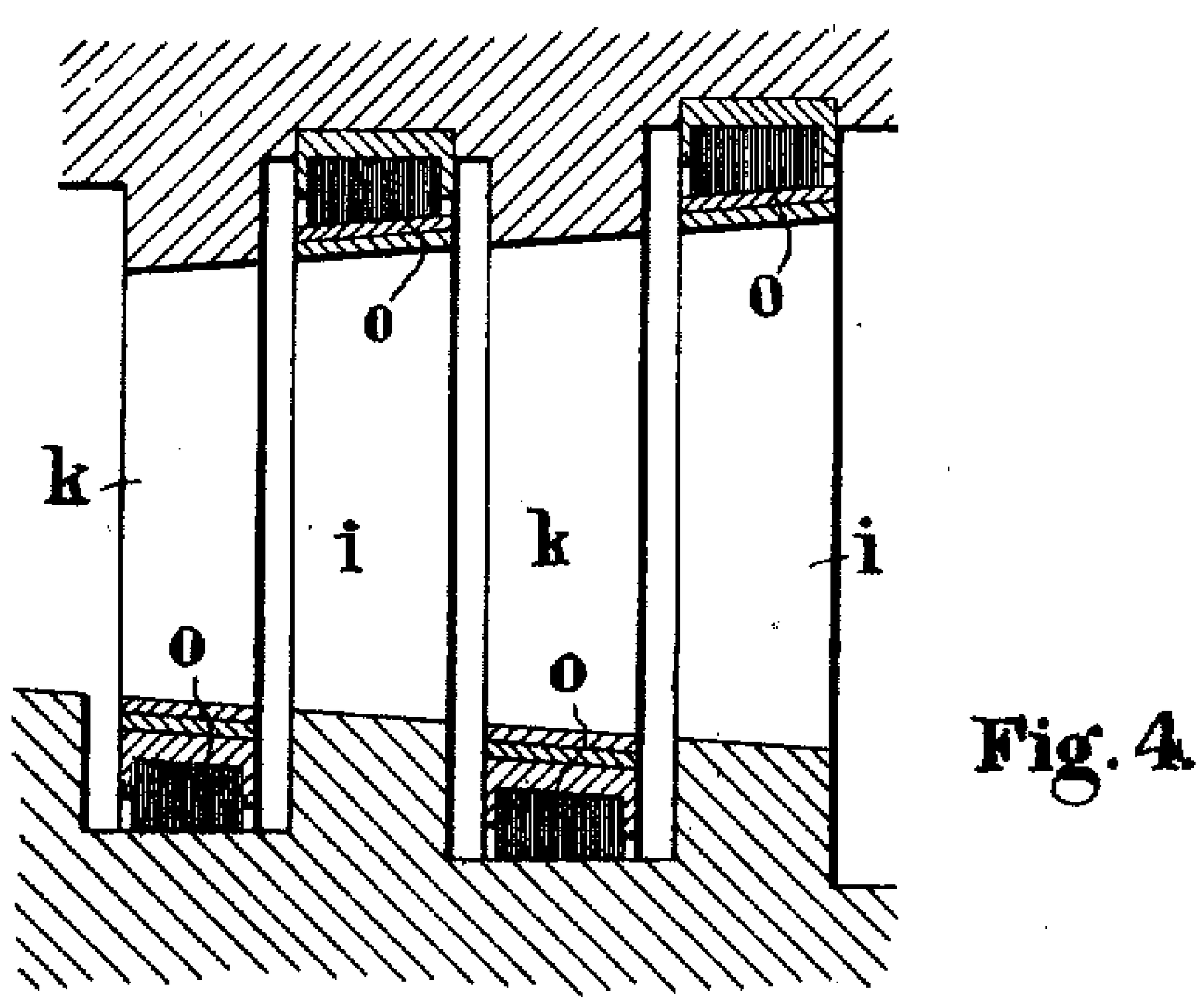

Fig. 4.

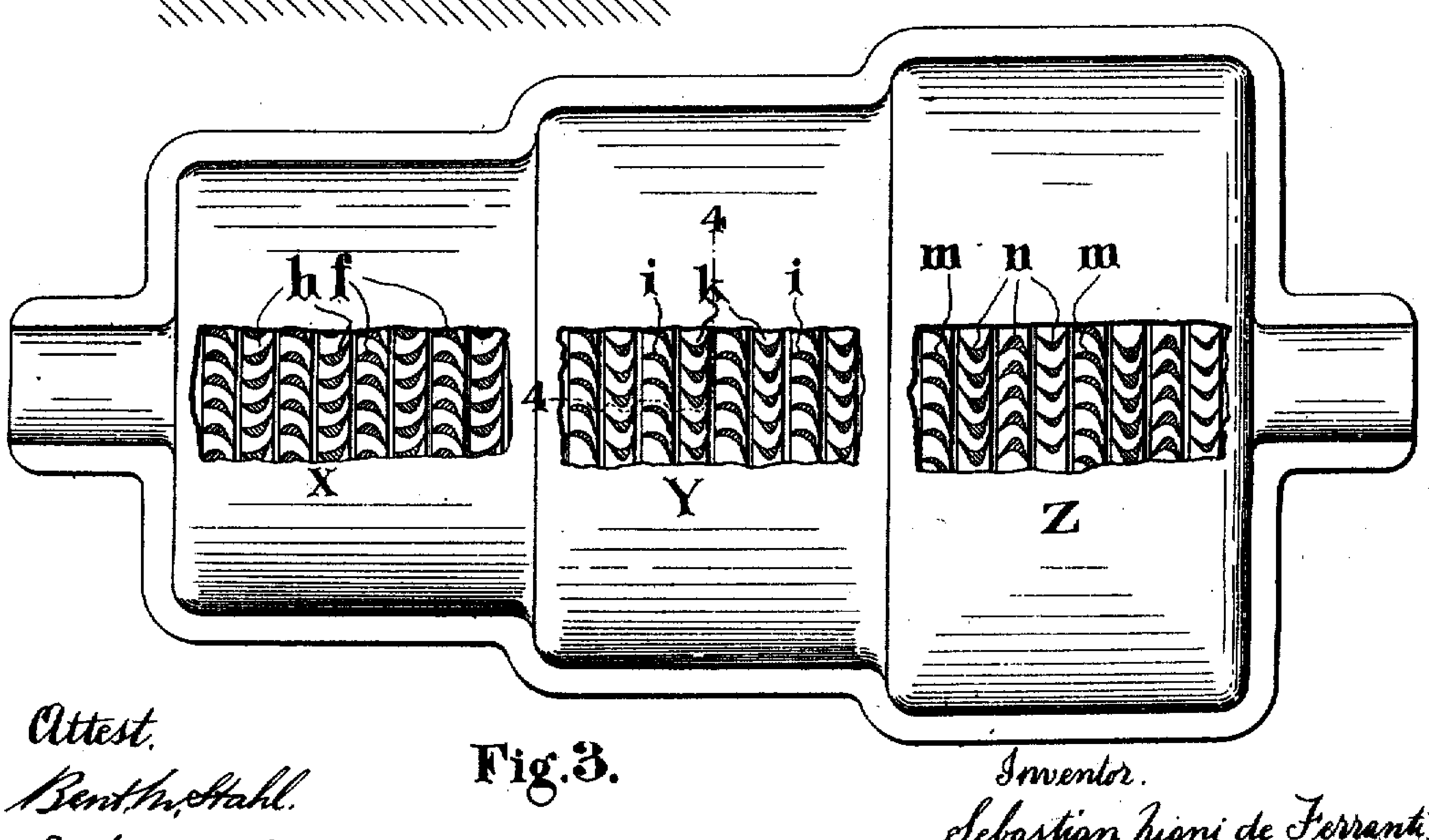

Fig. 3.

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Bent M. Stahl.
Ewd L. Tolson.

Inventor.
Sebastian Ziani de Ferranti.
by Spear Middleton Donaldson & Spear
Atty's.

UNITED STATES PATENT OFFICE.

SEBASTIAN ZIANI DE FERRANTI, OF GRINDLEFORD, ENGLAND.

ELASTIC-FLUID TURBINE.

No. 907,981. Specification of Letters Patent. Patented Dec. 29, 1908.

Application filed August 9, 1907. Serial No. 387,915.

To all whom it may concern:

Be it known that I, SEBASTIAN ZIANI DE FERRANTI, a subject of the King of Great Britain and Ireland, and residing at Grindleford, in the county of Derby, England, (late of 31 Lyndhurst road, Hampstead, London, N. W., England,) have invented certain new and useful Improvements in and Relating to Elastic-Fluid Turbines, of which the following is a specification.

My invention relates to elastic fluid turbines, using either gas or steam and is applicable with especial advantage to turbines using superheated working fluid such as I have described in my U. S. Patent No. 892,818.

In dealing with the turbines referred to it is found that owing to the greater amount of energy in the high temperature fluid, a larger number of rows of blades is required to convert it usefully than in a turbine using saturated steam at the same pressure.

The primary object of the present invention is to provide a turbine which will efficiently utilize a working fluid containing a large amount of energy and which can at the same time be of moderate length and of speeds as slow as and in some cases slower than those now used in saturated steam turbines. In order to secure these results either in turbines of the type referred to above or in turbines of any other type to which my invention is applicable, I adopt blade sections having very fine edges and I proportion these blades and arrange them among themselves in a manner to be hereinafter described so that the jets issuing from between adjacent blades coalesce or practically coalesce into a continuous jet, thus reducing eddy-making spaces to a minimum.

In some cases I employ my improved blading in conjunction with blading of the Parsons reaction type in which a drop of pressure occurs, so as to extract larger amounts of energy per pair of moving and fixed blades than has heretofore been possible.

In order to secure the continuous jet referred to above in the case of impulse blades I find that the cross sectional area of the path between adjacent blades should be substantially constant and this owing to the change of shape of the inter-blade area necessitates a difference of pressure to obtain the flow through the blades, to maintain which difference some form of packing is necessary.

I will now describe certain specific forms of my invention, referring for this purpose to the accompanying drawings, of which—

Figure 1 shows a preferred form of blading according to my invention, Fig. 2 being a section on the line A B of Fig. 1; Fig. 3 shows a view of a turbine in which the character of the stages progressively alters in a manner to be hereinafter described, Fig. 4 being a part longitudinal section on the line 4—4 of Fig. 3 to a larger scale showing a brush-like packing applied to the blade ends.

The drawings are of a diagrammatic or conventional nature and are not intended to show such working details as are common knowledge to those skilled in the art.

According to one modification of my invention, I employ blades, *a*, (see Fig. 1) individually of symmetrical cross section and I arrange these blades so that their axes of symmetry, C D, make an angle as shown with their plane of rotation, E F. The result of this arrangement is that the breadth, *b*, of the nterblade inlet is greater than the breadth, *c*, of the interblade outlet. Further, I prefer to shape each blade so that its operative face has an entry of practically no curvature, increases progressively to a maximum curvature at the center and decreases thence to a minimum curvature or straight path at the exit. Thus referring to Fig. 1, the entry being straight may be looked upon as struck with a radius of infinite length while succeeding small arcs are struck from centers, 2, 3, 4, etc., with radii decreasing to a minimum at the center.

To obtain the best results I find that the cross sectional area of the inter-blade paths should be maintained substantially constant and in order to secure this result I lengthen the blade from inlet to outlet as shown in Fig. 2.

The inter-blade passages, *d*, narrowing towards the outlet thus correspond to the cross section naturally assumed by the fluid as it piles up against the concave blade face on account of the action of centrifugal force and the inter-blade passages run full to the outlet itself without the formation of dead spaces; owing to the straight thin edges of the blade, adjacent jets in this way coalesce and the jet of fluid issuing from between the blades is continuous.

In Figs. 3 and 4 a specific application of my invention is shown to the case of a turbine having stages of progressively varying character. Thus, the high pressure stage, X, is formed of alternate rows of fixed Parsons blading, *f*, having fine edges to coalesce adjacent jets, and similar movable blading, *h;* the middle stage, Y, is provided with alternate rows of fixed Parsons blading, *i*, having fine edges and movable blading, *k*, of my improved type while the low pressure stage Z, has one row of Parsons blading, *m*, with fine edges alternating with a plurality of rows, *n*, of my improved blading. As stated above, to obtain the best results both impulse and Parsons blading should be packed, as shown for example in Fig. 4, where the brush-like packing, *o*, described in my U. S. Patent specification, No. 885032, is applied to the blade ends; in the case of the impulse blades a difference of pressure is thus maintained to cause a flow of fluid through the inter-blade passages.

It will be evident that many other applications of my invention may be made, Figs, 3 and 4 showing merely one example of the use of my improved blading applied to a turbine the stages of which progressively vary.

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

1. In combination in a turbine, a series of impulse blades individually of symmetrical cross section, said blades being angled to give a fluid inlet broader than the corresponding outlet and each having uniform thin straight edge portions as seen in cross section to coalesce adjacent blades together with fluid packings for said blades.

2. In combination in a turbine, a series of impulse blades individually of symmetrical cross section, said blades each lengthening from inlet to outlet and being angled to give a fluid outlet narrower than the inlet and said blades each having thin straight edge portions as seen in cross section, the effect of such disposition and form of blades being to coalesce adjacent jets issuing therefrom together with fluid packings for said blades to maintain a difference of pressure across them.

3. A turbine installation having in combination a high pressure portion having blading of the reaction (Parsons) type; an intermediate portion having alternate rows of velocity-generating and impulse blades and a low pressure portion being alternately one row of velocity-generating blades and a plurality of impulse blades.

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

SEBASTIAN ZIANI DE FERRANTI.

Witnesses:

ALBERT HALL,

W. D. DAVIDSON.