No. 886,515. PATENTED MAY 5, 1908.

A. JUDE.

TURBINE.

APPLICATION FILED OCT. 3, 1906.

2 SHEETS—SHEET 1.

Fig. 1.

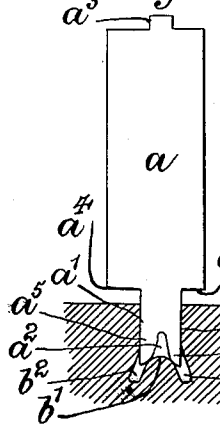


Fig. 2.

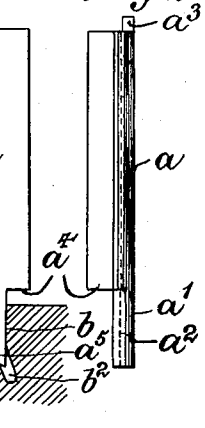


Fig. 5.

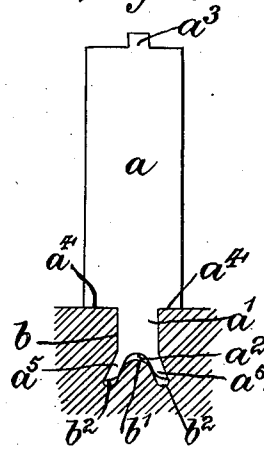
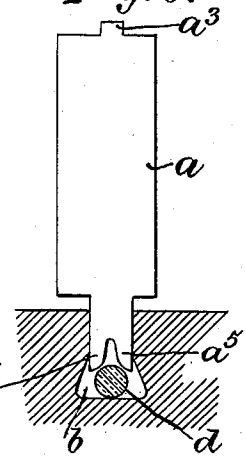


Fig. 6.



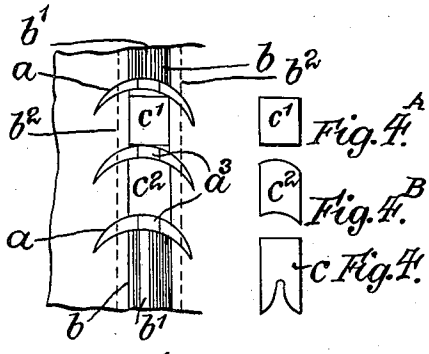


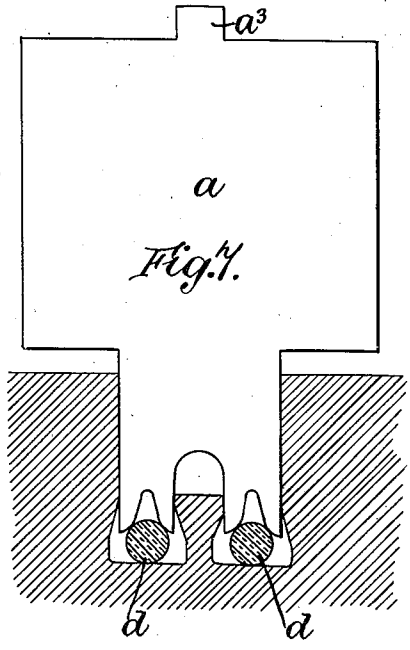
Fig. 3.

Fig. 4.A

Fig. 4.B

Fig. 4.C

Fig. 7.



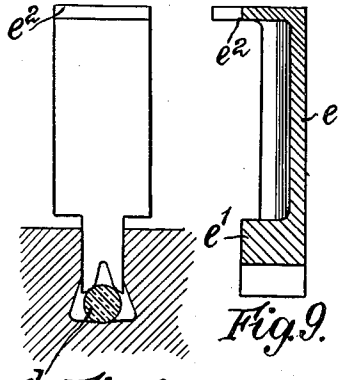


Fig. 8.

Fig. 9.

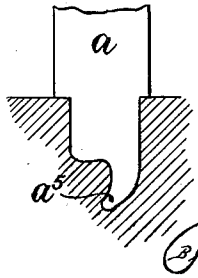


Fig. 4.A

WITNESSES

INVENTOR

Alexander Jude

Richards & Co

ATT'YS

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2 SHEETS—SHEET 2.

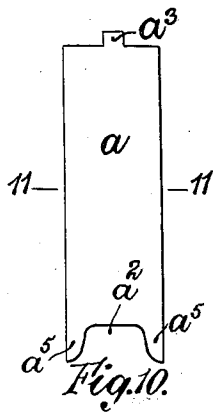

Fig. 10.

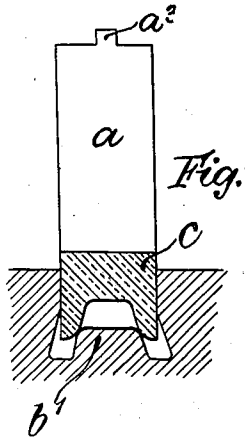

Fig. 12.

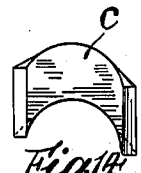

Fig. 12A.

Fig. 12A.

Fig. 11.

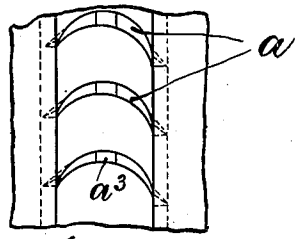

Fig. 13.

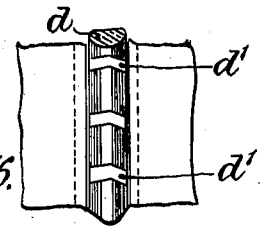

Fig. 16.

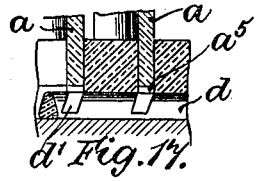

Fig. 17.

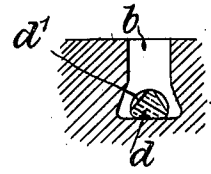

Fig. 15.

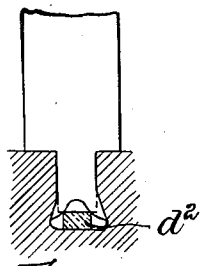

Fig. 20.

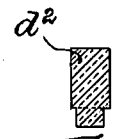

Fig. 19.

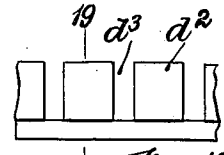

Fig. 18.

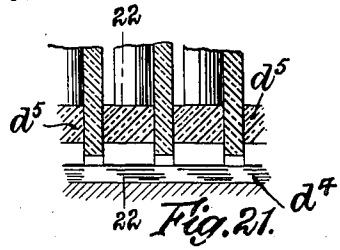

Fig. 21.

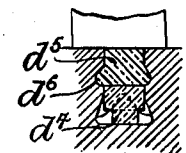

Fig. 22.

WITNESSES

INVENTOR

Alexander Jude

E. Richards Co

ATT'YS

UNITED STATES PATENT OFFICE.

ALEXANDER JUDE, OF BIRMINGHAM, ENGLAND, ASSIGNOR TO BELLISS & MORCOM LIMITED, OF BIRMINGHAM, ENGLAND.

TURBINE.

No. 886,515. Specification of Letters Patent. Patented May 5, 1908.

Application filed October 3, 1906. Serial No. 337,253.

To all whom it may concern:

Be it known that I, ALEXANDER JUDE, subject of the King of Great Britain, residing at Ledsam Street Works, Birmingham, county of Warwick, England, have invented new and useful Improvements in Turbines, of which the following is a specification.

This invention relates to improvements in the construction of guide-blades and vanes and to means for assembling them in and securing them to the stators and rotors respectively of turbine motors.

According to one form of construction the guide-blades or vanes or securing or filling blocks or both are formed with one or more deformable fangs, preferably in pairs, constituting a bifurcation, which, in the assembly of the parts, are distorted by being forced into the under cut portions of a ring-groove turned in the internal surface of the stator or the external surface of the rotor respectively, the space within the ring-groove being thereby completely filled and the guide blades or vanes secured therein by a clenching operation.

Various modifications of detail may be adopted for effecting the secure attachment by the clenching operation above described, as for example, the section of the groove may be adapted to effect the spreading of the fangs by means of a central ridge at the bottom of the groove or, alternatively, the spreader may be a longitudinal rod which is inserted in the groove preparatory to assembling and clenching. Again this separately made longitudinal spreader may be notched and thereby perform the further function of determining the pitch. For large blades and vanes two bifurcations may be provided on each, on the other hand a single fang may be used.

The various forms of construction referred to above are illustrated in Figures 1–22.

Referring to the first portion of the invention, Figs. 1–5 show the details of the construction and assembly of guide blades and vanes which are formed with a bifurcation. According to these figures a strip of metal of section suitable to form a guide-blade or vane a as shown in Fig. 3, is stamped or machined to a shape such as is indicated in Figs. 1 and 2, the breadth of the portion a^1, which forms the shank of the vane, being lessened by the removal of the thin edges and a notch a^2 being formed in the extremity of the shank. At the other end of the piece a, a lug a^3 is formed for the purpose of making a riveted attachment to the shrouding, in the usual way. The groove b into which the shank a^1 is intended to be inserted has a transverse section as shown in Figs. 1 and 5, there being a ridge b^1 left in the center of the bottom of the groove by turning a deep and narrow groove b^2 on each side thereof.

If a guide-blade or vane formed as described is forced or driven into the groove until the shoulders a^4 a^4 come in contact with the surface of the stator or rotor, as shown in Fig. 5, the fangs a^5 a^5 will be splayed into the undercut side grooves b^2 b^2 and thus clench the connection. Between the guide-blades or vanes a filling or distance piece, whose section has a profile like that of the shank a^1 as shown by c in Fig. 4, can be similarly clenched. These filling or distance pieces may have flat ends as shown by c^1 (Fig. 4^A) or they may be curved to the form of the front and back faces of the shank a^1 as shown by c^2 (Fig. 4^B).

In Fig. 6 a modified form of construction is shown in which, for the ridge b^1, is substituted a rod d which will serve to spread the fangs a^5 a^5 into the undercut sides of the groove b and similarly clench the guide-blade or vane within the groove.

Fig. 7 shows how the clenched fastening of Fig. 6 can be duplicated when large guide-blades or vanes are required to be secured. On the other hand Fig. 7^a shows how the fastening can be effected by a single fang.

Figs. 8 and 9 show two views of a guide-blade or vane e which is formed in one with its distance piece e^1, and also with its shrouding piece e^2, the rod d laid in the groove serving to spread the bifurcated portions into the undercut sides of the groove as in the previous examples.

Figs. 10 to 14^A refer to a modification of the construction shown in Figs. 1–5 in respect to the feature that the full breadth of the guide-blade or vane is retained in the shank portion. To effect the bifurcation the notch a^2 is made wider as shown in Fig. 10. In such a construction the portions splayed into the undercut sides of the groove are wider apart.

Fig. 11 is a section through 11—11 of Fig. 10 from which it will be seen that when the fangs a^5 a^5 which in this case are inclined to the sides of the groove, are splayed into the

undercut sides they will curl backwards and so augment their surface contact with the sides of the groove as indicated in the plan view of Fig. 13. In Figs. 14 and 14^A are shown in plan and elevation respectively the splayed condition of a distance piece *c* which is adapted to completely fill the space which intervenes between consecutive guide-blades or vanes. Fig. 12 represents the guide-blade or vane in elevation and filling piece in section assembled ready to be forced into the groove.

Figs. 15–17 show how the separately made, longitudinally placed spreading-piece *d* by having notches d^1 formed therein, before insertion in the ring-groove, is adapted to determine the pitch of the guide-blades or vanes, the intervening spaces being plugged by bifurcated blocks as before described.

Figs. 18–20 show a modification of the device last described in which, for the rod *d*, is substituted a notched filling piece d^2, the transverse section of which is shown in Fig. 19, this being taken along the line 19—19 of Fig. 18. The notches d^3 d^3 of this filling piece are adapted to receive the shanks of the guide-blades or vanes.

A still further modification of this device is shown in Figs. 21 and 22, Fig. 22 being a section along the line 22—22 of Fig. 21. In this the notched distance piece d^4 does not fill the grooves but leaves a space above to be filled with white metal d^5 cast or plugged in, undercut channels d^6 d^6 being formed in the sides of the groove which become filled by the white metal and assist in strengthening the connections.

Claims.

1. Means for securing turbine blades formed from a strip of uniform section to their carrying elements, comprising an undercut ring groove in the carrying element, and a bifurcated shank formed integrally with the blade, and means for directing the bifurcations into the undercut portions of the groove which means consists of a longitudinal rod.

2. Means for securing turbine blades formed from a strip of uniform section, to their carrying elements, comprising an undercut ring groove in the carrying element, and a bifurcated shank formed integrally with the blade and means for directing the bifurcations into the undercut portion of the groove which means consists of a notched longitudinal rod.

3. Means for securing turbine blades formed from a strip of uniform section to their carrying elements, comprising an undercut ring groove in the carrying element, and a duplicated bifurcated shank formed integrally with the blade, and means for directing the bifurcations into the undercut portions of the groove.

4. Means for spacing turbine blades, formed from a strip of uniform section, comprising an undercut ring groove in their carrying elements, and a filling piece having a fang which on being forced into the ring groove will be distorted to occupy the recess beneath the overhanging wall of the groove.

5. Means for spacing turbine blades formed from a strip of uniform section, comprising an undercut ring groove in their carrying elements, a bifurcated filling piece, and means for directing the bifurcations into the undercut portions of the groove.

6. Means for securing turbine blades formed from a strip of uniform section to their carrying elements, comprising an undercut ring groove in the carrying element, a shank formed integrally with the blades having a fang, and a filling piece having a fang, which fangs on being forced into the ring groove will be distorted to occupy the recess beneath the overhanging wall of the groove.

7. Means for securing turbine blades formed from a strip of uniform section to their carrying elements, comprising an undercut ring groove in the carrying element, a bifurcated shank formed integrally with the blades, a bifurcated filling piece, and means for directing the bifurcations into the undercut portions of the groove.

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

ALEXANDER JUDE.

Witnesses:

E. M. WEBB,

K. M. THOMPSON.