J. DAHL.

DEVICE FOR FIXING TURBINE BLADES.

APPLICATION FILED JAN. 12, 1909.

930,735. Patented Aug. 10, 1909.

3 SHEETS—SHEET 1.

Fig. 1.

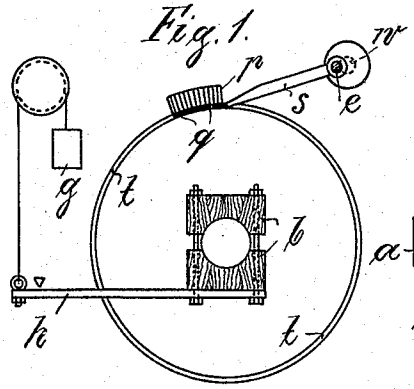


Fig. 2.

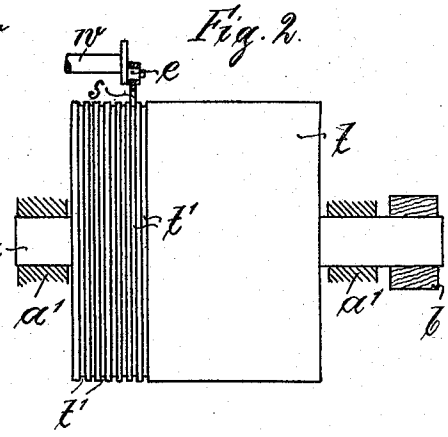


Fig. 3

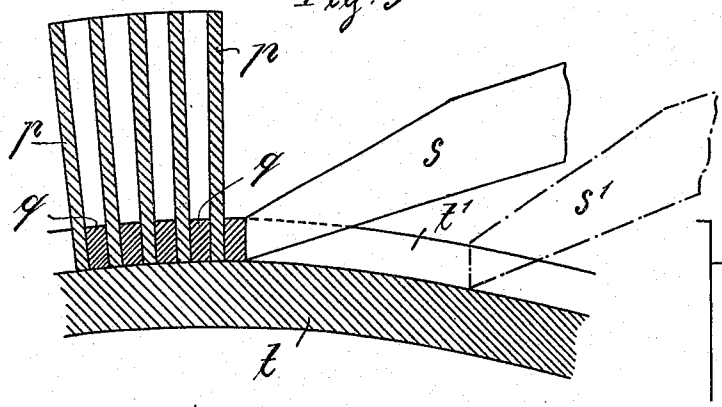


Fig. 4

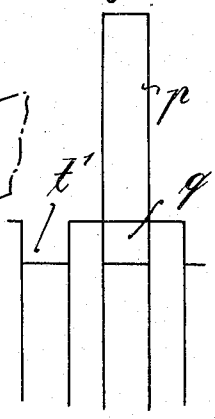
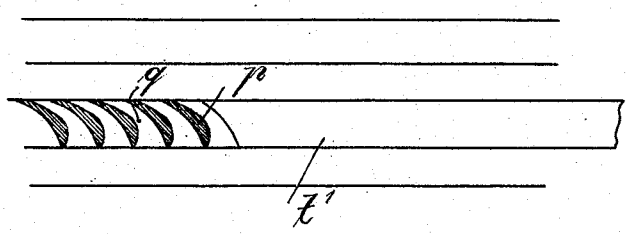


Fig. 5



Witnesses:
Floral Greenwald.
Jacob L. Diamond.

Inventor
Johannes Dahl
by L. K. Böhm,
Attorney

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3 SHEETS—SHEET 2.

Fig. 6

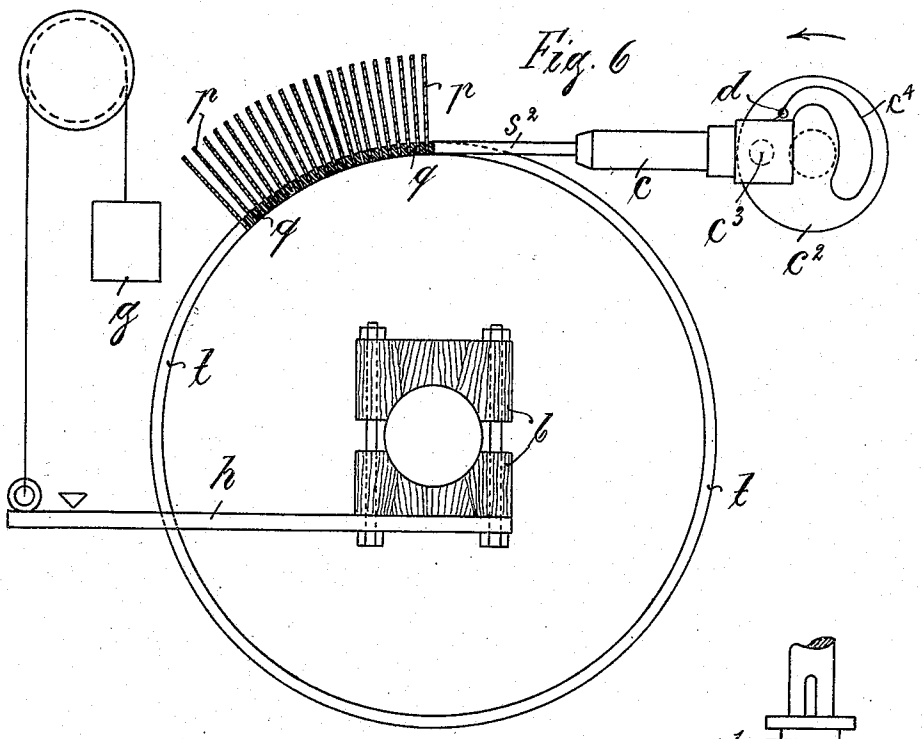
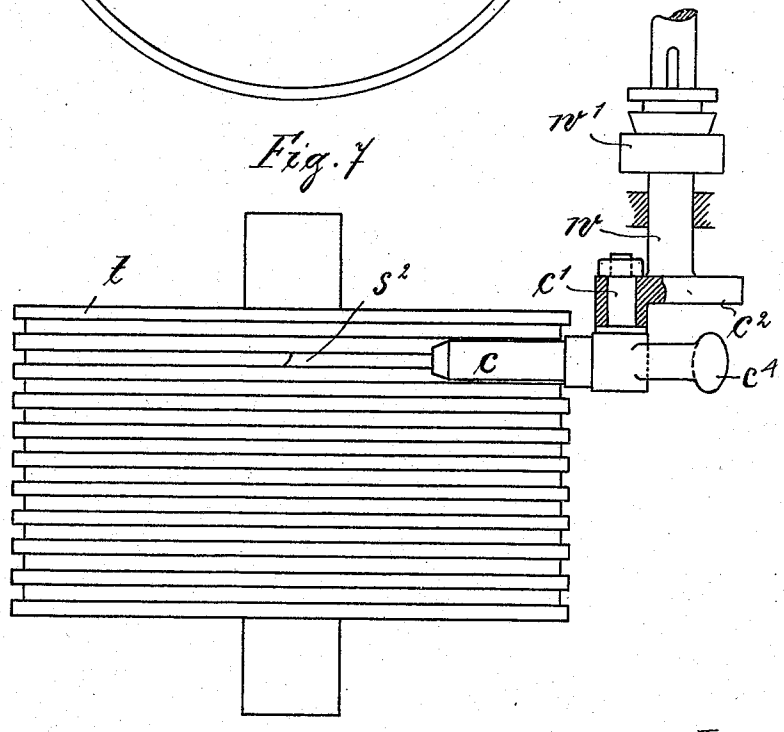


Fig. 7



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3 SHEETS—SHEET 3.

Fig. 8.

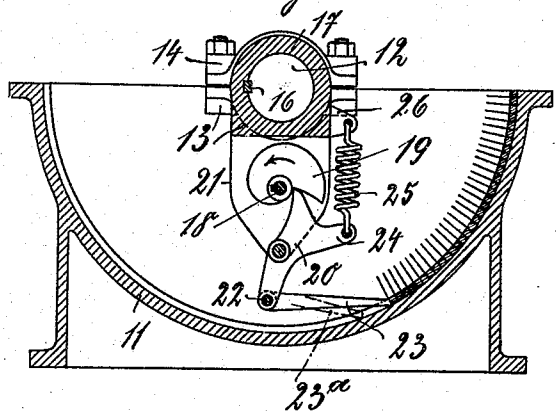
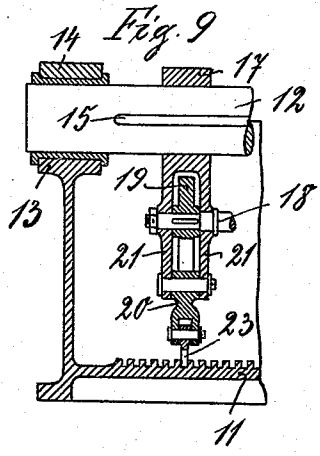


Fig. 9



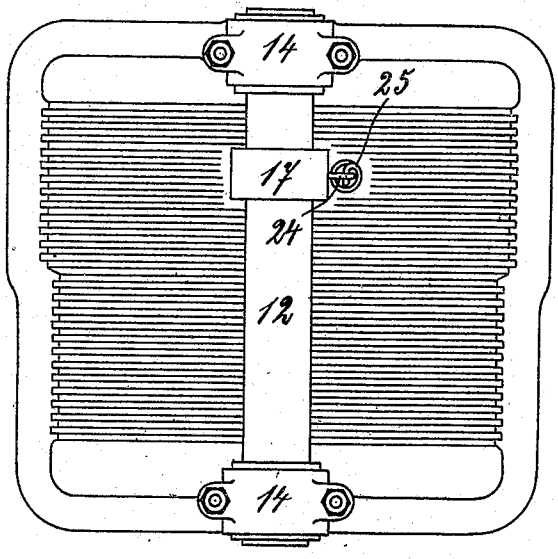


Fig. 10

Witnesses:
Flosa Steinwald.
Jacob L. Diamond

Inventor:
Johannes Dahl
by L. K. Böhm,
Attorney

UNITED STATES PATENT OFFICE.

JOHANNES DAHL, OF GROSS-FLOTTBEK, NEAR HAMBURG, GERMANY, ASSIGNOR TO BLOHM AND VOSS, COMMANDITGESELLSCHAFT AUF ACTIEN, OF HAMBURG, GERMANY, A FIRM.

DEVICE FOR FIXING TURBINE-BLADES.

No. 930,735. Specification of Letters Patent. Patented Aug. 10, 1909.

Application filed January 12, 1909. Serial No. 471,885.

To all whom it may concern:

Be it known that I, JOHANNES DAHL, a citizen of the free town of Hamburg, and resident of Gross-Flottbek, near the free town of Hamburg, Germany, engineer, have invented a new and useful Device for Fixing Turbine-Blades, of which the following is a specification.

This invention relates to a device for fixing turbine blades in their blade carrying members and its object is to provide a simple mechanical device for effecting this purpose.

To this end the invention consists in a device comprising a pressing tool mechanically reciprocated in a substantially tangential direction in the groove of the bladed member and means for applying a resistance to the tool or the bladed member or the tool operating parts, this resistance being overcome only at a pressure which is adequate to upset the turbine blade root or distance piece within its retaining groove. With this arrangement of device the turbine blades are all evenly set and upset within the groove so that no subsequent rectifying of the blades is necessary. Such rectifying has always been necessary when the turbine blades have been inserted and calked in place by hand. Further a very important effect obtained is that no side calking strip is required while at the same time I have found that a rectangular groove may be employed. The turbine blade roots and distance pieces fit loosely within this groove and are inserted by hand. The mechanically reciprocated pressing tool then upsets these turbine blade roots and distance pieces to cause them to grip tightly within their grooves. Experiments with a comparatively small size of blade have shown that with a fixing of this kind a force of 600 kg. was necessary to draw the blades from their carrying members and the finished crown of blades did not require any subsequent rectifying to bring them accurately into one plane.

The blades and distance pieces may be separately pressed into position or a blade and a distance piece or several blades and a corresponding number of distance pieces may be simultaneously pressed or upset within the groove. In the case of fixing blades on a drum, the drum is rotatably mounted and a brake or ratchet mechanism applied to prevent the rotation of the drum before the tool presses on the part to be fixed in the groove with a pressure sufficient to upset the said part or parts. It will be understood that the shape of the grooves forms no important part of this invention as it may be applied to blade carrying grooves which are rectangular in shape or which are provided with undercut parts.

The invention is illustrated somewhat diagrammatically in the accompanying drawings, in which—

Figure 1 is a diagrammatic side view and Fig. 2 is a diagrammatic front elevation of a turbine drum showing the apparatus according to the present invention and illustrating its operation, Fig. 3 is an enlarged section of the turbine drum and blades, Fig. 4 is a front elevation and Fig. 5 is a plan of the same, Fig. 6 is a side elevation, and Fig. 7 is a plan of a modified form of the apparatus especially applicable to the insertion of large blades, Fig. 8 is a sectional elevation, Fig. 9 is a sectional side view and Fig. 10 a plan of a device suitable for fixing blades in a turbine casing according to the present invention.

In carrying the invention into effect according to the form shown in Figs. 1–5 the turbine drum t having several grooves t' therein is to be provided with blades p which are divided from one another by distance pieces q. The axis a of the drum is supported in bearings a' and is provided with a brake b, the lever h of which is loaded by means of a weight g. Parallel to the axis of the drum there is supported a shaft w which at one end is provided with a disk carrying an eccentric pin e. The eccentric pin e has pivoted to it a pressing or calking tool s, the point of which fits in the grooves of the turbine drum and is adapted to press against the blades and distance pieces. These blades and distance pieces may be inserted in the groove by hand.

When the shaft w rotates the pressing tool is reciprocated in a substantially tangential direction between the positions s and s' Fig. 3. In the position s' the blades p and distance pieces q are inserted. During the motion from the position s' to the position s these blades are firmly pressed by the tool s. In consequence of the constant braking force exerted on the axis of the drum by the brake b, the pressure of the tool s is always the

same and this pressure may be adjusted by adjusting the brake. In all cases the pressure of the tool s on the distance pieces must be sufficient to upset the blade root and distance piece. When this pressure is reached the drum t is caused to rotate through a short distance by the further motion of the tool s. It will be seen that this further rotation is effected by overcoming the resistance which is applied to the drum by means of the brake and that this resistance is at least as great as the pressure necessary to upset the parts to be fixed in the groove.

When starting to insert a ring or crown of blades a wedge is inserted in the groove in the usual manner and the first blade butts against the wedge. When the crown of blades is almost completed a bent tool may be used for inserting a few of the last blades while the remaining blades are of course inserted by hand in the usual manner.

It will be understood that the resistance is preferably constant and that this constant resistance may be secured by various means. Further the resistance may be applied to the tool s or its moving mechanism. The invention also may be applied to blades fixed axially or radially.

According to the form shown in Figs. 6 and 7 the pressing tool s^2 forms the stem of a pneumatic hammer c which is pivoted to the pin c', mounted on a disk c^2. The disk c^2 is fixed to a driven shaft w. When this shaft rotates in the direction of the arrow in Fig. 6 the stem s^2 is moved in a substantially tangential direction to the turbine groove.

The method of fixing the parts p and q in this device is as follows: The axis a is braked for instance in the manner described with reference to Figs. 1 and 2. The pin c' is moved at the rotation of the shaft w in the direction of the arrow to a point d and during this time the parts p and q to be inserted are laid in the grooves. In the position d the rotation of the shaft w is stopped by throwing out a coupling w'. The supply of air to the hammer c is then opened by the operator holding the handle c^4 of the pneumatic hammer so that the stem c makes a series of impacts against the blade p or distance piece q. The pneumatic hammer is then put out of operation and the shaft w allowed to rotate further. The pin c' then moves from the point d to the point c^3 and in this motion pushes the drum t one stage further against the braking action which is applied to the axis a. The resistance offered by the brake must be sufficient to prevent the action of the pneumatic hammer causing rotation of the drum. The steady pressure applied from the point d to the point c^3 finishes the upsetting of the blades and distance pieces q in the manner described above with reference to Fig. 1. This form of apparatus is specially suited for large blades and may be applied to the insertion of blades in either the turbine drum or casing.

In Figs. 8–10 I have shown a form of my invention specially applicable for use in the insertion of turbine blades in a turbine casing. In this device the turbine casing 11 supports a shaft 12 in bearings 13. The upper cover 14 of the bearings 13 may be tightened down on the shaft 12 for the purpose of giving a braking action. The shaft 12 is provided with a feather way 15 in which a feather or spline 16 is adapted to slide. The spline 16 is carried by an eye 17. On this eye there is mounted a shaft 18 which may be driven by a motor through a flexible shaft. The shaft 18 has mounted on it a cam 19 which coöperates with one arm of a lever 20 which is supported between the cheeks 21 on the eye piece 17. The lever 20 has pivoted to it at 22 the pressing tool 23. Further the lever 20 carries on an arm 24 a spring 25 fixed to a bracket 26 on the eye piece 17.

The operation of this device is as follows: When the shaft 18 is rotated the cam 19 causes the pressing tool 23 to be withdrawn to the position shown in dotted lines at 23^a. When the pressing tool is in this position the distance piece and blade are inserted. The shaft 18 then rotates further until the finger on the lever 20 is released by the cam 19 so that the spring 25 draws on the arm 24 and thereby brings the tool 23 sharply against the blade and distance piece. The tension of the spring 25 is sufficient to cause the upsetting of the blade and distance piece and also to overcome the resistance applied to the shaft 12 by the covers 14. Owing to the tool 23 being held firmly against the blade or distance piece by the spring 25, this spring pulls on the bracket 26 and thereby rotates the shaft 12 through a short distance. It will be understood that if desired the tool 23 might be moved by positive means against the blades and distance pieces for instance in the manner shown in Figs. 1 and 2.

It will be understood that many modifications may be made in the device above described. Thus a power hammer may be arranged in the manner shown in Figs. 8–9, to operate on the blades to be fixed on the casing, the essential feature being that the power hammer as in Figs. 6 and 7 is mechanically moved or guided toward and away from the work.

I claim:—

1. A device of the kind described for fixing turbine blades and the like in their grooves on the blade carrying member comprising, a pressing tool movable in the groove, means for moving said tool substantially tangentially in the groove and means for applying a resistance to one of said re-

cited parts said resistance being overcome only at a pressure adequate to upset the part to be fastened in the groove substantially as described.

2. A device of the kind described for fixing turbine blades and the like in their grooves on the bladed member comprising, a power hammer having a stem fitting into the turbine groove, means for moving said power hammer and stem substantially tangentially in said groove and means for applying a resistance to said bladed member to prevent said bladed member moving under the action of the hammer until adequate pressure is applied to upset the part to be fastened in the groove.

3. A device of the kind described for inserting and fixing turbine blades with roots and distance pieces between said roots in a blade carrying member having grooves, comprising a pressing tool fitting in said grooves, means for reciprocating said pressing tool substantially tangentially in said grooves and braking means applied to said blade carrying member for the purpose set forth.

4. A device of the kind described for fixing turbine blades and distance pieces in a blade carrying member of a turbine, said member having grooves, comprising a rotatable shaft mounted parallel to the axis of said bladed member, a pin carried eccentrically by said shaft, a pressing tool mounted on said pin and reciprocating substantially tangentially in the grooves of said bladed member and means for applying a brake to said bladed member.

5. A device of the kind described for fixing turbine blades and distance pieces in a blade carrying member of a turbine, said member having grooves, comprising a rotatable shaft mounted parallel to the axis of said blade carrying member, a disk carried by said shaft, a pin eccentrically fixed on said disk, a pneumatic hammer mounted on said pin, a stem on said hammer movable in the grooves on the blade carrying member and a brake for said blade carrying member.

6. A device of the kind described for fixing turbine blades and distance pieces in a blade carrying member of a turbine, said member having grooves, comprising a rotatable shaft mounted parallel to the axis of said blade carrying member, a coupling adapted to be placed in and out of operation in said shaft, a disk carried by said shaft, a pin eccentrically fixed on said disk, a pneumatic hammer mounted on said pin, a stem on said hammer movable in the grooves on the blade carrying member and a brake for said blade carrying member.

In witness whereof I have hereunto set my hand in the presence of two witnesses.

JOHANNES DAHL.

Witnesses:

ERNEST H. L. MUMMENHOFF,

OTTO W. HELLMRICH.