Oct. 20, 1931. B. V. DENSMORE 1,828,409

REACTION BLADING

Filed Jan. 11, 1929

FIG. 1.

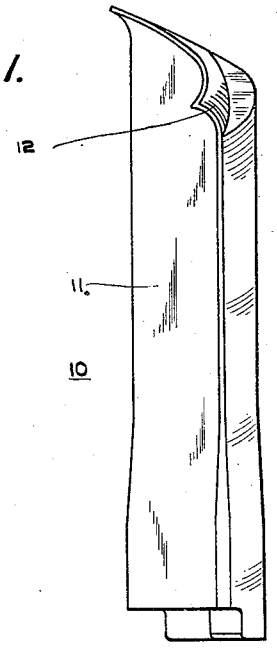
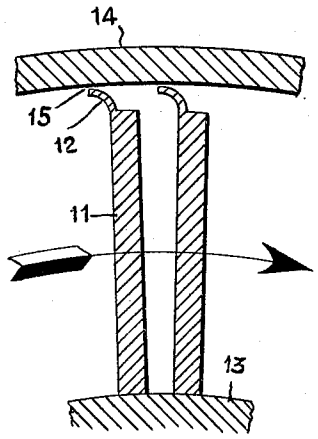


FIG. 2.



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UNITED STATES PATENT OFFICE

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REACTION BLADING

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My invention relates to elastic fluid turbines, and more particularly to the reaction blading for such turbines, and it has for an object to improve the efficiency of apparatus of this character.

It is one of the inherent characteristics of reaction turbines, or of the reaction stages of any turbine, that the pressures on the opposite sides of each row of blades are different. This is due to the fact that the steam expands in the moving as well as in the stationary blades and there is a drop in pressure between the two sides of every row of blades. Hence, there is a tendency for steam, or other working fluid to pass in a continuous stream around the tips of the blades toward the region of lower pressure.

To counteract this tendency, it is customary to provide a relatively small clearance between the tips of the moving blades and the casing, in one instance, and between the tips of the stationary blades and the rotor, in the other. Under such conditions, rubbing sometimes occurs at the tips of the blades, causing the latter to chatter, or vibrate. When this rubbing occurs, the tip of a blade is temporarily retarded so that the blade is bent backwardly until it is free of the rubbing surface, or until its resiliency causes it to snap forward and thus, to thrust its tip portion directly toward, or into any adjacent, or rubbing surface, and the blade is again bent backwardly, and so on; the motions just described being those which occur when the blade is in a vibratory condition.

The more serious consequences are due to impacts, or other contacts resulting from the forward swing of the tip of the blade and which cause the rubbing surface to seize the tip, or to otherwise arrest this forward motion, for such contacts tend to push the tip of a blade directly into any adjacent surface. It will be apparent, therefore, that a relatively slight rubbing at the tip of a blade may easily cause sufficient chattering, or vibration, to eventually produce a failure by breakage.

It is a more particular object of this invention, therefore, to provide turbine blades with means for preventing serious vibration when rubbing occurs.

This and other objects are effected by my invention, as will be apparent from the following description and claims taken in connection with the accompanying drawings, wherein:

Fig. 1 is an elevation of a reaction blade; and

Fig. 2 is a fragmentary sectional view of a turbine having blades in accordance with the present invention.

According to one preferred form of my invention, the tip of a reaction blade is provided with a bendable extension which is formed as a continuation of a working surface of the blade, and inclined backwardly with respect to the direction of rotation. By virtue of this backwardly inclined extension, it is assured that, should any rubbing occur, the extended portion will merely be bent over, the point of contact will always follow the blade and the tip portion will not be pushed directly toward, or into the rubbing surface, but will drag over it in such a manner as to tend to dampen vibration, thus avoiding any destructive vibration.

This will be more apparent from the drawings wherein I have shown the blade 10, consisting of a blade portion 11, as usual, and a relatively thin, bendable extension 12. As shown in Fig. 2, the blade is mounted on a turbine rotor 13, the tip end of the blade portion 11 being disposed adjacent the casing 14 with the usual radial clearance. The bendable extension 12 projects outwardly from the tip of the blade, preferably as a continuation of a working surface, and also preferably as a continuation of the face of the blade, and this extension is also initially inclined backwardly with respect to the direction of rotation, or with respect to the direction of relative movement of the tip of the blade and any surface with which this tip might come in rubbing contact. A close radial sealing clearance, indicated at 15, is provided between the bendable extension 12 and the adjacent surface of the casing 14, so that the bendable extension is normally not in contact with said surface. By arranging

this bendable extension so that it is initially inclined backwardly in the manner just described, it will be clear that the radial clearance 15 may be exceedingly small, and in the event any rubbing occurs, the point of contact will always follow the blade and hence, will cause the rubbed metal to flow in one direction and tend to prevent vibration when the rub takes place. Should any rub occur with my novel blade, it will thus be seen that no serious consequences will result and that, when access is had to the blading, the rubbed edge portion may be trimmed and straightened and the original clearance restored.

The extension 12, as will be noted from the drawings, extends transversely of the blade. When the edge comes into contact with minute irregularities of the adjacent surface of the casing 14, the edge will yield or bend in the longitudinal direction of the blade. Thus the blade is not held back and does not vibrate.

It will be readily apparent, therefore, that I have provided a turbine blade with means for preventing vibration due to rubbing.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are imposed by the prior art or as are specifically set forth in the appended claims.

What I claim is:

1. In a turbine, the combination of a rotor and a casing, a turbine blade carried by one of said parts with its tip end adjacent the other of said parts, said tip end being formed with a relatively thin extension bendable longitudinally of the blade and having close sealing clearance with said other part, said extension being bent backwardly with respect to the direction of rotation of the blade relative to said other part.

2. The combination defined in claim 1, in which the bendable extension is formed as a continuation of one of the working faces of the blade.

In testimony whereof, I have hereunto subscribed my name this 27th day of December, 1928.

BENJAMIN V. DENSMORE.