No. 779,949. PATENTED JAN. 10, 1905.

A. F. MACDONALD.

# SUPPORT FOR INTERMEDIATE TURBINE BUCKETS.

APPLICATION FILED JAN. 11, 1904.

Fig. 1.

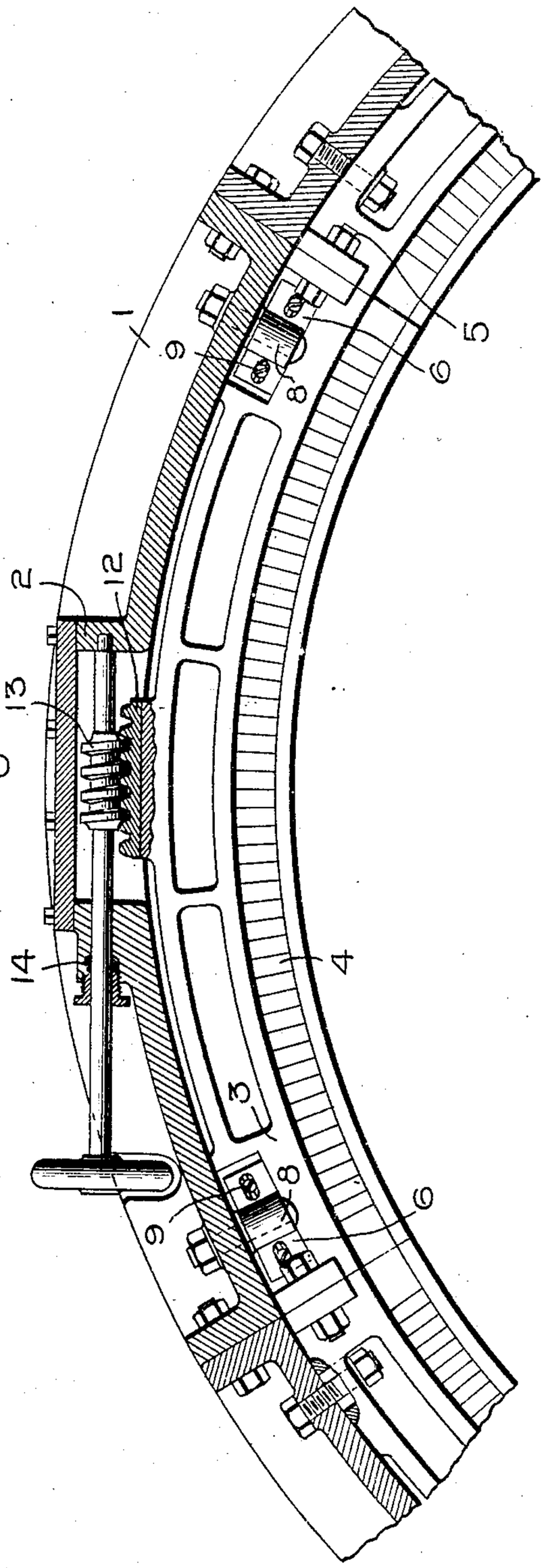



Fig. 4.

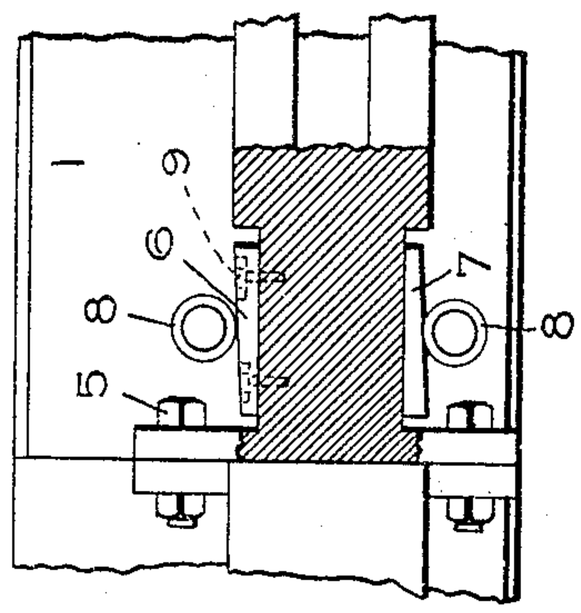



Fig. 3.

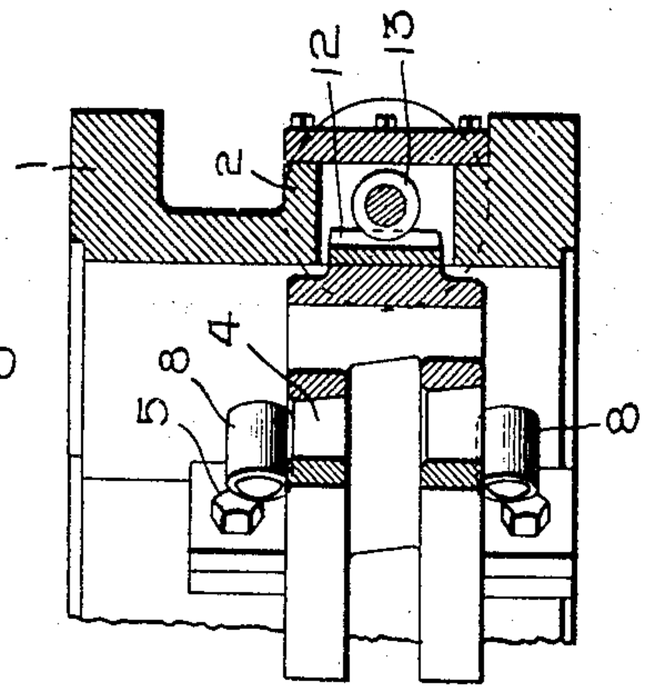
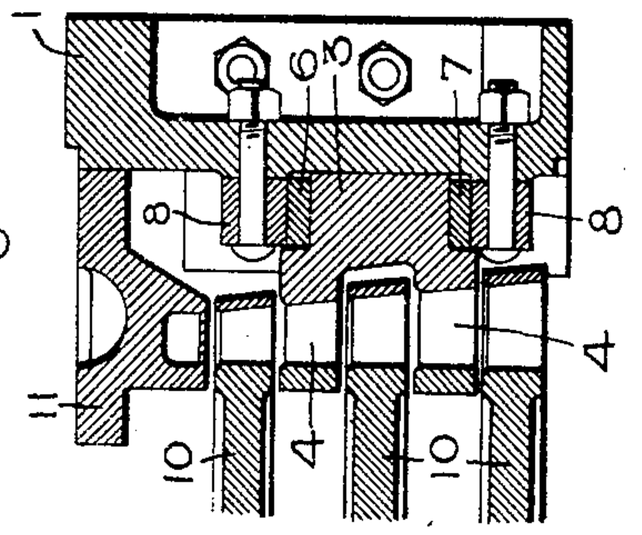



Fig. 2.




Witnesses:
Marcus L. Byng.
Helen Orford

Inventor:
Alexander F. Macdonald,
by Albert G. Davis
Att'y.

PHOTO-LITHOGRAPHED BY SACKETT & WILHELMS LITHO. & PTG. CO. NEW YORK.

No. 779,949. Patented January 10, 1905.

# UNITED STATES PATENT OFFICE.

ALEXANDER F. MACDONALD, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

## SUPPORT FOR INTERMEDIATE TURBINE-BUCKETS.

SPECIFICATION forming part of Letters Patent No. 779,949, dated January 10, 1905.

Application filed January 11, 1904. Serial No. 188,518.

*To all whom it may concern:*

Be it known that I, ALEXANDER F. MACDONALD, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Supports for Intermediate Turbine-Buckets, of which the following is a specification.

Considerable delay is experienced at times in starting compound multistage elastic-fluid turbine units into operation, owing to the unequal expansion of the shaft and the wheel-inclosing casing, which causes the buckets and discharging devices to rub. This has resulted in either using excessively-large clearances or making the wheel or intermediate buckets adjustable. The former practice is unsatisfactory, because it reduces the economy by permitting the motive fluid to escape without performing useful work. The second practice, as now followed, is satisfactory to a certain extent; but it has its limitations. The intermediate buckets, more especially those of the high-pressure stage, are arranged in segments which cover a relatively small arc of the wheel and are each provided with a separate adjusting means. This means that each segmental set of buckets is independently adjustable, which involves the exercise of careful and painstaking work if each and all of the sets are to be correspondingly adjusted. Moreover, the work of adjusting is multiplied by the number of sets of buckets in the given stage or stages. In small machines relative adjustment of the wheel and intermediate buckets has been attained by making the casing adjustable longitudinal of the shaft. Obviously this is impracticable for machines of any substantial size. In certain types of machine, more especially in the low-pressure stage or stages, these intermediate buckets extend entirely around the wheel, or substantially so, and it is the practice to make them non-adjustable with relatively large clearances. In such cases the wheel and its shaft have been adjusted longitudinally by a means engaging the shaft. So far as I am aware it has never been attempted, prior to my invention, to adjust the intermediates of a turbine with respect to the casing and wheel where said intermediates extended entirely or substantially around the casing.

The present invention has for its object to overcome the objections above pointed out and to provide a simple means for adjusting the fluid-discharging devices or intermediate buckets of a turbine with respect to the wheel-buckets and casing, which is applicable to large as well as small machines, and this whether the buckets are arranged segmentally or extend entirely around the wheel.

In carrying out the invention the fluid-discharging devices or intermediate buckets are so mounted that by giving them a relatively slight angular motion independent of the casing or from their usual position either by hand or power-actuated means they can be adjusted longitudinally of the shaft or casing, or both.

A simple means for carrying out the invention comprises a frame mounted within the wheel-casing upon which are mounted one or more sets of buckets or discharging devices, each set comprising one or more rows of buckets. The frame may inclose only a portion of the wheel or wheels or it may extend entirely around it or them. Between the frame and the casing are inclined surfaces for moving the frame axially. The said surfaces may be on the frame or on the casing, as desired. The surfaces can with advantage be a part of the frame and arranged to engage with rollers mounted on fixed studs on the casing. Situated outside of the casing, so as to avoid opening it and the trouble incident thereto, is an actuator for imparting angular movement to the frame, which is connected by gearing or other means with the frame. Moving the actuator causes the frame to be rotated slightly in one direction or the other, and as the inclined surfaces engaging with the rollers are moved in one direction or the other the frame as a whole is moved in an axial direction either up or down in a vertical machine or to the right or left in a horizontal machine, and in this manner the clearance between relatively

moving parts is adjusted. The adjusting devices for the several stages in a multistage machine can be connected for simultaneous adjustment, but I consider it better practice to adjust them separately. By means of this rotary adjustment of the frame the buckets and nozzles can be moved relative to each other into proper alinement. In order to hold the buckets in proper alinement, especially where a segmental frame is employed, it is best to place inclined surfaces and rollers on each side of the frame. In order to relieve the strain on the adjusting device, clamping means accessible from the outside are provided, which normally lock the parts in place.

I have used the term "intermediate buckets" in a broad sense as meaning devices for discharging fluid to a wheel, and they may serve merely to direct the fluid against the wheel-buckets at the proper angle or impart velocity to the fluid, or both. The passages between the buckets may expand or not, as desired.

In the accompanying drawings, which illustrate one embodiment of my invention, Figure 1 is a horizontal section of a part of a vertical turbine. Fig. 2 is a partial vertical section of the same machine. Fig. 3 is a partial vertical section of the machine, taken on the plane passing through the gearing for adjusting fluid-discharging devices; and Fig. 4 is a detail sectional view showing the arrangement of the rollers and inclined plates for moving the discharging devices axially.

1 represents the casing of the turbine, which may be made in a single piece or in sections to suit the requirements. At one or more points the casing is provided with covered projections 2, which contain the means employed to adjust the position of the fluid-discharging devices. Located entirely within the casing and extending wholly or partially around the wheel is a frame 3, to which the discharging device or intermediate buckets 4 are secured. This frame may be made in a single piece or in segmental pieces united by the bolts 5. Attached to the opposite faces of the frame 3 are plates 6 and 7, having inclined surfaces which engage with the rollers 8, carried by the casing. These plates are provided with slots and retaining-bolts 9, whereby they may be adjusted.

In the present illustration three rows of wheel-buckets 10 are provided; but the number can be varied as desired. Between the rows of wheel-buckets are situated the fluid-discharging devices or intermediate buckets 4, and between the wheel and intermediate buckets are clearances, which are necessary for mechanical reasons. From Fig. 2 it will be seen that as the frame 3 is moved axially up or down the clearance above and below the wheel-buckets will be changed.

Situated above the wheel and in line with the buckets is a nozzle 11, which may be of the expanding or non-expanding type, as desired. It is preferable to extend the nozzle over an arc which approximates that covered by the intermediate buckets or discharging devices 4.

Since the frame 3 is supported between rollers which engage with oppositely-inclined plates carried thereby, it follows that if the frame be rotated in one direction or the other it will also be moved axially, and changing the axial position of the frame varies the clearances between the stationary and moving parts. A rack 12 is bolted or otherwise secured to the frame, and meshing with the rack is a worm 13, the shaft for which extends through suitable packing 14 in the casing and is provided with a hand-wheel at its outer end. Rotating this hand-wheel in one direction or the other will move the frame angularly, and the oppositely-inclined plates 6 and 7 engaging with the roller 8 will give the frame an axial movement.

In accordance with the provisions of the patent statutes I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. An elastic-fluid turbine comprising a shaft, wheel-buckets, and a device for discharging fluid against them, in combination with a means for changing the angular position of said device about the wheel without changing the angle of delivery.

2. An elastic-fluid turbine comprising a shaft, wheel-buckets, and a device for discharging fluid against them, in combination with a means for changing the angular and axial position of said device about the wheel-shaft.

3. An elastic-fluid turbine comprising a casing, wheel-buckets, and a device for discharging motive fluid to the buckets, in combination with a frame for supporting the device which surrounds the wheel and is inclosed by the casing and separate therefrom, and a means for moving the frame with respect to the buckets.

4. An elastic-fluid turbine comprising a casing, wheel-buckets, intermediate buckets arranged in sets which extend around or substantially around the wheel, in combination with means for simultaneously and correspondingly adjusting all of the sets of intermediates with respect to the wheel-buckets and casing.

5. An elastic-fluid turbine comprising a casing, wheel-buckets, and a device normally stationary and supported by the casing for discharging fluid to the buckets, in combina-

tion with a frame which carries the fluid-discharging device and is angularly adjustable about the wheel.

6. An elastic-fluid turbine comprising a casing, wheel-buckets, and a device for discharging fluid against the buckets, in combination with a frame for the device which is carried by the casing, and a means for moving the frame angularly and axially with respect to the casing.

7. An elastic-fluid turbine comprising a casing, wheel-buckets, and a device for discharging fluid against the buckets, in combination with a frame for the device, a support for the frame which is carried by the casing, and a means for imparting a combined angular and axial movement to the frame for adjusting the clearance.

8. An elastic-fluid turbine comprising a casing, wheel-buckets, and a fluid-discharging device, in combination with a frame for supporting the device, inclined bearing-surfaces between the casing and the frame, and means for moving the frame on said inclined surfaces.

9. An elastic-fluid turbine comprising a casing, wheel-buckets, and a fluid-discharging device, in combination with a frame for the device, and plates having inclined surfaces for moving the frame axially.

10. An elastic-fluid turbine comprising a casing, wheel-buckets, and a fluid-discharging device, in combination with a frame for the fluid-discharging device which surrounds the wheel and is located between it and the casing, and means for moving the frame axially with respect to the wheel-carrying shaft and casing.

11. An elastic-fluid turbine comprising a casing, wheel-buckets, and a fluid-discharging device, in combination with a frame for the device which engages the casing, means for moving the frame axially, and a device for moving the frame angularly.

12. An elastic-fluid turbine comprising a casing and wheel-buckets, in combination with a device for discharging fluid against the buckets which is movable axially and angularly for adjusting the clearance, and a means for securing the fluid-discharging device in place.

13. An elastic-fluid turbine comprising a casing and wheel-buckets, in combination with a fluid-discharging device, gearing for imparting angular movement to the device, and means coacting with the gearing to move the device axially.

14. An elastic-fluid turbine comprising a casing and wheel-buckets, in combination with a fluid-discharging device, a frame inclosed by and separate from the casing to which the device is attached, and supporting means located within the casing and engaging with opposite sides of the frame.

15. An elastic-fluid turbine comprising a casing and wheel-buckets, in combination with a fluid-discharging device, a frame, plates attached to the frame and having inclined surfaces, and means attached to the casing and engaging with the plates for supporting the frame.

16. An elastic-fluid turbine comprising a casing and wheel and intermediate buckets, in combination with a segmental frame located within and independent of the casing which surrounds the wheel and supports the intermediate buckets, devices for uniting the segments, and means for adjusting the position of the frame.

17. An elastic-fluid turbine comprising a casing, wheel-buckets, intermediate buckets arranged in sets occupying different angular positions around the wheel, a frame located within and supported by the casing to which the sets of intermediates are attached, and means for adjusting the position of the intermediates and frame without opening the casing.

In witness whereof I have hereunto set my hand this 7th day of January, 1904.

ALEXANDER F. MACDONALD.

Witnesses:
BENJAMIN B. HULL,
HELEN ORFORD.