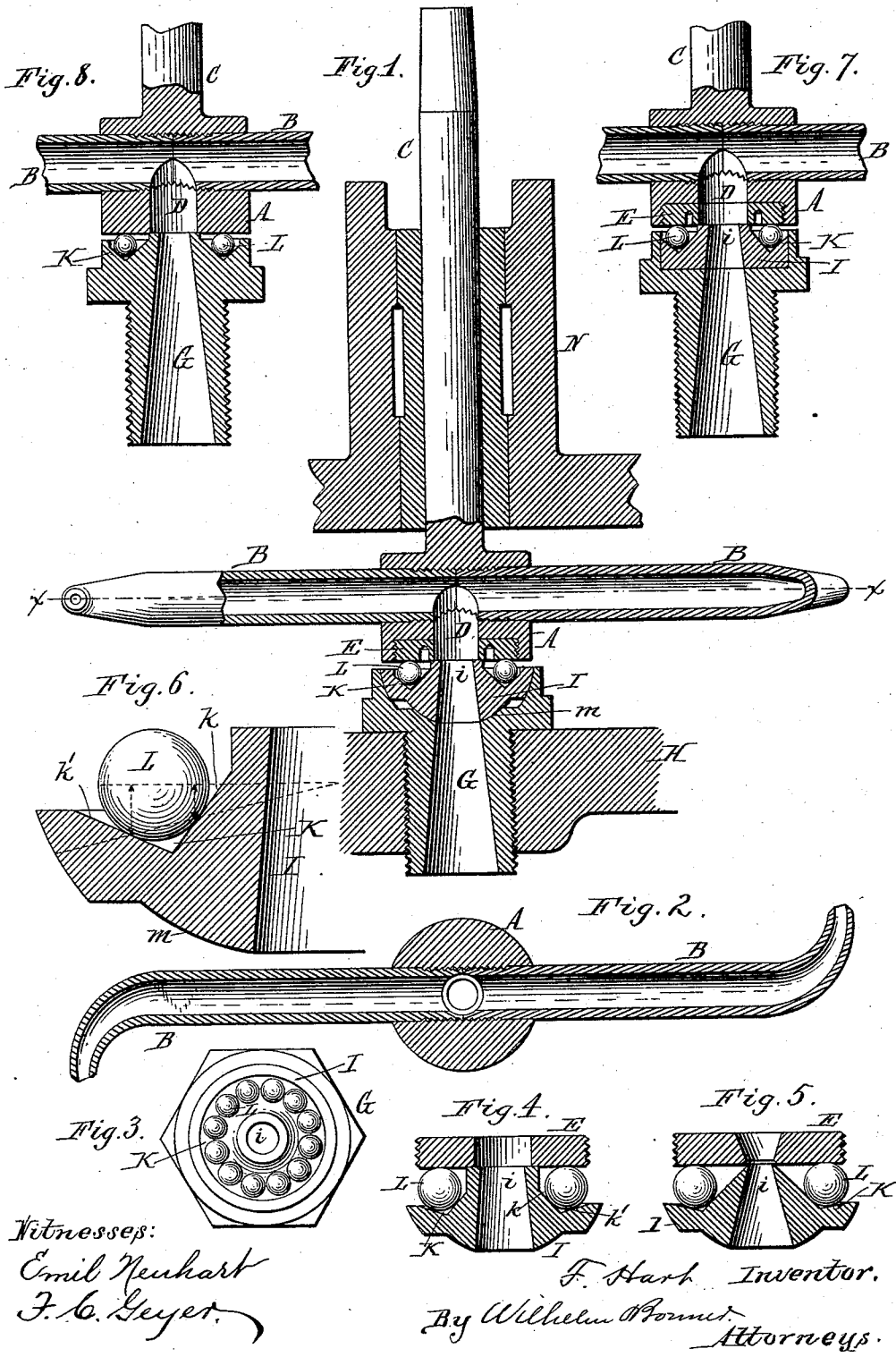
(No Model.)

F. HART.

STEAM TURBINE.

No. 486,829. Patented Nov. 22, 1892.



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UNITED STATES PATENT OFFICE.

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STEAM-TURBINE.

SPECIFICATION forming part of Letters Patent No. 486,829, dated November 22, 1892.

Application filed May 2, 1892. Serial No. 431,415. (No model.)

To all whom it may concern:

Be it known that I, FREDERICK HART, a subject of the Queen of Great Britain and Ireland, residing at Poughkeepsie, in the county of Dutchess and State of New York, have invented a new and useful Improvement in Steam-Turbines, of which the following is a specification.

This invention relates to that class of steam-turbines or reaction-wheels which consist of hollow arms receiving the steam at the hub and discharging it tangentially at or near their outer ends. These turbines rotate at a very high speed, and have heretofore been supported, as shown in United States Letters Patent No. 379,690, dated March 20, 1888, by a vertical step-journal projecting downwardly from the turbine and having a series of annular shoulders of decreasing diameter downwardly, which shoulders rest on a step-wheel having its axle arranged horizontally and provided with a like number of supporting-faces of decreasing diameter, so that each shoulder of the step-journal finds a rolling-support on one of the shoulders of the step-wheel. This construction of the turbine-support is expensive, and it is difficult and expensive to make repairs in the same, because one part cannot be renewed or repaired without readjusting the other parts. For instance, should a new step-wheel be inserted the turbine is raised from the steam-nozzle which enters its hub from below, and these parts must be readjusted to produce a snug fit.

The objects of my invention are to produce a support for the turbine, which is simpler in construction and more easily adjusted for wear and in which the wear parts can be more easily renewed.

In the accompanying drawings, Figure 1 is a sectional elevation of a steam-turbine provided with my improvements. Fig. 2 is a horizontal section in line *x x*, Fig. 1. Fig. 3 is a top plan view of the steam-nozzle and connecting parts on which the turbine is supported. Figs. 4 and 5 are vertical sections showing different forms of the nozzle, hub-plate, and interposed balls. Fig. 6 is a fragmentary vertical section of the nozzle. Figs. 7 and 8 are vertical sections showing modified constructions of my improvement.

Like letters of reference refer to like parts in the several figures.

A represents the hub of the turbine, and B the horizontal arms projecting laterally therefrom and opening at their outer ends tangentially in opposite directions.

C represents the spindle extending upwardly from the hub and connecting with the centrifugal separator or other machine or part which is driven by the turbine.

D represents the cavity which is formed in the lower portion of the hub and which communicates with the inner ends of the hollow arms. This cavity opens downwardly and is surrounded at its lower end by an annular wear-plate E, of steel or other suitable material, which is screwed or otherwise secured in a recess in the lower side of the hub.

G represents the supply-pipe which is screwed into the top plate H of the steam-chest, from which steam is supplied to the turbine or which forms the end portion of the steam-supply pipe. This pipe is provided in its upper side with a recess in which is seated a removable nozzle I, having a central opening *i*, which communicates with the cavity D of the hub and delivers the steam to the same. This nozzle is provided in its upper side with an annular groove K, which surrounds the opening of the nozzle and in which are placed balls L, upon which the wear-plate E of the hub rests, so that the turbine finds its support upon these balls. The nozzle is provided on its lower side with a spherical knuckle *m*, which rests in a correspondingly-shaped seat at the base of the recess of the steam-pipe and which permits the nozzle to align itself with the turbine. The spindle of the turbine is journaled in a bearing N, of usual construction, which is secured to the frame of the seperator or other machine or to the turbine-housing.

The turbine is supported upon the steam-pipe by means of the grooved nozzle, balls, and wear-plate and rotates freely on its support, because the friction is reduced to a minimum by the antifriction-balls. The wear-plate of the hub, the balls, and the nozzle, either or all of them, can be readily renewed when required, so that repairs of the parts which are liable to become worn can be quickly made at small expense.

The ball-groove in the nozzle may be of any ordinary or suitable construction; but I prefer the following construction: The inner face or side *k* of the groove is made steeper or more abruptly inclined than the outer or side face *k'*, so that the balls roll in contact with the inner side of the groove on a smaller circle than with the outer side of the groove, as indicated by the dotted lines in Fig. 6, and the angles of the two sides of the groove are such that the diameter of the inner circle of contact of the ball bears the same proportion to the diameter of the outer circle of contact which the distance of the inner circle of contact from the center of the nozzle, which forms the axis of rotation, bears to the distance of the outer circle of contact from the same center. This relative arrangement of the two sides or faces of the groove causes the balls to roll in the same without grinding friction very much as a conical wheel rolls on a conical tread or path. This materially reduces the friction of the balls in the groove, which is of considerable importance in machines which rotate at the very high speed with which, for instance, centrifugal creamers are operated. The nozzle may have a flat lower surface resting upon a flat seat at the base of the recess in the steam-pipe, as represented in Fig. 7, and the nozzle may be formed at the end of the steam-pipe and the ball-groove be formed in the upper surface of this rigid nozzle, and the removable wear-plate in the lower side of the hub may be omitted, as represented in Fig. 8; but these constructions are less desirable, because the alignment and renewal of the parts is less easily accomplished. The upper face of the nozzle is arranged in the plane of contact of the flat bearing-surface of the turbine with the balls, so that all of the contact-points of the supporting parts are arranged in the same horizontal plane, or substantially so, whereby gaging of the top plate is rendered unnecessary, as the parts will fit snugly when the uppermost contact-points of the balls and the top face of the nozzle are practically in the same plane.

I claim as my invention—

1. The combination, with the turbine having a flat bearing-surface on its lower side, of a nozzle arranged below said bearing-surface, an annular groove formed in the upper surface of said nozzle around the opening thereof, and antifriction-balls arranged in said groove and supporting the flat bearing-surface of the turbine, substantially as set forth.

2. The combination, with the turbine having a flat bearing-surface on its lower side, of antifriction-balls supporting said surface and a nozzle arranged below said bearing-surface and having an annular ball-groove formed in its upper surface around its orifice and having between said orifice and said groove a flat face arranged substantially in the plane of contact of the flat bearing-surface of the turbine with the balls, substantially as set forth.

3. The combination, with the turbine having a flat bearing-surface on its lower side, of a nozzle arranged below said bearing-surface and having in its upper surface an annular groove surrounding its orifice and on its under side a spherical knuckle, a supply-pipe provided with a seat in which said knuckle rests, and antifriction-balls arranged in said groove and supporting the flat bearing-surface of the turbine, substantially as set forth.

4. The combination, with the supply-pipe and the turbine, of a removable nozzle provided on its under side with a spherical knuckle resting in a spherical seat in the supply-pipe and provided in its upper side with an annular groove, antifriction-balls arranged in said groove, and a flat wear-plate secured to the under side of the turbine and bearing on said balls, substantially as set forth.

5. The combination, with the turbine, of a nozzle provided with a ball-groove, which has its inner and outer faces arranged at different angles, and balls arranged in said groove and supporting the turbine, substantially as set forth.

Witness my hand this 29th day of April, 1892.

FREDERICK HART.

Witnesses:
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