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Patented Nov. 18, 1902.

G. C. HENNING.
REVERSING TURBINE.
(Application filed Feb. 26, 1901.)

(No Model.)

2 Sheets—Sheet 1.

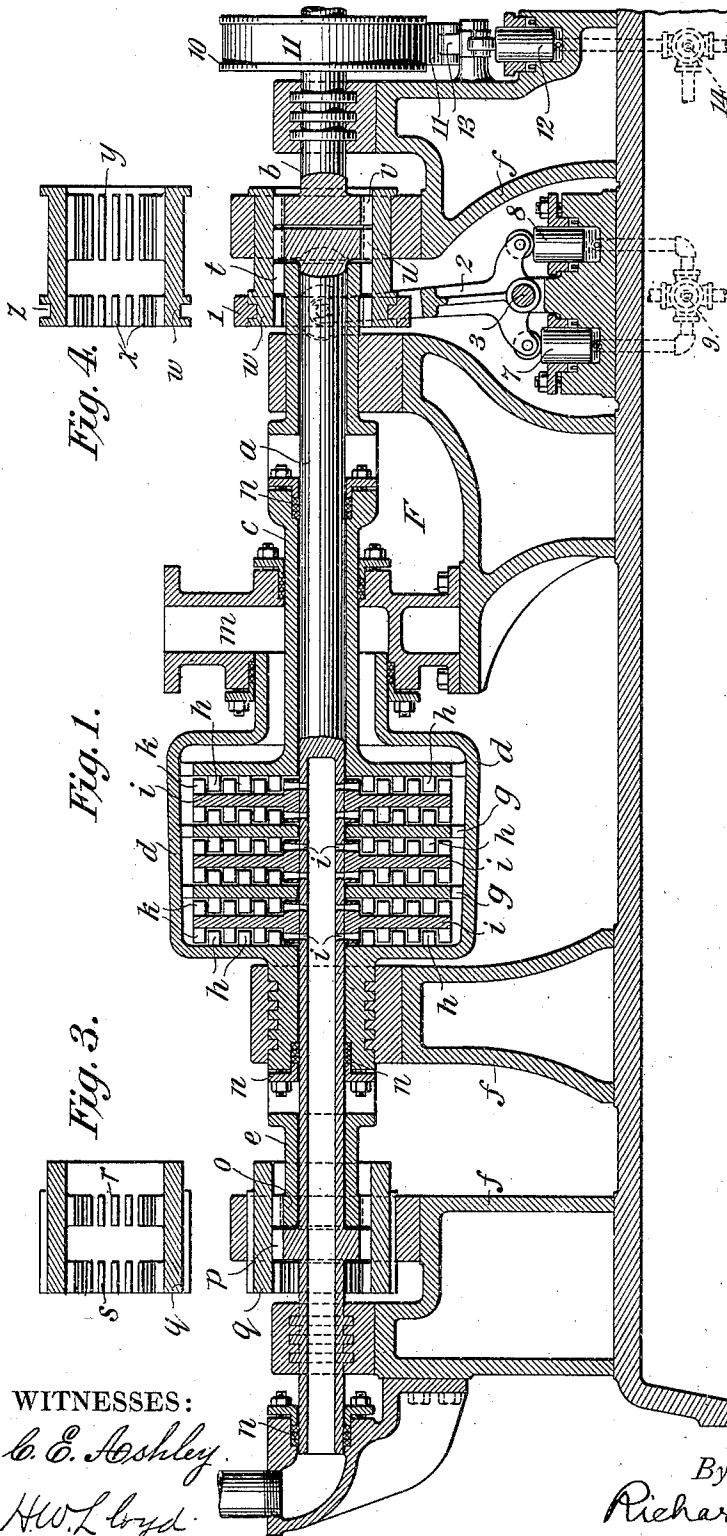


Fig. 1.

Fig. 3.

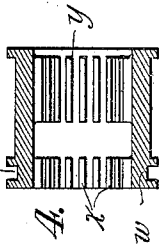
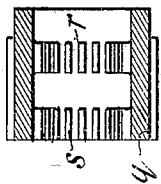


Fig. 4.

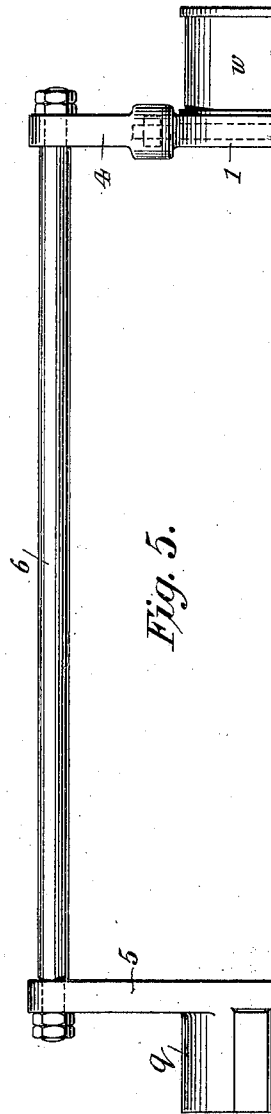


Fig. 5.

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(No Model.)

2 Sheets—Sheet 2.

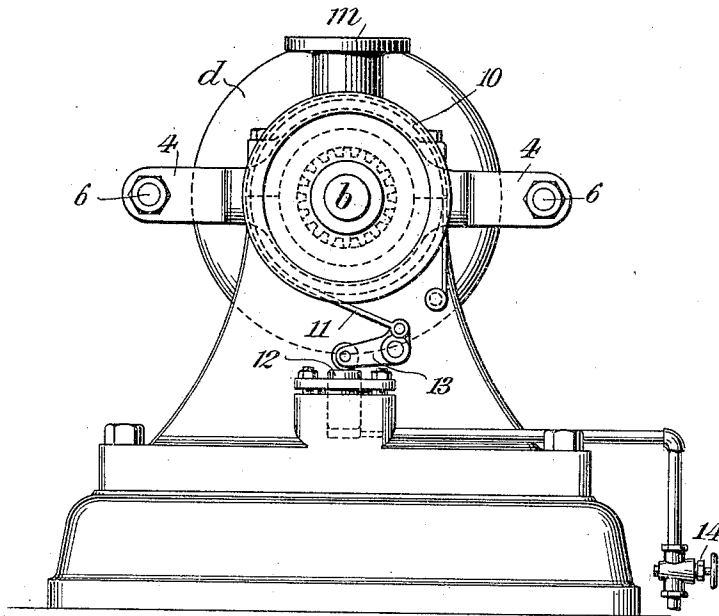


Fig. 2.

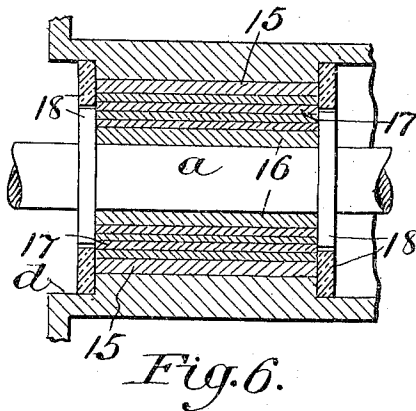


Fig. 6.

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UNITED STATES PATENT OFFICE.

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REVERSING TURBINE.

SPECIFICATION forming part of Letters Patent No. 713,637, dated November 18, 1902.

Application filed February 26, 1901. Serial No. 43,877. (No model.)

To all whom it may concern:

Be it known that I, GUSTAVUS C. HENNING, a citizen of the United States, and a resident of New York city, in the county of New York and State of New York, have invented a certain new and useful Improvement in Reversing Turbines, of which the following is a specification.

The present invention relates to reaction or turbine engines and has for its main object the use at will of either member of the couple forming the engine as the abutment or stationary part and the other member as the moving or driver part, thus obtaining reverse motion from the engine.

In engines of the class referred to it has hitherto been impossible to obtain reversed motion from a single engine on a boat or other confined space. One well-known form of reaction or turbine engine comprises a fixed casing provided with one or more parallel disks, each having vanes (which have the steam-ports in them) and a journaled shaft provided with one or more disks alternating with those of the casing and also provided with rows of vanes. The rows of vanes on all said disks are concentric, and the vanes on the shaft-disks alternate with those of the casing-disks. I have elected to illustrate my invention in connection with an engine of the general type last referred to; but it is to be understood that I do not limit myself to that type of reaction-engine, since there are many forms of such engines in which my invention can be used, and I mean to include all such within my claims.

According to the present invention the hitherto fixed or stationary vane-carrying casing is journaled in suitable bearings, as well as the vane-carrying shaft, and means are provided for locking said vane carrier or casing and said shaft individually against motion of rotation, so that each when so locked becomes the abutment, as it were, against which the pressure acts as it turns the other or non-locked member. In this new arrangement the shaft rotates in one direction and the casing rotates in the other direction, and these rotations may be simultaneous; but I prefer to lock one member of the couple while the other member is in motion, so that one be-

comes the abutment and the other becomes the driver. The motion of the driving member may be transmitted and used as desired. I may transmit the motion of either or both members of the couple to one and the same part, as a second shaft, to drive the same at different rates of speed or in reverse directions. When the motion of both casing and shaft are transmitted to a second shaft, I prefer to have such second shaft in line with the first or driver shaft.

To these and other ends the invention consists of features of construction, arrangements, details, and combinations of devices hereinafter described, and more particularly pointed out in the appended claims.

The preferred form of the invention is illustrated in the accompanying drawings, forming part of this specification, in which—

Figure 1 is a vertical central longitudinal sectional view of an engine in which the invention is embodied. Fig. 2 is an end view from the right in Fig. 1. Figs. 3, 4, and 5 are detail views, respectively, of clutch members and gears. Fig. 6 is a sectional view of a bearing for concentric rotatory high-speed shafts, such as are herein shown.

In the drawings references *a b* designate independent shafts arranged in line with each other with their adjacent ends slightly separated, and *c* is a sleeve in which one end of shaft *a*, that end thereof next shaft *b*, is journaled or has a bearing. The sleeve forms part of or is rigidly connected with a casing *d*, and *e* designates a sleeve at the opposite side of the casing *d*, which sleeve *e* also surrounds the shaft *a*. The sleeves *c* and *e* are suitably journaled in a fixed framework *f*, and I remark that one or more of these bearings may be thrust-bearings. The shaft *a* projects beyond the sleeve *e* and is suitably journaled, preferably, by at least one thrust-bearing in the framework *f*. By preference, one of the bearings for the shaft *b* is a thrust-bearing in the framework *f*.

The casing *d* is shown as having several disks *g* fast thereto, and these disks have concentric rows of vanes *h* thereon, and shaft *a* has one or more disks *i* fast thereon, which alternate with the disks *g*, and also have concentric rows of vanes *k* thereon,

which alternate with the rows *h*. The vanes *h k* are so set relatively to each other that the steam or other medium introduced between them causes the shaft *a* and casing *d* to revolve in opposite directions unless one or both be fixed against motion of rotation. The steam or other medium may be introduced in any known or suitable manner. For purposes of illustration I have shown that end of shaft *a* which is journaled in frame *f* as hollow and connecting with a steam-pipe in the frame *f* and with ports *l*, opening into the space or spaces between the disks *g i* and casing *d*.

The exhaust is through ports in the disks *g* and a port or ports *m* in the frame *f*. Suitable packing-boxes *n* prevent the leakage of steam along the shaft *a* and the sleeves *c e*.

At the end of the sleeve *e* is a gear *o*, fast to or integral with the sleeve. Outside of the sleeve and close to the end thereof the shaft *a* has a gear *p* fast thereon. Preferably, the gears *o p* have the same diameters and the same number of teeth or engaging parts. A sleeve *q* surrounds the gears *o p*, and is provided with internal teeth arranged in two rows *r s*. These teeth are adapted to mesh with the gears *o p*, as will be understood. The sleeve *q* is longer than the width of the two gears *o p*. As shown in the drawings, the rows of teeth *r s* are so spaced apart as to provide a space which comes opposite one of the gears *o p* whenever the other gear is engaged by the corresponding one of the rows *r s* of teeth, the gear and teeth being wholly in mesh. The sleeve *q* is splined to the frame *f*, so as to be capable of endwise motion and incapable of motion of rotation, or other means may be employed to permit of such endwise motion while preventing motion of rotation of the said sleeve *q*. The sleeve *q* thus locks either the casing *d* or the shaft *a* to the fixed framework *f*, according to its position, and leaves the other member free to rotate.

The sleeve *c* has a gear *t* fast thereon or integral therewith at its end, and the adjacent ends of the shafts *a b* are provided, respectively, with gears *u v*, fast thereon. The gears *t u v* are shown in the drawings as being of equal diameters and as having the same number of teeth, this being the preferred arrangement merely. Surrounding the gears *t u v* is a ring *w*, having at least two rows *x y* of internal teeth, of which one row *y* is as wide as gears *u v* together. The space between the rows *x y* is sufficient to allow them to clear gear *t* when teeth *y* are in mesh with gears *u v*, as shown in Fig. 1. The teeth *y* remain in mesh permanently with gear *v*, but not with gear *u*, whenever ring *w* is shifted to cause row *x* to fully mesh with the gear *t*.

The sleeve *q* and ring *w* are by preference so connected together as to move endwise simultaneously. This connection may be made in any suitable manner, and a convenient way

of connecting these parts is shown in the drawings, where ring *w* is provided with a circumferential groove *z*, with which an internally-flanged ring 1 engages. The ring 1 is provided with trunnions at opposite sides and is journaled in the forks of a double bell-crank or T-shaped lever 2, which is fulcrumed on the frame *f*, as by a shaft 3. The ring 1 has lateral arms 4, which are rigidly connected with arms 5, extending laterally from sleeve *q*, by means of rods 6 and suitable nuts, thus making a rigid frame of the ring 1, sleeve *q*, arms 4 5, and rods 6 and causing ring *w* and sleeve *q* to move endwise in unison with each other.

The lever 2 may be operated in any suitable manner, as by hydraulic rams 7 8, which engage with antifriction-rollers on the horizontally-disposed arms of the lever 2. A suitable cock at 9 in the pipes for supplying pressure to the rams controls the pressure thereunder, relieving the pressure under one ram as it turns the pressure on under the other ram, whereby the lever 2 may be rocked to move the rings 1 and *w* and the sleeve *q* endwise simultaneously.

The shaft *b* may have fast thereon a brake-wheel 10, with which a strap-brake 11 coacts, the strap being operated in any suitable manner, as by a ram 12, lever 13, and a cock 14, which controls the fluid-pressure by which the ram 12 is operated. This brake device serves to hold the shaft *b* stationary during the shifting of ring *w* and sleeve *q* whenever shaft *b* is disconnected from one and connected with the other of the shaft *a* and casing *d* members of the engine-couple.

It will be noted that the means shown in the drawings for connecting the shaft *b*, which may, as above stated, have propellers thereon, with the shaft *a* and the casing *d* are such that whenever the shaft *b* is held fast by the brake the part connected to and rotating therewith (either the shaft *a* or the casing, as the case may be) is also held fast by the said brake, while that part forming the abutment, as either the casing or the shaft *a*, is also held fast by the toothed sleeve *q*. It will also be noted in such case that neither the shaft *a* nor the casing is disengaged from the sleeve *q* before the other is engaged therewith, and the same statement is true of the said shaft and casing and the shaft *b*. Thus when the parts are in the positions thereof shown in the drawings the shafts *a b* are connected together, while casing *d* is held fast by sleeve *q*, and if now the brake be put on and the connected shafts held fast the endwise-moving sleeves may be shifted with ease for the purpose of connecting the shaft *b* and the casing, and thereby reversing the motion of the shaft when the brake is released and steam again admitted. It will thus be seen that the described construction provides a means whereby the inertia of the moving parts and the action of water on propellers dragged there-

through may be quickly overcome and the reversing effected.

In the positions of the parts shown in the drawings the shafts *a b* are connected together through the ring *w* and teeth *y*, while the casing *d* is locked against motion of rotation by the sleeve *q* and shaft *a* is free to rotate. In this position of the parts the casing *d* forms the abutment.

By shifting the ring *w* and sleeve *q* to the right in Fig. 1 until teeth *y* are disengaged from gear *u*, teeth *x* engaged with gear *t*, and the sleeve *q* freed from gear *o* and engaged with the gear *p* the shafts *a b* are disconnected from each other, the casing *d* connected with the shaft *b* and also left free to rotate, and shaft *a* locked against motion of rotation, and thereby becoming the abutment of the engine-couple.

Instead of gears on shafts *a b* and sleeves *c q* polygonal or other suitable parts may be employed, the sleeves *q* and ring *w* being provided with the counterparts of such polygonal or other parts for engagement therewith to connect the shafts, casing, and framework for the purposes of the invention, and by the word "gear" or the like in my claims I mean to and do include all the forms above named; nor is it essential to the embodiment of the invention that the parts be located and arranged as shown in the drawings, since the same results in greater or lesser degree may be attained in substantially the same way by many rearrangements and changes in location of parts, the gist of my invention lying in making either member of a reaction-engine the abutment and the other member the driving member at will and in causing each of said members when rotating to act as a driver. By the term "vanes" or the like in my claims I include all suitable forms of vanes, including that wherein the steam-ports are located in such vanes, as in a well-known form of reaction or turbine engine.

In order to secure the proper rotation of the casing about its center of mass, I arrange a yielding support or bearing for it—such, for example, as that shown in Fig. 6, where there is a metal bushing 15, on which the casing is free to turn, a sleeve or bushing 16, free to turn on the shaft *a*, and elastic oil-packed rings 17 between said bushings, suitable means, as collars or rings 18, being provided for retaining the parts in proper position and mutual relation. In operation this bearing permits the casing, which should be balanced as nearly as may be, to rotate freely about its center of mass, the shaft *a* being locked against motion of rotation, and so, also, of the shaft *a* when it is free to rotate, the casing being then locked against motion of rotation.

Having thus fully and clearly described the nature of my invention, what I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination of a rotatory vane-carrying casing having a thrust-bearing, a rotatory vane-carrying shaft also having a thrust-bearing, a second or driven shaft at the end of and in line with the first-named shaft and also having a thrust-bearing, gears on said shafts and casing adjacent to each other, a rotatory internal gear for connecting said gears by pairs thereof, the gear on the driven shaft always being a member of the pair, whereby the driven shaft may be connected at will with either the casing or the first-named shaft, and means for locking either the vane-carrying shaft or the casing against rotation when the other is coupled with the driven shaft.

2. In a reaction or turbine engine, the combination of a journaled vane-carrying casing, a journaled vane-carrying shaft, means for locking said casing or said shaft individually against rotation, a second shaft in line with the first-named shaft, adjacent gears on said casing and said shafts, and an endwise-movable rotatable ring having internal teeth for engaging said gears to connect the second shaft with the casing or the first-named shaft to be driven thereby in reverse directions, substantially as described.

3. In a reaction or turbine engine, the combination of a journaled shaft *a*, a sleeve *c* independently rotatable thereon, a shaft *b* in line with shaft *a*, gears on the adjacent ends of said shafts and sleeve, a rotatable endwise-movable internally-toothed ring for connecting the shaft *a* or sleeve *c* independently with shaft *b*, means for locking shaft *a* or sleeve *c* individually against rotation, and means for driving shaft *a* and sleeve *c* in reverse directions, substantially as described.

4. In a reversing turbine or reaction engine, the combination of a journaled turbine-casing, a journaled turbine-shaft, means for locking said casing or said shaft against motion of rotation, and a bearing for said casing and shaft consisting of two concentric bushings and elastic oil-packed rings separating them, substantially as described.

5. In a reversing reaction or turbine engine, the combination of a journaled turbine-casing, a turbine-shaft, and a bearing for said casing consisting of two concentric bushings and elastic rings separating them, substantially as described.

6. In a reaction or turbine engine, the combination of a rotatory vane-carrying casing, a rotatory vane-carrying shaft, means for locking either of said parts against rotation, a second or driven shaft, means for connecting said driven shaft with either of the said vane-carriers to be driven thereby in opposite directions, and a brake mechanism for holding the driven shaft and the vane-carrier connected therewith against motion of rotation during the shifting of the said locking and connecting means.

7. In a reaction or turbine engine, the com-

combination of rotatory driver vane-carrying casing and shaft, means for locking either against rotation, a second or driven shaft in line with the first or driver shaft, juxtaposed gears on
5 said shafts and casing, an endwise-movable rotatory internally-toothed sleeve continuously engaged with the driven-shaft gear and engaging with the gear on either of the casing or driver-shaft parts before becoming dis-
10 engaged from the other, and brake mechan-

ism for holding fast the driven shaft and the parts connected therewith during the shifting of said locking means and said sleeve.

Signed at New York, in the county of New York and State of New York, this 23d day of 15 February, A. D. 1901.

GUS. C. HENNING.

Witnesses:

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