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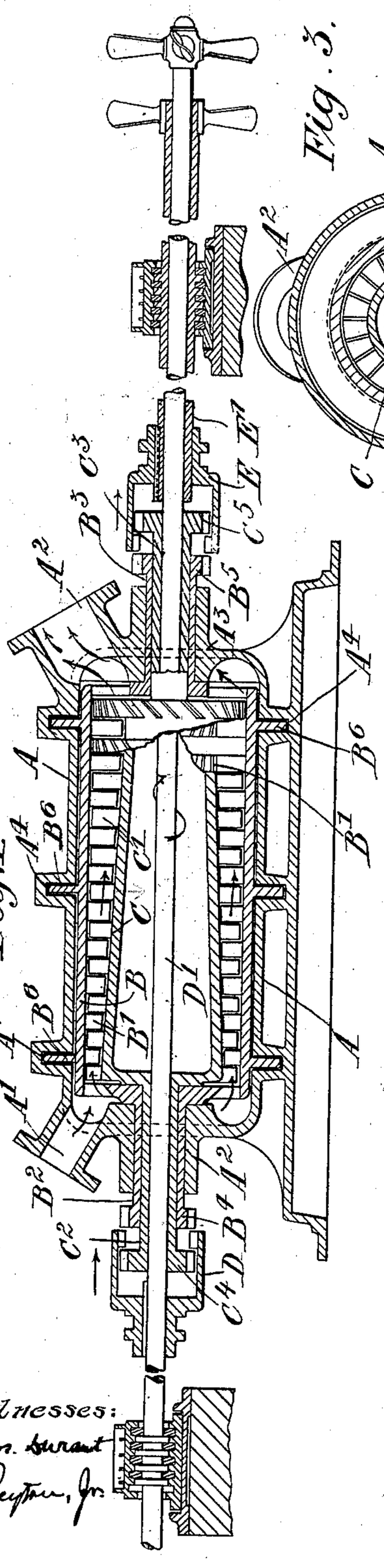
Patented Dec. 11, 1900.

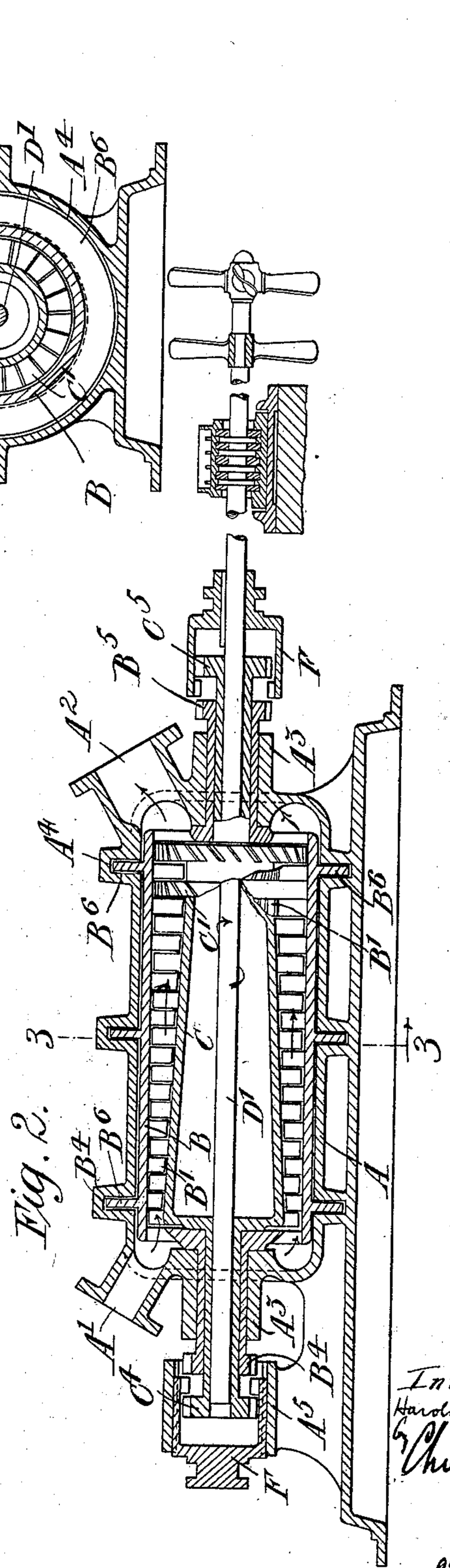
H. T. ASHTON.

TURBINE.

(Application filed Apr. 21, 1900.)

(No Model.)





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UNITED STATES PATENT OFFICE.

HAROLD THOMAS ASHTON, OF LONDON, ENGLAND.

TURBINE.

SPECIFICATION forming part of Letters Patent No. 663,715, dated December 11, 1900.

Application filed April 21, 1900. Serial No. 13,767. (No model.)

To all whom it may concern:

Be it known that I, HAROLD THOMAS ASHTON, a subject of the Queen of England, residing at Blackheath, London, county of Kent, England, have invented certain new and useful Improvements in or Relating to Turbines, (for which I have made application for Letters Patent in Great Britain, No. 4,295, dated March 6, 1900,) of which the following is a specification.

This invention relates to turbines of the kind having members rotatable positively and negatively by the flow of the working fluid through them, it being the main object of the invention to so dispose the blades or other guides for the operating fluid, the rotatable members, and the fluid-supply conduit that opposite rotative reactions are set up between the rotating members only and not between such members and the walls of the supply-conduit or any portion of the stationary casing or frame of the machine—that is to say, if the supply-conduit were so disposed that the entering working fluid struck the first of the rotating members tangentially that member would in order to be efficient have to be given, for reasons well known to designers of turbines, a peripheral velocity but little less than the speed of the entering working fluid, whereas if the working fluid be delivered according to this invention between the coöperating rotating members out of an annular supply-passage in which it is free to circulate has to acquire rotation from the first of the rotatory members with which it meets, and as a consequence, the effective reactions take place solely between those rotary members. The rotary members aforesaid then may be caused to have approximately only one-half the speed which the single rotating member in an ordinary turbine of equal power would have. Thus the centrifugal stresses in the apparatus and the constructional difficulties attendant thereon are materially reduced. Confinement of the reactions tending to produce rotation of the working parts to the rotating members for the purpose described is thus secured by so disposing the supply-conduit that no reaction tending to rotate the conduit or casing of the machine around the axis of rotation of the moving parts can occur.

This invention further relates to the improvement of turbines in such a manner that reversal of the body or apparatus driven by them can be effected without involving reversal of the turbine itself or of the general direction of flow of the working fluid through it, so that reversed driving can be readily accomplished with no less efficiency than forward driving. Such improvement is chiefly intended to be applicable to steam-driven turbines; but it may also be utilized with turbines driven by other fluids.

A further object of this invention is the combination, with a turbine of the kind which has members rotatable positively and negatively, of change-over clutches or other reversing devices and driven shafts all so arranged and operating that reversal of the shafts can be effected without involving the reversal of the rotating members or of the general direction of flow of the working fluid. This portion of the invention is applicable with particular advantage to marine purposes, as will hereinafter appear.

This invention relates also to an improved packing device comprising a liquid filling and applicable to turbines of the kind above referred to.

According to this invention the turbine or reaction-engine employed may be of a known type, which is constructed with its blades or other coöperative rotatable parts so disposed that working fluid traversing them in one general direction rotates one part positively while rotating the companion part negatively. For example, the casing which carries the guide-vanes of the turbine is so mounted that it may rotate in the opposite direction to the turbine wheel inclosed therein, the general direction of the flow being parallel to the axis of rotation of the casing and wheel.

The driven body might be a single shaft, in which case it would be operated by members rotatable positively and negatively in the manner described and a clutch or other device by which each member could in turn be coupled to the driven body, so that reversal of that body would be effected without reversal of the rotatable members or of the flow of the working fluid. In this modification a brake or a locking-bolt or other retaining device may be employed to keep stationary the member not required to rotate with

the driven body. The vanes of the member which happens to be fixed act as guide-vanes for the fluid acting upon the rotating member.

Conveniently the turbine wheel is adapted for forward driving, while by fixing this wheel and coupling up the casing to the shaft to be driven backward driving will be effected. In another arrangement, which in common with that above described is applicable to marine work, two or more propellers are mounted upon concentric shafts, one within the other, driven by a turbine whose members rotate positively and negatively in the manner described, the propellers upon one of these driven shafts being right-hand helices and those on the other driven shaft being left-hand helices. The shafts are coupled up, respectively, to the shaft of the inner turbine wheel and to the rotating casing or outer wheel of the turbine, the propellers being thus rotated in opposite directions, preferably with approximately equal velocities, the relative velocity between them being in such case the sum of the two absolute velocities and the latter being about one-half of that which would exist in an ordinary turbine, in which only the wheel turns. The rotary members need not, however, run at equal speeds in opposite directions, for they might be geared together or so affected by the resistances as to be caused to run at different speeds. It will be seen that in turbines according to this invention the same power may be obtained at the same absolute speed as in turbines as heretofore made, while the diameter of the movable parts is greatly reduced. Again, for a given diameter of turbine double the relative speed of the members can be employed with the same absolute velocity for each as for the one rotating member in a single turbine, the length of turbine necessary for the development of a given power being thus reduced. Other variations of these related factors of relative speed, diameter, and length of turbine can be made as may be desired; but the fact that there are two moving parts in coöperation as against the coöperation of a single fixed and a single moving part in the ordinary turbine enables the centrifugal forces in the improved turbine to be reduced for a given power considerably below the magnitudes they would possess in an ordinary turbine.

The two shafts previously referred to can be geared to a single driven machine or device, if desired, by any suitable gearing.

Reversal of the driving is obtained by employing friction or other clutches conveniently disposed at either end of the turbine. These clutches are so arranged that the rotating members of the turbine may be coupled up to either of the concentric shafts, according to the direction in which it is desired to effect motion, the clutches changing over the connections, as may be required. Instead of the change-over clutch other reversing apparatus may be employed, the object of the combination of reversing apparatus with the members of the turbine which rotate positively and negatively being to enable reversal of the driven shaft to be effected, while avoiding reversal of the rotating members or of the general direction of flow of working fluid through the apparatus, and thereby maintaining an efficiency of operation which would be considerably reduced were the members rotated reversely by causing the fluid to act on the backs instead of on the faces of the blades or their substitutes. This arrangement also enables a reversal of full power to be obtained without an increase of weight in the turbine such as would necessarily occur if separate reversing turbines or reversing members in the turbines were employed.

If desired, the construction in which two driven shafts or the like are operated by two reversely-turning turbine members can have a retaining device to act on either of those members, so as to enable one of the two shafts to be driven alone, as in the arrangement described above, or devices for disconnecting both shafts may be employed.

In the accompanying drawings, Figure 1 is a diagrammatic longitudinal central section of an improved turbine according to this invention applied to the operation of a pair of reversible concentric propeller-shafts. Fig. 2 is a view similar to Fig. 1, illustrating the application of a turbine constructed according to this invention to the operation of a single reversible propeller-shaft; and Fig. 3 is a section on the line 3 3 of Fig. 2.

Like letters indicate like parts throughout the drawings.

With reference first to Fig. 1, a casing A, having an inlet A′ and an outlet A^2 for the working fluid, contains concentric cylinders B and C, upon which are blades B′ C′, reversely disposed upon their respective cylinders aslant the axes thereof, so that working fluid admitted by the inlet A′ pursues a zigzag path through zigzag conduits formed by the successive sets of blades B′ C′ and flows in the general direction of the length of the apparatus to the outlet A^2. The blades B′ C′ may be curved or shaped in any of the various well-known ways.

The cylinders B and C are provided at their ends with necks B^2 C^2 B^3 C^3, which fit rotatably one within the other and are supported in bearings A^3 in the ends of the casing. Clutch elements B^4 C^4 B^5 C^5, which are toothed spur-disks, are formed on the necks B^2 C^2 B^3 C^3 and can be engaged by sliding devices D E, each constituted by an internally-toothed ring adjustable endwise into gear with either one of the pair of clutch elements in proximity to it. The device D is mounted upon a central propeller-shaft D′, upon which it can be moved endwise by any convenient adjusting device, while it is prevented from rotating in relation to the shaft by a feather or otherwise. The device E is similarly mounted upon an external tubular propeller-shaft

E′. Each device D or E, with its related group of elements B^4 C^4 or B^5 C^5, constitutes a change-over clutch—that is to say, a clutch which changes over the connections between the cylinders B C and shafts D′ E′—as follows: By adjusting, for example, the device D endwise in the direction of the arrow marked near it in Fig. 1 the cylinder B will be put into operative connection with the inner shaft D′ through the element C^4, and by moving the device E in the same direction the cylinder C will be put into operative connection with the outer shaft E′ through the element B^5. By moving the devices D and E in the opposite direction the connections will be changed over, the cylinder C becoming connected to the shaft D′ and the cylinder B to the shaft E′. To prevent steam entering at A′ from passing out of the apparatus otherwise than through the passages occupied by the blades between the cylinders B and C, the ends of the latter are closed and arranged to fit closely together around the necks B^2 C^2 B^3 C^3, which can be packed hydraulically or otherwise, while on the cylinder B circumferential flanges B^6 are made to extend from the exterior into circular grooves A^4 in the casing A, a liquid filling being provided in each groove A^4. The flange B^6, rotating at a high speed in the groove and carrying around the liquid filling with it, causes the latter to be held centrifugally in the clearance between the blade and the interior of the groove, so as to make a fluid-tight joint exerting but very little friction upon the adjacent parts. The water of condensation in the apparatus will flow into the grooves and may be utilized as the liquid filling.

Where the operation of the device is such that at times the flanges B^6 have no rotation in the grooves A^4, as in the modification illustrated in Figs. 2 and 3 and hereinafter described, the part on which the flanges B^6 are formed can be provided with other packing devices of any usual type or can be allowed to move endwise to bring the sides of the flanges close against the adjacent wall of the groove.

Instead of employing clutches of the type shown to connect the cylinders B C with the shafts D′ E′ any other convenient mechanism might be adopted for connecting the cylinder B alternately to the shaft D′ or E′ and the cylinder C alternately to the shaft E′ or D′.

When working fluid is admitted at the inlet A′, it passes between the cylinders B and C in the direction indicated by the arrows between them, pursuing a zigzag course between the blades B′ C′ in the general direction of the outlet A^2. The blades on the drum C are disposed aslant in relation to the axis at some such angle as is indicated in Fig. 1 by the blades which are shown in elevation at one end thereof, and the blades B′ are reversely inclined. Consequently the drum C will rotate in the direction indicated by the helical arrow encircling the shaft D′—that is to say, "positively," if viewed looking toward the part E from the part D—and the drum B will turn in the reverse direction. By coupling up the drum C to the shaft D′ the latter also will turn in the direction of the helical arrow, and by coupling up the drum B to the shaft E′ the latter will turn negatively—*i. e.*, in a direction the reverse of that indicated by the helical arrow. To reverse the direction of rotation of the shafts D′ E′, the change-over clutch apparatus D B^4 C^4 and E B^5 C^5 is adjusted so as to change over the connections of the shafts and the cylinders in the manner previously described, the direction of rotation of the shafts thereby being changed, while that of the cylinders remains unaltered in order that the working fluid not having the direction of its motion or the nature of its flow changed with regard to the active or front faces of the blades may operate just as efficiently when the shafts are reversed as when they run in the directions which were originally assumed for them.

Two turbines of the kind illustrated in Fig. 1, for instance, could be coupled together end for end with the cylinders B joined together and with the cylinders C similarly connected to each other, the working fluid being led into the middle of the casing of the apparatus between the two sets of cylinders and going in opposite directions, one-half to each end, so that end thrust set up by the working fluid in one end of the apparatus would be balanced by that set up in the opposite direction at the opposite end. Radial-flow turbines or those of the jet type with coöperating parts rotating positively and negatively could similarly have their corresponding parts coupled in pairs or could be coupled with a parallel-flow turbine.

In the modification illustrated in Figs. 2 and 3 the shaft E′ is discarded, there being only a single shaft D′, to which the device E is connected. The clutch elements C^4 B^4 are adapted to be engaged by a retainer F, which resembles the device D of Fig. 1 and slides endwise, but cannot turn in a fixed extension A^5 from the casing A.

By moving the part F endwise it can engage and retain either the element C^4 or the element B^4, so as to hold stationary the cylinder B or C. That one of the two cylinders which is not held can be coupled by the device E to the shaft D′, which will rotate in the direction of the helical arrow upon it if it be coupled to one and in the reverse direction if it be coupled to the other. In either case the relative rotation of the cylinders remains unaltered in direction, as also does the flow of the working fluid. The flanges B^6 would in this modification have to be a good working fit in the grooves A^4, so as to fit close against the wall of each groove when displaced by permitting the cylinder B to move endwise in the manner hereinbefore suggested.

Although in the examples illustrated several sets of blades are shown, two sets only

might be used—one set on the rotary casing and one on the wheel. Instead of two driven shafts, one within the other, one of them might extend out at one end of the casing and the other at the opposite end.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a turbine the combination with a rotatable member of guides for an operating fluid disposed at an angle upon that member, a similar member coaxial with the former having fluid-guides reversely disposed upon it at an angle, coaxial members adjacent to the rotatable members, a fluid-supply conduit and clutches attached to the adjacent members and operating upon both rotatable members to engage them with or disengage them from the adjacent members substantially as set forth.

2. In a turbine the combination with a rotatable member of guides for an operating fluid disposed at an angle upon that member, a similar member coaxial with the former and having fluid-guides reversely disposed upon it at an angle, a fluid-supply conduit, coaxial driven shafts, two clutches by which at will either member is operatively connected to either driven shaft and upon those shafts helical blades substantially as set forth.

3. In a turbine the combination with a rotatable member of guides for an operating fluid disposed at an angle upon that member, a similar member coaxial with the former and having fluid-guides reversely disposed upon it at an angle, a fluid-supply conduit, coaxial driven shafts, and two clutches by which at will either member is operatively connected to either driven shaft substantially as set forth.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HAROLD THOMAS ASHTON.

Witnesses:

B. E. DUNBAR KILBURN,

HARRY B. BRIDGE.