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PATENTED MAY 24, 1904.

B. J. CAMPBELL.
FLUID VISCOSITY MOTOR OR TURBINE.

APPLICATION FILED SEPT. 8, 1903.

NO MODEL.

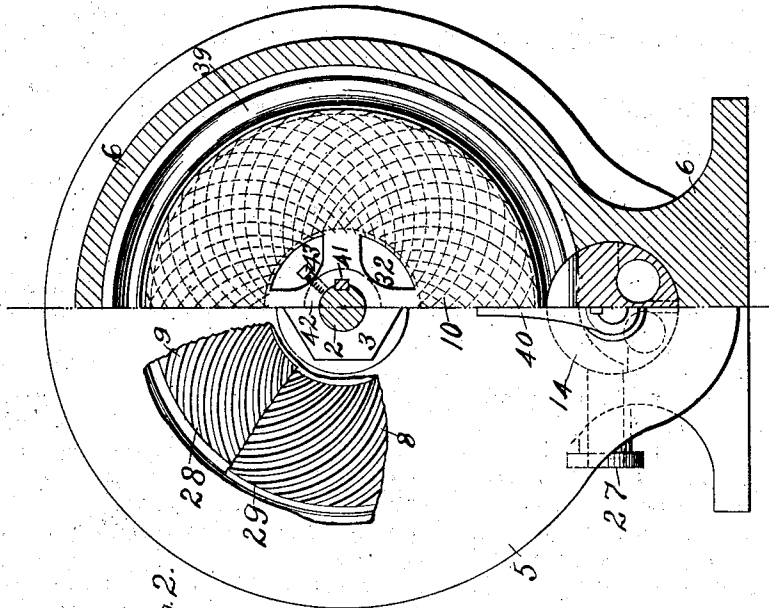


Fig. 2.

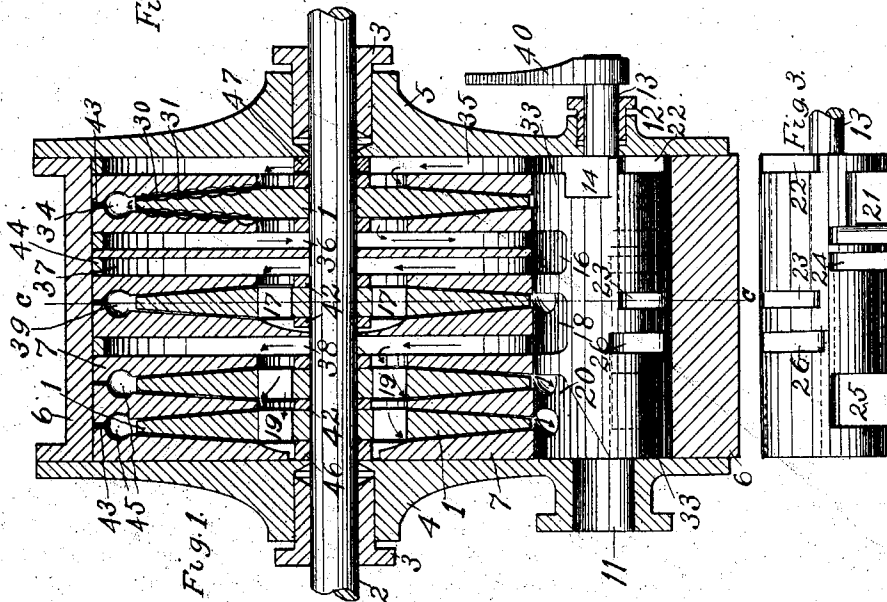


Fig. 1.

Fig. 3.

WITNESSES:
Clairborne B. White
Rutledge Barker

Ben J. Campbell
INVENTOR.

UNITED STATES PATENT OFFICE.

BEN J. CAMPBELL, OF DANVILLE, VIRGINIA.

FLUID-VISCOSITY MOTOR OR TURBINE.

SPECIFICATION forming part of Letters Patent No. 760,776, dated May 24, 1904.

Application filed September 9, 1903. Serial No. 172,501. (No model.)

To all whom it may concern:

Be it known that I, BEN J. CAMPBELL, a citizen of the United States, residing at Danville, Pittsylvania county, Virginia, have invented new and useful Improvements in Fluid-Viscosity Motors or Turbines, of which the following is a specification.

My invention relates to a reversible fluid viscosity or friction motor of the turbine class in which the stress-producing motion or rotation is caused principally by the fluid friction of streams of fluid moving in nearly opposite direction and in contact at the dividing plane. This result may be attained in several ways, such as an outer casing with inner surface cylindrical, an inner cylinder adapted to rotate within said outer casing in close working fit, but not in actual contact, on which helical spiral threads or grooves are cut in opposite directions, as right-hand spirals on rotating cylinder and left-hand spirals on inner surface of outer or fixed cylinder, or vice versa, by frusta of cones with spirals cut as above, or by disks with plane surfaces perpendicular to axis of rotation in close working fit, on which suitable grooves are cut eccentrically outward in nearly opposite directions, crossing the radius at an acute angle, preferably about sixty-five degrees, right-hand grooves cutting the radius at any point at about an angle of sixty-five degrees on rotating member and similar left-hand grooves on fixed member, or vice versa. It may now be seen that fluid under pressure admitted at any point, as one end of cylinder, cone, or near axis of revolving disks, will tend to flow through the spirals of grooves to points of lower pressure, making practically two sheets of fluid flowing in contact in nearly opposite directions at very great speed relative to each other, inducing between the surfaces a stress which tends to produce relative motion of the parts. To reverse the rotation, it is but necessary to reverse the points of admission and exhaust. Another action of the flow of fluid along the grooves which augments the viscosity stress between the parts resembles somewhat the impact and reaction of the compound turbine. It is caused by the fluid tending to flow through the shortest path to points of lower pressure,

leaving one set of grooves at points where hollows of other grooves cross, impinging at nearly a right angle on grooves on opposite member. Thus an action and reaction is set up, thereby adding materially to the development of power.

As shown by the accompanying drawings, the preferable form of my invention is the slightly-cone-shaped disk revolving between stationary members, which gives the best distribution of metal, is compact, practicable of construction, and admits of any amount of compounding desired to make the motor reversible.

My invention further comprises a reversing-valve of novel design, which by turning one-half-revolution reverses the points of admission and exhaust for each of the elements of the motor.

Referring to the drawings, Figure 1 represents a longitudinal section of an engine of the reversible compound type, showing the reversing-valve and exhaust-port. Fig. 2 is an end view of the engine, showing a half-section along the line *c c* and representation of the grooves on the rotatable and fixed members. Fig. 3 is a bottom view of the reversing-valve, showing in greater detail its design.

Let 1 1 indicate the rotatable members, slightly-conical disks suitably fixed rigidly to shaft 2, as by key 41, with means for longitudinal adjustment, as by annular piece 42, carrying stud 43, said shaft 2 running in suitable bearings, and stuffing-boxes 3 3, carried by end casings 4 5, with collars 46 47 limiting its thrust; 7 7, the stationary members, conforming in shape to and adapted to inclose between them said rotatable members, all of which are inclosed within the end casings 4 5 and cylindrical casing 6; 33, the reversing-valve in position for the normal or direction of motion of greatest power, which serves its purpose as follows: Steam or the actuating fluid enters through the admission-port 27 at 14, thence through the open annular chamber 35 to central part of motor, thence along the grooves between the fixed and rotatable member into concentric chamber 34, back to center of wheel on opposite side of rotatable

member, into annular chamber 36, then to valve at 16, thence to annular chamber 37, as shown by the arrows, thence through holes 32 and outward on both sides of rotatable member into chamber 39, into valve at 18, thence to center of wheel through holes or ports 19 to all sides of rotatable members in that set. Thus through the motor exhausting at 11 in reverse position the actuating fluid enters through admission-port 27 at 21 into chamber 36, thence through grooves of first unit or member into annular chamber 35, into valve at 22, thence through port shown by dotted lines to 23, into concentric chamber 39, thence toward center, into annular chamber 37, into valve at 24, thence to 25, thence toward center of third system of units, into annular chamber 38, to valve at 26, thence out at exhaust-port 11.

13 is shaft of valve in suitable stuffing-box and bearing 12, to which a lever 40 or other suitable means is attached for turning the valve one half-revolution in reversing.

43 represents packing-rings, of suitable metal or other material, which may be used to give longitudinal adjustment to the fixed members. The dotted lines 10 show the manner in which grooves cross each other. 9 shows the right-hand grooves on one side of the fixed members; 8, the left-hand grooves on adjacent surfaces on rotatable members.

The preferable shape of the groove is semi-circular or segmental, though a V-shaped groove could be used.

It is to be noted that the grooves 28 in the fixed members do not extend quite to the end of the grooves 29 of the rotating members, thus imparting to the latter its remaining energy of motion and the reaction of the exhaust.

It is apparent that the fluid acts on the entire surfaces, there being no retarding-friction, which is so wasteful of energy at speeds of revolution common to the turbine.

In a motor or an engine where it is not desirable that it be reversible the reversing-valve may be dispensed with entirely, thus somewhat simplifying its construction. In this case steam can enter at any point of casing into annular chamber 35, flow outwardly between the plates into concentric chamber 34, thence back to center, then to center of second wheel and out between the members into chamber 39, which could be provided at any point or points around with holes allowing it to flow directly into next annular chamber, thus through the engine to suitable exhaust, which may be at any convenient point on casing.

The construction as here outlined shows some axial thrust, which for marine or vertical engines would be desirable to balance the thrust of the propeller or the weight of shaft, dynamo, &c., but easily admits of construction that is balanced as to axial thrust.

A suitable governor may be attached to shaft 2, regulating the supply of fluid admitted through port 27.

It is apparent that changes from the construction herein disclosed may be made. Therefore I do not wish to be understood as limiting myself to the precise form of construction shown and described, but desire the liberty of making such changes as may fairly come within the spirit and scope of my invention.

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

1. In a fluid-viscosity motor of the turbine class in combination, a shaft rigidly secured thereon, rotatable members having on lateral surfaces a multiplicity of grooves, a plurality of fixed members, adapted to inclose said rotatable members having on adjacent surfaces a multiplicity of grooves oppositely disposed as to direction, suitable admission, and exhaust ports with means for conducting the actuating fluid from one set of grooves to the next set in the series, substantially as set forth.

2. In a fluid-viscosity motor of the turbine class in combination, a shaft, rigidly secured thereon rotatable members having on lateral surfaces a multiplicity of grooves crossing radius at an acute angle, a plurality of fixed members conforming in shape to, and adapted to inclose said rotatable members, having on adjacent surfaces a multiplicity of grooves oppositely disposed as to direction, their direction being such that the actuating fluid in following along them to points of lower pressure flows in direction of motion of rotating members, suitable admission and exhaust ports with means for conducting the actuating fluid to and from the grooves of one member of the series to those of the next member or members, &c., substantially as set forth.

3. In a fluid-viscosity motor of the class described, in combination, a shaft, rigidly secured thereon a plurality of disks, adapted to rotate, having cut or made on lateral surfaces thereof a multiplicity of grooves, originating a suitable distance from center running eccentrically outward to periphery, a plurality of relatively fixed or stationary members, conforming in shape to and adapted to inclose said rotatable members, said fixed members having on contacting surfaces a multiplicity of similar grooves, oppositely disposed to grooves on said adjacent surfaces, their direction being such that the actuating fluid in flowing along them to points of lower pressure flows in direction of motion of rotating members, suitable inlet and exhaust ports with means for conducting the actuating fluid to and from the grooves of one set to those of next set in the series, substantially as set forth.

4. In a compound fluid-viscosity motor of

the class described, the combination of a shaft, rigidly secured thereon a plurality of disk-like members, adapted to rotate, a plurality of relatively fixed or stationary members, whose lateral surfaces conform to and are adapted to inclose said rotatable members, the surfaces between said rotatable and fixed members being formed by a multiplicity of grooves, crossing the radius at an acute angle, oppositely disposed as to direction on adjacent surfaces, the direction of grooves on fixed members being such that fluid under pressure in flowing along them to points of lower pressure flows in direction of motion of rotating members, said grooves on fixed members beginning and ending nearer the axis than the beginning and ending of similar oppositely - disposed grooves on rotatable members, a suitable casing comprising end parts having suitable bearings and stuffing-boxes, a cylindrical part forming the body inclosing said rotatable and fixed members, suitable inlet and exhaust ports, said inlet-port admitting fluid under pressure to annular chamber 35 communicating with first set of grooves with suitable means for conducting fluid from thence to next set of grooves, thus in series to all the elements of the motor, thence suitably connected to exhaust-port 11, as and for the purpose specified.

5. In a reversible fluid-viscosity motor of the turbine class, the combination of a plurality of rotatable members 1, 1, rigidly secured to shaft 2, running in bearings and stuffing-boxes 3, 3, suitably carried by end casings 4, 5, an outer cylindrical casing 6, 6, with suitable cylindrical chamber for reversing - valve 33, inlet-port 27, exhaust-port 11, relatively fixed or stationary annular members 7, 7, having between adjacent surfaces near outer edge annular fluid-chambers 39, 45, connected with reversing-valve as at 18, 20, annular chambers 35, 36, 37, 38, forming fluid - passages to or from reversing-valve, said reversing - valve having on one side suitable cross-chambers 16, 18, 20, for conducting fluid from one element to the next element of the series, a shaft 13, in suitable bearing and stuffing-box 12, with suitable means attached to said shaft for turning valve one half-revolution in reversing, suitable means on opposite side of valve for reversing points of admission and exhaust for each of the elements of the motor, substantially as set forth.

6. In a reversible compound fluid-viscosity motor of the turbine class the combination of a plurality of rotatable members 1, 1, rigidly secured to shaft 2, running in bearings and stuffing-boxes 3, 3, suitably fixed to end casings 4, 5, an outer cylindrical casing 6, 6, with suitable cylindrical chamber for reversing-valve 33, bearings and stuffing - boxes 12, means attached to end shaft 13 for turning valve one half-revolution to reverse the engine, inlet-port 27, exhaust-port 11, relatively fixed

or stationary annular members 7, 7, having between adjacent surfaces at outer edge annular fluid-chambers 39 connected with reversing-valve as at 18, 20, or 23, 25, Fig. 3; annular chambers 35, 36, 37, 38, conducting fluid from reversing - valve to central part of rotatable members, or vice versa, a multiplicity of grooves on lateral surfaces of rotatable and fixed members, oppositely disposed on adjacent surfaces, cutting the radius at any point at an acute angle, the direction of grooves on fixed members being such that fluid under pressure flowing along them to points of lower pressure flows with respect to axis in direction of motion of rotating members, said grooves on stationary members beginning and ending somewhat nearer the axis than grooves 8 of rotatable members, as shown at 28, and 29, as and for the purpose specified.

7. In a reversible compound fluid-viscosity motor of the turbine class, in combination, a shaft, rigidly secured thereon with suitable means for longitudinal adjustment, a plurality of rotatable members, disk-like cylinders with a multiplicity of suitable grooves cut or made on lateral surfaces ending a suitable distance from axis and at periphery, the said grooves cutting the radius at any point at an acute angle, having such direction that fluid under pressure in flowing along them to points of lower pressure flows in the reverse direction of motion of said rotating members, said members having a plurality of suitable holes 32, cut near center, admitting fluid freely to each side of rotating member or members, a plurality of stationary annular members, having lateral surfaces conforming in shape to and adapted to inclose in close working fit said rotatable members with a multiplicity of suitable grooves on lateral surfaces cutting the radius at any point at an acute angle having a direction the reverse of similar grooves on opposed surfaces of rotatable members, said grooves beginning and ending a suitable distance nearer the axis than like grooves on rotatable members, said fixed members having annular fluid-chambers 39, 45, near periphery, in communication with reversing-valve as at 18, 20, said fixed members having a suitable hole in central part for shaft at division of each unit or system of units, with metal or suitable packing to prevent escape of actuating fluid to chamber of units of lower pressure, other stationary members having a larger hole approximately to the inner ends of grooves, for the free passage of the actuating fluid to all the units in the same system, annular internal chambers 35, 36, 37, 38, with suitable distance-pieces 44, suitable casing 4, 5, 6, with suitable bearings and stuffing-boxes 3, reversing-valve 33, with suitable inlet-ports 27, exhaust-port 11, means attached to shaft 13 for turning valve one half-revolution in reversing, substantially as shown and specified.

8. In a reversible compound fluid-viscosity

motor of the turbine class in combination with suitable shaft, having collars 46, 47, limiting axial thrust, rotatable and stationary members, suitable means 42, and 43, adjusting longitudinally said rotatable and fixed members, a reversing-valve 33, adapted to be rev-
 5 olubly inclosed with fluid-tight fit in cylindrical chamber in casing, and end shaft 13 with suitable bearing and stuffing-box 12,
 10 suitable means attached to shaft 13 to revolve said valve one half-revolution in reversing, said reversing-valve having on one side chamber 14, connecting inlet-port and annular chamber 35, cross-chamber 16, connecting annular chamber 36 of first system with chamber
 15 37 of second system, cross-chamber 18 connecting fluid passages or chambers of second system of units to annular chamber 38, cross-chamber 20 connecting annular chambers of third system of units to exhaust-port
 20 11, suitable means on opposite side of valve for conducting fluid when reversed from inlet-port to annular chamber 34, from annular chamber 35 to annular chamber 39, from annular chambers 37 to annular chambers 45,
 25 from annular chamber 38 to exhaust-port 11, substantially as set forth.

9. In a reversible compound fluid-viscosity motor of the turbine class in combination with
 30 shaft 2, rotatable members 1 secured thereto, with means for longitudinal adjustment, stationary members inclosing said rotatable members, with means for longitudinal adjustment, a suitable casing inclosing said station-
 35 ary and rotatable members annular fluid-chambers 34, 39 45, between said stationary mem-

bers near outer circumference and just with-
 out or beyond periphery of rotatable mem-
 bers, said rotatable and stationary members
 having a multiplicity of suitable grooves cut
 40 or made on adjacent surfaces, cutting radius at any point at an acute angle, oppositely dis-
 posed on adjacent surfaces of said members,
 with suitable direction on said members as to
 direction of flow of actuating fluid, annular
 45 fluid-chambers 35, 36, 37, 38 open to shaft, suitable inlet and exhaust ports, a cylindrical chamber in casing for reversing-valve 33, rev-
 olubly fitted, fluid-tight at contact-points on
 surfaces, an end shaft 13, suitable means at-
 50 tached thereto for revolving reversing-valve one half-revolution, a bearing and stuffing-
 box 12 carried by end casing, a chamber 21,
 on first quadrant of valve connecting inlet-
 port 27 to annular chamber 35, on adjacent
 55 quadrant a chamber 22, suitable hole opening to 23, connecting annular chamber 35 to an-
 nular chamber 39, on first quadrant, suitable chambers 24, 25, connected by suitable hole,
 connecting annular chamber 37 to annular
 60 chambers 45, suitable chamber 26 on second quadrant with suitable hole open at exhaust
 end, and opening into cross-chamber 20, also
 to exhaust at 11, substantially as set forth.

In testimony whereof I have signed my name
 65 to this specification, in the presence of two sub-
 scribing witnesses, this 7th day of September,
 1903.

BEN J. CAMPBELL.

Witnesses:

RUTLEDGE CARTER,
 CHAMPE T. BARKSDALE.