No. 824,449. PATENTED JUNE 26, 1906.

C. J. STUART.

TURBINE ENGINE.

APPLICATION FILED OCT. 20, 1905.

2 SHEETS—SHEET 1.

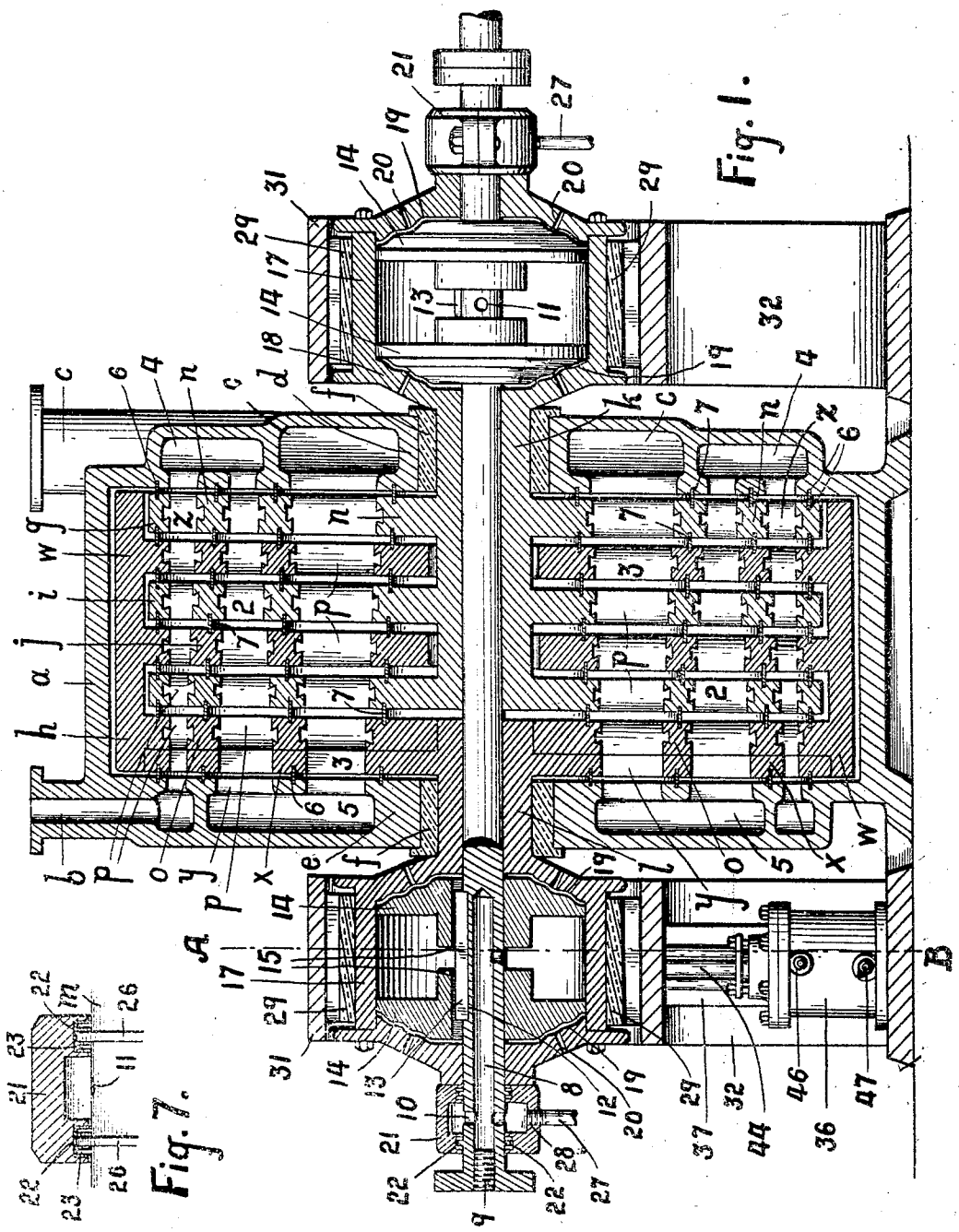


Fig. 1.

Fig. 7.

Witnesses.

Lloyd Blackmore

Winthrop. Colton.

Inventor.

C. J. Stuart

by C. J. Fehlerstonhaugh Atty.

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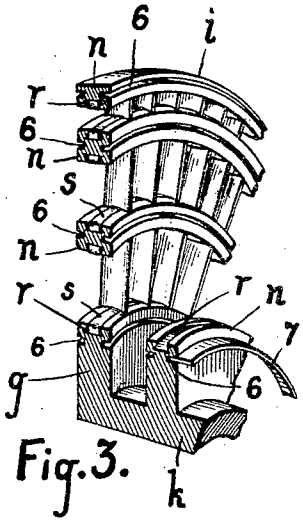


Fig. 3.

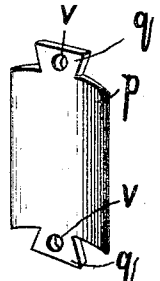


Fig. 4.



Fig. 6.

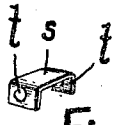


Fig. 5.

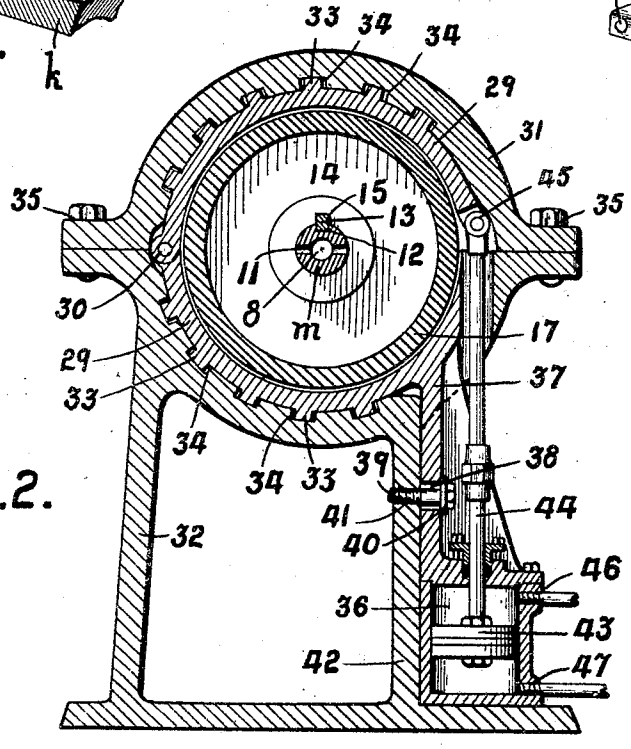


Fig. 2.

Witnesses.

Lloyd Blackmore

Winthrop Colton.

Inventor.

C. J. Stuart

by E. J. Fitzsimmons Atty.

UNITED STATES PATENT OFFICE.

CHARLES JOURDEAN STUART, OF MONTREAL, CANADA.

TURBINE-ENGINE.

No. 824,449. Specification of Letters Patent. Patented June 26, 1906.

Application filed October 20, 1905. Serial No. 283,664.

To all whom it may concern:

Be it known that I, CHARLES JOURDEAN STUART, a subject of the King of Great Britain, residing at 417 Duluth avenue, in the city of Montreal, in the district of Montreal, in the Province of Quebec, in the Dominion of Canada, have invented certain new and useful Improvements in Turbine-Engines, of which the following is a specification.

This invention relates to improvements in turbine-engines as described in the present specification and illustrated in the accompanying drawings, that form part of the same.

The invention consists, essentially, of a casing having a suitable inlet and exhaust and bearings centrally disposed in the heads thereof, a pair of turbines journaled in the aforesaid bearings and having the inner termini of their hubs coadjacent within the casing and their blade-carrying disks alternately arranged, respectively, a rotatable shaft having a direct bearing on said hubs and extending therethrough, and clutches having one of their members rigid with the outer ends of said hubs and their other member mounted on said shaft.

The objects of the invention are to utilize the expansile fluid operating the turbine to the fullest extent possible, to insure an exhaust at low pressure, to provide a reversing means which shall have a force substantially equal to the forward movement, and to devise a compact and durable construction without materially increasing the cost of production in such machines.

In the drawings, Figure 1 is a longitudinal sectional view of the turbine and clutches. Fig. 2 is a cross-sectional view of the clutch mechanism through A B in Fig. 1. Fig. 3 is a perspective detail of a section of the turbine-disks. Fig. 4 is a perspective detail of the blade. Fig. 5 is a perspective detail of the retaining-wedge inserted between the blades circumferentially. Fig. 6 is an enlarged perspective detail of a portion of a packing ring or baffle. Fig. 7 is a sectional detail of a fluid-box adjacent to the clutches.

Like characters of reference indicate corresponding parts in each figure.

a is a turbine-casing having the inlet *b* and the exhaust-opening *c* and the bearings *d* and *e* in the heads thereof.

f represents bushings inserted in the bearings *d* and *e*.

g and *h* are turbines formed of a plurality of disks *i* and *j*, respectively, extending from the hubs *k* and *l*, journaled in the bearings *d* and *e*, respectively.

m is a shaft extending through the hubs *k* and *l* and beyond each head of the casing.

The hubs *k* and *l* terminate at their inner ends in proximity one to the other, and there is a direct bearing between the shaft and the said hubs throughout the entire length of the latter, though it must be understood that if it is considered advisable in construction to reduce the weight of said hubs some of the metal may be removed from the interior wall intermediate of their length. The disks *i* and *j* are formed of a plurality of solid rings *n* and *o*, between which are interposed the blades *p*, thus having the rings and blades in said disks alternate radially. The blades *p* are curved throughout their entire length and have at the ends thereof the dovetailed tongues *q*, which fit into the dovetailed slots *r* in the rings *n* and *o*.

s represents wedges filling in the slots *r* between the tongues *q* of the blades *p* and having the teats *t* on the outer surfaces of their inturned flanges *u*, said teats corresponding to and fitting into the holes *v* through the tongues *q*.

The innermost rings *n* of the turbine *g* are firmly secured or form part with the hub *k*, and their blades *p* extend therefrom to the next rings, and from the next rings to outer rings, and so on to the outermost rings. The innermost rings *o* of the turbine *h* encircle the hub *l* between the innermost rings *n* of the turbine *g*, and their blades *p*, which are set in the opposite direction to the blades of the turbine *g*, extend to the next ring and from that ring to the next succeeding rings, and so on until the outermost rings are reached, which are firmly secured to or form part with the drum *w*. The said drum *w* is rigidly secured to or forms part with a disk *x*, through which are the openings *y* to and from the passages throughout the blades. The disk *x* is rigidly secured to or forms part with the hub *l*, to which is also secured the end disk of the disks *j*. It will be thus seen that the disks *j*, through the drum *w*, extend from and are supported by the hub *l*, encircling the shaft *m*, and each of the disks *j* reaches in between the disks *i*, having their inner rings, as explained, encircling the hub *k*. In this arrangement of disks, while the separate turbines are closely defined by their separate hubs, yet the expansile-fluid passages *z*, 2, and 3 are through the blades of both turbines

and when one of said turbines is held stationary the other must move through the expansion of the fluid as it travels throughout said passages.

4 represents communicating ports or passages from the passages *z* to the passages 2, and 5 represents ports from the passages 2 to the passages 3.

In order to utilize the fluid sent into the passages *z*, 2, and 3 to the fullest extent possible, the rings are very close together at the inlet to the passage *z*, and consequently the blades very short. In the next disk, however, the outer rings are a little farther apart and the blades a little longer than in the first, and so on throughout the several disks to the end of the passage *z*. At the beginning of the passage 2 the blades are a trifle longer than at the end of the passage *z*, and the said passage 2 gradually increases in width until it reaches the communicating port to the passage 3, and at the beginning of the passage 3 the blades are a trifle longer than at the end of the passage 2, and the said passage 3 gradually widens until it reaches the exhaust, where the blades are at their longest. Thus there is a gradual flare from the inlet to the passages until the exhaust is reached. It must be here emphasized that in this arrangement of passages the fluid immediately on entering is brought into contact with the shortest blade of the turbine at the circumference thereof where the greatest speed is required, and as its passes on more surface area of blade is provided—that is, the steam in its more expanded state has a greater surface area for its impact until it reaches the passage nearest the shaft, where at a low pressure it strikes the longest blades, and of course the speed of the turbine at this point is less than at the circumference of the wheel. Consequently there is an even distribution of power throughout the turbine.

6 represents annular slots formed in the sides of the rings *n* and *o* and in the heads of the casing *a*.

7 represents baffles in the form of rings and inserted in the annular slots 6, so that any pressure of the expansile fluid from one fluid-passage will force a baffle 7 to the wall of its slot 6 and effectually prevent escape of expansile fluid to the next passage.

The shaft *m* at the ends thereof which extend beyond the casing *a* is hollowed, forming the chambers 8 within said shaft. The said chambers are closed at the ends by the plugs 9, but have the inlets 10 and the outlets 11. 12 represents longitudinal slots in the periphery of said shaft and toward each end thereof. 13 represents feathers inserted in said slots. 14 represents disks mounted on the shafts *m* toward each end thereof and having the slots 15 across the inner wall thereof corresponding to the feathers 13 and permitting a sliding motion for said disks along the shaft *m*. The outer faces of the disks 14 are ridged, and the said disks rotate with the shaft continuously.

17 represents revoluble cylinders having their inner heads 18 rigidly secured to or forming part with the outer ends of the hubs *k* and *l* and encompassing the disks 14, which operate as pistons within said cylinders. The cylinders 17 have the ridged inner surfaces 19 to their heads corresponding to the ridged surfaces 16 of the disks 14. 20 represents air-vents through the heads of the cylinders 17 to allow the escape of air from between the surfaces 16 and 19. 21 represents boxes mounted on the shaft *m* immediately adjoining the cylinders 17 and communicating with the chambers 8 through the inlets 10. 22 represents glands formed in the walls of the boxes 21 adjacent to the shaft and in which are the baffle-rings 23, having the inturned flanges 24 and encircling the shaft *m* between the wall of the annular slots 25 and the annular rings 26 on the shaft. 27 represents pipes leading from a suitable expansile-fluid supply through the inlets 28 into the boxes 21. Communication is thus established from the expansile-fluid supply through the boxes 21 and the chambers 8 into the cylinders 17 to operate the disks 14. The boxes 21 are preferably split and have their halves secured firmly together in order to form the glands 22. 29 represents split straps surrounding the cylinders 17 and hinged at 30 and supported in the circular frame 31 which is supported from the base 32. 33 represents corrugations on the outer surfaces of the straps 29, fitting into corresponding recesses 34 in the interior walls of the frames 31. The upper halves of the frames 31 are securely bolted at 35 over the said straps, and sufficient play is permitted said straps within the frames to loosen their grips on the cylinders 17 and permit the said cylinders to revolve within the straps.

36 represents cylinders supported on the bases 32 and rigidly connected to the lower halves of the straps 29 by the bars 37. 38 represents slots in the bars 37, and 39 represents threaded bolts inserted through the washers 40 and into correspondingly-threaded orifices 41 in the standards 42 of the frames, the washers 40 loosely abutting the outer surfaces of the bars 37. 43 represents pistons operating in the cylinders 36 and having the rods 44 therefrom pivotally connected at 45 to the upper halves of the straps 29. 46 and 47 are inlet and exhaust openings to the cylinders 36. It may be here explained that the corrugations from the outer surfaces of the straps fitting into the recesses in the wall of the frame will prevent the said straps from rotating with the cylinders 17, and through the action of the pistons 43 in the cylinders 36 said straps will be either gripped securely to the said cylinders 17, keeping them from rotating, or loosened therefrom to permit of their free rotation,

according to the position of the pistons in the cylinders.

In the operation of this engine expansible fluid from a suitable source of supply enters through the inlet *b* in the casing *a* and on to the entrance of the passage *z*, where the blades of the turbines are at their shortest, and there passes on and exerts pressure on the blades of every alternate disk as the blades of the other disk are set in the opposite direction and the turbine held by the clutch mechanism, as hereinafter more fully explained. The expansile fluid passes on through the passage *z* and on through the passages 2 and 3 by means of the connecting-ports 4 and 5 and causes the turbine, which is free, to rotate. The fluid as it reaches the innermost set of blades is almost fully expanded, and therefore is allowed a greater surface to work on, and the final exhaust through the opening *c* is at very low pressure. Coincidentally with the turning on of expansile fluid to the turbine-casing fluid is admitted to one of the cylinders 17 through a box 21. In the meantime the pressure of fluid in the cylinder 36, immediately beneath the cylinder 17, which is being operated, is exhausted and fluid admitted through the inlet 47, raising the piston, and thus relieving the grip of the strap 29 on the cylinder 17 and leaving the latter free to rotate. The entrance of the fluid into the cylinder 17 in operation forces the disks 14 apart toward the heads, which are ridged correspondingly with the outer surfaces of the disks, thus insuring the rotation of the said disks with the cylinder 17.

In the description of the parts in detail it has already been explained that the heads of the cylinders 17 and the hubs of the wheels are rigidly secured together or formed of the same piece, and in this instance I shall for convenience describe the operation of the cylinder 17, secured to the hub *k*. When it is desired to revolve the shaft in the direction for which the blades are set in the turbine *g*, the cylinder 17, secured to the hub 1, is securely gripped by its strap 29 through the turning-on of fluid into the inlet 46 in its lower cylinder 36. This pull of the piston-rod on the upper half of the strap pulls down on said upper half; but in order to obviate the difficulties incident to too great a pull in one direction the cylinder 36 rises slightly against the pull of the rod 44. This will raise the lower half of the strap, and between the downward pull on the upper half and the upward motion of the lower half the cylinder 17 is firmly gripped to prevent it from rotating. The disks 14 in the said cylinder 17 are free to rotate therein, and consequently will turn with any motion of the shaft. The hub *k*, which is secured to the free cylinder 17, is set in motion by the turbine *g*. This causes the said cylinder 17 to revolve, and as the disks 14 form a secure clutch on the heads of said cylinder the said disks will revolve, and also the shaft, in the direction impelled by said turbine.

To reverse the motion of the shaft, the cylinder 17, which has been rotating, is gripped in the same manner as above described and the other cylinder is released by loosening the strap and fluid is turned on thereinto and through its connection with the hub 1 the shaft is rotated. The hub *k*, which is now stationary, will hold the disks so, and the disks extending from the hub 1 will rotate with the impact of the fluid, and as the blades are set in the opposite direction the motion of the shaft is reversed.

It may be mentioned with particular reference to the reversing mechanism, as the stationary turbine is intimately connected through its hub, its cylinder 17, and the strap 29 with the stationary frame 31 a structure is thus provided in which the rotating turbine turns in a substantially stationary frame throughout.

What I claim as my invention is—

1. In a turbine-engine, the combination with the casing having a suitable inlet and exhaust and bearings centrally disposed in the heads thereof, of a pair of turbines journaled in the aforesaid bearings and having the inner termini of their hubs coadjacent within the casing and their blade-carrying disks alternately arranged respectively, a rotatable shaft having a direct bearing on said hubs and extending therethrough, and clutches having one of their members rigid with the outer ends of said hubs and their other member mounted on said shaft, as and for the purpose specified.

2. In a turbine-engine, the combination with the casing having a suitable inlet and exhaust and bearings centrally disposed in the heads thereof, of a turbine having a plurality of disks rigidly secured to the hub thereof, said disks having blades interposed radially, and a turbine having disks alternating with the aforesaid disks and blades set in the opposite direction and supported from a hub extending into proximity with the aforesaid hub at its inner end, a shaft having a direct bearing on said hubs at their inner and outer ends, and clutches adjoining the outer ends of said hubs, as and for the purpose specified.

3. In a turbine-engine, the combination with the casing having a suitable inlet and exhaust and bearings centrally disposed in the heads thereof, of a pair of turbines journaled in the aforesaid bearings and having the inner ends of their hubs terminating coadjacent within the casing, and disks extending from said hubs alternately arranged, said disks having blades interposed radially, and set in opposite directions in said turbines respectively and forming a plurality of fluid-

passages flaring from a narrow inlet to a comparatively wide outlet adjacent to the shaft, a shaft extending through said hubs, and suitable clutch mechanism, as and for the purpose specified.

4. In a turbine-engine, the combination with the casing having a suitable inlet and exhaust and bearings centrally disposed in the heads thereof, of a pair of turbines journaled in the aforesaid bearings and having the inner termini of their hubs coadjacent within the casing and a plurality of disks extending radially from one of said hubs and a plurality of disks arranged alternately with the aforesaid disks and extending from a drum carried by a disk rigid with the other hub, said disks having blades interposed at intervals radially, forming a continuous fluid-passage from the circumference inwardly, a shaft extending through said hubs, and clutch members mounted on said shaft coacting with clutch members rigid with the outer ends of said hubs, as and for the purpose specified.

5. In a turbine-engine, the combination with the casing having a suitable inlet and exhaust and bearings centrally disposed in the heads thereof, of a pair of turbines journaled in the aforesaid bearings, a shaft extending through the hubs of said turbines, revoluble cylinders having their inner heads rigid with the outer end of said hubs and rigid inner surfaces to their heads, pairs of disks slidably arranged on said shaft within said cylinder and rotating therewith and having rigid outer surfaces, means for feeding fluid to said cylinders, and means for holding one of said cylinders stationary, as and for the purpose specified.

6. In a turbine-engine, the combination with the casing having a suitable inlet and exhaust and bearings centrally disposed in the heads thereof, of a pair of turbines journaled in the aforesaid bearings, a shaft extending through the hubs of said turbines and having fluid-chambers therewithin at the ends thereof and inlets and outlets to said chamber, a pair of cylinders rigid with the outer ends of said hubs respectively and having ridged inner surfaces to their heads, a pair of disks in each of said cylinders having ridged outer surfaces corresponding to the aforesaid inner surfaces of the cylinders and keyed to said shaft and sliding laterally thereon, and fluid-boxes having inlets and encircling the inlets to said chambers, as and for the purpose specified.

7. In a turbine-engine, the combination with the casing having a suitable inlet and exhaust and bearings centrally disposed in the heads thereof, of a pair of turbines journaled in the aforesaid bearings, a shaft extending through the hubs of said turbines and hollowed from each end and plugs closing the ends and forming chambers within said shaft having suitable inlets and outlets, fluid-boxes having inlets and immediately adjoining said cylinders and surrounding the inlet to said chambers, a pair of disks keyed to said shaft within each of said cylinders and sliding freely along on said keys and means for gripping one of said cylinders and holding the same stationary, as and for the purpose specified.

8. In a turbine-engine, the combination with the casing having a suitable inlet and exhaust and bearings centrally disposed in the heads thereof, of a pair of turbines journaled in the aforesaid bearings, a shaft extending through the hubs of said turbines, having hollowed ends and plugs in said ends forming chambers having inlets and outlets, a pair of cylinders inclosing the outlets from said chambers and having ridged inner surfaces to their heads, disks in each of said cylinders each having a ridged surface meeting the aforesaid ridged surfaces, fluid-boxes surrounding the inlets to said chambers and having inlets thereto, hinged straps encircling said cylinders, and means for tightening or loosening said straps around said cylinders, as and for the purpose specified.

9. In a turbine-engine, the combination with the casing having a suitable inlet and exhaust and bearings centrally disposed in the heads thereof, of a pair of turbines journaled in the aforesaid bearings, a shaft having chambers formed therewithin at the ends thereof and suitable inlets and outlets, a pair of revoluble cylinders having ridged inner surfaces to their heads, a pair of disks in each of said cylinders having ridged outer surfaces, split traps hinged and having corrugations on the outer surfaces thereof, circular frames supported from bases and having recesses in their inner walls corresponding to the aforesaid corrugations in the straps, and fluid-cylinders on said bases having pistons connected by suitable rods to one of the halves of each of said straps, as and for the purpose specified.

10. In a turbine-engine, the combination with the casing having a suitable inlet and exhaust and bearings centrally disposed in the heads thereof, of a pair of turbines journaled in the aforesaid bearings, a shaft extending through the hubs of said turbines having chambers formed therewithin at the ends thereof and suitable inlets and outlets thereto, a plurality of cylinders rigid with the outer ends of said hubs having ridged inner surfaces, a pair of disks in each of said cylinders having ridged outer surfaces corresponding to the aforesaid inner surfaces and keyed to said shaft and having a limited sliding motion thereon, hinged straps encircling said cylinders, circular frames supporting said straps, vertically-arranged cylinders having suitable inlets and exhausts, and a rigid connection to the lower half of each of

said straps, pistons operating therein and rods therefrom pivotally connected to the upper half of each of the said straps, and boxes surrounding and inlets to the chambers in the said shaft and having inlets thereto, as and for the purpose specified.

11. In a device of the class described, in combination, a casing, a turbine journaled therein, a shaft extending through said casing and turbine, a revoluble cylinder rigidly connected with said turbine and having corrugated inner surfaces to its heads, a pair of pistons operating in said cylinder and keyed on said shaft having a free lateral motion thereon, means for introducing fluid to said cylinder between said pistons, and means for arresting the rotation of said cylinder, as and for the purpose specified.

12. In a device of the class described, in combination, a casing having a suitable inlet and exhaust, a turbine suitably journaled in said casing, a shaft extending through said casing and turbine, a revoluble cylinder rigidly connected with said turbine and having corrugated inner surfaces to its heads and air-vents therethrough, a pair of pistons operating in said cylinder having corrugated surfaces corresponding to the aforesaid corrugated surfaces, means for introducing fluid between said pistons, a split strap hinged encircling said cylinder and having a corrugated periphery, a circular frame supported from a suitable base and having recesses in the inner wall thereof corresponding to the corrugations of the strap and encircling the latter, a cylinder supported on the said base and having a rigid connection with the lower half of said strap, a piston operating in said cylinder and a rod therefrom pivotally connected to the upper half of said strap, as and for the purpose specified.

13. In a device of the class described, in combination, a casing having suitable inlets and exhausts, a turbine journaled in said casing, a shaft, hollowed from the end thereof forming a chamber having suitable inlets and outlets, and extending through said turbine and casing, a revoluble cylinder, having rigid connection with said turbine, ridged inner surfaces to its heads and mounted on said shaft and inclosing the aforesaid outlets, a pair of disks having correspondingly-ridged surfaces and slidably arranged on said shaft within said cylinder and rotatable with said shaft, a fluid-box having a suitable inlet and encircling said shaft and inclosing the aforesaid inlets and having glands in the walls thereof, a circular frame surrounding said cylinder having recesses in the inner wall thereof and supported from a suitable base, a hinged strap having corrugations corresponding to the said recesses and encircling said cylinder, a vertically-arranged cylinder resting on the aforesaid base having rigid connection with the lower half of said strap and suitable inlets and exhausts, a piston operating therein, and a rod therefrom pivotally connected to the upper half of said strap, as and for the purpose specified.

14. In a device of the class described, in combination, a casing having a suitable inlet and exhaust, a turbine journaled in said casing, a shaft having annular projections and extending through said turbine and casing, a fluid-controlled clutch mechanism mounted on said shaft and connected with said turbine, a stationary box encircling said shaft having a suitable inlet and connections with said fluid-controlled clutch mechanism, and glands formed in slots in the walls of said box having baffle-rings with inturned flanges encircling said shaft in the interstices between annular projections from said shaft and the walls of the slots in which said glands are formed, as and for the purpose specified.

15. In a device of the class described, in combination, a casing having a suitable inlet and exhaust, a shaft, a turbine journaled in said casing, having a hub, a plurality of rings rigid with said hub, a plurality of curved blades of gradually-varying length beginning from the outermost blades inwardly, and extending from said rings to an intermediate plurality of rings, a plurality of curved blades extending from said intermediate rings and gradually varying in length, beginning from the outermost blades at the other side of the casing, and extending to a second intermediate plurality of rings, a plurality of curved blades extending from the latter rings and varying in length beginning from the other side of the casing, and extending to the outermost rings, said blades forming a fluid-passage, having a narrow inlet and gradually flaring in the passage along through the various sets of blades to a wide exhaust near the shaft, as and for the purpose specified.

16. In a device of the class described, in combination, a casing having suitable inlet and exhaust and connecting ports, a shaft, a turbine having a hub journaled in said casing, rings extending from said hub and rigid therewith, blades extending from said rings, rings connected to the outer end of said blades, blades extending from the latter rings and connected to rings at their outer ends, and blades extending outwardly from the last-named rings and secured to the outermost rings, and annular slots in the sides of all of said rings and in the sides of the casing adjacent to said rings, and baffle-rings introduced in said annular slots, as and for the purpose specified.

17. In a device of the class described, in combination, a casing having suitable inlet and exhaust and connecting ports, a turbine having a hub journaled in said casing, a plurality of rings rigid with said hub having dovetailed slots at their outer ends, a plurality of rings having annular dovetailed slots,

blades having dovetailed tongues fitting into the said dovetailed slots, wedges having inturned flanges filling in said dovetailed slots between said dovetailed tongues, said blades and said rings being arranged radially to form a fluid-passage gradually flaring from the inlet adjacent to the circumference to the exhaust adjacent to the hub, baffle-rings introduced in annular slots in the sides of said rings and casing between the fluid-passages, and a shaft through said turbine and casing, as and for the purpose specified.

18. In a device of the class described, in combination a casing having a suitable inlet and exhaust, a pair of turbines formed of hubs having their inner termini coadjacent within the casing and rings having annular dovetailed slots and curved blades having dovetailed tongues joining said rings and forming disks arranged alternately and supported from said hubs, said disks having wedges filling in the annular slots between the tongues of the blades, and annular slots in the sides of the rings, and baffle-rings in said annular slots, a shaft extending through said hubs, and clutch mechanism connected to said turbine and shaft, as and for the purpose specified.

19. In a device of the class described, in combination, a casing having a suitable inlet and exhaust, a turbine journaled in said casing and formed of a plurality of rings having annular dovetail slots, and a plurality of curved blades having dovetail tongues at each end thereof fitting into said dovetail slots, and removable wedges intervening between said tongues in said slots, as and for the purpose specified.

20. In a device of the class described, in combination, a casing having a suitable inlet and exhaust, a turbine journaled in said casing and formed of a plurality of rings having annular dovetail slots, and a plurality of curved blades having dovetail tongues at each end thereof fitting into said dovetail slots, and orifices through said tongues, and removable wedges intervening between said tongues in said slots having inturned flanges, and teats thereon corresponding to said orifices, as and for the purpose specified.

Signed at Montreal, in the city and district of Montreal, in the Province of Quebec, in the Dominion of Canada, this 16th day of October, 1905.

CHARLES JOURDEAN STUART.

Witnesses:

G. H. TRESIDDER,

B. HERGER.