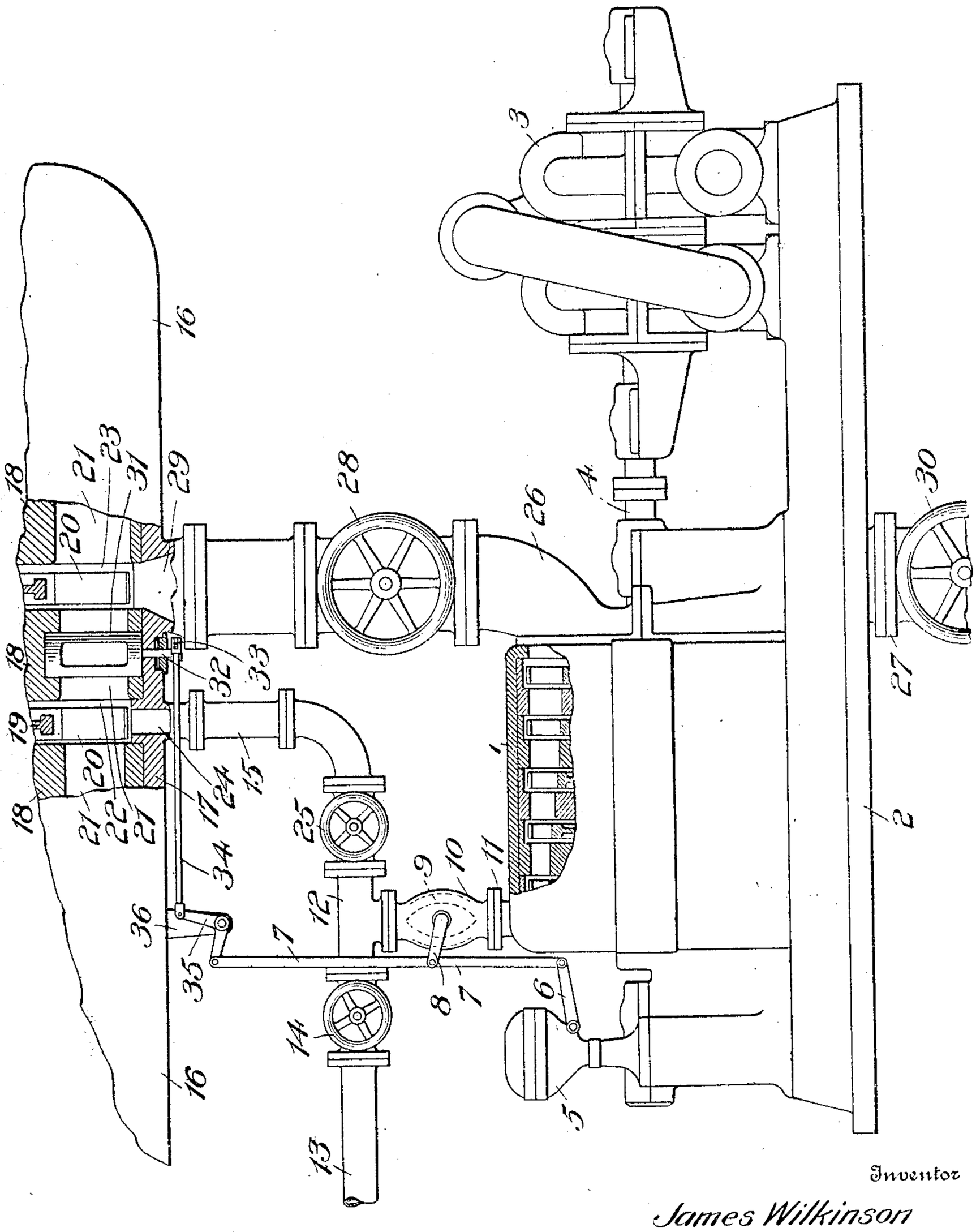
J. WILKINSON.

STEAM TURBINE.

APPLICATION FILED DEC. 14, 1906.

920,232.

Patented May 4, 1909.



Inventor

James Wilkinson

Witnesses

Edwin L. Bradford

P. H. Burch

By Robt. W. Johnston Jr.

Attorney

UNITED STATES PATENT OFFICE.

JAMES WILKINSON, OF PROVIDENCE, RHODE ISLAND, ASSIGNOR TO WILKINSON TURBINE COMPANY, OF BIRMINGHAM, ALABAMA, A CORPORATION OF ALABAMA.

STEAM-TURBINE.

No. 920,232. Specification of Letters Patent. Patented May 4, 1909.

Application filed December 14, 1906. Serial No. 347,878.

To all whom it may concern:

Be it known that I, JAMES WILKINSON, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented new and useful Improvements in Steam-Turbines, of which the following is a specification.

My invention relates to improvements in the construction and operation of small power auxiliary turbines, utilized for driving pumps, blowers, etc., and adapted to coöperate with a turbine or set of turbines of larger power and of any desired construction.

It is my purpose to enable the auxiliary to be operated with high economy which I obtain by passing the steam therethrough with a small drop in pressure, thereby reducing to a minimum the leakage losses; the major portion of the energy of pressure of the steam being previously or subsequently converted into energy of velocity in normal manner in the main turbine.

Considered broadly, my invention contemplates a main turbine and an auxiliary turbine of relatively small power which are so connected up that part of the steam which drives the main turbine is, for a portion of its passage from boiler to the exhaust or condenser, caused to flow, with a comparatively small drop in pressure, through said auxiliary turbine, the small drop in pressure producing energy of velocity which may be efficiently abstracted by any desired number of rows of buckets, thereby making possible the construction at small cost of a highly efficient low speed auxiliary. As thus broadly considered, the boiler steam may be supplied directly to the auxiliary and discharged therefrom into an intermediate point of the working passage of the main turbine; or, as claimed in a pending application No. 320,112, the auxiliary may be connected up in a by-pass between portions of the working passage of the main turbine, in which case the steam for the auxiliary is shunted around one or more rows of buckets in said main turbine; or the auxiliary may receive its steam from a low pressure portion of the working passage of the main turbine and exhaust directly to the atmosphere or condenser. In the accompanying drawings I have shown the auxiliary not only adapted to be operated in any one of these three ways, as occasion may require, but also to act as an independent unit when the main turbine is out of service. Also the auxiliary may be shut down without interfering with the efficient operation of the main turbine. The auxiliary turbine, by reason of its coöperative relationship with the working passage of the main turbine, may be designed to operate with the highest efficiency at any desired shaft speed since, within a comparatively small drop in pressure, any desired number of expansions of its working fluid may be obtained. Thus, for instance, the auxiliary may abstract velocity from the fluid by five rows of vanes across which the drop in pressure will correspond substantially to the drop in pressure across one, two, or more, of the rows of vanes in the main turbine. This gives a relatively low shaft speed to the auxiliary and at the same time enables it to act as an independent part of the main turbine and with the same practical economy.

A further object of my invention is to provide the auxiliary with an independent governing means, which if desired may operate valve means adapted to reduce the working passage of the main turbine proportionately as steam is shunted therefrom through the auxiliary.

As illustrative of one embodiment of my invention, but without limitation to the construction or arrangement of parts therein shown, reference is made to the accompanying drawings in which I illustrate an auxiliary turbine driving a compound centrifugal pump and disposed below a main turbine which is broken away to show the manner in which the auxiliary is connected up therewith and also the compensating valve for the shunted steam.

The auxiliary turbine 1 is mounted on the base 2 which also supports a compound centrifugal pump 3 driven by the shaft 4 of the turbine. A speed governor 5 is also driven by the turbine and, in the usual manner, rocks an arm 6 which raises or lowers a rod 7 to which a crank arm 8 is pivotally connected. This crank operates a butterfly valve 9 in the pipe 10 which is connected at one end to the supply port 11 of the auxiliary and at the other end to a T-coupling 12 connected at one end to an independent boiler steam supply pipe 13 with a valve 14 therein, and at the other end to a pipe 15 which communicates with the working passage of the

main turbine 16. As illustrated, this main turbine is of the multi-stage impact type having a casing 17 subdivided into stages by diaphragms 18. A bucket wheel 19, having one or more peripheral rows of buckets 20, is disposed within each stage and adapted to be rotated by the steam which flows through nozzles 21 in the diaphragms and is directed thereby against the buckets, the succeeding nozzles forming a working passage of increasing proportions in which the steam, as it flows through the main turbine, is expended in stages and the resultant energy of velocity imparted to the bucket wheels.

I have illustrated the auxiliary as designed to operate with a drop of pressure substantially corresponding to that which occurs between the stages 22 and 23 of the main turbine. The pipe 15 communicates with the stage 22 through a port 24 in the casing 17, and, when a valve 25 in said pipe is open, admits steam from the main turbine, under the control of valve 9, into the auxiliary. I provide two independent exhaust pipes 26 and 27 for the auxiliary, the former being provided with a valve 28 and adapted to communicate with stage 23 through a port 29 in the casing, while the latter is provided with a valve 30 and opens into the atmosphere or a condenser. In the nozzle 21 between the stages 22 and 23, I place a rotary valve 31, such as is described and claimed in my Letters Patent No. 751,888, and provide an operating stem 32 therefor which passes through a suitably packed opening in the casing 17 and has fixed on its outer end a crank 33 connected by a rod 34 to a bell crank lever 35. This lever is journaled on a support 36 and at its outer end is connected to the upper end of the governor shifted rod 7, the connections being such that as the valve 9 is opened the valve 31 is closed and vice versa. The valve may be operated by hand if desired. Its use enables that portion of the working passage of the main turbine around which the steam is diverted to the auxiliary, to be restricted, thereby maintaining the working passage of the main turbine proportioned to the volume of steam flowing therethrough at all points. The steam may be shunted around two or more stages, in which case the working passage may be designed with respect thereto as is claimed in my said pending application.

In operation, a variety of driving effects as to speed and power may be obtained from the auxiliary turbine. Thus by opening the valves 25 and 28 and closing the valves 14 and 30, the auxiliary, under the control of its governor, will be operated solely by the steam shunted from the main turbine, the governor 5 controlling the admission of this steam as it is required and simultaneously reducing or cutting off the nozzle passage between stages 22 and 23. If increased power is desired, the valve 14 may be opened, or if desired, valve 25 may be closed and the auxiliary driven by the boiler steam flowing through pipe 13. The turbine when driven in this manner may be adapted to exhaust to the atmosphere or a condenser instead of into the main turbine, by closing valve 28 and opening valve 30. Also valves 14 and 28 may be closed and the auxiliary driven by steam diverted from the main turbine and exhausted to the atmosphere or condenser. The working passage of the main turbine, as referred to above and hereafter in the claims, covers the passage through which the steam flows from the supply to the exhaust and may include conduits between the casings of a compound turbine.

In compliance with the requirements of the patent statutes, I have described and illustrated one embodiment of my invention, but as it may be variously modified within the scope of my invention, I do not desire to be understood as limited to the details of construction or the arrangement of parts hereinbefore described.

What I claim as new and desire to secure by Letters Patent, is:—

1. The combination with a main turbine and its bucket bearing rotor, of an auxiliary turbine having a bucket bearing rotor of smaller diameter than that of the main turbine, means to inter-connect said turbines to cause part of the steam supply for the main turbine to be temporarily diverted so that it flows in parallel through said auxiliary, and a working passage in said auxiliary which, for a given drop in pressure in the steam, causes it to be expanded against a greater number of successive rows of buckets than it is expanded against in the main turbine for the same drop in pressure.

2. The combination with a main turbine, of an auxiliary turbine of relatively smaller size and power, means independent of the main turbine to supply motor fluid at high pressure to said auxiliary turbine, and means to exhaust said auxiliary turbine into the working passage of the main turbine, substantially as described.

3. The combination with a main turbine, of an auxiliary turbine of relatively smaller power, means to shunt part of the motor fluid from the working passage of the main turbine through said auxiliary, means to admit an independent supply of motor fluid to said auxiliary, and means to exhaust the motor fluid from said auxiliary into the working passage of the main turbine.

4. The combination with a main turbine, of an auxiliary turbine of relatively smaller power, means to deliver to said auxiliary turbine high pressure motor fluid and fluid of lower pressure diverted from the main turbine, two independent exhaust ports for said auxiliary turbine, one communicating with

the working passage of the main turbine and the other independent of said main turbine, and valve means to close said exhaust ports.

5. The combination with a main turbine, of an auxiliary turbine of relatively smaller power, means to operate said turbine with motor fluid diverted from said working passage to the main turbine, two independent exhaust ports for said auxiliary turbine, one communicating with the working passage of the main turbine and the other independent of said main turbine, and valve means to cut off said exhaust.

6. The combination with a main turbine, of an auxiliary turbine of relatively smaller size and power, means to govern the supply of motor fluid to said auxiliary responsive to its speed, and means to exhaust said auxiliary into the working passage of the main turbine.

7. The combination with a main turbine, of an auxiliary turbine, means to supply said auxiliary with motor fluid diverted around part of the working passage of said main turbine, and an independent governing means for the auxiliary acting on the supply of diverted motor fluid.

8. The combination with a main turbine, of an auxiliary turbine of relatively smaller power, means to divert part of the motor fluid from the working passage of the main turbine to said auxiliary, and valve means, in the said working passage beyond the supply point for the auxiliary turbine, which are adapted to reduce the cross-sectional area of said working passage to compensate for the motor fluid diverted.

9. The combination with a main turbine, of an auxiliary turbine operated by motor fluid diverted around part of the working passage of the main turbine, and valve means in said part of the working passage of the main turbine to restrict the flow of motor fluid therethrough when the auxiliary turbine is in operation.

10. The combination with a main turbine, of an auxiliary turbine supplied with motor fluid diverted around part of the working passage of the main turbine, a governor for the auxiliary turbine, valve means to control the diversion of motor fluid to the auxiliary, and valve means to reduce the cross-sectional area of the working passage of the main turbine to compensate for the steam diverted, both valve means being controlled by said governor.

11. The combination with a main turbine, of an auxiliary turbine, a by-pass for the motor fluid between portions of the working passage of said main turbine, said auxiliary being included in said by-pass, and valve means to restrict the shunted portion of the working passage of the main turbine to compensate for the motor fluid shunted through the auxiliary turbine.

12. The combination with a main turbine operating by stage expansion, of an auxiliary turbine, means to supply said auxiliary with steam from one stage of the turbine, and means to exhaust said auxiliary into the succeeding stage of the main turbine.

13. The combination with a main turbine divided into stages by diaphragm partitions, of an auxiliary turbine, means to supply said auxiliary with motor fluid diverted from a stage of the main turbine, means to exhaust said auxiliary into a lower pressure stage of the main turbine, a nozzle passage in the low pressure diaphragm of the stage from which said motor fluid is diverted, and a rotary valve seated in said diaphragm and adapted to close said passage, substantially as described.

14. The combination with a main turbine, of an auxiliary turbine, means to supply said auxiliary turbine with motor fluid diverted from the working passage of the main turbine, means to return the motor fluid exhausted from the auxiliary into said working passage at a point of lower pressure, valve means to restrict the working passage throughout the portion around which the motor fluid is shunted, valve means to regulate the supply of fluid to the auxiliary, and means responsive to the speed of the auxiliary which acts on said valve means in a manner to open the one as it closes the other, and vice versa.

15. In a turbine set, a main turbine, an auxiliary turbine fed from said main turbine, rotatable means in said auxiliary driven by said fluid, and means to discharge the fluid from said auxiliary into a part of the said main turbine where substantially equal pressure conditions obtain.

16. A turbine set comprising a main turbine, an auxiliary of relatively small power, passages connecting the supply and exhaust ends of said auxiliary with said main turbine so that motor fluid will be diverted temporarily from said main turbine and used to drive said auxiliary, and rotatable buckets in said auxiliary acted upon by said fluid in its passage therethrough.

17. In a turbine set, a main and an auxiliary turbine each comprising a plurality of rows of rotating buckets and interposed stationary guide devices, supply and exhaust passages for the auxiliary which open into the main turbine at points between which a lesser number of rows of rotating buckets are disposed than are provided in the auxiliary, substantially as described.

18. In a turbine set, a main and an auxiliary turbine each comprising a plurality of rows of rotating buckets and interposed stationary guide devices, supply and exhaust passages for the auxiliary, whereby a portion of the working fluid of the main turbine is shunted through said auxiliary,

and means in said latter turbine to abstract the velocity from its working fluid due to its drop in pressure therein a different number of times than occurs in the case of the working fluid in the main turbine between the same pressures.

19. Two interconnected coöperating turbines having bucket bearing rotors of different diameters and means to shunt a part of the working fluid for one so that it flows back thereinto through the other, said latter turbine being of relatively small power and serving as an auxiliary, and instrumentalities in said turbines whereby determined shaft velocities are obtained from said turbines at equal efficiencies.

20. The combination with a main turbine, of an auxiliary turbine of relatively smaller power, means to interconnect said turbines so that the *vis viva* of the motor fluid driving said auxiliary is partially expended in driving the main turbine, and a centrifugal feed pump driven by said auxiliary.

21. The combination with a main turbine and an auxiliary turbine of relatively smaller power, and steam connections between said turbines so arranged as to cause the motor fluid, initially admitted to one of said turbines, to flow into the working passage of the other, said connections being arranged and said turbines being designed to provide for the conversion in the main turbine of a greater percentage of the energy of pressure of the motor fluid which drives the auxiliary turbine into velocity than is converted in the auxiliary turbine, and a centrifugal pump direct connected to said auxiliary.

22. A turbine, in combination with a second turbine which is subjected to a smaller pressure difference than the first, the second turbine being operated by a portion of the same motive fluid which passes through and operates the first and exhausting into the first turbine.

23. In combination, a turbine wherein a given drop in pressure of the motive fluid takes place, a second turbine wherein a drop in pressure takes place that is less than in the first turbine, the second turbine being in shunt to and exhausting into the first and operated by a portion of the same motive fluid which passes through and operates the first turbine.

24. In combination, a high-speed turbine, a low-speed turbine, means causing a portion of the same motive fluid which passes through and operates the high-speed turbine to pass through and operate the low-speed turbine, and means discharging the exhaust of the low-speed turbine into the high at a region of intermediate pressure.

25. In combination, a turbine having an inlet and an exhaust, a second turbine also having an inlet and an exhaust, means supplying motive fluid to the turbines at the same initial pressure, and means causing a portion of the motive fluid which passes through and operates the first turbine to pass through the second and operate it, the pressure difference between the inlet and exhaust of the second turbine being less than that of the first.

26. In combination, a main turbine, an exhaust therefor, an auxiliary turbine, an exhaust therefor, means for supplying both turbines with motive fluid, and means for conveying the exhaust of the auxiliary turbine to an intermediate pressure region in the main turbine so that said exhaust will perform useful work in the main turbine.

27. In combination, a high-speed multi-stage turbine, an exhaust conduit therefor, a low-speed turbine, an exhaust conduit therefor, means admitting high pressure motive fluid to the turbines, and means conveying the exhaust from the auxiliary turbine into an intermediate stage in the multi-stage turbine so that said exhaust will perform useful work as it flows to the exhaust conduit of the multi-stage turbine.

28. In combination, a high-speed turbine, a low-speed turbine, means supplying the turbines with fluid at the same pressure, means causing a part of the same motive fluid which passes through the low-speed turbine to enter the high-speed turbine and perform work therein, and controlling means for regulating the passage of motive fluid through the low-speed turbine.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

JAMES WILKINSON.

Witnesses:
GEO. R. BROWN,
LINUS D. ARMSTRONG.