

No. 872,377.

PATENTED DEC. 3, 1907.

F. SAMUELSON.
GOVERNING MECHANISM FOR TURBINES.
APPLICATION FILED JUNE 1, 1905.

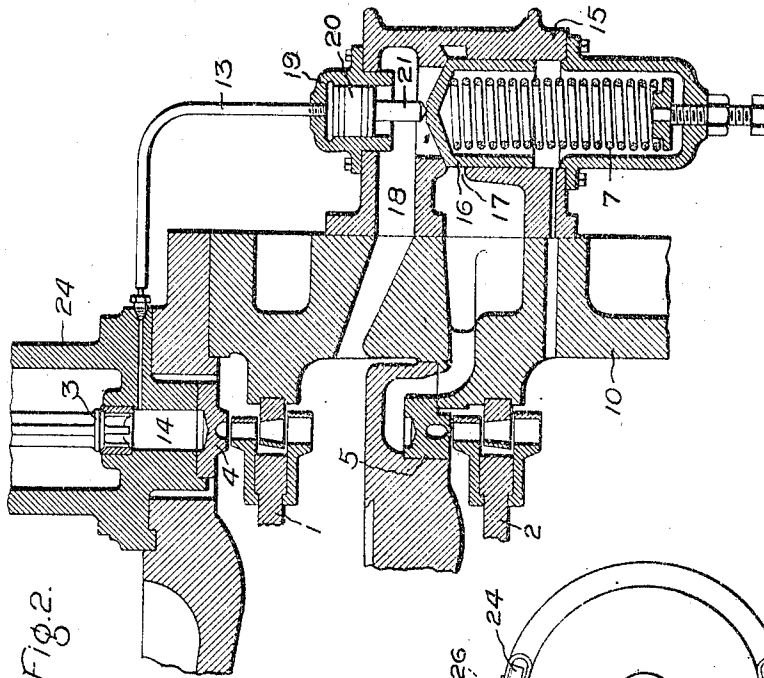


Fig. 2.

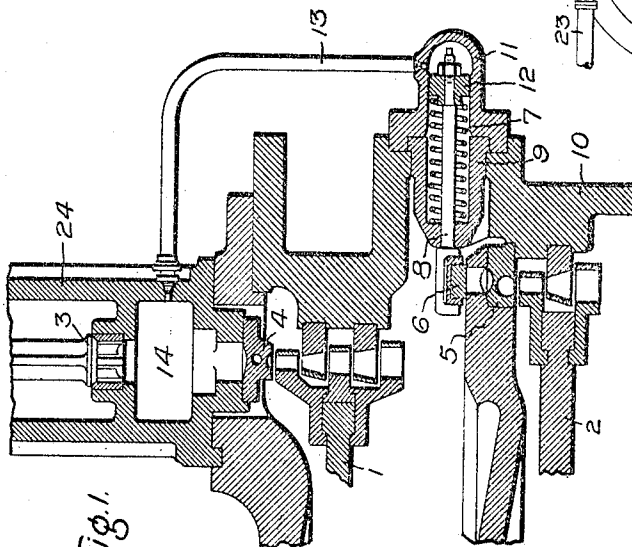


Fig. 1.

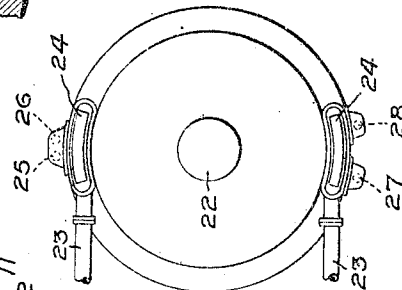


Fig. 3.

Witnesses:
Marcus L. Byng.
Alex. F. Macdonald.

Inventor:
Frederick Samuelson,
by *Albush & Davis*
Att'y.

UNITED STATES PATENT OFFICE.

FREDERICK SAMUELSON, OF RUGBY, ENGLAND, ASSIGNOR TO GENERAL ELECTRIC COMPANY,
A CORPORATION OF NEW YORK.

GOVERNING MECHANISM FOR TURBINES.

No. 872,377.

Specification of Letters Patent.

Patented Dec. 3, 1907.

Application filed June 1, 1905. Serial No. 263,212.

To all whom it may concern:

Be it known that I, FREDERICK SAMUELSON, a subject of the King of Sweden, residing at Rugby, England, have invented certain new and useful Improvements in Governing Mechanisms for Turbines, of which the following is a specification.

This invention relates to the governing of elastic fluid turbines of the type described in British Patent, No. 19,247 of 1896 in which the governing is effected by varying the quantity of steam delivered by the inlet nozzle or nozzles without change in the ratio of expansion effected in the nozzles. In such turbines in order to work with the maximum economy under varying loads it is desirable to vary the capacity of the steam passage in the various stages of the machine in proportion to the variation in the quantity of steam admitted to the inlet nozzles for each load.

The purpose of this invention is to provide means for automatically accomplishing this object and to this end it consists in providing motor operated valves controlling a portion of the inlets to one or more of the stages after the first and in causing these valves to be actuated automatically so as to maintain the desired pressures within the different stages of the machine.

In carrying this invention into effect according to one modification as applied to a two stage turbine, I provide a number of slide valves controlling a portion of the inlet passage to the nozzles of the second stage. Each of these valves is normally held closed by means of a spring operating on one side of a piston working in a closed chamber fitted to the side of the turbine casing. The part of the chamber on the other side of each piston is connected by a pipe or passage with the valve-controlled supply chamber of one or more inlet nozzles of the first stage of the machine. The number of valves provided on the second stage is arranged in accordance with the load conditions to be fulfilled in practice.

According to another modification, instead of a slide valve for controlling the inlet nozzles of the second stage I employ a piston valve. This valve works in a chamber or casing attached to the side of the turbine and controls a passage between the exhaust of the first stage and a portion of the inlet nozzle supply chamber of the second stage.

This valve works vertically and in its closed position is held up against its seat at the end of a ring opening forming part of said passage by means of a spring. The spring is inclosed within a removable cap through the top of which an adjusting screw passes by means of which the spring pressure may be regulated. This cap also enables the valve to be readily removed from its casing for examination or repair.

On the upper part of the valve chamber, directly above the valve, is also fitted a cap forming the cylinder for a small piston the stem of which abuts against the top of the piston valve. The upper end of this chamber is connected to the supply chamber of an inlet nozzle or nozzle section by means of a pipe. When the steam supply to this chamber is cut off the piston valve is held in its closed position by means of the spring but when steam is admitted to the first stage nozzle the pressure passes to the small cylinder at the top of the second stage valve casing, forcing the small piston downwards and, thereby opening the piston valve against the force of its controlling spring. Steam is thus admitted through the passage from the first stage to the inlet nozzles of the second stage controlled by the piston valve, in accordance with the load condition.

The accompanying drawings illustrate means for carrying my invention into effect as applied to a two stage elastic fluid turbine, Figure 1 being a sectional view of part of a turbine in which the admission of fluid to the second stage is controlled by a valve operated by fluid from the inlet nozzle of the first stage; Fig. 2 is a similar view of a turbine in which the admission of fluid to the second stage is controlled by a piston valve which besides being operated by the high pressure fluid as in the first modification may also on emergency be operated by the exhaust fluid from the first stage, and Fig. 3 is a plan view of a vertical-shaft turbine showing the arrangement of the admission and stage valves.

In carrying my invention into effect according to the modification illustrated in Fig. 1, I provide an elastic fluid turbine of the type above referred to in which the velocity of the fluid is extracted in two stages and caused to operate on two moving elements or wheels 1 and 2 arranged in separate chambers. Steam or other elastic fluid is

admitted to the first stage through an inlet valve 3 of any well-known type and passes through the inlet nozzle 4 to the wheel 1. After having passed through and operated on the wheel or wheels in the first stage the fluid passes through the nozzles 5 into the second stage. Some of these nozzles 5 however are controlled by valves such as the slide valve 6 normally held closed by the action of a compression spring 7 surrounding the valve rod 8. This valve rod passes into a hollow cylindrical casing 9 secured in any suitable manner in or formed integral with the turbine casing 10 and provided with a closing cap 11. Mounted within this cap on the end of the valve rod 8 is a piston 12 which slidingly fits the interior of the casing 9 or cap 11 and against the inner side of which the spring 7 abuts so as normally to hold the valve 6 in its closed position. The interior of the casing on the opposite side of the piston from the spring is in communication through the pipe 13 with the fluid space 14 between the inlet valve 3 and the nozzle 4 of the first stage.

It will be seen from the above description that when the inlet valve 3 is closed, no fluid can pass through the pipe 13 to the outer side of the piston 12 and the spring will hold the piston in its outermost position thereby maintaining the valve 6 closed. If however, the load on the turbine be increased so as to cause the valve 3 to open, some of the working fluid will pass through the pipe 13 to the interior of the casing 9 on the outer side of the piston. This fluid acting on the piston overcomes the pressure of the spring and causes the valve to uncover or partly uncover the inlet nozzle 5 of the second stage thereby accommodating for the increased volume of fluid admitted to the first stage, by the opening of the valve 3, by providing increased passage area to the second stage. It is to be understood that the valve 3 may only control the admission of fluid to one inlet nozzle or to a group of nozzles, and similarly, the valve 6 may also control, one or a group of nozzles admitting fluid to the second stage of the turbine.

In the modification illustrated in Fig. 2, the valve controlling the admission of fluid from the first to the second stage is provided with a separate housing or casing 15 secured to the turbine casing. Inside this casing is a spring pressed piston valve 16 which is adapted to control the passage of fluid through a port 17 leading to the inlet nozzles of the second stage. The upper end of this piston valve is directly in communication with the exhaust side of the first stage of the turbine through a port or passage 18 but the spring controlling it is so adjusted that normally it maintains the piston valve on its seat against the pressure of the exhaust. Should however the pressure of the

exhaust in the first stage rise beyond a predetermined amount the spring will be overcome causing the piston valve to move downwards and to uncover the passage to the nozzles of the second stage, thereby relieving the pressure of the exhaust. Mounted directly in line with the piston valve 16 is a cap or cylindrical casing 19 the lower end of which is open to the passage 18 and the upper end of which is in communication with the fluid space 14 through a pipe or passage 13. Sliding in this casing is a piston 20 provided with a stem 21 adapted to engage with the upper end of the piston valve 16. The spring 7 controlling the piston valve is preferably made adjustable so that the valve can be made to open at any predetermined exhaust pressure. The operation of this modification is practically the same as described above with reference to the first modification viz:— When valve 3 is opened to admit more fluid to the nozzles of the first stage, some of the fluid passes through the pipe 13 to the upper side of the piston 20 causing it to move downward and with it the piston valve 16 through the pressure of the piston stem 21 on its upper side, thereby uncovering the port 17 and allowing fluid to pass from the exhaust side of the first stage through passage 18 and port 17 to the inlet nozzles of the second stage.

Although I have described my invention as applied to a two stage machine it will be obvious that it is equally applicable to the control of the various stages of a machine having more than two stages. It will further be obvious that without departing from the spirit of the invention instead of actuating the stage controlling valves by fluid pressure these valves may be otherwise automatically actuated. For example where the valves controlling the nozzles on the first stage are operated by electromagnets, similar electromagnets may be conveniently employed for operating the valves between stages, the electromagnets of the first and succeeding stage valves being interlocked in a manner obvious to those skilled in the art.

In Fig. 3, which shows a plan view of a vertical-shaft turbine, 22 represents the governor-inclosing dome directly over the main shaft. Steam or other elastic fluid is admitted to the turbine by the branched conduit 23. Steam from the conduit enters the chests 24 containing the individual and separately actuated valves 3 which regulate the admission of motive fluid to the first-stage nozzles 4. 25 and 26 represent stage valves located in a common casing which control the passage of steam or other motive fluid from the first to the second stage. These valves may be located directly under the admission valves or displaced therefrom. 27 and 28 represent stage valves located in independent casings which control the passage

of steam between successive stages, as for example between the second and third stages of a four-stage machine. The number of stages provided with these valves can be increased or decreased as the conditions of service demand.

Having now particularly described and ascertained the nature of my said invention, and in what manner the same is to be performed, I declare that what I claim is —

1. A turbine divided into stages with wheel buckets for the stages, in combination with a valve for controlling the passage of motive fluid through one of the stages, and a fluid actuated valve controlling the passage of motive fluid through another stage, the said valve receiving its operating fluid when the first mentioned valve moves from its seat.

2. In a multi-stage turbine of the type hereinbefore referred to, a motor-operated valve or valves controlling the fluid passage between two or more stages, said valve or valves operating automatically in accordance with the pressure within the valve controlled supply chamber of a nozzle or nozzles of the first stage, substantially as described.

3. In a multi-stage turbine, of the type hereinbefore referred to, a motor-operated valve or valves controlling the fluid passage between stages said valve or valves being normally held in the closed position by means of a spring and opened by means of fluid pressure admitted from the supply chamber of a nozzle or nozzles of the first stage, substantially as described.

4. A turbine comprising wheel buckets and fluid-discharging devices arranged in stages, in combination with a stage valve which is normally operated by high-pressure fluid but which opens automatically upon an increase in stage pressure above a certain amount.

5. A turbine comprising wheel buckets and fluid-discharging devices arranged in stages, a stage valve which opens under a predetermined increase in stage pressure, a means for normally opening said valve by motive fluid of a pressure above that of the stage, and a means for controlling the action of the motive fluid of higher pressure.

6. A turbine divided into stages, with wheel buckets and discharging devices for

the stages, in combination with a plurality of valves controlling the passage of motive fluid through one of the stages, and a plurality of successively operating stage valves which are moved by fluid pressure, the stage valves receiving their actuating fluid when the first-mentioned valves move from their seat.

7. A turbine divided into stages, with wheel buckets and discharging devices for the stages, admission valves for the high-pressure stage, valves between stages which are normally governed by the admission valves, the said stage valves also opening in response to a definite increase in stage pressure, and means opposing the opening of the stage valves and causing them to operate successively.

8. A turbine comprising wheel buckets and fluid-discharging devices arranged in stages, in combination with admission valves, stage valves automatically opening under abnormal stage pressure, means responding to high pressure for normally opening the stage valves, and a device for closing each of the stage valves irrespective of whether it is opened by stage or high pressure.

9. A turbine divided into stages with wheel buckets for the stages, in combination with a valve controlling the passage of motive fluid through a stage, a second valve controlling the passage of motive fluid through another stage, a fluid actuated motor for moving the second valve in one direction, a mechanical motor for moving it in the opposite direction, and a conduit leading to the fluid actuated motor which is controlled by the first mentioned valve.

10. A turbine divided into stages with wheel buckets for the stages, in combination with a nozzle, a controlling valve therefor, a stage nozzle, a stage valve controlling it, a fluid actuated motor for moving the stage valve in one direction, a spring for moving it in the opposite direction, and a conduit that communicates with the motor and the first mentioned nozzle at a point between its controlling valve and the point of discharge.

In witness whereof, I have hereunto set my hand this 23rd day of May, 1905.

FREDERICK SAMUELSON.

Witnesses:

MARSHAL HALSTEAD,
ERNEST HARKER.