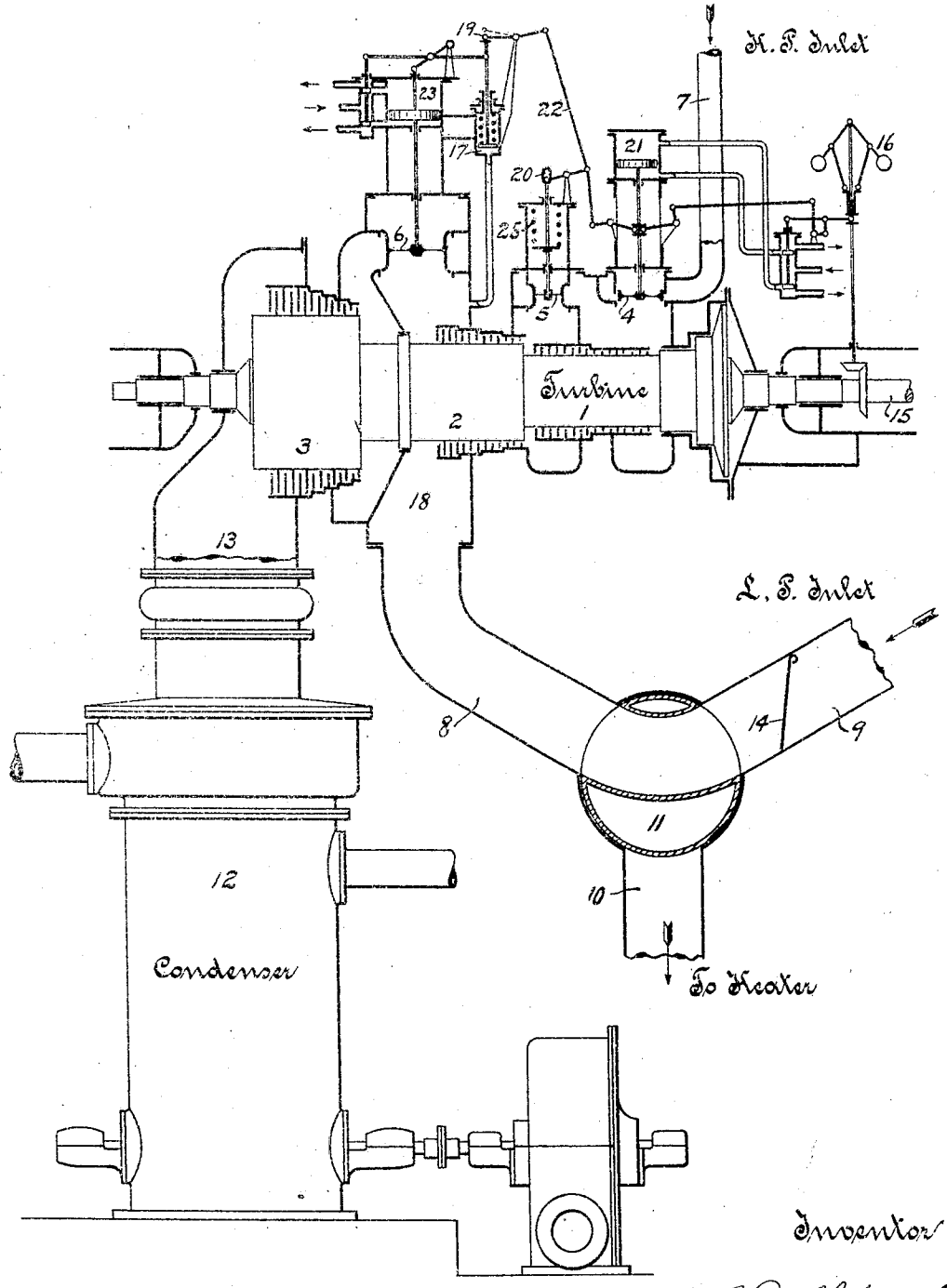
H. P. DAHLSTRAND.

TURBINE SYSTEM.

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1,309,796. Patented July 15, 1919.



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TURBINE SYSTEM.

1,309,796. Specification of Letters Patent. Patented July 15, 1919.

Application filed April 14, 1916. Serial No. 91,840.

To all whom it may concern:

Be it known that I, HANS P. DAHLSTRAND, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a certain new and useful Improvement in Turbine Systems, of which the following is a specification.

This invention relates to improvements in the construction and operation of turbine systems, and especially to improved devices for regulating compound turbines and for permitting interchangeable operation of such turbines either as mixed pressure or as bleeder turbines.

An object of the invention is to provide a turbine system which is simple in construction and efficient in operation. One of the more specific objects is to provide a compound turbine system which may be interchangeably operated either as a mixed pressure or as a bleeder system. Another object is to provide a low pressure stage valve normally controllable by the pressure in a low pressure region of the turbine, which valve may under certain conditions of operation of the system be operated by the high pressure inlet valve actuating speed governor. A further object is to provide means for effecting operation of the low pressure stage valve through the high pressure inlet valve actuating mechanism. Still another object is to provide a regulating system for a compound turbine in which a single speed responsive device is capable under certain conditions of variation in load or speed of the turbine, of effecting operation of a high pressure inlet valve, a by-pass valve, and a low pressure stage valve. A further object is to provide a system of regulation which will act automatically to utilize all of the motive fluid to the greatest possible extent.

In order to avoid confusion, the various controlling valves employed in the present system may be defined as follows:

A high pressure inlet valve is one which controls the admission of high pressure fluid from a high pressure source to a high pressure turbine stage.

A by-pass valve is one which controls the flow of fluid around one or more stages of the turbine.

A low pressure connection valve is one which controls either admission or extraction of low pressure fluid to or from a low pressure region between stages.

A low pressure stage valve is one which controls the admission of fluid directly to the low pressure stage or stages from a low pressure region between stages.

A clear conception of an embodiment of the invention may be had by referring to the drawing accompanying and forming a part of this specification.

The single figure of the drawing is a diagrammatic part sectional view of a turbine system embodying the invention.

The compound turbine forming an element of the present system, comprises essentially a high pressure stage 1, an intermediate stage 2, and a low pressure stage 3, all preferably rotatable about the same shaft 15, but not necessarily housed within a common casing. The high pressure stage 1 communicates with a high pressure inlet 7 through which the flow of fluid is controllable by means of a high pressure inlet valve 4. The exhaust of the high pressure stage 1 communicates directly with the inlet of the intermediate stage 2. The exhaust of the intermediate stage 2 communicates directly with a low pressure region or chamber 18 which is in open communication with a low pressure connection 8. The low pressure stage 3 has its inlet communicating with the low pressure region or chamber 18 through a low pressure stage valve 6, and has its exhaust in open communication with a condenser 12 through an exhaust pipe 13. The condenser 12 is an essential element of the system especially when operating mixed pressure.

A low pressure connection valve 11 is adapted to interchangeably establish communication between the low pressure connection 8 and either a low pressure admission conduit or pipe 9 or a low pressure extraction conduit or pipe 10. The valve 11 is unnecessary in cases where the heater is convertible into either a steam consumption device or a source of supply. The low pressure admission pipe 9 is preferably provided with a non-return check valve 14 for preventing back flow of fluid from the region or chamber 18 to the low pressure supply source.

The high pressure inlet valve 4 is operable by means of a fluid pressure operated servo-

motor 21 which is controllable directly by means of a speed responsive means or governor 16 driven by the main shaft 15 in the usual manner. A by-pass conduit 24 controllable by means of the by-pass valve 5, connects the inlet of the high pressure stage 1 with the inlet of the intermediate stage 2, thereby permitting steam to flow around the high pressure stage when the valve 5 is open. The by-pass valve 5 is normally held in closed position by means of a spring 25, and may be opened under certain conditions of operation, by means of the speed governor 16. The upper extremity of the stem of the by-pass valve 5 is provided with an elongated slot 20 which provides a lost motion connection between the train of mechanism 22 and the stem of the valve 5. The low pressure stage valve 6 is operable by means of a servo-motor 23 which is normally controllable by means of a pressure responsive device 17 operable by variations in pressure in the low pressure region or chamber 18. The train of mechanism 22 forms a connection between the servo-motor 23 of the low pressure stage valve 6 and the stem of the high pressure valve 4. A lever 19 comprising an element of the train of mechanism 22 is normally so positioned that it will not interfere with the operation of the pressure responsive device 17.

During normal operation of the system, and assuming the turbine to be operating mixed pressure, low pressure steam is being admitted to the chamber 18 through the connection 8 and low pressure inlet pipe 9, the low pressure connection valve 11 being positioned as indicated. Upon establishing a predetermined pressure in the chamber 18 sufficient to move the piston of the pressure responsive device 17 against the restraining pressure of the spring, the low pressure stage valve 6 is opened, permitting steam to flow through the low pressure stage 3 to the condenser 12 through the exhaust pipe 13.

If the quantity of low pressure steam thus admitted to the low pressure stage 3 is insufficient to carry the load on the turbine, the speed governor 16 becomes effective to actuate the servo-motor 21 and to admit steam from the high pressure inlet 7 through the high pressure inlet valve 4 to the high pressure stage 1, the steam thus admitted passing through the high and intermediate stages 1, 2, to the low pressure chamber 18. If after full opening of the high pressure inlet valve 4, the combined high and low pressure steam supplied is still insufficient to carry the load, the speed governor 16 will adjust the train of mechanism 22 to such a position that the lost motion afforded by the slot 20 is taken up and the by-pass valve 5 is opened, when high pressure steam from the inlet 7 will be admitted through the by-pass conduit 24 and by-pass valve 5 directly to the inlet of the intermediate stage 2.

If during normal operation of the machine the low pressure supply through the low pressure inlet pipe 9 fails, all of the steam necessary for operation of the turbine will be supplied from the high pressure inlet 7 and the steam exhausted from the intermediate stage 2 into the low pressure chamber 18 will build up in pressure sufficiently to close the check valve 14 and to control the opening of the low pressure stage valve 6. If for any reason such as sudden falling off of the load, an excessive speed rise takes place, the governor 16 will act automatically to successively close the by-pass valve 5, the high pressure inlet valve 4, and the low pressure stage valve 6. If at the time of excessive speed rise, the turbine is operating entirely upon low pressure steam, the speed governor 16 will act through the high pressure inlet valve actuating mechanism and the train of mechanism 22 to so adjust the lever 19 that the control of the low pressure stage valve 6 is taken away from the pressure responsive device 17 and the valve 6 will be automatically closed by the speed governor 16.

If it is desired to operate the turbine as a bleeder, the low pressure connection valve 11 should be adjusted so as to establish communication between the connection 8 and the extraction pipe 10. All of the steam for operating the turbine is then admitted through the high pressure inlet valve 4, this valve being controlled by the speed governor 16 to adjust for variations in load and in the quantity of steam extracted. If for a constant load, the demand for steam in the bleeder system increases, more steam is withdrawn from the chamber 18 through the connection 8, thus producing momentary reduction in pressure in the low pressure chamber 18. This reduction in pressure acts through the pressure responsive device 17 to either partially or completely close off the low pressure stage valve 6. Closing of the low pressure stage valve 6 produces a drop in speed of the turbine, thereby causing the governor 16 to become effective in opening the throttle valve 4 a greater amount to reestablish the speed and to increase the quantity of steam delivered to the chamber 18. If the demand for steam in the bleeder system continues to increase after the valve 4 has been entirely opened, this additional demand is supplied by opening the by-pass valve 5, and if necessary entirely closing the low pressure stage valve 6 and maintaining the same in closed position. If the demand for steam in the bleeder system decreases, the low pressure valve 6 and the high pressure inlet valve 4 will be automatically adjusted by the pressure responsive device 17 and the speed governor 16, to accommodate

such decrease in demand and also to accommodate the load on the turbine. If no steam is required in the heater, the turbine may be operated as a normal turbine, all steam admitted to the high pressure stage 1 passing through the intermediate and low pressure stages 2, 3, and being delivered to the condenser 12.

It will thus be noted that the turbine may be converted from a mixed pressure to a bleeder system, or vice versa, at the will of the operator. The pressure regulation of the low pressure stage valve 6 automatically adjusts this valve so that any steam not otherwise utilized will become effective in delivering power to the shaft 15. The speed governor 16 automatically takes care of the speed changes and will entirely stop the flow of steam to all stages upon abnormal increases in speed. In order to permit utilization of the turbine either as a mixed pressure or as a bleeder turbine, the low pressure stage 3 is preferably designed as a normal turbine, thereby readily permitting such conversion without substantial decrease in efficiency. The valve 11 may be omitted in cases where the heater receives steam from an outside source in addition to that supplied by the turbine, and where when no steam is required in the heater, it is desirable to utilize the outside supply to drive the low pressure stage 3.

It should be understood that it is not desired to be limited to the exact details of construction shown and described, for obvious modifications within the scope of the appended claims will occur to a person skilled in the art.

It is claimed and desired to secure by Letter Patent,—

1. In a turbine system, a high pressure stage, a low pressure region in open communication with said stage, a low pressure stage, a condenser communicating with said low pressure stage, a low pressure stage valve between said region and said low pressure stage, means for controlling the operation of said stage valve, low pressure fluid conducting means communicating with said region, a high pressure inlet valve, governor means for operating said high pressure valve, and means associated with said governor means for taking the control away from said stage valve controlling means and for operating said stage valve, only when the speed of said turbine reaches a predetermined high valve.

2. In a turbine system, a high pressure stage, a low pressure region in open communication with said stage, a low pressure stage, a condenser communicating with said low pressure stage, a low pressure stage valve between said region and said low pressure stage, means for controlling the operation of said stage valve, low pressure fluid conducting means communicating with said region, a high pressure inlet valve, governor means for operating said high pressure valve, and means associated with said governor means for preventing said stage valve controlling means from operating when the speed of said turbine reaches a predetermined high value.

3. In a turbine system, a high pressure stage, a low pressure region in open communication with said stage, a high pressure inlet valve, a low pressure stage, a condenser communicating with said low pressure stage, a low pressure stage valve between said region and said low pressure stage, means responsive to variations in pressure in said region for effecting operation of said stage valve only, low pressure fluid conducting means communicating with said region, and speed responsive means for effecting operation of said high pressure valve, said speed responsive means also effecting operation of said stage valve independently of the pressure actuating said pressure responsive means.

4. In combination, a high pressure stage, a high pressure inlet valve, a low pressure region in open communication with said stage, a low pressure stage, a condenser communicating with said low pressure stage, a low pressure stage valve between said region and said low pressure stage, means responsive to variations in pressure in advance of said stage valve for effecting operation of said stage valve only, low pressure fluid conducting means communicating with said region, and a speed governor for effecting operation of both said high pressure and said stage valves.

5. In combination, a high pressure stage, a high pressure inlet valve, a low pressure region in open communication with said stage, a low pressure stage, a condenser communicating with said low pressure stage, a low pressure stage valve between said region and said low pressure stage, means responsive to variations in pressure in advance of said stage valve for effecting operation of said stage valve only, low pressure fluid conducting means communicating with said region, and a speed responsive means for effecting operation of said high pressure valve, said speed responsive means also effecting operation of said stage valve independently of the pre-low-pressure-stage pressure.

6. In combination, a high pressure stage, a high pressure inlet valve, mechanism for operating said valve, a low pressure region in open communication with said stage, a low pressure stage, a condenser communicating with said low pressure stage, a low pressure stage valve between said region and said low pressure stage, mechanism for operating said stage valve, a train of mecha-

nism between said high pressure and stage valve operating mechanisms, means responsive to variations in pressure in advance of said stage valve for effecting operation of said stage valve mechanism only, low pressure fluid conducting means communicating with said region, and speed responsive means for effecting operation of said high pressure valve mechanism directly and of said stage valve mechanism through said train of mechanism.

7. In combination, a turbine having a plurality of stages and a low pressure region between successive stages, a condenser communicating with a low pressure stage of said turbine, a by-pass around a high pressure stage of said turbine, a high pressure inlet valve, a by-pass valve, a low pressure stage valve between said region and a low pressure stage, low pressure fluid conducting means communicating with said low pressure region, pressure responsive means for effecting operation of said stage valve, and speed responsive means for effecting operation of all of said valves.

8. In a turbine system, a high pressure stage, a low pressure stage, a condenser communicating with said low pressure stage, an intermediate stage, a low pressure region in open communication with said intermediate stage, a by-pass around said high pressure stage, a high pressure inlet valve, a by-pass valve, a low pressure stage valve between said region and said low pressure stage, low pressure fluid conducing means communicating with said low pressure region, pressure responsive means for normally effecting operation of said stage valve only, and speed responsive means for normally effecting operation of said high pressure and by-pass valves only.

9. In combination, a turbine having high and low pressure stages and an intermediate stage, a low pressure region in open communication with said intermediate stage, a condenser communicating with said low pressure stage, a by-pass connecting the inlets of said high pressure and intermediate stages, a high pressure inlet valve, mechanism for effecting operation of said high pressure valve, a by-pass valve, a low pressure stage valve between said region and said low pressure stage, low pressure fluid conducting means communicating with said region, a train of mechanism connecting said by-pass and stage valves with said high pressure valve operating mechanism, and speed responsive means for effecting operation of said high pressure valve mechanism directly and of said other valves through said train of mechanism.

10. In a turbine system, a high pressure stage, a low pressure stage communicating therewith, a source of low pressure fluid, fluid extraction means, and means for connecting said low pressure stage to either said source or said extraction means.

11. In a turbine system, a high pressure stage, a low pressure stage communicating therewith, means for admitting low pressure fluid to said low pressure stage, a source of low pressure fluid, fluid extraction means, and means for connecting said admission means to either said source or said extraction means.

12. In a turbine system, a high pressure stage, a low pressure stage communicating therewith, a source of low pressure fluid, fluid extraction means, means for connecting said low pressure stage to either said source or said extraction means, and means for preventing flow of fluid from said high pressure stage to said low pressure source when said low pressure stage is connected to said source.

In testimony whereof, the signature of the inventor is affixed hereto.

HANS P. DAHLSTRAND.

Corrections in Letters Patent No. 1,309,796.

It is hereby certified that in Letters Patent No. 1,309,796, granted July 15, 1919, upon the application of Hans P. Dahlstrand, of Milwaukee, Wisconsin, for an improvement in "Turbine Systems," errors appear in the printed specification requiring correction as follows: Page 3, line 57, claim 1, for the word "valve" read *value;* page 4, line 35, claim 8, for the word "conducing" read *conducting;* and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 2nd day of September, A. D., 1919.

[SEAL.]

M. H. COULSTON,

Acting Commissioner of Patents.

Cl. 60—43.