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UTILIZING EXHAUST STEAM IN TURBINE PLANTS.

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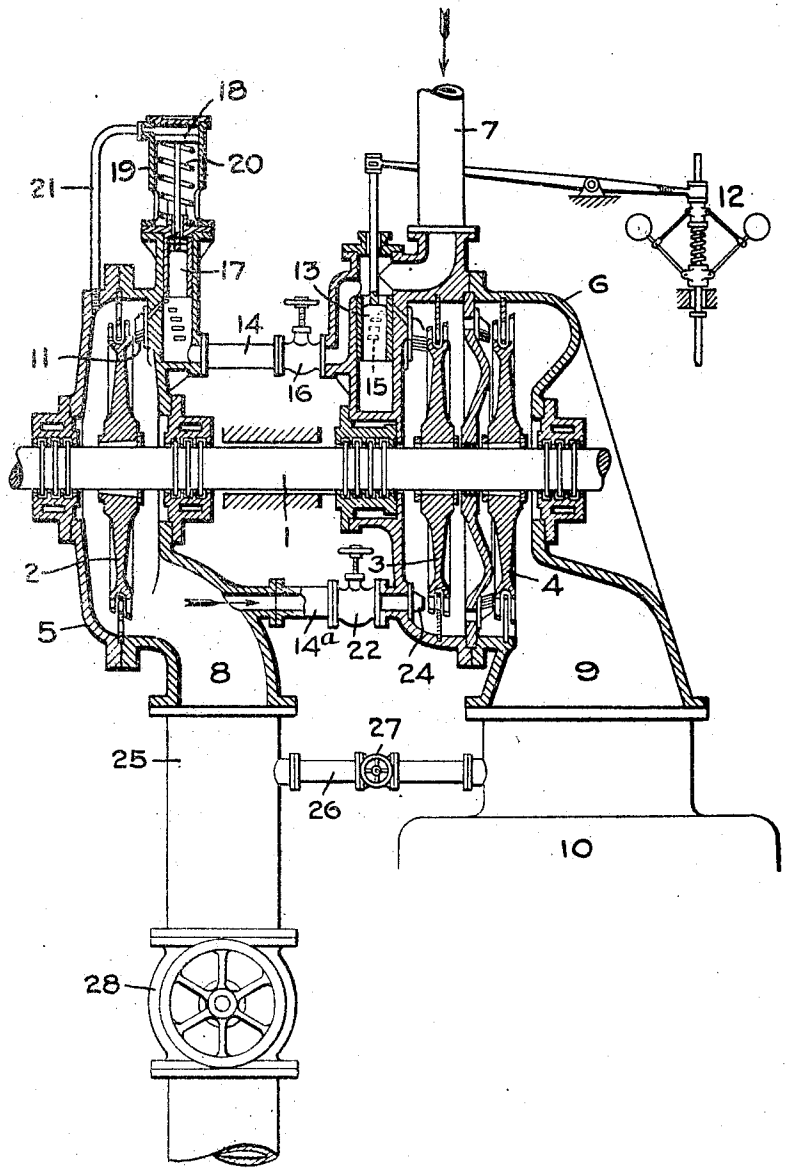
1,029,353. Patented June 11, 1912.



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UNITED STATES PATENT OFFICE.

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UTILIZING EXHAUST-STEAM IN TURBINE PLANTS.

1,029,353. Specification of Letters Patent. Patented June 11, 1912.

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To all whom it may concern:

Be it known that I, GEORG FORNER, a subject of the King of Prussia, residing at Berlin, Germany, have invented certain new and useful Improvements in Utilizing Exhaust-Steam in Turbine Plants, of which the following is a specification.

The present invention relates to steam power plants in which steam is drawn off from one or more intermediate pressure points in a turbine after it has performed work in said turbine and has had its pressure reduced to a greater or less extent.

The object of my invention is to provide a turbine and a governing mechanism therefor of improved construction whereby the steam will be effectively and economically utilized, both in driving the turbine and its load and in furnishing steam for heating or other industrial purposes.

In carrying out my invention, a multistage turbine of any suitable type is provided. The turbine may with advantage act on the impulse plan. The turbine comprises two elements, a main high pressure element through which steam passes on its way to the heating or other device or devices, and a supplemental element operating on the mixed pressure plan that is connected to a condenser. The rotors of the main and supplemental elements are mounted on the same shaft and in such manner, that the thrust on one is balanced to a greater or less extent by the thrust on the other. The governing mechanism is so arranged that live steam is supplied to the main element only so long as it is capable of handling the load and supplying the necessary amount of steam to the heating system. When, however, the load conditions require, live steam is admitted to the mixed pressure or supplemental element, and the latter will then assist the main element in driving the load on the shaft. One of the stages of the mixed pressure turbine receives steam from the exhaust of the high pressure portion. This supply may be controlled by hand or automatically as is desired. The admission of steam to the turbine as a whole is controlled by a speed governor driven by the shaft and also by means of valve mechanism that is sensitive to variations in the shell or wheel casing pressure of the high pressure portion. The valve mechanism is so arranged that the valve for the main high pressure element or portion must be fully opened before the governor opens the passage or passages conveying live steam to the supplemental mixed pressure element or portion.

The invention is diagrammatically illustrated in the accompanying drawing, which shows a turbine and its valve mechanism in axial section.

On the common shaft 1 are mounted the wheel 2 of the main high pressure portion, and the wheels 3 and 4 of the supplemental mixed pressure portion, the said wheels being inclosed in suitable casings or shells 5 and 6. Steam at any suitable pressure is supplied to the turbine by the inlet pipe 7. The exhaust from the high pressure portion is discharged by the conduit 8 to the heating system, and the exhaust from the mixed pressure turbine is delivered by the conduit 9 to the condenser 10. Each of the wheels is provided with two or more rows of buckets between which rows are intermediate buckets for reversing the direction of the steam. Steam is supplied to the buckets by nozzles 11 of any suitable construction.

12 indicates a speed governor that is driven by the turbine shaft through suitable gearing. This governor actuates the throttle valve 13 directly or indirectly as is desired. This valve has a double purpose. That is to say, it controls the passage of steam through the conduit 14 to the high pressure portion of the turbine, and also controls the passage of steam to the mixed pressure portion of the turbine through the ports 15 shown in dotted lines. In the pipe 14 connecting the parts of the turbine, is a valve 16, in this case hand operated, by means of which the high pressure portion can be cut out of service.

17 indicates a valve for controlling the admission of steam to the high pressure portion. This valve is attached to the piston 18 contained in the cylinder 19. A spring 20 tends to open the valve at all times against the steam pressure existing in the cylinder above the piston. Steam is admitted to the cylinder above the piston by the pipe 21 that is connected to it and to the shell or casing of the high pressure portion of the turbine. It will thus be seen that any steam which

gets into the high pressure portion of the machine is subject to the control, first, of a speed responsive device, and second, of a pressure responsive device, the latter being an important feature for the reason that the amount of steam taken by the heating system generally bears no relation to the load, and hence to the speed of the turbine. The valves 13 and 17 are so arranged that the former does not admit steam to the supplemental mixed pressure portion until the valve 17 is fully opened. This would be the case when the load on the turbine is too great to be handled by the bucket wheel 2 and such steam as exhausts from it and flows through the conduit 14ª under the control of valve 22 and acts on the low pressure wheel 4. By using the nozzle 24 and directing the steam therefrom against the first wheel, a certain amount of useful work is obtained therefrom although the wheel is not designed to receive low pressure steam. Owing to this fact, I omit the intermediate buckets in front of this nozzle.

By reason of the arrangement of the pipe 14ª, the main high pressure portion of the turbine can be used in conjunction with the supplemental element when the heating system is shut off. This arrangement also has the advantage that when the requirements of the heating system are small, steam from the high pressure portion can be utilized in the mixed pressure portion, and excessive heating of the parts of the high pressure portion due to friction are avoided, by reason of the continuous flow of steam.

When the high pressure portion is cut out of service by closing the valve 16, it is desirable to connect the conduit 8 and the pipe 25 leading to the heating system with the condenser by means of pipe 26 containing a hand-controlled valve 27. In the pipe 25 leading to the heating system is a shut-off valve 28 of any suitable construction. When the conduit and the pipe 25 are connected to the condenser, the valve 22 in the conduit 14ª connecting the parts of the turbine, should be closed. Under these conditions the wheel 2 rotates in a vacuum thereby reducing the rotation losses and the wheels 3 and 4 operate as a high pressure condensing turbine.

In accordance with the provisions of the patent statutes, I have described the principle of operation of my invention, together with the apparatus which I now consider to represent the best embodiment thereof; but I desire to have it understood that the apparatus shown is only illustrative, and that the invention can be carried out by other means.

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

1. In combination, a turbine comprising a high pressure element in which the steam expands to the permissible heating pressure, a mixed pressure element supplementing the work of the former in driving a load, a conduit connected to and receiving the exhaust from the high pressure element for heating purposes, means for supplying a portion of the exhaust steam from the high pressure element to the mixed pressure element, and means for supplying high pressure steam to the high and mixed pressure elements.

2. In combination, a turbine comprising a high pressure element in which the steam expands to the permissible heating pressure, a mixed pressure element supplementing the work of the former in driving a load, means supplying low pressure steam thereto, a conduit connected to and receiving exhaust steam from the high pressure element for heating purposes, a regulator sensitive to the pressure of the steam entering the conduit for controlling the admission of steam to the high pressure element, and a speed governor for controlling the admission of high pressure steam to the mixed pressure element.

3. In combination, a turbine comprising a high pressure element and a mixed pressure element, a conduit receiving exhaust steam from the high pressure element, controlling valves for both elements, that for the high pressure element receiving steam after it has passed through the controlling valve of the mixed pressure element, a speed governor that controls the valve of the mixed pressure element, and a pressure sensitive regulator for the valve of said high pressure element.

4. In a steam plant in which steam is drawn off for industrial purposes, the combination of a main turbine element through which said steam passes and performs work, a supplemental turbine element, means for admitting steam thereto only when said main element cannot carry the load, and a conduit that receives steam from the main turbine for industrial purposes.

5. In a steam plant in which steam is drawn off for industrial purposes, the combination of a main turbine element through which said steam passes and performs work, a conduit receiving steam therefrom, a supplemental turbine element, a throttle valve which admits steam to the main element up to the point where it is operating at full capacity and thereafter admits steam to the supplemental element, and a speed governor for controlling said valve.

6. In a steam plant in which steam is drawn off for industrial purposes, the combination of a main turbine element through which said steam passes and performs work, a supplemental turbine element mounted on the same shaft as the main element and having its thrust opposed thereto, a throttle valve that is common to both elements and arranged to supply the main element up to

its full capacity and thereafter to admit steam to supplemental element, and a conduit for conveying exhaust steam from the main element to a stage of the supplemental element.

7. In combination, a main turbine element, a staged supplemental turbine element, a conduit connected to and receiving exhaust steam from the main element for heating purposes, a condenser connected to the supplemental element, means for supplying high pressure steam to either or both elements, and a conduit for conveying exhaust steam from the main element to a low pressure stage of the supplemental element.

8. In combination, a main turbine element, a staged supplemental turbine element, a conduit connected to and receiving exhaust steam from the main element for heating purposes, a condenser connected to the supplemental element, means for supplying high pressure steam to either or both elements, a conduit for conveying exhaust steam from the main element to a low pressure stage of the supplemental element, and a conduit for connecting the casing of the main element to the condenser when it is running under certain conditions to reduce rotation losses.

9. In a system of the character described, the combination of a main element, a supplemental element, a conduit that receives steam from the main element for industrial purposes, a conduit conveying exhaust steam from the main element to a corresponding pressure stage in the supplemental element, and means for supplying high pressure steam to both of said elements.

10. In a system of the character described, the combination of a main element that receives fluid from one source only, a supplemental element that receives fluid from the same source as the main element and also receives exhaust steam from said main element and operates on the mixed pressure plan, and a speed governor means that controls the admission of fluid from the source to both of said elements.

In witness whereof, I have hereunto set my hand this 20th day of January, 1912.

GEORG FORNER.

Witnesses:

ERICH UBERLEE,

OSCAR EBERTH.