Jan. 6, 1942. G. B. WARREN 2,269,235

MULTISTAGE ELASTIC FLUID TURBINE

Filed Dec. 22, 1939

Fig. 1.

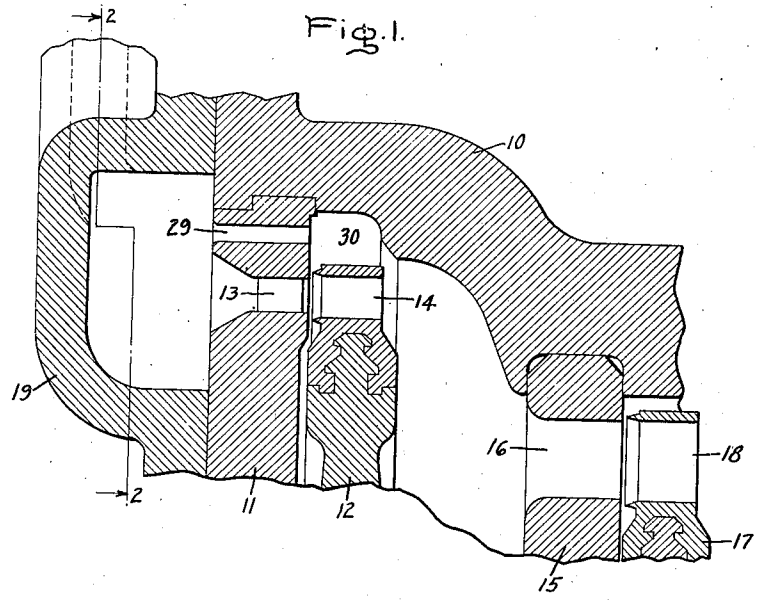
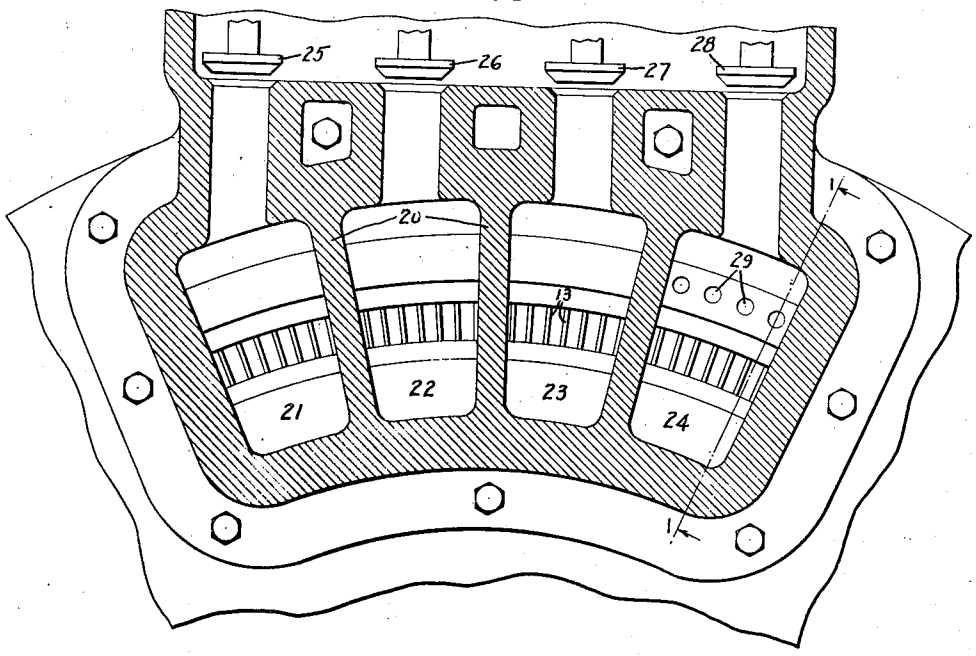


Fig. 2.



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MULTISTAGE ELASTIC FLUID TURBINE

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3 Claims. (Cl. 253—69)

The present invention relates to multi-stage elastic fluid turbines for operation with elastic fluid of high pressure, particularly to turbines including valve chest arrangements for separately admitting elastic fluid to separate nozzle sections of the first stage known as partial admission turbines. The high pressure of the elastic fluid causes considerable stresses and shocks in the bucket wheel of the first stage. In order to withstand these high stresses it has been necessary heretofore either to increase the arc of admission of elastic fluid to the first wheel with the resulting high water rate and to increase the pitch and the width of the buckets of the first stage or to reduce the total amount of elastic fluid admitted to the turbine.

The object of my invention is to provide an improved construction and arrangement of multistage turbines whereby they may be operated at a high rate of flow of elastic fluid without thereby overloading the first or high pressure stages thereof. This is accomplished in accordance with my invention by an arrangement including a valve chest having chambers for separately admitting elastic fluid to separate nozzle sections of the first stage and conducting a part of the elastic fluid from the valve chest directly to a lower stage, that is, by bypassing the first turbine stage. In a preferred embodiment the nozzle plate for the first turbine stage has an opening or openings through which elastic fluid is conducted from the valve chest directly to the second or lower stage. The flow through this opening may be controlled by the valve which controls the admission of elastic fluid to the last section of the nozzle plate. Such bypass openings in the nozzle plate or diaphragm may be provided with advantage in both partial and full admission arrangements.

For a better understanding of what I believe to be novel and my invention, attention is directed to the following description and the claims appended thereto in connection with the accompanying drawing.

In the drawing Fig. 1 illustrates a sectional view along line 1—1 of Fig. 2, and Fig. 2 is a section along lines 2—2 of Fig. 1.

The elastic fluid turbine illustrated in the drawing comprises an outer casing or shell 10 enclosing a plurality of turbine stages including a first stage having a nozzle plate 11 suitably supported on the shell 10 and a bucket wheel 12 conveniently supported on a rotatable shaft, not shown. The nozzle plate 11 has blades or partitions 13 for properly directing elastic fluid towards a row of buckets 14 of the wheel 12. The partitions 13 of the nozzle plate or diaphragm 11 have inner ends secured to a plate or disk and outer ends securely fastened to a band or ring. During operation elastic fluid discharged from the first stage, that is, from the bucket wheel 12, is conducted to a second turbine stage comprising a nozzle diaphragm 15 having nozzle openings 16 and a bucket wheel 17 with a row of buckets 18.

On the present example, elastic fluid is conducted to the nozzle plate 11 by a partial admission arrangement for limiting the arc of supply of elastic fluid to the first stage. More specifically, the partial admission arrangement in the present instance comprises a valve chest 19 having a plurality of partitions 20 forming chambers 21, 22, 23, 24 for conducting elastic fluid to separate sections of the nozzle plate 11. The flow of fluid to the chambers 21 to 24 is controlled by valves 25, 26, 27 and 28 respectively. These valves are ordinarily operated in succession whereby the arc of admission and the total load output is gradually increased at relatively good efficiency and satisfactory water rates. The maximum load output of ordinary turbines is limited by the rate of flow of elastic fluid through the first turbine stage, in the present instance through the nozzles formed by the partitions 13 of the nozzle plate 11. This maximum rate of flow in accordance with my invention may be increased by the provision of a bypass from the valve chest to a lower stage. This is accomplished by a plurality of openings 29 formed in the outer band of the nozzle plate 11 of the first stage and a channel 30 between the bucket wheel 12 and the shell 10 for conducting elastic fluid from the valve chest 19 directly to the nozzle diaphragm 15 of the second stage, thus by-passing the bucket wheel 14. The flow through the openings 29, that is, through the bypass connecting the valve chest directly with the second or a lower turbine stage, is controlled by one of the valves in the valve chest, preferably the valve 28, controlling the flow to the last section of the nozzle plate. Thus, during operation the valves 25 to 28 are opened in succession, with the valve 28 being opened last to admit elastic fluid to both the last section of the nozzle plate and the bypass openings 29. With this arrangement the maximum rate of flow is no longer limited by consideration of safety and water rate with regard to the first stage, that is, the maximum flow may be conveniently increased without increasing stresses of the first stage bucket wheel.

Having described the method of operation of my invention, together with the apparatus which

I now consider to represent the best embodiment thereof, I desire to have it understood that the apparatus shown is only illustrative and that the invention may be carried out by other means.

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

1. Multi-stage high pressure elastic fluid turbine comprising a first stage having a bucket wheel and a nozzle plate, a second stage, a valve chest with separate chambers for elastic fluid and a valve means for each chamber for separately conducting elastic fluid to several sections of the nozzle plate, said nozzle plates having openings in an outer portion of one section only for conducting elastic fluid from one of the chambers directly to a lower stage to permit operation with high rate of elastic fluid flow without overloading the first stage.

2. Multi-stage high pressure elastic fluid turbine comprising a first stage having a bucket wheel and a nozzle plate forming a plurality of nozzles for directing elastic fluid to the bucket wheel and outer openings adjacent the nozzles for bypassing elastic fluid with regard to the bucket wheel to permit operation with high rate of elastic fluid flow without overloading the first stage, and a valve chest having separate chambers and a valve for each chamber for conducting and controlling the flow of elastic fluid to separate sections of the nozzle plate, one of the chambers communicating with a last section of the nozzle plate which section forms said outer openings, and the valve for said chamber controlling both the flow of elastic fluid to the nozzles and to the openings of the last section of the nozzle plate.

3. Multi-stage high pressure elastic fluid turbine having a casing, an elastic fluid chest, a first stage including a bucket wheel and a nozzle plate forming a plurality of nozzles for conducting elastic fluid from the chest to the bucket wheel, a second stage, and means for increasing the rate of elastic fluid flow without overloading the first stage, said means comprising a bypass formed by openings in the nozzle plate adjacent the nozzles and by a channel formed between an outer portion of the turbine wheel and the casing in axial alignment with the openings to connect the second stage directly to the chest.

GLENN B. WARREN.