No. 875,111. PATENTED DEC. 31, 1907.

F. SAMUELSON.

ELASTIC FLUID TURBINE.

APPLICATION FILED MAY 28, 1907.

Fig. 1.

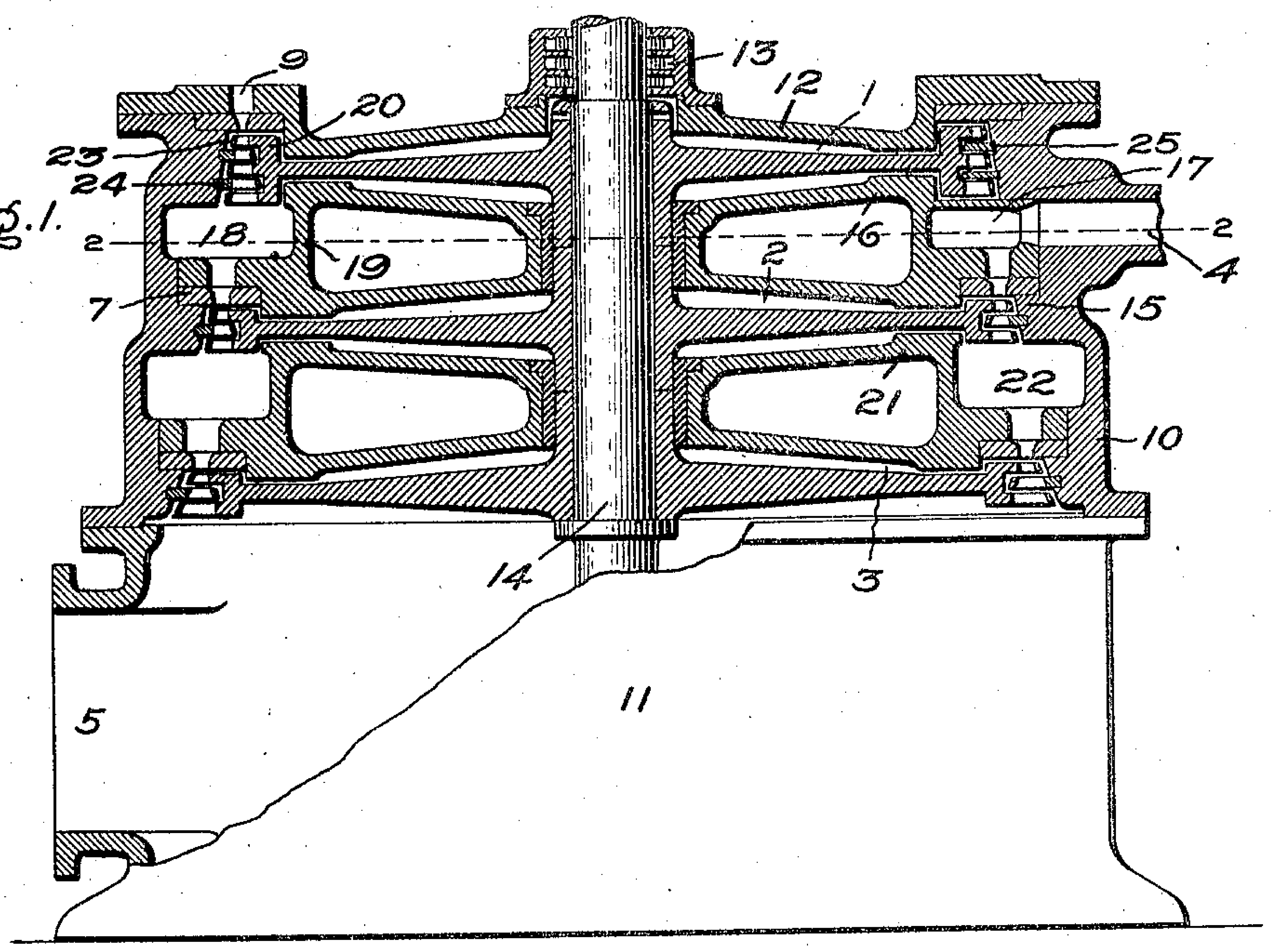
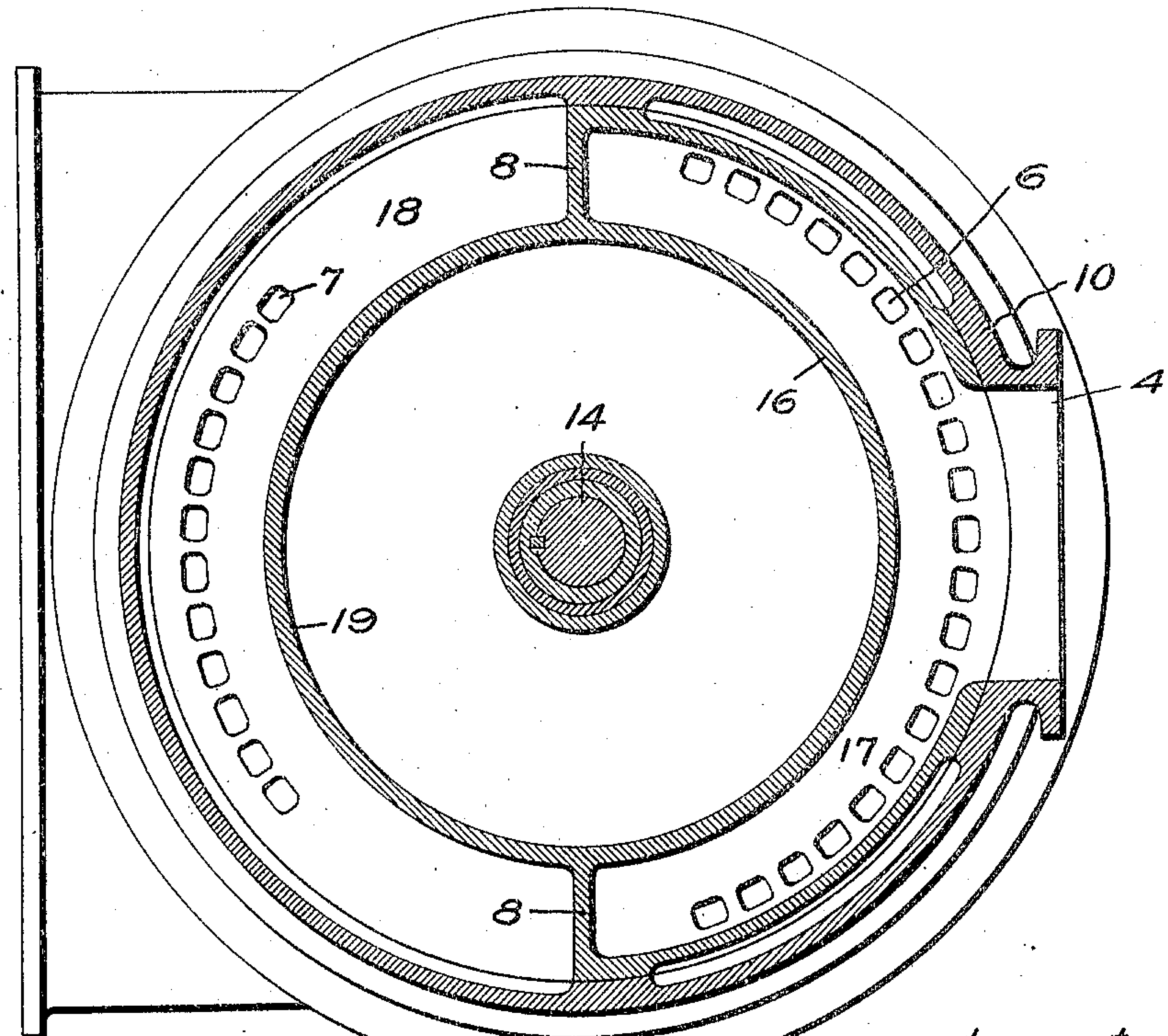


Fig. 2.



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UNITED STATES PATENT OFFICE.

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

ELASTIC-FLUID TURBINE.

No. 875,111. Specification of Letters Patent. Patented Dec. 31, 1907.

Application filed May 28, 1907. Serial No. 376,083.

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 Elastic-Fluid Turbines, of which the following is a specification.

My invention relates to improvements in turbines operated by exhaust fluid such as steam supplied from a reciprocating engine or other source of supply. Turbines of this kind as hitherto constructed have in some cases been designed so as to be suitable for efficient working only with exhaust steam and therefore in cases where no exhaust supply was available and it was necessary to operate the turbine by live steam taken from a boiler, the pressure of the steam had to be reduced so as to render it suitable for operating the turbine, thereby causing a large loss in efficiency. In other cases it has been proposed to use an ordinary high-pressure multi-stage turbine and to admit the exhaust fluid to a stage corresponding in pressure to that of the exhaust fluid. In the latter arrangement the exhaust steam is admitted to the turbine of the multi-stage type to one of the low-pressure stages in such a manner as to fill the whole of the high-pressure stage and thereby increase the rotation losses when it is desired to operate the turbine wholly by exhaust steam, owing to the friction and windage encountered by the idle wheel rotating in the exhaust steam.

The object of my invention is to overcome the disadvantages of the turbines above described and to this end it consists in admitting the exhaust steam to a multi-stage turbine through the stationary nozzles or guide vanes of a low or medium pressure stage, the conduit for supplying steam to these nozzles being entirely shut off from the stage or stages of higher pressure, so that when the turbine is operated entirely by exhaust steam the pressure in the first stage or stages of high pressure is that of the exhaust steam after it has been expanded in the exhaust admission passage to the pressure of the next lower stage of the turbine.

In carrying my invention into effect as applied to a turbine of the multi-stage type, the exhaust steam is admitted to a certain number of nozzles in such a stage that the exhaust steam has, on its way to the condenser, to pass through a sufficient number of moving wheels to enable its energy to be effectively extracted. In this stage one part of the nozzles is thus in communication with the exhaust steam conduit and the remaining nozzles receive their supply, if any, from high-pressure steam expanding through the preceding stage or stages which thus are at no time worked by exhaust steam. Below the stage where the exhaust steam is admitted the expanded high-pressure steam and exhaust steam, when both supplied, mix at equal pressures and pass together through the remaining stages, if any, of the turbine. It will thus be understood that in the case of the turbine being driven by exhaust steam alone and the wheel or wheels of the first stage or stages thus running idle the pressure of the medium in which these wheels rotate will be equal to the pressure of the exhaust steam after it has expanded through its first stage. As this pressure which is communicated to the idle wheels by the nozzles now not used by any high pressure steam may be condenser pressure and is in any case a very low one, the losses caused by friction and windage resistance of the idle wheels, which otherwise would be a very serious objection, are here reduced to a minimum, thus making the turbine efficient not only when operated with high pressure and exhaust steam at the same time but also when driven by one of these agencies only.

In the accompanying drawings which illustrate one of the embodiments of my invention, Figure 1 represents a sectional side elevation and Fig. 2 is a sectional end elevation on the line 2—2 of Fig. 1.

The turbine illustrated is provided with three stages 1, 2 and 3 and the supply of exhaust steam is admitted to the stage 2 through the inlet conduit 4 and passes through stages 2 and 3 in which its energy is efficiently extracted on its way to the condenser through outlet 5. In stage 2 the main stationary sectional nozzle 6 is in communication with and receives exhaust steam from the conduit 4, the other or secondary sectional nozzle 7 receives its steam supply, if any, from the stage 1, no mixing of the supplies taking place until they have passed through the nozzles into stage 2, the two nozzles 6 and 7 being separated by barriers 8. Stage 1 is at no time supplied with exhaust steam but receives live steam from any convenient source through the conduit

9. On the condenser side of stage 2 the exhaust steam supply and the expanded live steam supply mix at equal pressures and pass together through the remaining stage 3 of the turbine. It will be seen that when the turbine is being driven by exhaust steam alone the wheel in stage 1 will be running idle the pressure of the medium in which it is revolving being equal to the pressure of the exhaust steam after it has passed through stage 2. As this pressure is very low the losses caused by friction and windage of the wheel in stage 1, which otherwise would be high and be a very serious objection, are reduced to a minimum. A turbine constructed in this manner is thus very efficient not only when operated by live and exhaust steam combined but also when driven by either of these agencies alone.

It will be obvious that although I have illustrated a turbine having one stage only in which the live steam supply is expanded this number may be increased without departing from my invention, also the number of stages through which the exhaust steam passes may be increased or decreased from that shown.

The turbine is provided with a casing 10 mounted on the chambered base 11. The upper end of the casing is provided with a head 12 having a packing 13 surrounding the main shaft 14. The casing is provided with an internal shoulder 15 which supports the upper diaphragm 16. In this diaphragm is a chamber 17 which is supplied wholly by exhaust steam from the conduit 4, the said chamber being entirely cut off from the first stage wheel compartment. The chamber supplies the main stage nozzles or nozzle sections 6 of which there are a greater number than secondary nozzle 7 supplied by steam from the chamber 18. The chamber 18 is formed partially by the outer casing and partially by the vertical wall 19 of the upper diaphragm. The first stage wheel is provided with a bucket structure 20 which is wider than the wheel web and the upper surface of the diaphragm is in close proximity to said web and bucket structure to assist in forming the chamber 18. The ends of the chamber 18 are formed by the vertical barriers 8 which are common to the chambers 17 and 18. The second diaphragm 21 also rests on a shoulder formed on the inside of the casing, the latter being suitably divided to permit said diaphragms to be mounted in place. The second diaphragm coöperating with the wall of the casing and the web of the second wheel forms a chamber 22 in which the low pressure steam passing the main stage nozzles 6 mixes with the steam from the nozzles 7 when the latter are in service, the pressures of the two streams being of course equalized therein. Each wheel rotates in its own compartment which compartments are cut off as far as possible from the chambers 18 and 22, the chamber 17 being entirely cut off from the first wheel compartment. The main and secondary stage nozzles are situated between the internal shoulders and the diaphragms are held in place wholly or largely by the pressure and weight of said diaphragms. Suitable bolts or screws may be employed to unite them with the diaphragms to facilitate handling.

The first stage wheel is provided with a greater number of rows of wheel buckets 23 than are the subsequent stages. By reason of this arrangement the first stage can be made to perform a geater amount of work than any one of the subsequent stages. The drop in fluid pressure in the admission nozzles in this case will be greater than in the subsequent nozzles and sufficient to lower the first stage pressure to safe working conditions. Between the rows of wheel buckets are intermediate buckets 24 which receive fluid from the wheel buckets and after changing its direction discharge it at the proper angle against the wheel buckets in the adjacent row.

In the initial stage the nozzles and intermediate buckets occupy only a portion of the wheel circumference. To reduce rotation losses blank rings 25 may be extended around the wheel from one end of the intermediates to the other.

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. An elastic fluid turbine comprising a plurality of stages working at different pressures, each stage having fluid discharging devices and wheel buckets for extracting energy from the motive fluid, in combination with stage fluid discharging devices which are shut off from receiving fluid from a higher pressure stage, and a conduit which supplies low pressure fluid to said stage devices.

2. An elastic fluid turbine comprising a plurality of stages working at different pressures, bucket wheels therefor, admitting and discharging devices for the first stage receiving high pressure fluid, in combination with two sets of fluid discharging devices for an intermediate stage, one set receiving fluid exhausting from a wheel, the second being shut off from the first, and a conduit that supplies low pressure fluid to the second set of devices only.

3. An elastic fluid turbine comprising a plurality of stages working at different pressures, rows of wheel buckets therefor, high

pressure fluid admitting and discharging devices for the first stage, and an inclosing casing, in combination with a diaphragm between two of the stages containing chambers, one of which receives fluid from the preceding row of buckets, the other being shut off from said supply, a conduit for admitting fluid at low pressure to the last mentioned chamber, and stage fluid discharging devices which receive fluid from both chambers and discharge it against the adjacent row of buckets.

4. An elastic fluid turbine comprising a plurality of stages operating at different pressures, main stage nozzles which are cut off from receiving high pressure fluid, a conduit for admitting low pressure fluid thereto, nozzles for a stage of higher pressure receiving high pressure fluid, secondary stage nozzles that are cut off from the main stage nozzles and receive motive fluid exhausting from a wheel, wheel buckets for extracting energy from the high and low pressure motive fluids, and an exhaust conduit that is common to all of the nozzles.

5. An elastic fluid turbine comprising stages working at different pressures, each containing a wheel compartment, fluid discharging devices and bucket wheels for the stages, in combination with a conduit for supplying high pressure motive fluid, a chamber which receives motive fluid from a wheel, a second chamber which is shut off from receiving motive fluid from a wheel, a conduit admitting low pressure fluid to the second chamber only, a third chamber that receives motive fluid from both the high and low pressure supply conduits and equalizes the pressures thereof, and an exhaust conduit common to all of the wheel buckets.

6. An elastic fluid turbine comprising stages working at different pressures, each containing fluid discharging devices, those in the initial stage causing a greater drop in pressure than those in the subsequent stage or stages, and a conduit admitting high pressure fluid to the initial stage, in combination with a set of stage nozzles which are shut off from receiving motive fluid from preceding stage, a conduit for discharging low pressure fluid to said set of stage nozzles, and a chamber which receives the fluid from both sources and equalizes the pressures.

In witness whereof, I have hereunto set my hand this fifteenth day of May, 1907.

FREDERICK SAMUELSON.

Witnesses:
CHARLES H. FULLER,
J. A. FOSTER.