No. 803,829.

PATENTED NOV. 7, 1905.

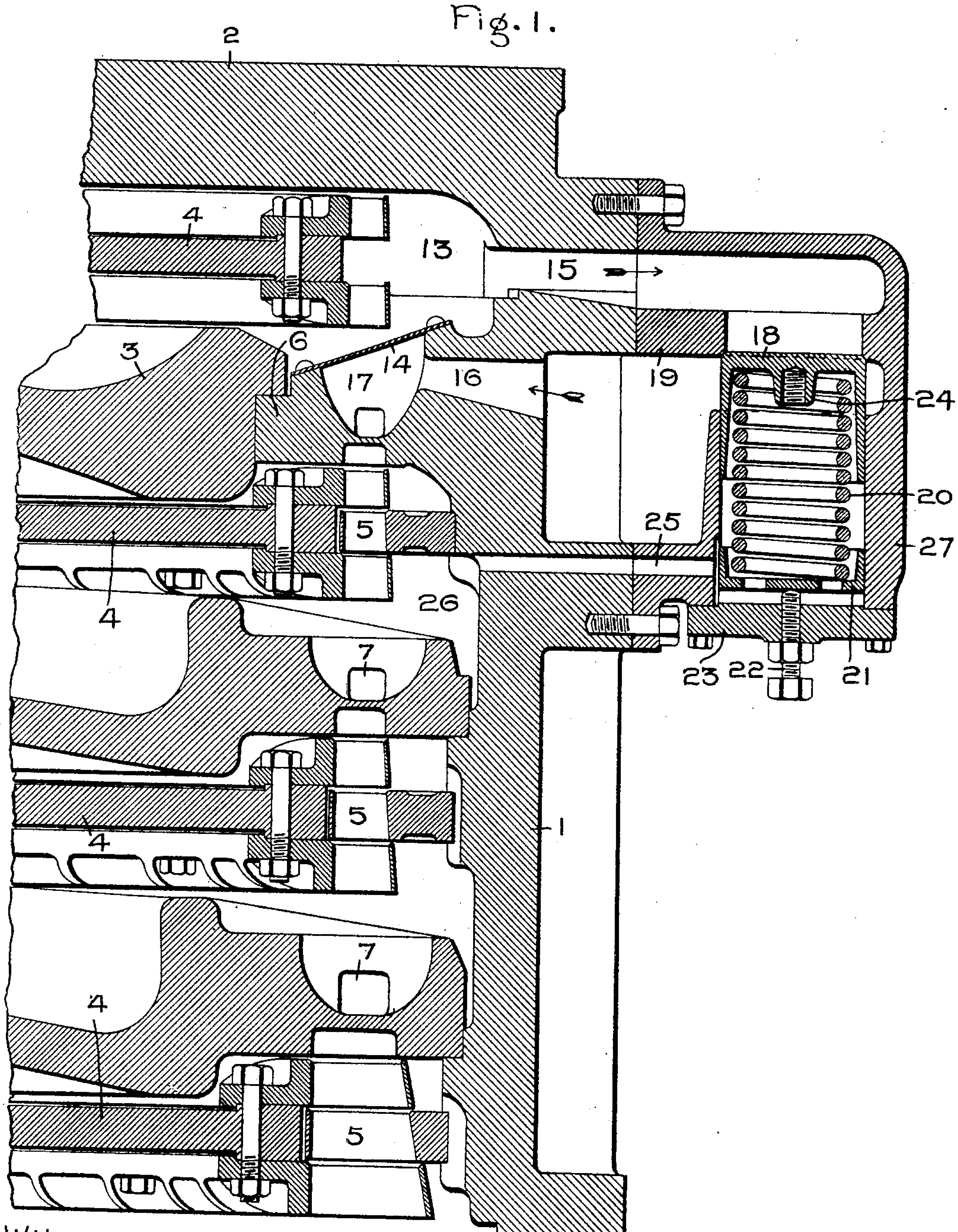
O. JUNGGREN.

RELIEF MECHANISM FOR ELASTIC FLUID TURBINES.

APPLICATION FILED SEPT. 29, 1903.

2 SHEETS—SHEET 1.

Fig. 1.



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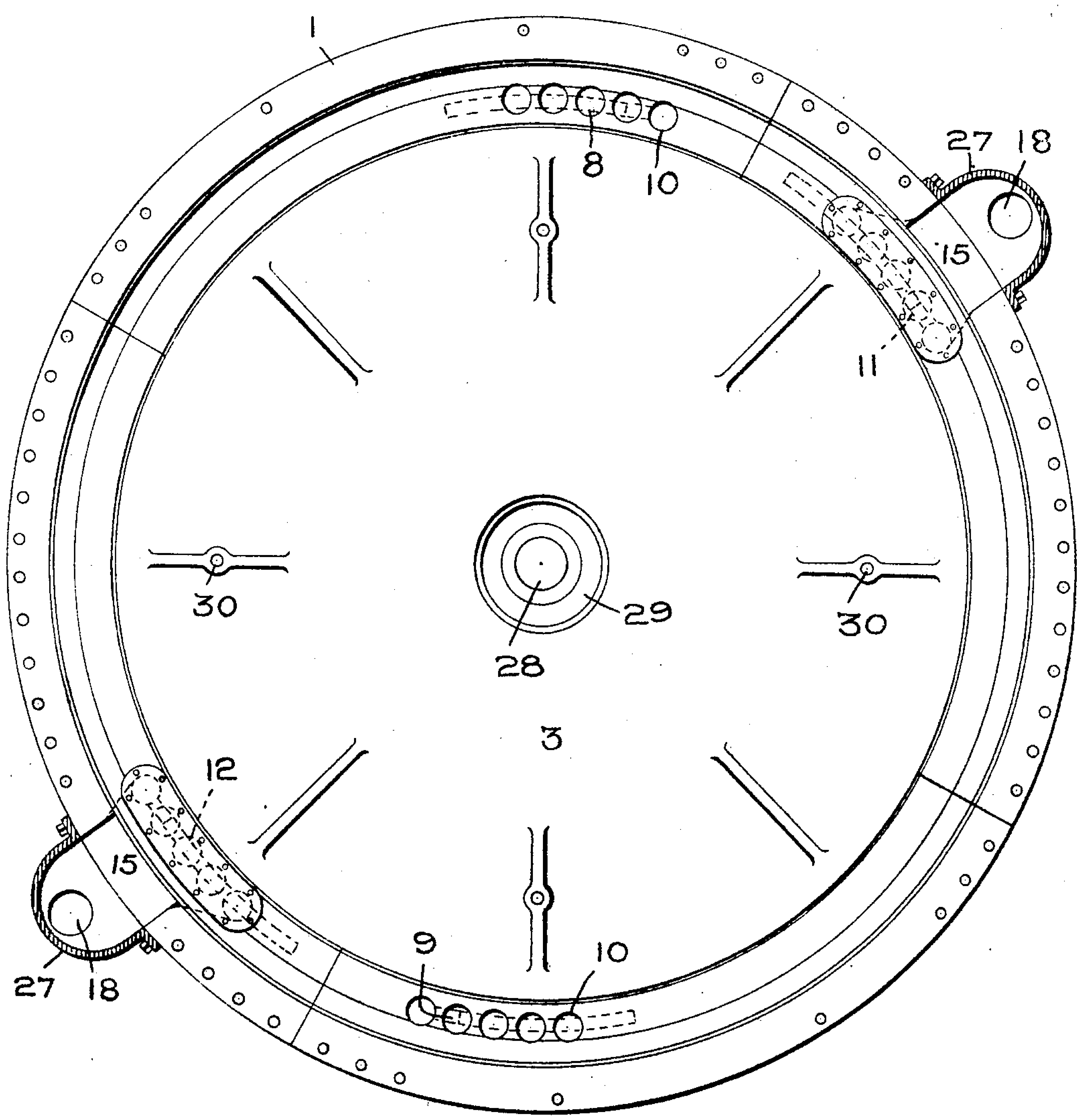
2 SHEETS—SHEET 2.

Fig. 2.



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UNITED STATES PATENT OFFICE.

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RELIEF MECHANISM FOR ELASTIC-FLUID TURBINES.

No. 803,829. Specification of Letters Patent. Patented Nov. 7, 1905.

Application filed September 29, 1903. Serial No. 175,036.

To all whom it may concern:

Be it known that I, OSCAR JUNGGREN, a citizen of the United States, residing at Schenectady, in the county of Schenectady and State of New York, have invented certain new and useful Improvements in Relief Mechanism for Elastic-Fluid Turbines, of which the following is a specification.

Owing to the variations in load on a multi-stage turbine of the elastic-fluid type there are times when the pressure on the wall or diaphragm which separates the wheel-compartments exceeds the predetermined amount. This excess pressure is due to an increase in the volume of steam delivered by the nozzle or nozzles or nozzle-sections to the compartments of which the wall or diaphragm forms a part and is usually due to an increase in load on the turbine which causes the governing mechanism to admit more motive fluid—as, for example, by opening one or more sections of a sectionalized nozzle. The particular form of governor used to regulate the machine is immaterial, the point to be considered being the protection of the wall or diaphragm from injurious pressures.

The object of the present invention is to provide a relief mechanism which is simple in construction and reliable and efficient in operation.

Between one stage and the next are one or more valves, which to distinguish them from the governing or regulating valves I term "by-pass valves," which open under a predetermined condition as to pressure. The valve or valves may be weighted in any suitable manner and may be arranged to operate simultaneously or successively, as desired. I prefer to have them operate successively, since by so doing a more nearly even pressure will be preserved in the wheel-compartment. The motive fluid in order to prevent its effect being lost when the valve opens is discharged into a succeeding shell or compartment of lower pressure. This discharge is preferably into the adjacent shell of lower pressure in order to effectively utilize the fluid; but it can take place into a shell which is more remote, if desired. This discharge can take place directly into the shell, in which case it does no useful work in passing; but it is preferable to discharge it through what I term "overload" or "auxiliary" nozzles, that are normally inactive and are prevented from receiving fluid directly from the main steam-space of the compartment. In this way the excess steam from one shell or wheel-compartment is made to do useful work in passing to a shell or shells of lower pressure.

The first stage or shell is provided with suitable nozzles or fluid-discharging devices and a governor of any approved type to compensate for load changes. One or more of the stages or shells of lower pressure are provided with as many main nozzles or discharging devices as are necessary for average load conditions, which nozzles may be in permanent open communication with the shell and receive steam directly therefrom or they may be valved, as desired. In addition to these nozzles are overload or auxiliary nozzles, which are closed to the steam-space of the shell and receive steam only through the weighted by-pass valve or valves. These valves are set to open under a predetermined increase in pressure. When more than a single valve is employed, the weights on the valves differ, so that they operate successively. In other words, the auxiliary or overload nozzles are in a connection or conduit from one stage to another and are controlled in their action by an automatic valve.

To reduce the strain on the parts and also to simplify the construction, the main and auxiliary nozzles are separate structures, and for certain types of turbine, especially large sizes, it will be found advantageous to form the main nozzles on one part of a segmental bucket-wheel shell and the overload or auxiliary nozzles in a separate part or segment of the same shell. They may, however, be supported in a different manner, if desired.

The by-pass valve may be mounted in a separate casing that is attached to the exterior of the main casing or shell, in which case it is readily accessible.

One or more rows of wheel-buckets may be provided for each stage, depending upon the character of the nozzles or fluid-distributing devices.

In the accompanying drawings, which illustrate one embodiment of my invention, Figure 1 is a partial vertical section of a two-wheel-per-stage turbine; and Fig. 2 is a horizontal section of the same, taken on a plane just above the upper diaphragm.

1 represents the casing of the machine, which is provided with a top or cover 2 and one or more walls or diaphragms 3. Between the cover and the upper diaphragm and between adjacent diaphragms are bucket-wheels 4 for fractionally abstracting the velocity of the fluid-stream due to the nozzles. In the present illustration two rows of wheel-buckets are provided for each stage, with a row of intermediate buckets 5 between each pair of wheel-buckets. The function of these intermediate buckets is to receive steam from one row of wheel-buckets and after changing its direction discharge it properly against the adjacent row of wheel-buckets. The upper diaphragm 3, owing to the high pressure to which it is subjected, is made smaller than the other diaphragms. Situated below and supporting the diaphragm 3 is an overhanging projection 6, formed on a segment of the wheel-casing. In the projection is formed a nozzle, which is composed of a plurality of closely-associated sections. The nozzle may be of the expanding or non-expanding type. The lower-pressure diaphragms are mounted on small shoulders formed on the inside of the casing and are provided at one or more points near their peripheries with nozzles 7, which are preferably of the sectionalized type and may or may not expand between the receiving and discharge orifices, as is desired.

Referring to Fig. 2, the arrangement of the second-stage nozzles will be seen. The casing 1 is divided into sections. In the present illustration four of these sections are shown and the lines of division between sections are in radial planes. 8 and 9 represent the main nozzles for supplying elastic fluid to the bucket-wheel of the second stage, it being understood that the first stage has been removed in this figure for the purpose of illustration. Each of these nozzles is of the sectionalized type and is composed of five sections, each section being provided with a suitable bowl 10, which delivers steam or other elastic fluid to the nozzle-orifice. The nozzles are situated diametrically opposite and are of sufficient capacity to handle the normal load on the turbine. The nozzles on the subsequent stages are designed to handle the increased volume of steam at the reduced pressure. Situated at suitable points with respect to the main nozzles are overload or auxiliary nozzles 11 and 12. These nozzles are formed in sections of the casing separate from those sections which carry the main nozzles. The object of this arrangement is to prevent the weakening of any one of the casing-segments by cutting away a considerable mass of metal, as would be the case if all of the nozzle-sections were formed therein. The main nozzles 8 and 9 are in permanent communication with the upper wheel-chamber 13, Fig. 1.

The auxiliary nozzles are permanently covered by a plate or other suitable means 14, and adjacent thereto the wheel-casing is cut away to form a passage 15, which forms a part of a by-pass connection around one of the diaphragms. Situated below the passage 15 is a second passage 16, Fig. 1, which discharges fluid into all of the bowls 17 of the auxiliary or overload nozzles.

In order to control the passage of fluid from one wheel-chamber to the next and to relieve the pressure on the diaphragm, an automatic by-pass valve is provided comprising a piston-like portion 18, which engages with a conical seat on the partition 19. The piston is weighted or held against its seat by a coiled compression-spring 20. The lower end of the spring is supported in the cup-shaped abutment 21, that may be adjusted by a screw 22. The screw is carried by a detachable plate 23, and when it is desired to remove the valve for the purpose of inspection or repair this plate, together with the abutment and spring, are removed, and by inserting a screw-threaded rod in the projection 24 the piston can be withdrawn, it being understood that this piston makes a close fit with its inclosing cylinder. The piston-valve is arranged in a manner similar to an ordinary pop safety-valve—that is to say, it does not open until the pressure exceeds a certain amount and when once opened it remains so until there is a considerable decrease in steam-pressure. This effect is obtained by beveling the end of the piston. In this manner the effective area of the valve when closed is somewhat less than when open.

In order that the pressure on the piston may be in a measure balanced, a passage 25 is provided which opens the cylinder-space back of the piston to the wheel-chamber 26. Under normal conditions the valve is in the position shown, but when the pressure within the upper wheel-chamber 13 exceeds a predetermined amount the by-pass valve opens and motive fluid is permitted to flow through the passages 15 and 16 into the auxiliary nozzles, the latter being arranged to effectively discharge the fluid against the bucket-wheel mounted in the wheel-chamber 26. One or more of these by-pass valves may be provided for a given stage. I find it convenient in the present embodiment of my invention to provide two such valves and to adjust them differently, so that they will operate successively.

Referring to Fig. 2, it will be seen that the by-pass valves and their casing 27 are situated diametrically opposite, and the latter are bolted to the main casing so that they can readily be attached and removed. 28 represents the main shaft, and 29 a packing, which prevents motive fluid from escaping from one wheel-chamber to the next without performing useful work. 3 represents the upper diaphragm, which is provided with suitable strengthening-ribs, some of which are provided with screw-threaded holes 30 to receive eyebolts, the latter being used in assembling and taking down the machine.

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. A multistage turbine, containing a diaphragm or wall, wheels and discharging devices, in combination with a valve which opens under a predetermined pressure on a diaphragm and discharges motive fluid from one stage into another.

2. A multistage turbine, including a wall or diaphragm between stages, in combination with discharging devices which are normally inactive, and a valve which opens under predetermined conditions and discharges fluid into the said devices.

3. A multistage turbine, comprising a wall or diaphragm between stages, and nozzles for supplying fluid to the wheels, in combination with a valve which opens and discharges motive fluid from one stage to another when the nozzles are incapable of handling the requisite amount of fluid and the pressure on a diaphragm exceeds a certain amount.

4. A turbine comprising a casing and a diaphragm or wall for separating it into stages, in combination with a passage leading from one stage and into another, and an automatic valve situated outside of the casing for controlling the flow of fluid through the passage.

5. A turbine comprising a casing and a diaphragm or wall for separating it into stages, in combination with a passage leading from one stage and into another, an automatic valve for controlling the flow of fluid through the passage, and a passage which communicates with the space back of the valve and also with a stage of lower pressure than the first for assisting to balance the valve.

6. A turbine comprising two or more stages, each stage containing a bucket-wheel, nozzles which are in open communication with one stage and discharge motive fluid therefrom against the wheel of the adjacent stage, in combination with auxiliary nozzles which are situated between stages and are closed to the stage of higher pressure, and means for supplying fluid to the auxiliary nozzles under predetermined conditions.

7. In a multistage turbine, the combination of bucket-wheels, main nozzles which are in open communication with one stage and discharge into another, auxiliary nozzles arranged to discharge fluid into the same stage as the main nozzles, a means closing the auxiliary nozzles against the fluid-supply of said stage, and a valve which controls the supply of fluid to said auxiliary nozzles.

8. A multistage turbine, in combination with valves which control the passage of fluid from one stage to another, and operate successively under changes in pressure.

9. A multistage turbine, in combination with a plurality of valves which control the passage of fluid from one stage to another and operate successively under changes in pressure, and auxiliary devices each of which receives fluid from a valve.

10. In a turbine, the combination of a sectional casing, containing a wheel-compartment, a main nozzle carried by one section of the casing, which is in open communication with the wheel-compartment, an auxiliary nozzle carried by another section which is closed to the wheel-compartment, and a valve which automatically opens and discharges fluid into the auxiliary nozzle when the pressure in the compartment exceeds a predetermined amount.

11. A multistage turbine comprising a casing, bucket-wheels and separate chambers therefor, and nozzles for discharging fluid against the buckets, in combination with a by-pass valve for discharging fluid from one wheel-casing to another, and a casing for the by-pass valve which is attached to the main turbine-casing.

12. An elastic-fluid turbine comprising bucket-wheels, a diaphragm or wall for separating one wheel from another, and devices for discharging fluid against the wheels, in combination with a plurality of auxiliary nozzles or nozzle-sections, and a by-pass valve which opens when the pressure in one wheel-compartment exceeds a predetermined amount and discharges fluid from said compartment through all of the auxiliary nozzles or nozzle-sections.

13. An elastic-fluid turbine which is divided into stages and is provided with means for discharging fluid from one stage to another, in combination with a valved conduit separate from the normal working path of the motive fluid through which the fluid is discharged when the pressure in a given stage exceeds a predetermined amount.

14. An elastic-fluid turbine which is divided into stages and is provided with a nozzle for discharging fluid from one stage to another, in combination with a second nozzle normally inactive, and a valved conduit separate from the normal working path of the fluid which discharges fluid into the second nozzle when the pressure in a given stage exceeds a predetermined amount.

15. An elastic-fluid turbine divided into stages and provided with main nozzles or discharging devices, in combination with auxil-

iary nozzles or discharging devices which are normally inactive, and discharge into a stage of lower pressure, and a conduit separate from the normal path of the working fluid which discharges to the auxiliary nozzles.

16. An elastic-fluid turbine which is divided into stages and is provided with buckets and fluid-discharging devices, in combination with successively-operating valves which respond automatically to variations in shell-pressure.

17. An elastic-fluid turbine which is divided into stages and is provided with means for discharging fluid from one stage to another, in combination with conduits separate from the normal working path of the motive fluid, and valves for the conduits which are adjusted to operate successively.

18. An elastic-fluid turbine comprising a wheel-casing made in sections with main nozzles carried by one section of the casing, and normally idle auxiliary nozzles which are carried by a different section.

19. In an elastic-fluid turbine operating by stage expansion, a series of automatic valves between two wheel-compartments which are adapted to operate successively to admit pressure to the succeeding stage, when the fluid-supply to the turbine varies.

20. In an elastic-fluid turbine operating to fractionally abstract the velocity of the fluid-pressure, wheel-compartments, passages forming conduits between said compartments, and a series of automatic valves to interrupt the flow of fluid through said passages which successively open and close sensitive to a varying internal pressure.

21. In an elastic-fluid turbine operating by stage expansion, a plurality of normally closed passages which when opened form conduits for the fluid between stages, means to normally close said passages to create definite pressures in the several stage-compartments, which pressures automatically maintain themselves by controlling means to open said passages.

22. In an elastic-fluid turbine operating by stage expansion and having a plurality of passages between stages, a separate stage-pressure-actuated valve for each passage.

In witness whereof I have hereunto set my hand this 26th day of September, 1903.

OSCAR JUNGGREN.

Witnesses:
C. E. PLOEMSSEN,
N. O. ZECH.