No. 845,295. PATENTED FEB. 26, 1907.

W. L. R. EMMET.

STEAM TURBINE.

APPLICATION FILED SEPT. 22, 1904.

3 SHEETS—SHEET 1.

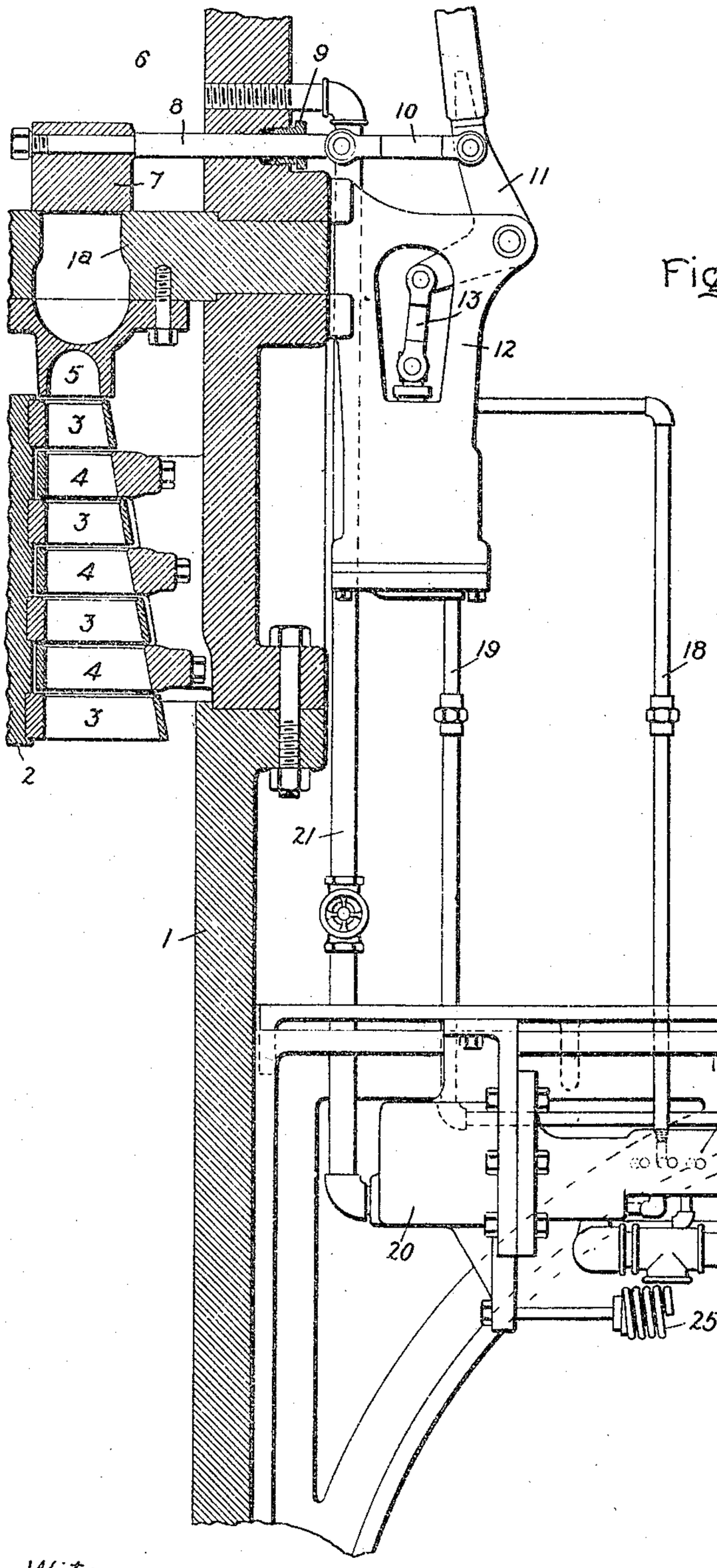

Fig. 1.

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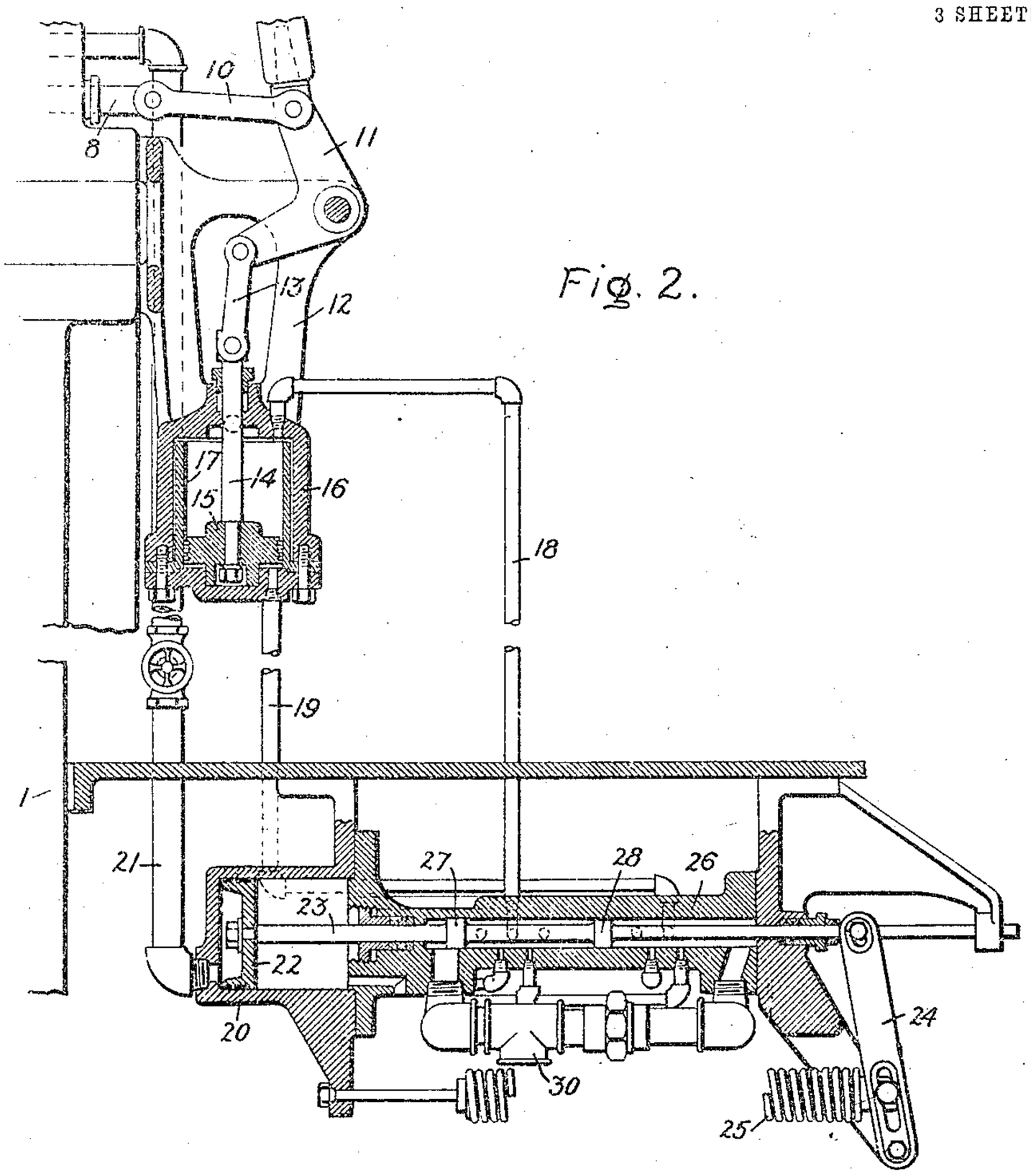
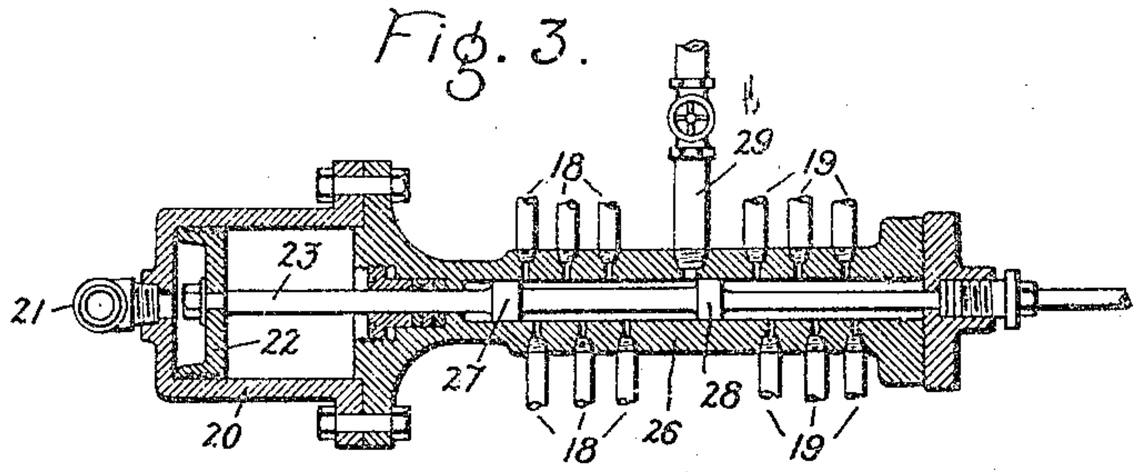


Fig. 2.

Fig. 3.



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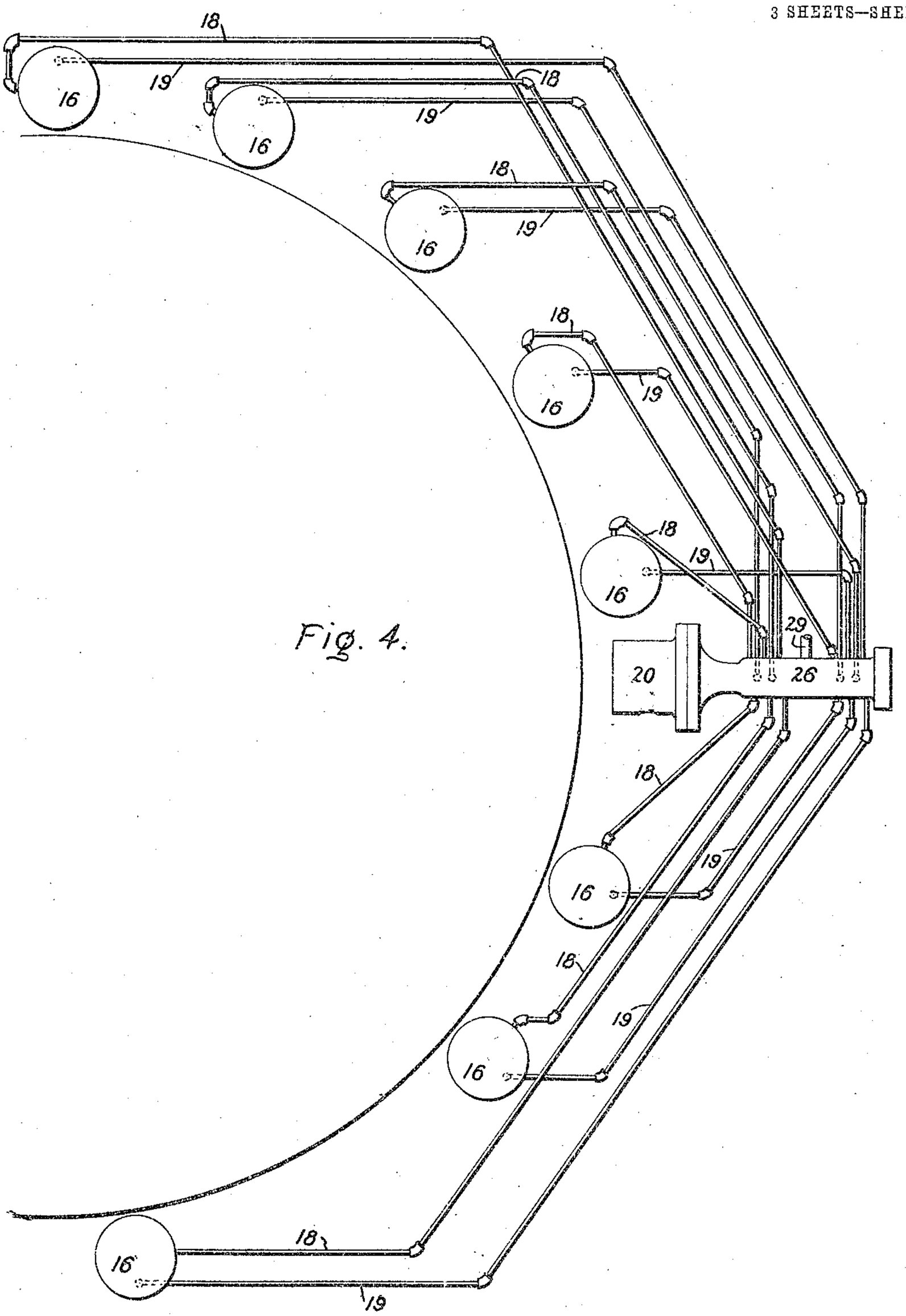

Fig. 4.

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UNITED STATES PATENT OFFICE.

WILLIAM L. R. EMMET, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

STEAM-TURBINE.

No. 845,295. Specification of Letters Patent. Patented Feb. 26, 1907.

Application filed September 22, 1904. Serial No. 225,441.

To all whom it may concern:

Be it known that I, WILLIAM L. R. EMMET, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Steam-Turbines, of which the following is a specification.

This invention relates to turbine-engines driven by elastic fluid which is conducted through two or more stages, with a certain drop in pressure between said stages.

For economic reasons it is desirable that the predetermined ratios of temperature and pressures between the several stages be maintained as nearly constant as possible. This is also desirable from a mechanical standpoint in order to prevent the expansion and contraction which would follow any changes in the temperature ratios existing between different portions of the engine.

The object of my invention is to preserve the predetermined ratios of pressure and corresponding temperature and to do this automatically.

To this end my invention consists in the combination, with a turbine-engine having two or more stages, of valves controlling ports between said stages, a movable abutment for actuating each valve separately, pipes for conveying fluid-pressure to both sides of said abutment, and a valve controlling said pipes and responsive to changes in steam-pressure in the higher of two stages.

In the accompanying drawings, Figure 1 is an elevation of my regulating apparatus applied to a steam-turbine. Fig. 2 is a section of the same. Fig. 3 is a section of the controller on a plane at right angles to Fig. 2 Fig. 4 is a plan view of the device.

The turbine to which the apparatus is applied is of the vertical Curtis type; but it is equally applicable to other types, whether upright or horizontal.

In Fig. 1 is shown in section at 1 the wall of the casing in which the bucket-wheels rotate, one of these being shown at 2, provided with four sets of buckets 3, coöperating with three sets of stationary intermediates 4. Steam is supplied to the upper set of buckets through nozzles 5, of which there may be any suitable number, leading through a diaphragm 1^a from an upper stage or chamber 6, in which another bucket-wheel may be located.

The admission of steam to the nozzles 5 is for the purposes of my invention controlled by special valves 7, which are auxiliary to the usual speed-regulating valves. (Not shown.) There may be any suitable number of these valves, Fig. 4 providing for eight. Each valve is attached to a stem 8, passing out through a stuffing-box 9 in the wall of the casing and connected with a movable abutment. The preferred mode of connection is by a link 10, pivoted to one arm of a bell-crank lever 11, suitably fulcrumed in a frame 12, attached to the casing, and having its other arm connected by a link 13 with a piston-rod 14, fastened to a piston 15, which works in a cylinder 16, secured to or cast integral with the frame 12. The cylinder may have a lining 17 of brass, if desired. Two pipes 18 19 enter the respective ends of the cylinder and convey thereto and therefrom a fluid under pressure, preferably water.

The pipes from the several cylinders all run to a controller, by means of which the water is admitted to the cylinders successively in a given order and exhausted therefrom in reverse order. The controller is governed in its operation by the steam-pressure in the higher stage—that is, the stage from which the steam passes to the next.

A convenient construction of controller is shown in the drawings. A steam-chamber, such as the cylinder 20, is connected by a pipe 21 with the higher stage of the turbine. In the cylinder is a movable abutment, such as a piston 22, whose rod 23 after passing through a valve-chest is connected with a lever 24, to which is attached a spring 25, urging the piston against the steam-pressure. The valve-chest 26 is preferably cylindrical, and on the valve-rod 23 are two heads 27 28, fitting the valve-chest. Between the pistons a water-supply pipe 29 enters the valve-chest, and at each end of the chest, beyond the limit of travel of the pistons, an exhaust-port communicates with a common escape-pipe 30. The pipes 18 all enter the valve-chest at points between the supply-pipe 29 and the cylinder 20, while the pipes 19 enter said chest on the other side of said supply-pipe. The space between the heads 27 28 is sufficient to connect the supply-pipe with all of one or the other set of pipes when the piston 22 is at the corresponding end of its travel.

The operation of the apparatus is as fol-

lows: In the drawings the valves 7 are all closed, the piston 22 being at that end of its cylinder where the steam-pipe 21 enters, and the water-supply pipe being therefore in communication with all of the pipes 18, which convey water to the upper ends of the cylinders 16. Now if the steam-pressure in the higher stage increases to such a point as to injuriously alter the ratio between itself and that in the next stage the piston 22 moves over until the pressure behind it is balanced by the spring. The accompanying movement of the rod 23 and its two heads 27 28 opens one or more of the pipes 18 to the exhaust and one or more of the pipes 19 to the water-supply. The pipes 19 thus connected with the water-pressure are those which run to the lower ends of the cylinders 16, whose respective pipes 18 have been connected with the exhaust. The water-pressure in those pipes 19 thus supplied enters the corresponding cylinders under the pistons 15 and forces them upward, thereby opening the corresponding valves 7, which permits an exhaust of steam from the higher to the lower stage, and thus effect a restoration of the normal ratio of pressure in the two stages. The piston 22 shifts to and fro as the pressure in the higher stage varies, opening and closing the valves 7, and thus serving to maintain automatically the normal ratio of pressures and temperatures in the several stages.

It is evident that the mechanism shown and described is also capable of use to regulate the admission of elastic fluid to the first stage of a turbine, in which case the opening and closing of the valves 7 would depend upon variations of pressure in the steam-main or the valve-chest. By another obvious modification the controller-valve can be moved by a device responsive to changes in speed or load instead of pressure, so that the machine will maintain a constant speed or output, as the case may be.

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. The combination with a steam-turbine, having two steam-containing chambers, of ports connecting said chambers, a valve controlling each port, a fluid-pressure motive device for operating each valve, a controller regulating the supply of fluid-pressure to and from said motive devices, and automatic means responding to changes in steam-pressure for operating said controller.

2. The combination with a steam-turbine, having two steam-containing chambers, of ports connecting said chambers, a valve controlling each port, an abutment movable by fluid-pressure for operating each valve, pipes for conveying fluid-pressure to both sides of said abutment, a valve for controlling the admission and exhaust of fluid-pressure to and from said pipes in regular order, and a device responsive to changes in steam-pressure for actuating said controlling-valve.

3. The combination with a steam-turbine having two steam-containing chambers, of ports connecting said chambers, a valve controlling each port, a fluid-pressure device for operating each valve, a cylinder communicating with the chamber having the higher steam-pressure, a piston movable in said cylinder, and a valve connected with said piston and controlling the supply of fluid to the valve-operating devices.

4. The combination with a steam-turbine having two or more stages, of separate valves controlling the flow of steam from one stage to the next, and a device responsive to variations in pressure in the higher stage and controlling said valves by means independent of the motive fluid.

5. The combination with a steam-turbine having two or more stages, of ports between said stages, a separate valve controlling each port, and a valve-operating device responsive to changes in steam-pressure in a higher stage and controlling said valves by means independent of the motive fluid.

6. The combination with a steam-turbine having two or more stages, of ports between said stages, separate valves controlling said ports, a cylinder connected with the higher stage, a piston movable in said cylinder, a controlling-valve, and operative connections between said piston and said controlling-valve.

7. The combination with a steam-turbine having two or more stages, of ports between said stages, valves controlling said ports, a movable abutment connected with each valve, pipes for conveying fluid-pressure to both sides of each abutment, and a fluid-pressure controller responsive to variations in steam-pressure in the higher stage.

8. The combination with a steam-turbine having two or more stages, of valves controlling the passage of steam from one stage to another, a movable abutment connected with each valve, pipes for conveying fluid-pressure to both sides of each abutment, a valve-chest from which said pipes run, a valve in said chest controlling said pipes, and a movable abutment connected with said valve and exposed on one side to the steam-pressure in the higher stage.

9. In a governing mechanism for elastic-fluid turbines, the combination of a plurality of regulating-valves which have an open and a closed position but no intermediate, a hydraulic motor for actuating each of the

valves, a controlling-valve common to the regulating-valves, and a means responsive to changes in stage-pressure for adjusting the controlling-valve.

10. In a governing mechanism for elastic-fluid turbines, the combination of a plurality of regulating-valves which have an open and a closed position but no intermediate, a hydraulic motor for actuating each of the valves, a controlling-valve, a plurality of passages leading from the motors to the casing of the controlling-valve, and an abutment responsive to changes in stage-pressure for moving the controlling-valve to and fro to cover and uncover the said passages.

11. In a governing mechanism for elastic-fluid turbines, the combination of a source of steam-supply, a source of hydraulic pressure, valves regulating the passage of steam through the turbine, motors actuated by fluid from the source of hydraulic pressure, and a steam-actuated motor for controlling the action of the hydraulic motors.

12. In a governing mechanism for elastic-fluid turbines, the combination of a source of steam-supply, a source of hydraulic pressure, valves regulating the passage of steam through the turbine, motors actuated by fluid from the source of hydraulic pressure, a valve which is common to the hydraulic motors, and a motor for admitting fluid to the hydraulic motors successively and cutting it off in like manner in response to changes in stage-pressure.

13. In a governing mechanism, the combination of a valve controlling the passage of fluid through the turbine, a hydraulic motor for actuating the valve, a controlling-valve for the motor, a device for actuating this valve that responds to changes in pressure of the fluid passing through the turbine, and a yielding abutment that opposes the said device and returns the valve to its initial position.

14. In a governing mechanism, the combination of a plurality of valves for controlling the passage of motive fluid through the turbine, a hydraulic motor for actuating each of the valves, conduits leading to and from the motors, a regulating-valve which controls the conduits leading to and from the motors, and a motor actuated by the same motive fluid which passes through the turbine for controlling the passage of fluid to the hydraulic motors.

15. In combination, a multistage-turbine, a plurality of stage-valves for controlling the passage of steam from one stage to another, hydraulic motors which are supported by the turbine-casing and located outside of the steam-space, a regulating-valve, conduits from the motors leading to and from the regulating-valve, and a motor actuated by steam-pressure for causing the valve to open and close the stage-valves in accordance with changes in steam-pressure.

16. In a governing mechanism for turbines, the combination of a plurality of regulating-valves, a hydraulic motor for each valve, a controlling-valve that causes the motors to successively open and close the regulating-valves, and a motor actuated by the fluid supplied to the turbine for moving the controlling-valve.

In witness whereof I havehereun to set my hand this 7th day of September, 1904.

WILLIAM L. R. EMMET.

Witnesses:

ALEX. F. MACDONALD,

HELEN ORFORD.