S. A. MOSS.

GOVERNING MECHANISM FOR GAS TURBINES.

APPLICATION FILED APR. 4, 1906.

1,000,968.

Patented Aug. 15, 1911.

3 SHEETS—SHEET 1.

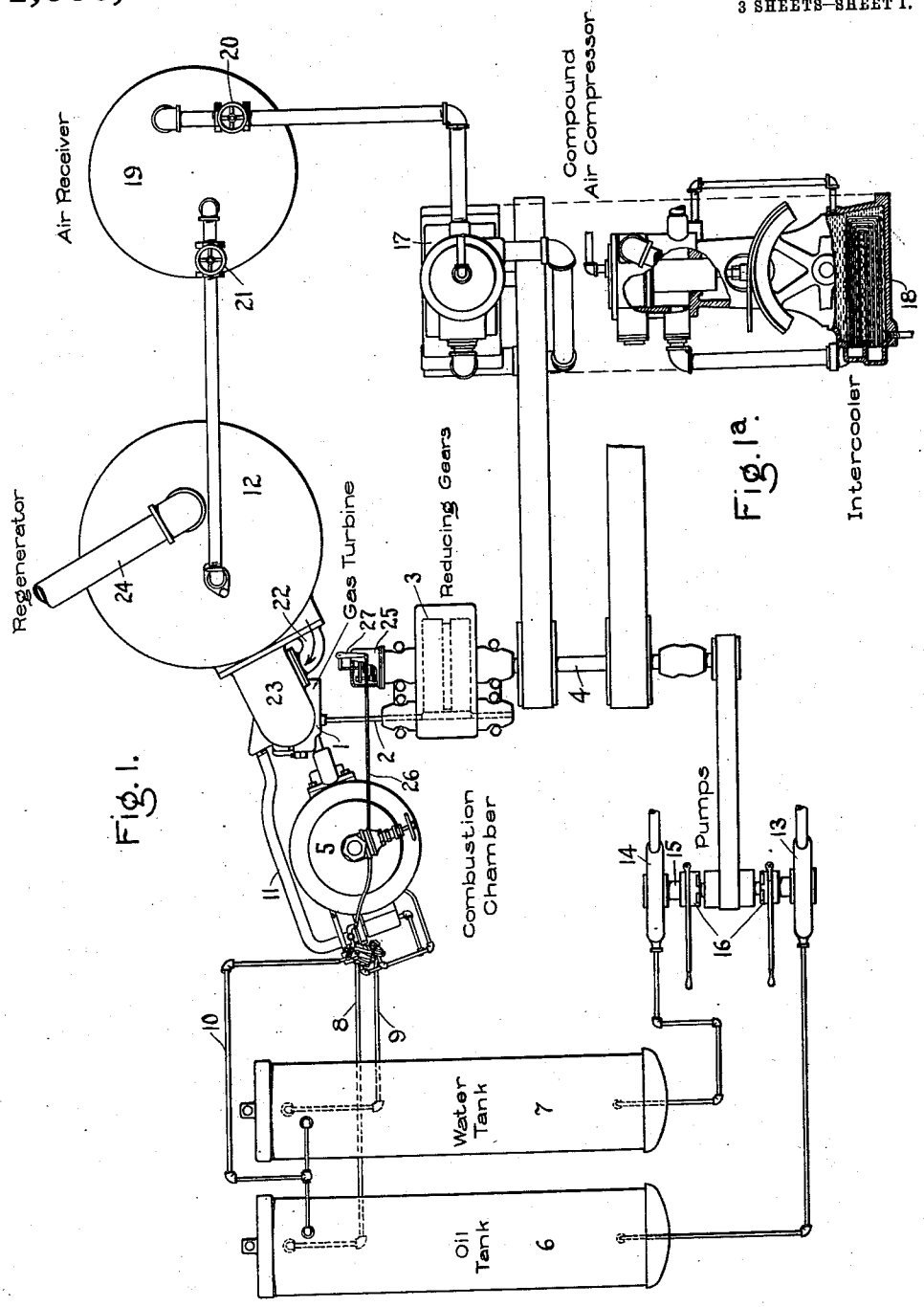

Fig. 1.

Fig. 1a.

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3 SHEETS—SHEET 2.

Fig. 2.

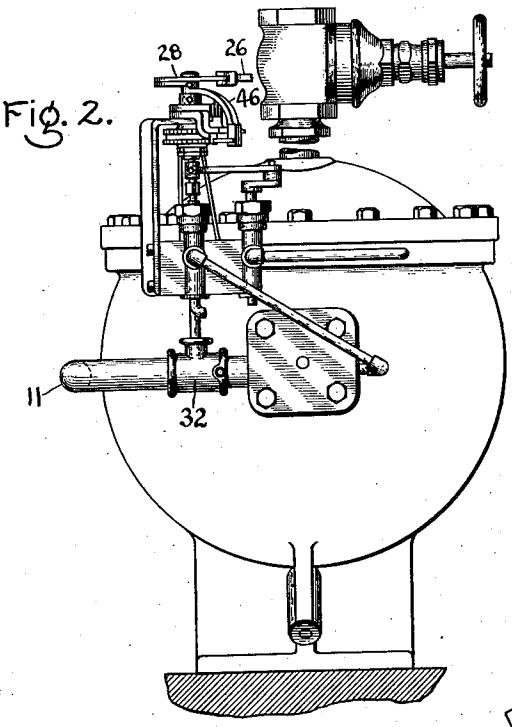
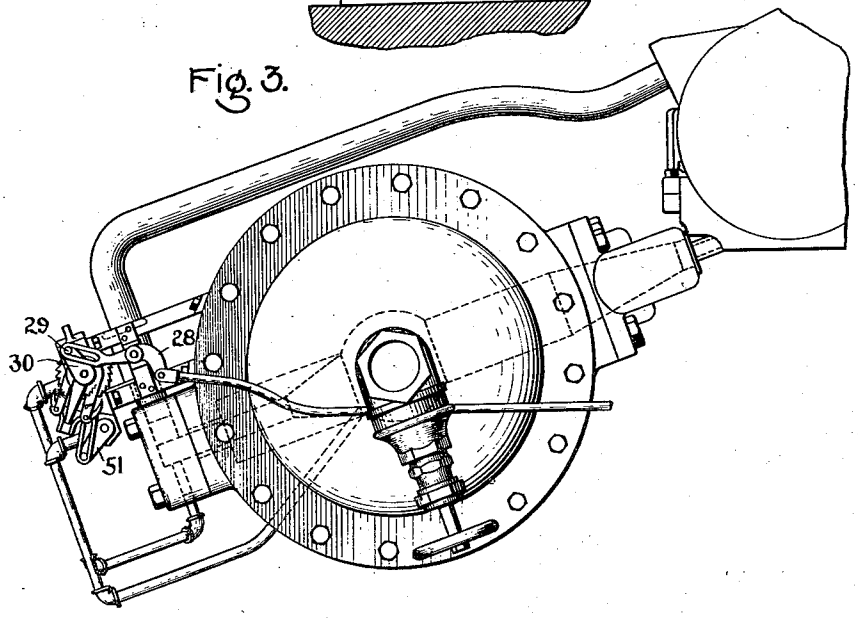


Fig. 3.



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3 SHEETS—SHEET 3.

Fig. 4.

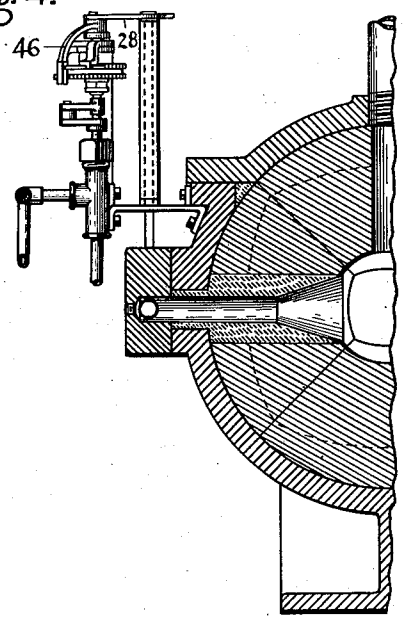


Fig. 5.

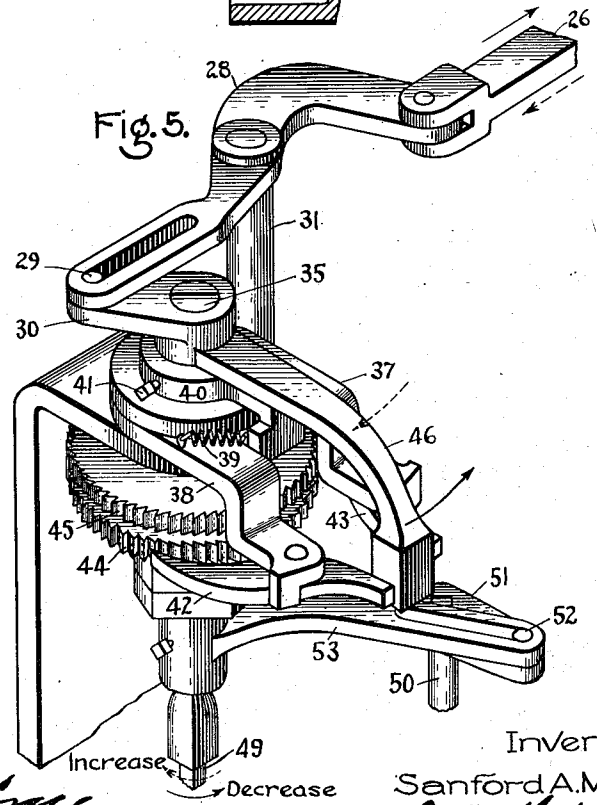
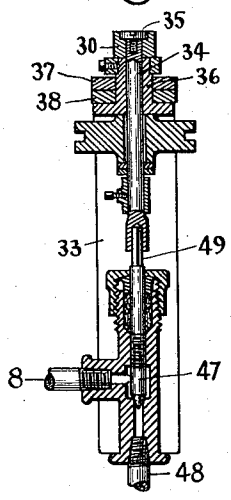


Fig. 6.



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UNITED STATES PATENT OFFICE.

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GOVERNING MECHANISM FOR GAS-TURBINES.

1,000,968. Specification of Letters Patent. Patented Aug. 15, 1911.

Original application filed December 31, 1904, Serial No. 239,089. Divided and this application filed April 4, 1906. Serial No. 309,743.

To all whom it may concern:

Be it known that I, SANFORD A. MOSS, a citizen of the United States, residing at Lynn, county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Governing Mechanism for Gas-Turbines, of which the following is a specification.

The present invention relates to governing mechanisms for gas turbines, and is a division of my application Serial No. 239,089, filed December 31, 1904, the said division having been made at the requirement of the United States Patent Office under the provisions of Rules 41 and 42.

The invention has for its object to provide a mechanism which will efficiently govern the admission of fuel, air and cooling liquid to the combustion chamber of a gas turbine in accordance with the changes in load thereon.

In the accompanying drawings, which illustrate one of the embodiments of the invention, Figure 1 is a diagrammatic view of a gas turbine, together with its accessories; Fig. 1ª is a view in elevation, with certain of the parts broken away, of a compound or staged air-compressor; Fig. 2 is a detail view in elevation of the combustion chamber and the valves for regulating the admission of fuel, air and water; Fig. 3 is a plan view of the same; Fig. 4 is a partial sectional view of the combustion chamber, showing the relation of the valve mechanism thereto; Fig. 5 is a perspective view of the mechanism for actuating the fuel- and water-controlling valves; and Fig. 6 is a sectional view through the fuel-controlling valve spindle.

Referring to Fig. 1, 1 is a gas turbine of suitable construction having a main shaft 2 that is connected through reducing gears 3 with the power shaft 4. 5 represents the combustion chamber which receives fuel from the tank 6 and a cooling fluid such as water from the tank 7. The former tank is connected to the chamber by the pipe 8, and the latter by the pipe 9. In order to equalize the pressures in the two tanks and also in the air or other gas supply and the combustion chamber, an equalizing pipe 10 is connected to both tanks and to the pipe 11 conveying air from the regenerator 12 to the combustion chamber. Fuel is supplied to the tank 6 by means of a suitable pump 13, and water is supplied to the tank 7 by the pump 14. These pumps may with advantage be of the centrifugal type, the rotating elements of which are mounted on the shaft 15, the latter being belted or otherwise connected to the power shaft 4. Each pump is provided with a clutch 16 by means of which the rotating elements can be started and stopped.

17 represents a compound or stage air-compressor, and between the cylinders or stages is an intercooler 18 (Fig. 1ª) for reducing the temperature of the air undergoing compression. The compressor is belted or otherwise connected to the power shaft 4 of the turbine. The compressor discharges into an air receiver 19 through a conduit containing a valve 20, the latter being employed for shutting off the connection between the compressor and the receiver when the turbine is shut down. The receiver discharges air under pressure to the regenerator 12 through a conduit containing a shut-off valve 21. The regenerator contains one or more coils of pipe, conduits or passages suitably arranged through which the air passes and is gradually heated by the exhaust from the turbine. After passing through the coil or coils of the regenerator the highly heated air is discharged through the conduit 22, as indicated by the arrow, through a chamber surrounding the exhaust-carrying conduit 23 into the pipe 11, the latter communicating with the combustion chamber. The exhaust gases from the turbine, after passing through the regenerator, are discharged by the conduit 24.

Referring more particularly to the regulating mechanism, Fig. 1, 25 represents a centrifugal governor mounted on the end of the power shaft 4. This is connected to the valve-actuating mechanism by a rod 26. The motion from the governor to the rod is transmitted through a link and bell-crank lever 27, and the relation of the parts is such that the lower end of the bell-crank lever moves to the right under increase in speed and to the left under decrease in speed.

Referring now to Figs. 2 to 6, inclusive, the construction of the valve mechanism will be described in detail. 26 represents the rod which is connected at its right-hand end with the centrifugal governor and on the left-

hand end with a lever 28 having a slotted end to receive the pin 29 carried by the arm 30. The lever 28 is rigidly attached to a spindle 31 which also forms the stem or a continuation of the throttle valve 32, Fig. 2, in the air supply pipe 11. As the rod 26 moves to and fro the spindle of the valve is oscillated back and forth to vary the admission of air to the combustion chamber. As the rod moves in the direction of the full-line arrow, Fig. 5, it tends to decrease the supply of air by restricting its passage to the combustion chamber; on the other hand, when the rod moves in the direction of the dotted arrow, the reverse action takes place. 33 represents a bracket having a horizontally extending portion at its upper end, through which the spindle 34 extends. The upper end of the spindle receives the arm 30, which is loosely mounted thereon and held in place by the screw 35. The bracket is provided with an upright tubular projection 36, upon which are mounted the hub-like portions of the actuators 37 and 38. These actuators are normally held in the position shown in Fig. 5 by extension springs 39, one spring being provided for each arm. The outer end of each spring is connected to an actuator and the inner end to a fixed abutment 40 that is secured to the tubular projection 36 of the bracket by a set-screw 41. The outer ends of the actuators 37 and 38 are each provided with pawls 42 and 43, which engage with oppositely disposed ratchets 44 and 45. When the arm 46, which is rigidly connected to the arm 30, is moved in the direction of the dotted arrow, it depresses the inner end of the pawl 42, so that it engages with the lower ratchet 44, and in so doing rotates the spindle of the fuel supply valve 47 in a direction to increase the supply of fuel passing from the pipe 8 to the pipe 48, Fig. 6. At the time this action takes place, the actuator 37 remains stationary and in engagement with the abutment 40. As soon as the arm 46 moves back to the central position, as shown in Fig. 5, the spring 39 moves the actuator 38 back to its normal position, while the valve stem 49 remains stationary. On the other hand, if the arm 46 moves in the direction indicated by the full-line arrow, the pawl 43 will be moved into engagement with the teeth of the upper ratchet 45 and cut down the supply of fuel by rotating the valve stem in the direction shown by the arrow marked "Decrease," Fig. 5. The valve controlling the supply of water to the combustion chamber is provided with a stem 50, the latter being attached to arm 51. On the end of the arm is a pin 52 located in a slot formed in a crank 53, the latter moving in unison with the stem of the fuel valve. As the fuel-controlling valve is moved in one direction or the other from its neutral position, the supply of water to the combustion chamber is correspondingly increased or decreased as the case may be.

From the foregoing it will be seen that the movements of the rod 26 control the supply of fuel, air and water to the combustion chamber and that the ratchets and pawls form a lost-motion connection between the load-responsive device and the fuel and water-controlling valves. To state the matter in other words, the air-controlling valve is directly actuated and the fuel and water-controlling valves indirectly.

As the supply of air to the combustion chamber is reduced by throttling, the speed of the bucket wheel is instantly reduced. Vice versa, as the supply of air increases, the wheel will speed up. Decreasing the supply of air from normal will also throttle the supply of fuel to the combustion chamber. The decrease in the amount of fuel supplied is not noticed immediately, but sooner or later its effect will be noticed and the governor will then return the air-controlling valve to its normal position, the fuel-controlling valve remaining in its throttling position. A further decrease in speed due to lack of energy or an increase in load or both will cause the governing mechanism to increase the amount of air supplied and open the fuel-controlling valve to a greater extent until the maximum supply is being delivered.

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 a governing mechanism for gas turbines, the combination of a turbine, a combustion chamber for supplying energy to the turbine, a source of fuel supply which discharges into the chamber, a valve which controls the admission of fuel to the chamber, a ratchet and pawl device for moving the valve, and a speed-responsive device for actuating said device.

2. In a governing mechanism for gas turbines, the combination of a turbine, a chamber wherein combustion continuously takes place under pressure and the products thereof are supplied to the wheel of the turbine to produce rotation, sources of fuel and gas supplies feeding into the chamber and under a pressure superior to that of the chamber, valves for throttling the admission of fuel and gas to the chamber to a greater or less extent, a load-responsive device, a connection from the load-responsive device for positively moving the gas-controlling valve, and

a lost-motion connection between the fuel-controlling valve and the load-responsive device for actuating the valve.

3. In a governing mechanism for gas turbines, the combination of a turbine, a combustion chamber for supplying energy to the turbine, a source of fuel supply which discharges into the chamber, a valve controlling the admission of fuel to the chamber, a speed-responsive device, a ratchet and pawl moved by the speed-responsive device for increasing the supply of fuel to the chamber as the load increases, and a ratchet and pawl moved by said device for decreasing the supply of fuel as the load decreases.

4. In a governing mechanism for gas turbines, the combination of a turbine, a combustion chamber for supplying energy to the turbine, a source of fuel supply which discharges into the chamber, a valve controlling the admission of fuel to the chamber, a speed-responsive device, a ratchet and pawl moved by the speed-responsive device for increasing the supply of fuel to the chamber as the load increases, a ratchet and pawl for decreasing the supply of fuel as the load decreases, and a valve also actuated by the ratchets and pawls for controlling the admission of a cooling fluid to the combustion chamber.

5. In a governing mechanism for gas turbines, the combination of a turbine, a chamber wherein combustion continuously takes place under pressure and the products thereof are supplied to the wheel of the turbine to produce rotation, sources of fuel, air and water supplies discharging into the combustion chamber and at a pressure superior to that of the chamber, a speed-responsive device driven by the turbine, an air-controlling valve which is positively actuated by the speed-responsive device, and fuel- and water-controlling valves which are indirectly actuated by the speed-responsive device.

6. In a governing mechanism for turbines, the combination of a chamber wherein combustion continuously takes place under pressure, a turbine, a conduit receiving the products of combustion from the chamber and discharging them to the turbine to produce rotation, a source of compressed air discharging into the chamber, a source of fuel supply also discharging into the chamber, the pressures of the air and fuel supplies being superior to that of the chamber, and a governing mechanism which first throttles the air supply and then the fuel supply to the combustion chamber as the speed of the turbine increases.

7. In a governing mechanism for turbines, the combination of a chamber wherein combustion continuously takes place under pressure, a turbine, a conduit receiving the products of combustion from the chamber and discharging them to the turbine wheel to produce rotation, a source of compressed air discharging into the chamber, a source of fuel supply also discharging into the chamber, the pressures of the fuel and air supplies being superior to that of the chamber, a valve controlling the air supply, a valve controlling the fuel supply, a governor which first moves the air-controlling valve and then the fuel-controlling valve, and a means intermediate the fuel-controlling valve and the governor, which permits the air-controlling valve to move without disturbing the fuel-controlling valve.

8. In combination, a turbine, a combustion chamber for supplying energy to the turbine, a source of fuel supply which discharges into the chamber, a valve for controlling the admission of fuel to the chamber, means for opening and closing the valve comprising a spindle, a connection between the spindle and the valve, a support in which the spindle is rotatably mounted, ratchet wheels mounted on the spindle and having oppositely inclined teeth, a fixed abutment on the support, actuators arranged on opposite sides of the abutment and mounted to turn about the axis of the spindle, pawls carried by the actuators, springs that tend to hold the actuators in inoperative position in engagement with the abutment, an arm mounted to turn about the axis of the spindle and having a portion that projects between said actuators, a speed-responsive device driven by the turbine, and means connecting the device and said arm so that as the arm is moved thereby in either direction, it engages an actuator and causes its pawl to move one of the ratchet wheels.

In witness whereof, I have hereunto set my hand this second day of April, 1906.

SANFORD A. MOSS.

Witnesses:

JOHN A. MCMANUS, JR.,

HENRY O. WESTENDARP.