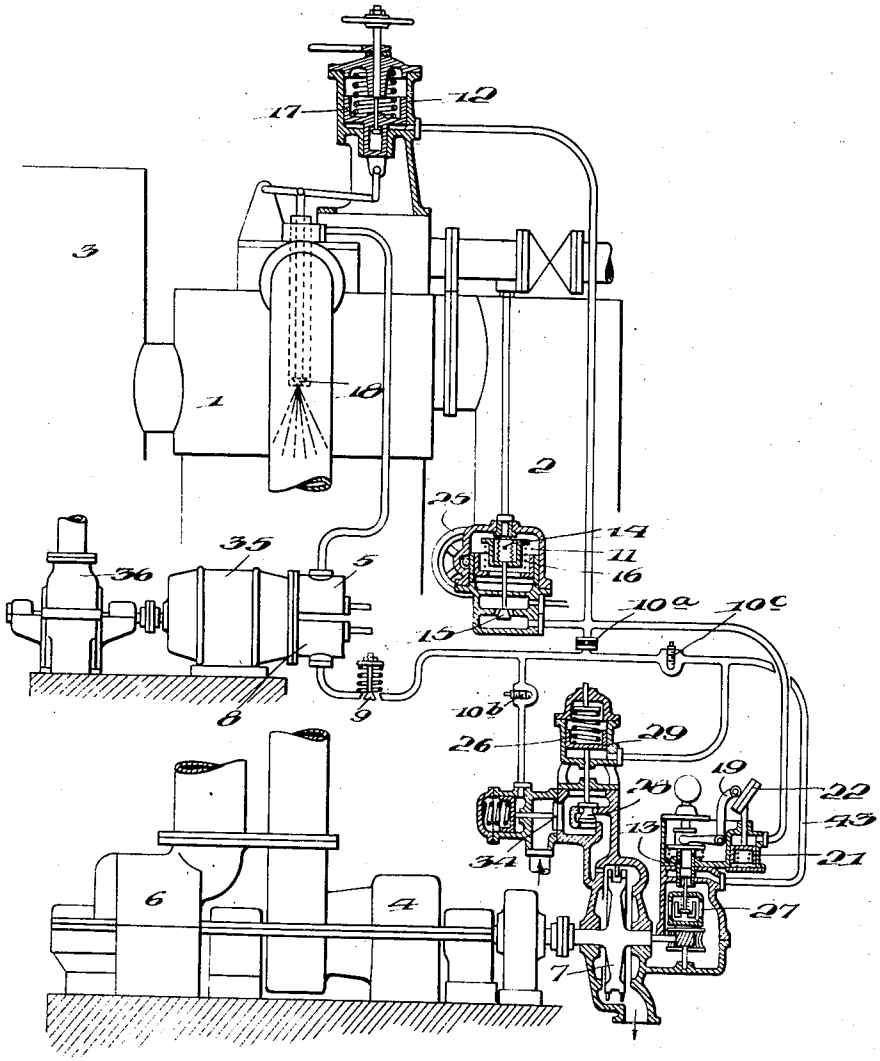
July 21, 1942. C. SEIPPEL 2,290,772

AUTOMATIC REGULATING SYSTEM FOR PRESSURE-FIRED STEAM GENERATORS OR THE LIKE

Filed Sept. 28, 1938 2 Sheets-Sheet 1

Fig. 1.



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Fig. 3.

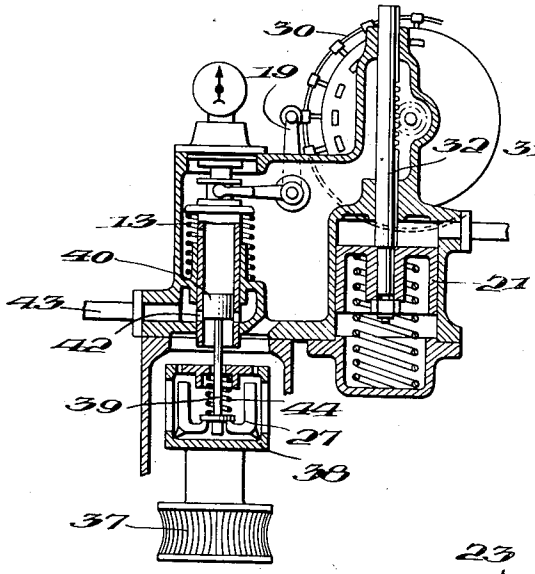


Fig. 4.

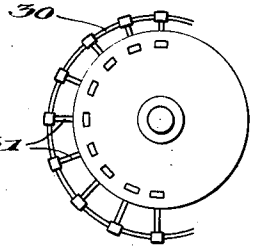
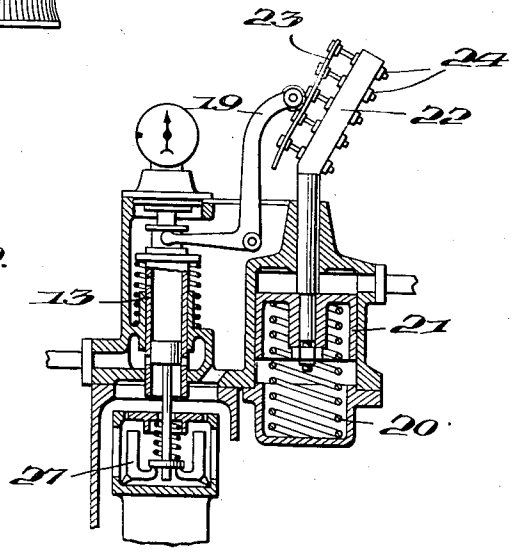


Fig. 2.



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AUTOMATIC REGULATING SYSTEM FOR PRESSURE-FIRED STEAM GENERATORS OR THE LIKE

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Application September 28, 1938, Serial No. 232,233
In Germany January 21, 1938

5 Claims. (Cl. 236—26)

In my United States Letters Patent No. 2,060,535, November 10, 1936, I have described a regulating system for pressure fired steam generators in which air is supplied to the combustion chamber by a compressor which is driven by a gas turbine and by an auxiliary motor. The turbine is driven by waste combustion gases. The speed of the auxiliary motor and of the compressor is regulated in accordance with the steam pressure in the generator. Thus, variations in the steam pressure in the generator may serve to vary the speed of the auxiliary motor and thereby also the speed of the compressor and consequently the air supply to the combustion chamber. The fuel supply to the combustion chamber also is controlled by variations in the steam pressure. This regulation is intended to maintain a predetermined pressure in the steam generator, regardless of variations in the steam demand upon the generator. By adjusting the setting of the speed regulating mechanism any desired boiler steam pressure may be established and will be maintained automatically. According to said patent an electric motor of a type capable of maintaining a constant speed under a varying load was selected for use as the auxiliary motor.

Now I have found that a steam turbine may serve as the auxiliary motor. The steam turbine is regulated in the usual way by varying the supply of driving steam. In accordance with the present invention the auxiliary steam turbine is provided with regulating mechanism for varying its speed to maintain a predetermined boiler pressure, regardless of the demand upon the boiler. It is also possible, as in the apparatus of the patent, to adjust the setting of the control mechanism so as to automatically maintain any desired steam pressure.

Apparatus in accordance with the invention is illustrated in the accompanying drawings in which:

Fig. 1 is a diagrammatic front elevation with parts in section showing the complete assembly of the steam generator and the controlling means;

Fig. 2 is an enlarged vertical section of a specific form of the mechanism for controlling the speed of the turbine;

Fig. 3 is an enlarged vertical section of a second specific form of mechanism for controlling the speed of the turbine; and

Fig. 4 is a front elevation of the curved track and supporting and adjusting mechanism shown in Fig. 3.

Referring to the drawings, 1 is a pressure fired steam generator, for instance a Velox boiler. 2 is the superheater and 3 the steam separator. The air for combustion is supplied by the compressor 4 and the fuel is supplied by the pump 5. The compressor 4 is driven by the gas turbine 6, the motive fluid for which is the hot gas coming from the superheater 2. According to the invention the steam turbine 7 is used as the auxiliary motor. Oil under pressure is supplied by the pump 8 and maintained under a definite pressure in the communicating pipes by the pressure limiting valve 9. This pressure is throttled down by the throttle valves 10*a*, 10*b* and 10*c* to the pressures which are suitable for operation of the auxiliary apparatus employed. This auxiliary apparatus includes the pressure regulator 11, the fuel regulator 12 and the mechanism for adjusting the position of the sleeve 13 which determines the speed of the turbine.

If the steam pressure in the generator changes due to change in the withdrawal of the steam therefrom, the pressure inside the metal bellows 14 likewise changes so that the oil regulating valve 15 is opened more or less under the influence of spring 16. More or less oil can thereby flow off, this resulting in a different oil pressure prevailing in the whole system beyond the throttle device 10*a*. The pressure on the effective piston 17 of the fuel regulator 12 therefore will likewise be different so that the regulating needle of the fuel injection nozzle 18 will spray into the combustion chamber more or less fuel that has been brought to high pressure by the fuel pump 5.

The regulation of the compressor delivering the air for combustion occurs at the same time as the regulation of the fuel supply. The compressor 4 and the steam turbine 7 are brought to a definite speed, determined by the position of the sleeve 13, which in turn is determined by the lever 19 cooperating with the piston 21 and slide plate 22. Piston 21 is actuated by the same oil under pressure that controls the piston 17 of the fuel nozzle 18. In order that the amount of fuel and air shall always remain in correct relation to each other, the slide plate 22 is provided with a curved track 23 (Fig. 2) the contour of which can be suited to requirements by adjusting screws 24. The piston 21 is lifted by a powerful spring 20. The turbine itself is regulated in the known way by valve 28 which is opened by the same controlling oil pressure through piston 29 and closed by spring 26. The adjustment of the oil pressure required for opening the valve 28 is accomplished by the sleeve 13 which cooperates with the speed

regulator 27 to control the discharge of oil from the pressure system supplied by the pump 8.

The speed regulator 27 is a centrifugal regulator driven by worm wheel 37 from the shaft of the turbine 7. If the speed of the turbine increases, the fly weights pivot at 38 and lift the rod 39 and piston 40, compressing the spring 44. This movement of piston 40 serves to uncover ports 42 in the sleeve 13 permitting oil supplied by pump 8 and pipe 43 to escape through ports 42 to the gear casing (not shown) from which it is returned to pump 8. This causes the oil pressure in pipe 43 to drop and as a result piston 29 moves downward and valve 28 closes. Valve 28 controls the supply of steam to turbine 7 so that the above described operation checks the increasing speed of the turbine or reduces it. Thus the pressure in the boiler determines the position of the valve 15 which in turn controls the oil supply to the furnace through the regulator 12 and also controls the setting of sleeve 13 through parts 19, 20, 21 and 22. The position of sleeve 13 determines the speed of the turbine 7. The associated devices, i. e., speed regulator 27, the throttle mechanism 28 and 29 and the valve 34 serve to regulate the speed of the turbine 7 in accordance with the setting of sleeve 13.

Instead of the more straight-lined curved track 23 (Fig. 2), a more circular path could likewise be used with advantage (Figs. 3 and 4). In this case, the curved track 30 is secured by adjusting screws 31 to a disk that is turned by the rack 32. For lifting the rack, a piston 21 is again employed as was described in connection with Figs. 1 and 2. Here, 19 is again the lever for changing the position of sleeve 13.

The turbine is provided, as is customary, with a safety regulator. 34 is the main intake valve which, being likewise under the pressure of the controlling oil, can be constructed as a rapid closing valve.

In addition to the fuel pump 5 and the controlling oil pump 8, the circulating pump 36 is likewise driven by the motor 35, in case the steam generator is provided with a circulating system.

In order likewise to be able to vary the boiler pressure as desired, the spring 16 to the diaphragm 14 is adjustable by handwheel 25.

The regulating arrangement described can be used not only for steam generators but also for any pressure firing, in connection with which any other condition of operation in place of steam pressure can be used for actuating the regulating devices.

I claim:

1. In a pressure fired device, means for supplying fuel, a compressor for supplying air for combustion of the fuel under pressure, a gas turbine driven by the combustion gases of said pressure fired device and a steam turbine, both turbines being operatively connected to said compressor, and regulating means to maintain said steam turbine at predetermined speeds corresponding to all loads of said pressure fired device, the regulating means comprising a sleeve, a sleeve-shifting means, and a device responsive to changes in load of the pressure fired device and acting simultaneously upon said fuel supply means and upon said sleeve-shiftng means, the latter comprising a curved track, a lever mechanism adapted to change the position of said sleeve, a speed governor operated by said steam turbine, and a device coupled with said governor and regulating by means of its position with regard to said sleeve the quantity of steam supplied to said steam turbine.

2. In a pressure fired device, means for supplying fuel, a compressor for supplying air for combustion of the fuel under pressure, a gas turbine driven by the combustion gases of said pressure fired device and a steam turbine, both turbines being operatively connected to said compressor, and regulating means to maintain said steam turbine at predetermined speeds corresponding to all loads of said pressure fired device, the regulating means comprising a sleeve, a sleeve-shifting means, and a device responsive to changes in load of the pressure fired device and acting simultaneously upon said fuel supply means and upon said sleeve-shifting means, the latter comprising a lever mechanism adapted to change the position of said sleeve, means responsive to changes in load of the pressure fired device for actuating said lever mechanism, a speed governor operated by said steam turbine, and a plunger-like member within said sleeve and reciprocatable therein, said plunger member being coupled with said speed governor and regulating by means of its position within said sleeve the quantity of steam supplied to said steam turbine.

3. In a pressure fired device, means for supplying fuel, a compressor for supplying air for combustion of the fuel under pressure, a gas turbine driven by the combustion gases of said pressure fired device and a steam turbine, both turbines being operatively connected to said compressor, and regulating means to maintain said steam turbine at predetermined speeds corresponding to all loads of said pressure fired device, the regulating means comprising an adjustable range governor responsive to the speed of said steam turbine for regulating the steam supply to said steam turbine, means responsive to the load demand on said pressure fired device for regulating the amount of fuel supplied to said pressure fired device and for correspondingly altering the regulating range of said governor in conformance with regulation of the amount of fuel supplied whereby said governor adjusts the supply of steam to said steam turbine to maintain a compressor speed at which the required amount of combustion air for the amount of fuel supplied is delivered by said compressor at maximum efficiency.

4. In a pressure fired device, means for supplying fuel, a compressor for supplying air for combustion of the fuel under pressure, a gas turbine driven by the combustion gases of said pressure fired device and a steam turbine, both turbines being operatively connected to said compressor, and regulating means to maintain said steam turbine at predetermined speeds corresponding to all loads of said pressure fired device, the regulating means comprising a control valve member comprising two relatively shiftable parts, means responsive to loads on the pressure fired device and acting simultaneously to regulate said fuel supply means and one of said shiftable parts, and a speed governor operated by said steam turbine and connected to regulate the position of the other shiftable part, whereby to control the amount of steam supplied to said steam turbine.

5. The combination with a pressure fired steam generator comprising means for supplying fuel, an air compressor supplying air for combustion of the fuel under pressure, and a gas turbine driven by the combustion gases connected to drive said air compressor, of a steam turbine also connected to drive said air compressor, adjustable

means responsive to the speed of said air compressor and steam turbine for regulating the supply of steam to the latter to maintain a definite predetermined operating speed of said air compressor corresponding to each amount of fuel supplied, and means responsive to the load demand on said steam generator for regulating the amount of fuel supplied and for correspondingly adjusting said speed responsive means whereby to regulate said steam turbine to effect operation of said air compressor at that predetermined speed at which the latter supplies with maximum efficiency the correct amount of air for the amount of fuel being supplied in accordance with any variation in said load demand.

CLAUDE SEIPPEL.