No. 743,661. PATENTED NOV. 10, 1903.

J. N. RICE, DEC'D.

S. E. RICE, ADMINISTRATRIX.

AUTOMATIC WATER AND FUEL FEED.

APPLICATION FILED AUG. 21, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

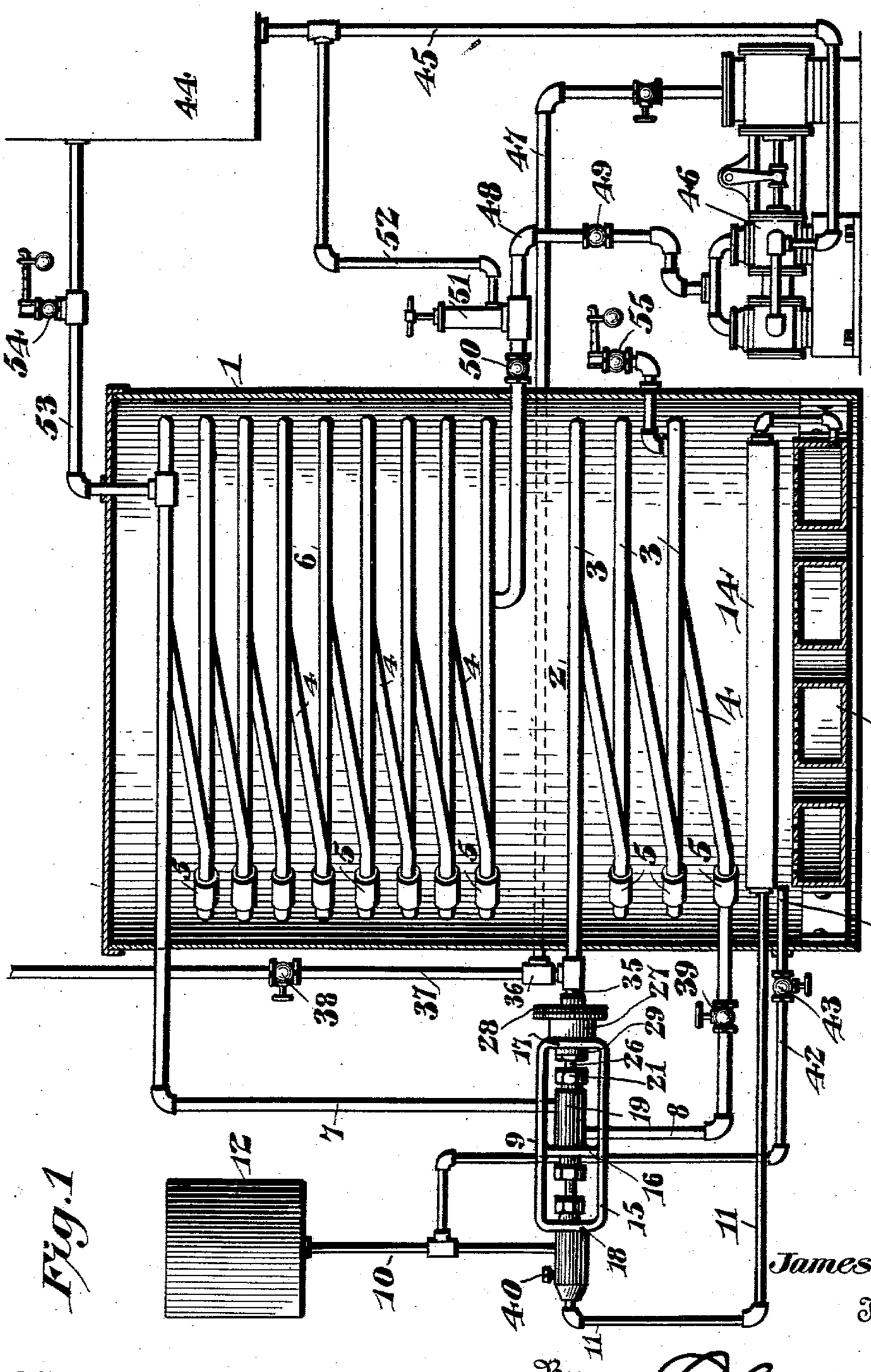

Fig. 1.

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Witnesses
Jas. E. McCathran
Louis G. Julihn

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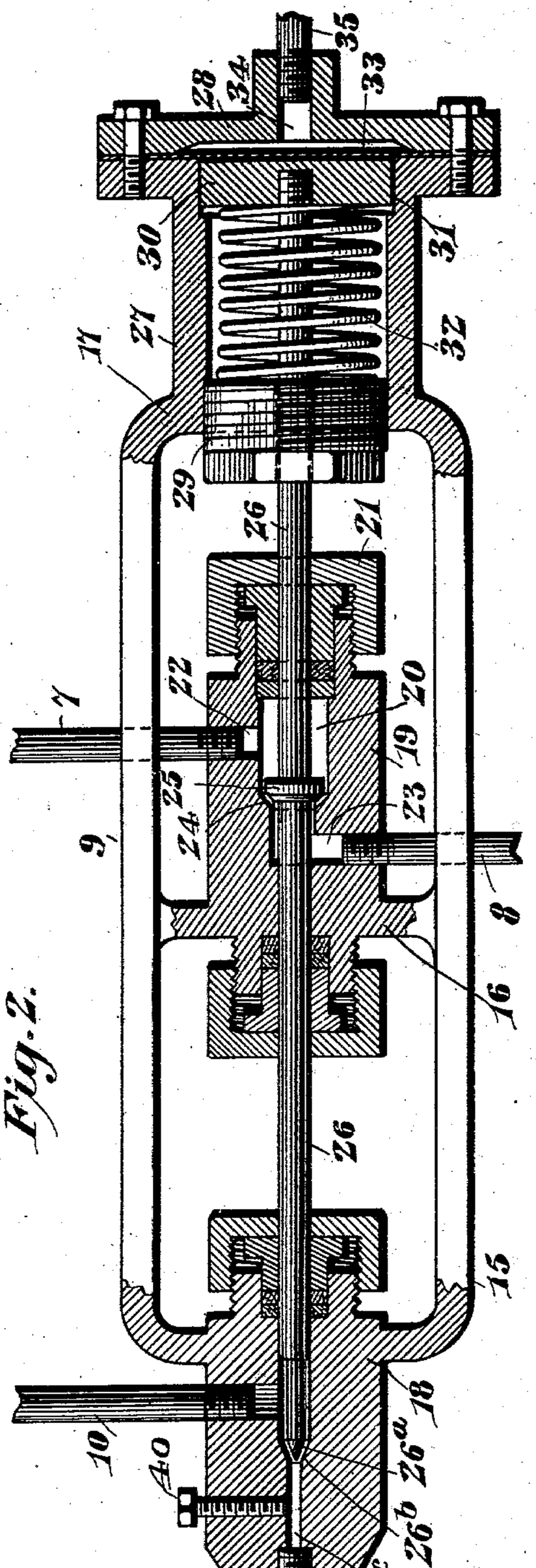

Fig. 2.

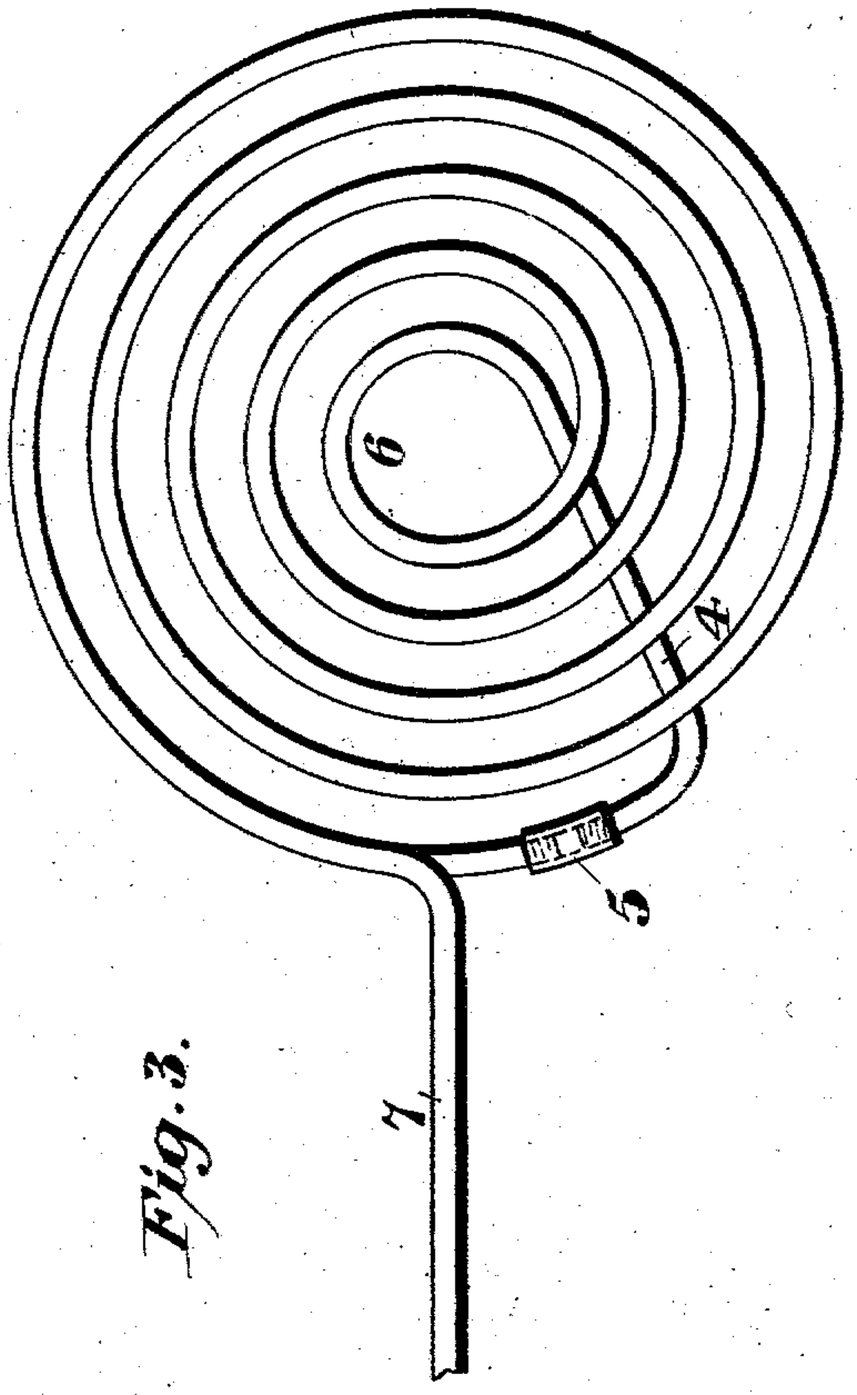

Fig. 3.

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No. 743,661. Patented November 10, 1903.

UNITED STATES PATENT OFFICE.

JAMES N. RICE, OF SCRANTON, PENNSYLVANIA; SARAH E. RICE ADMINISTRATRIX OF SAID JAMES N. RICE, DECEASED.

AUTOMATIC WATER AND FUEL FEED.

SPECIFICATION forming part of Letters Patent No. 743,661, dated November 10, 1903.

Application filed August 21, 1902. Serial No. 120,549. (No model.)

To all whom it may concern:

Be it known that I, JAMES N. RICE, a citizen of the United States, residing at Scranton, in the county of Lackawanna and State of Pennsylvania, have invented a new and useful Automatic Water and Fuel Feed, of which the following is a specification.

This invention relates to an automatic water and fuel feed for boilers of the instantaneous type, the object of the invention being to effect the automatic regulation of the water-supply for the boiler and the fuel-supply for the burner by the pressure of steam in the boiler in order that the generation of steam may be confined to such amount as is requisite under varying conditions.

To the accomplishment of this object the invention comprehends the aggroupment of a feed-water heater, a boiler, a burner for raising the temperature of the boiler to generate steam, a source of fuel-supply, and controlling means operated by the pressure of steam in the boiler and designed to regulate the water and fuel supply in accordance with the boiler-pressure. Obviously this arrangement of parts will provide a practically constant steam-pressure regardless of the varying demands upon the boiler, because an increased consumption of steam will manifestly lower the boiler-pressure, and this will in turn effect an instantaneous automatic increase of the water-supply and a proportionate increase of the fuel-supply to the burner. The generation of steam will thus be proportionate to the demand, flooding of the boiler-tubes will be prevented, and the consumption of fuel will be economized.

Other objects subordinate to that stated and additional novel features of construction will appear during the course of the succeeding description of that form of my invention which for the purpose of this disclosure is illustrated in the accompanying drawings.

In said drawings, Figure 1 is a sectional elevation of the apparatus complete. Fig. 2 is a sectional view of the combined water and fuel regulator, and Fig. 3 is a detail view of one of the coils employed in the construction of both the boiler and feed-water heater.

Like numerals of reference are employed to designate corresponding parts throughout the several views.

Within a suitable casing 1, designed merely to confine the heat, is located a boiler 2, comprising a series of tube-coils 3, each having a drop-terminal 4, constituting the inner end of the coil and coupled by means of a union 5 to the next lower coil of the series. Above the boiler is located a feed-water heater 6, comprising a series of coils constructed, connected, and relatively disposed like the coils of the boiler and designed to heat the feed-water prior to its delivery to the boiler. The water is fed from the upper coil of the heater 6 to the lower coil of the boiler, and within this line of communication are included the water-supply pipes 7 and 8 and the interposed regulator 9. The regulator 9 is also interposed between the fuel-pipes 10 and 11, constituting a line of communication between a source of fuel-supply—as, for instance, a fuel-tank 12—and a burner 13, located under the boiler. As shown, the pipe 11 is formed with an enlargement directly above the burner and constituting a vaporizer 14. It should be noted, however, that the burner and vaporizer are shown merely for the purpose of disclosing an operative structure, as any other form of heating means may be substituted for that shown, provided only that such means is furnished with a fuel-feed capable of automatic regulation.

The regulator 9 constitutes an important feature of the invention, since it is a combined regulating device for both the water and fuel feeds. This combined regulator comprises an open frame 15, having a transverse bar 16 located intermediate of the heads 17 and 18, which constitute the opposite ends of the frame. Located within the frame 15 and preferably extending in one direction from the transverse bar 16 thereof is a barrel 19, the interior of which defines a water-chamber 20, closed by a stuffing-box 21. The barrel 19 is formed with lateral ports 22 and 23 for the reception of the pipes 7 and 8, and in a plane intermediate of these ports is formed a valve-seat 24 for a water-regulating valve 25, mounted upon or integral with a stem 26 and located within the water-cham-

ber 20. Obviously the valve 25 will control the communication between the pipes 7 and 8, and therefore may be utilized for the regulation of the water-supply from the feed-water heater to the boiler.

The head 17 of the regulator-frame is formed with a barrel 27, closed at its outer end by a cap-plate 28 and at its inner end by a regulating-plug 29. The stem 26, to which the valve 25 is attached, is passed through the stuffing-box 21 and regulating-plug 29 and is provided at its extremity with a pressure-head 30, located within a pressure-chamber 31, constituting an enlargement of the internal bore of the barrel 27. Between the regulating-plug 29 and the pressure-head 30 is interposed a stout spiral spring 32, constituting a resistance device tending constantly to urge the head 30 in a direction to open the valve 25 and opposing a predetermined resistance to the closing of the valve. Opposed to the face of the head 30, at the side thereof opposite the spring 32, is a diaphragm 33, retained between the cap-plate and barrel. This diaphragm is designed to be flexed—as, for instance, by steam-pressure—to move the head 30 against the resistance of the spring 32, and thus close the valve 25 to cut off the water-supply to the boiler. In order, therefore, to conduct the steam to the regulator, the cap-plate 28 is provided with an axial port 34, into which is screwed a nipple 35, extending from a three-way fitting 36 and constituting a connection between the highest boiler-coil and a steam-pipe 37, the latter being provided with the usual throttle-valve 38.

The pressure-chamber 31 is of sufficient dimensions to accommodate the slight movement of the pressure-head 30 necessary to effect the closing of the valve 25. Thus it will appear that the steam-pressure from the boiler will be constantly directed against the outer face of the diaphragm 33 and unless opposed by a greater counter-pressure will hold the valve 25 in the closed position to cut off the communication between the feed-water heater and the boiler. Obviously, however, it is necessary to permit a constant flow of water from the feed-water heater to the boiler as long as the consumption of steam is sufficient to demand a constant supply of water to the boiler. It is therefore contemplated to provide for the closing of the valve 25 only at such times as the steam-pressure in the boiler rises beyond a predetermined limit. The retention of the valve 25 in the open position until such predetermined limit of pressure has been reached is insured by the spring or resistance device tending constantly to urge the valve to the open position, but arranged to be overcome to permit the seating of the valve whenever the steam has reached that pressure at which it is desirable to discontinue the water-supply.

The provision of the regulating-plug 24 for adjusting the resistance opposed by the resistance device or spring 32 to the closing of the valve permits the regulator to be set so that the water-supply will be regulated in accordance with any maximum steam-pressure desired, this pressure being approximately two hundred and fifty pounds under ordinary conditions.

The regulation of the fuel-supply is designed to be effected in a similar manner, since it is obvious that when a given steam-pressure has been attained in the boiler it is desirable to decrease the feed of fuel to the burner as well as to discontinue the supply of water to the boiler 2. The end of the stem 26 opposite the pressure-head 30 is tapered to form a terminal fuel-valve 26^a, designed to fit into a valve-seat 26^b, located between the ends of an angular fuel-port 26^c, formed in the head 18 of the casing. The adjacent ends of the fuel-pipes 10 and 11 are screwed into the head 18 and communicate with the opposite ends of the fuel-port 26^c, thus making the flow of fuel from the tank 12 to the burner dependent upon the position of the valve 26^a, which, as will be obvious, is determined by the position of the pressure-head 30 in the chamber 31.

The relative diameters of the water and fuel pipes or conduits will of course be proportioned in accordance with the relative quantities of water and fuel required for the proper generation of steam within the boiler. This proportion is approximately ten to one; but since it would be varied according to the construction of the boiler and the pressure of steam required the drawings are properly illustrative.

In addition to the automatic regulator I provide hand-operated valves 39 and 40 for determining the maximum feed of water and fuel. The valve 39 is located in the water-pipe 8, and the valve 40 is located in the fuel-port 26^c beyond the valve 26^a. (See Fig. 2.)

When a hydrocarbon-burner is employed, as illustrated in the present construction, the usual pilot-burner 41 will be supplied with oil by a pipe 42, controlled by a pilot-valve 43 and tapped into the pipe 10 between the fuel-tank and the regulator 9.

We have now seen the manner in which the boiler and feed-water heater are arranged and how the fuel and water feeds are automatically regulated by a regulating device common to both. It remains, therefore, to describe the manner in which the feed-water heater 6 is supplied with water. At a point exterior to the casing 1 is located a source of water-supply—as, for instance, a tank 44—in communication by means of a pipe 45 with a steam-pump 46, preferably though not necessarily what is known as the "Worthington duplex pump." The pump 46 is supplied with steam from the boiler 2 by a steam-pipe 47 in communication with the steam-pipe 37 at a point between the regulator and the throttle-valve 38. The water-main 48 of the pump communicates with the lowermost coil of the feed-water heater and is provided with

check-valves 49 and 50, between which is located a hand-pump 51, designed to be used in starting up the apparatus and having the water-supply pipe 52 connecting with the barrel of the pump and with the pipe 45, as shown. The feed-water heater is preferably provided with an overflow-pipe 45, communicating with the upper coil thereof and leading back to the tank 44, which overflow-pipe is preferably equipped with a safety-valve 54. The boiler is provided with a similar safety-valve 55.

In brief the operation of my device is as follows: The valve 54 in the overflow-pipe 53 is set to open at a somewhat higher pressure than that which will effect the automatic stopping of the pump 46. The resistance device of the automatic regulator is adjusted in accordance with the maximum steam-pressure desired in the boiler, and the valves 39 and 40 are set to determine the maximum water and fuel supply required for the generation of the desired steam-pressure without flooding the tubes, wasting the fuel, or unduly raising the temperature within the casing. The hand-pump 51 is now operated to pump the water from the tank 44 into the feed-water heater. The burner is lighted, and as the water and fuel valves of the regulator 9 will be open water will be supplied to the boiler and fuel to the burner. As soon as the steam generated in the boiler is sufficient to operate the pump 46 the latter will be automatically set in motion to supply water to the feed-water heater and thence to the boiler. This will continue until a predetermined steam-pressure has been attained in the boiler, which pressure will of course be determined by the adjustment of the resistance device 32 of the automatic regulator 9. As soon, however, as the pressure reaches such limit the pressure-head 30 will be forced back to close the water and fuel valves 25 and 26ª, thus reducing the water and fuel supply, according to the extent to which the valves are closed. Immediately upon the dropping of the steam-pressure below the proper point the regulator-valves will automatically open to increase the supply of water and fuel, and this regulation will be kept up indefinitely, so as to maintain a substantially constant steam-pressure notwithstanding the fluctuations in the consumption of steam. When the escape of water from the feed-water heater is prevented by the closing of the valve 25, the pump will automatically stop, but will instantly start again as soon as the back pressure is reduced by the escape of water from the heater. Thus by the employment of a duplex or other type of automatic pump, the construction and operation of which are familiar to those skilled in the art, the entire device is rendered completely automatic, the supply of water to the boiler and fuel to the burner being regulated by the combined regulator 9, and the supply of water to the feed-water heater being likewise automatically regulated in accordance with the demands made upon the heater by the boiler. If for any reason the pressure in the water-heater should exceed the pressure at which the valve 54 is set, the latter will open and the water (or steam if perchance such has been generated in the heater) will escape into the water-tank 44 to prevent the possibility of an explosion. The apparatus constructed and operated as described besides being completely automatic is compact in form and extremely economical in the consumption of both water and fuel. It is therefore well adapted as a generator for the motors of automobiles, steam-launches, fire-engines, and the like, and its use in such connections is contemplated.

Attention is called to the fact that while the invention in one aspect thereof comprehends the employment of a regulator common to both the water and fuel feeds, such regulator is not indispensable, since the invention in a broader aspect thereof comprehends the automatic control of both the water and fuel feeds by whatever means the desired result may be attained. The combined regulator is distinctly preferable, however, because when separate regulators are employed it is necessary to adjust them accurately to insure their simultaneous automatic action. Such relative adjustment is practically impossible, whereas the employment of a single regulator makes a disproportionate feed of water and fuel absolutely impossible and facilitates the adjustment of the device for use in connection with various forms of generating apparatus.

It is thought that from the foregoing the construction and operation of the preferred embodiment of my invention will be clearly apparent; but I wish it to be distinctly understood that I do not limit myself to the construction and arrangement of parts described, as, on the contrary, I reserve the right to effect such changes, modifications, and variations of the illustrated structure as may be fairly embraced within the scope of the protection prayed.

What I claim is—

1. In an apparatus of the character described, the combination with a boiler and burner, of means for supplying water to the boiler and fuel to the burner, water and fuel valves regulating the water and fuel supply, a stem carrying said valves and having a pressure-head, means for directing steam against said head from the boiler, and a resistance device opposing the movement of the head under steam-pressure.

2. In an apparatus of the character described, the combination with a feed-water heater, a boiler, a burner, and a source of fuel-supply, of a regulator located in the line of communication between the heater and boiler, and also in the line of communication between the source of fuel-supply and the burner,

said regulator including water and fuel regulating valves, a pressure-head and a stem carrying the valves and the head, means for directing steam from the boiler to move said pressure-head, and an adjustable resistance device for opposing the movement of the valves under steam-pressure.

3. In an apparatus of the character described, the combination with a boiler, feed-water heater, a burner, and a fuel-supply tank, of a regulator located in the line of communication between the heater and boiler, and also in the line of communication between the fuel-tank and burner, interdependent water and fuel regulating valves constituting elements of the regulator, means for leading steam to the regulator from the boiler to operate the valves, an adjustable device opposing the closing of the valves, a pump for supplying water to the feed-water heater, a water-supply tank in communication with the pump, an overflow-pipe leading back to the tank from the heater, and a safety-valve in the overflow-pipe.

4. In an apparatus of the character described, the combination with a feed-water heater, a boiler, and a burner, of means for leading water from the heater to the boiler, means for leading fuel to the burner, means for regulating the water and fuel supply, a tank, a steam-pump for pumping water from the tank into the heater, means for supplying said pump with steam from the boiler, and a hand-pump for initially filling the feed-water heater from the tank.

5. A combined fuel and water regulator including water and fuel regulating valves, a stem connecting said valves and provided with a pressure-head, an adjustable resistance device opposing the movement of the stem in one direction, and means for directing steam to operate the pressure-head to urge the valves in opposition to the resistance device.

6. A combined water and fuel regulator having a pressure-chamber and valve-seats, of a stem provided with water and fuel valves disposed opposite the seats, and with a pressure-head located in the pressure-chamber, a diaphragm opposed to the head, means for leading a fluid under pressure to the pressure-chamber to flex the diaphragm and move the head, a spring opposing the movement of the stem in one direction, and an adjustable device for regulating the tension of the spring.

7. In an apparatus of the character described, the combination with a casing, of a boiler and a feed-water heater located in the casing, heating means for the boiler and heater, and means controlled by the pressure of steam in the boiler for automatically regulating the supply of water to the boiler from the feed-water heater.

8. In an apparatus of the character described, the combination with a feed-water heater, a boiler, and heating means, of a pump for supplying water to the heater, an automatic regulating device located in the line of connection between the feed-water heater and boiler, and means for leading the steam from the boiler to the regulating device and pump respectively.

9. In an apparatus of the character described, the combination with a casing, of a feed-water-heating coil therein, a boiler-coil below the heating-coil, a heating device located below the boiler-coil, means for supplying water to the lower end of the heating-coil, a pipe for leading water from the upper end of the heating-coil to the lower end of the boiler-coil, and a regulating device located in the line of communication between the heater and boiler coils and controlled by steam-pressure.

10. In an apparatus of the character described, the combination with a casing, of a burner therein, a boiler-coil located above the burner, and a feed-water coil above the boiler, of a fuel-supply tank in communication with the burner, a pipe establishing communication between the upper end of the heating-coil and the lower end of the boiler-coil, means for supplying water to the lower end of the heating-coil, a combined water and fuel regulator for controlling the supply of fuel to the burner and water to the boiler, said regulator being controlled by steam-pressure.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

JAMES N. RICE.

Witnesses:
M. B. DEAN,
M. J. MURRAY, Jr.