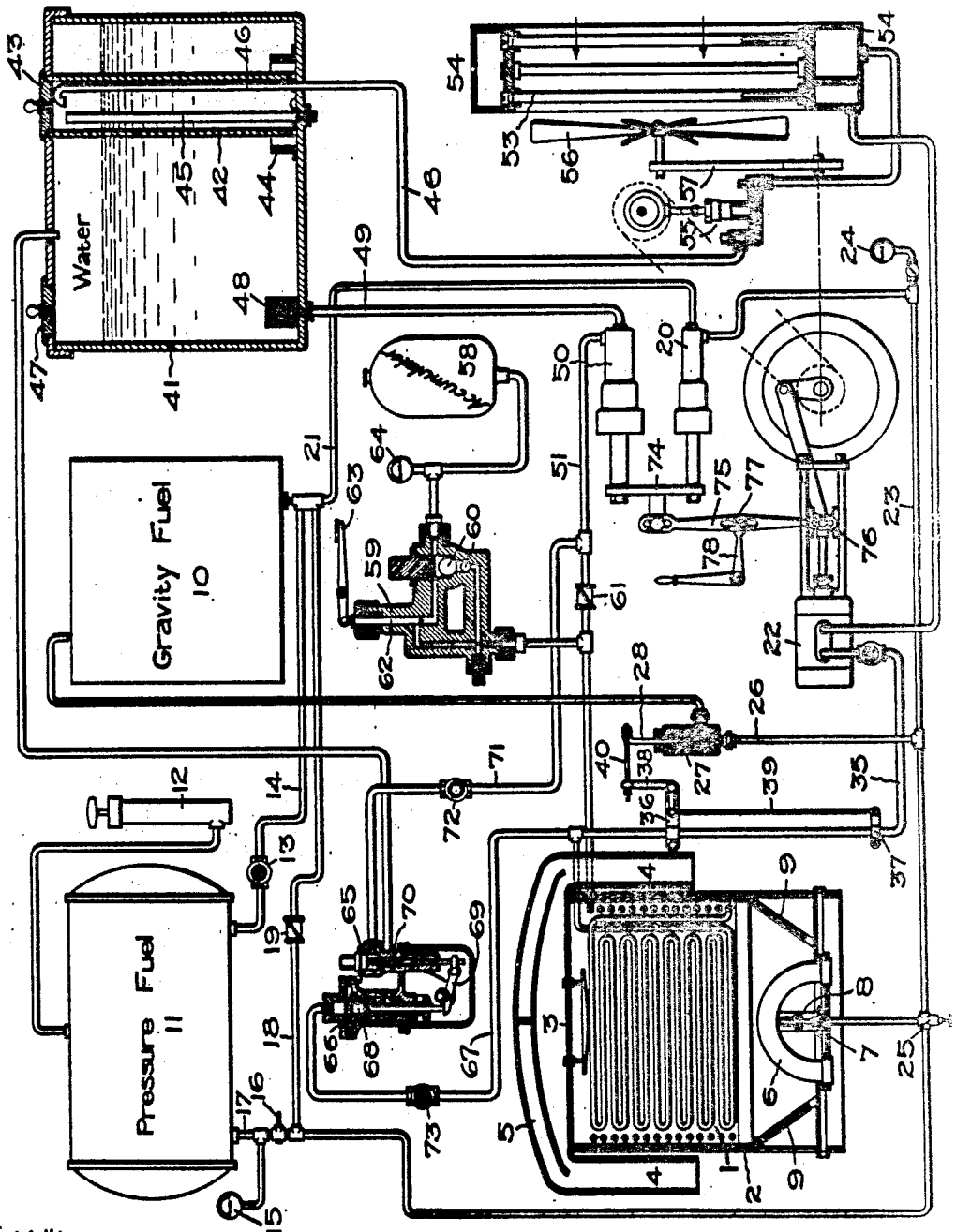


A. M. STANLEY.
POWER GENERATING SYSTEM.
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1,060,034.

Patented Apr. 29, 1913.



Witnesses:

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UNITED STATES PATENT OFFICE.

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POWER-GENERATING SYSTEM.

1,060,034.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, ARTHUR M. STANLEY, a citizen of the United States, residing at Lynn, in the county of Essex, State of Massachusetts, have invented certain new and useful Improvements in Power-Generating Systems, of which the following is a specification.

The present invention relates to power generating systems, wherein a coil boiler is provided which is heated by a hydro-carbon burner.

Theoretically in such a system, the amounts of fuel and water supplied to the burner and boiler respectively, should correspondingly increase when the demand for steam increases and by an amount determined by said increase, and decrease correspondingly when the load decreases and by an amount determined by said decrease. In practice I have found that such a system is defective in certain particulars, especially in starting initially, or in driving a suddenly applied heavy load. As applied to an automobile, for example, the engine and consequently the boiler and burner are suddenly called upon to perform more work when the road quickly changes from hard macadam to sand or a steep grade is encountered. Under these conditions there is danger of what is termed a "cold" boiler, meaning thereby that there is not heat enough produced by the burner to vaporize the cold water introduced into the boiler coil.

My invention has for its object to improve the type of power system referred to, whereby the initial starting is facilitated, and the ratio between the effective supplies of fuel to the burner and water to the boiler is capable of being adjusted to meet wide variations in load changes.

The accompanying drawing, which illustrates one of the embodiments of my invention, is a diagrammatic view of a power generating system.

1 indicates a coil boiler of any suitable construction, and 2 a casing therefor. This casing is provided with an opening 3 through which flue gases pass to the downwardly opening flues 4 when the apparatus is operating under normal conditions and to a natural draft flue 5 when the system is generating a small amount of power, in the case of a vehicle when the latter is standing still.

Situated below the coil boiler is a hydro-carbon burner of any suitable construction, comprising in the present instance a semi-circular vaporizer 6, a nozzle 7 for discharging the vapor and a baffle plate 8 which spreads the vapor and causes it to mix with the necessary amount of air previous to combustion. Situated on opposite sides of the burner are deflector plates 9 which deflect the incoming current of air to a point below the level of the baffle plate 8.

For convenience in describing the system, the parts relating to the fuel system will be described first, and later those relating to the water supply system.

10 indicates a fuel tank working under atmospheric pressure, and acting to supply fuel by gravity. This tank ordinarily occupies a convenient position above the level of the other fuel receiving parts.

11 indicates a fuel tank that is in practice considerably smaller than the tank 10 and the fuel therein is subjected to a suitable air pressure by means of the hand pump 12. Under ordinary conditions the air pressure in this tank is about 25 lbs. Bearing in mind that the pressure tank is below the gravity tank, when it becomes necessary to fill the pressure tank the pressure thereon is relieved and the hand valve 13 in the connection 14 between the two tanks is opened when fuel will flow from tank 10 to tank 11. After the necessary amount of fuel has passed into the pressure tank, the hand valve 13 is closed and tank 11 placed under suitable air pressure, which can be determined by the pressure gage 15 located at any convenient point. The fuel is normally confined within the tank 11 by a manually actuated valve 16 in the discharge pipe 17 of the tank. This pipe is connected to the vaporizer of the burner so that when the fuel pump is not operating, or is producing only a low pressure, fuel under pressure therefrom will keep the system in operation. The tank 11 may also be used in starting.

The gravity tank 10 is connected to the discharge pipe 17 of the pressure tank by a pipe 18 which contains a check valve 19 that opens toward the burner and closes to prevent fuel passing from the pressure tank to the gravity tank. The pipe 18 is used in service for maintaining a pilot flame. Fuel passes from the gravity tank 10 to the suc-

tion side of the fuel pump 20 by the pipe 21. This pump is driven by the steam engine 22 through a suitable power transmitting means which will be described later. The discharge side of the pump is connected to the burner by the pipe 23, which pipe contains a gage 24 suitably located within the range of vision of the operator. Located between the pipe 23 and the burner is a shut-off valve 25 by means of which the supply of fuel to the burner from the gravity tank, pressure tank and pump may be cut off. Connected to the pump discharge at a point between the pump and the burner, as for example, to the pipe 23, is a by-pass 26 for by-passing excess fuel back to the gravity tank 10. In this by-pass is a valve 27 comprising a screw threaded stem 28 having an arm on its upper end by means of which it can be rotated. Under normal operating conditions, this valve is closed so that no fuel is by-passed to the tank. In order to control the by-pass, a thermostatic regulator is provided, which may be made in a variety of ways, but which I prefer to make in the following manner. Mounted upon the pipe 35 discharging steam to the engine, are two clamps 36 and 37. To the upper clamp is pivotally attached a bell-crank lever 38. Its lower arm is pivotally connected by a rod 39 to the lower clamp 37. The upper end is connected by a rod 40 to the arm on the by-pass valve. As the temperature of the steam increases, the section of steam pipe between the clamp expands, which results in separating the clamps by a certain distance, and since the rod 39 is not so affected, the upper end of the bell crank lever is swung to the left and with it the stem 28 of the by-pass valve. This operation results in opening the valve by a greater or less amount, depending upon the increase in temperature of the steam, and hence a greater or less amount of fuel will be by-passed from the discharge side of the pump to the gravity tank. Assuming that the by-pass valve is open and the temperature of the steam falls below a certain point, that portion of the steam pipe between the clamps 36 and 37 will contract and in so doing, cause the bell crank lever to move and close the by-pass valve, when all of the fuel from the pump will pass into the burner.

The water system will now be described. 41 indicates a water tank from which water is supplied by gravity to the suction side of the water pump. Within the tank is located a vertical tube 42 which has a number of perforations or notches at the bottom to permit water to flow therefrom into the main portion of the tank. This tube is provided with a detachable cover 43 by means of which the interior of the tube can be inspected or cleaned. Located at the bottom of the tank and surrounding the tube is an oil trap 44, which in the practical embodiment of my invention I make in the form of a cylinder about four inches in height. This I have found to give satisfactory results. Located within the tube 42 is a pipe 45, which does not extend quite up to the top of the tank and extends through the tank and is open at both ends. This pipe forms an over-flow and determines the level of the water in the tank. There is also located within the tube 42 a pipe 46 for returning the water of condensation from the condenser to the tank. Since a reciprocating engine is employed as the motor agent and lubricant is necessary for lubricating the piston, a certain amount of oil will be carried over into the condenser and discharged into the tube 42, where it will float upon the water, and owing to the fact that an oil trap is provided it will be prevented from passing with the water into the pump. Whenever the tank is filled, which is done by removing the cover 47 and introducing a hose pipe, the water as it fills the tank also fills the tube 42 and causes the oil on top of the water therein to rise until finally it flows through the over-flow pipe 45 and escapes. Each time the tank is filled, I intentionally allow a certain amount of water to flow through the over-flow pipe 45 and in this manner I make sure that all the oil is carried off. The water from the tank passes through the strainer 48 and the pipe 49 to the suction side of the pump. Owing to the trap the oil in the tube is prevented from passing to the pump. The discharge from the water pump 50 is conveyed by the pipe 51 to a coil which surrounds the boiler proper and connects therewith. After the water is vaporized and steam at the desired pressure and degree of superheat is formed, it passes through the portion of the pipe forming the thermostatic regulator and the pipe 35 to the steam engine 22, wherein it performs useful work, and after exhausting passes to the surface condenser 53. This condenser comprises upper and lower headers 54, which are connected by a plurality of vertical tubes. The water of condensation is pumped by the reciprocating pump 55 through the pipe 46 into the tube 42 within the water tank. The pump 55 is driven by the engine 22, as is also the fan 56. This fan may be driven by a suitable belt or gearing 57 from the main shaft of the engine. The shape of the blades and the direction of rotation is such that the fan causes air to pass through the condenser in the direction of the arrow. The action of the fan is augmented when the power system is mounted on a vehicle by the movement of the vehicle itself. The air in passing through the condenser is warmed to a certain degree and I prefer to so arrange the fan 56 that it dis-

charges the air passing through the condenser, into the apertures admitting air to the burner.

In a system of this character it is necessary to provide means for forcing water into the boiler before sufficient steam is formed to drive the engine and pumps. Also to provide a means for temporarily assisting the water pump in case the demand for power exceeds the capacity of the pump when running at a definite speed. To provide for this, an accumulator 58 is used that contains a certain amount of water and also air under pressure. For normal operating conditions, I have found an air pressure of 200 lbs. per square inch to be satisfactory. Inserted between the accumulator and the discharge pipe 51 of the pump is a regulator 59, comprising in the present case two ball check valves 60 which open to permit of water being forced by the pump into the accumulator, but prevent water from passing from the accumulator into the pipe 51 and thence to the boiler. The connection between the regulator and the pipe 51 is made on the boiler side of the check valve 61, which opens toward the boiler and prevents water from being forced by the accumulator into and through the pump when the accumulator is in operation and its pressure is superior to that of the pump. In order to make use of the accumulator, a valve 62 is provided that is actuated by a foot-pedal 63, the latter being situated within easy reach of the operator and when used on a vehicle, preferably beside the steering post. Assuming for example, that the water pressure in the system has dropped down to an abnormally low point and the engine is running slowly and it is desired to suddenly increase the amount of power supplied by the system, the foot-pedal is depressed, which opens the valve and permits more or less water from the accumulator to pass into the boiler. The amount of water that is permitted to pass in this manner will be determined by the gage 64. While the accumulator is charged with air at 200 lbs. pressure per square inch, its actual working pressure is considerably higher than this, owing to the fact that the water on the discharge side of the pump has free access thereto and hence the pressure will be determined by that of the water system.

It sometimes happens as for example, when the apparatus is applied to a vehicle and the speed of the vehicle is high and the demand for steam is comparatively small, as for example, in going down grade, that an excess of water is provided. To prevent this from passing into the boiler a regulator 65 is provided that is under the control of the steam pressure. This regulator comprises a diaphragm 66, which is exposed on one side to boiler pressure by means of pipe

67, and on the other side to a spring-pressed abutment 68. Situated below the end of the abutment rod and mounted on knife edges, is a lever 69. The opposite end of the lever is adapted to engage and raise the stem of the by-pass valve 70. This valve controls the passage of water from the pipe 51 to the water tank by means of the pipe 71. In the pipe 71 is a hand valve 72, by means of which the by-pass can be cut out of service. The steam pipe 67 is provided with a hand valve 73 for cutting the diaphragm out of service in case of accident. The tension on the spring opposing the diaphragm is set to operate at any suitable pressure. I have found 500 lbs. to be satisfactory in actual practice. Owing to the fact that the pivot for the lever 69 is located nearer the axis of the abutment 68 than it is to the axis of the valve stem 70, it follows that a very small motion of the diaphragm will result in a considerable movement of the by-pass valve 70. This arrangement obviates or largely decreases the uncertainty of operation of the by-pass valve.

I have shown the plungers of the fuel and water pumps actuated by the cross-head 74, which cross-head is connected by a lever 75 with the cross-head 76 of the steam engine. The travel of the pump plungers is controlled by the sliding block 77 carried by a lever 78, adapted to be locked in a series of different positions depending upon the length of stroke it is desired to have the engine impart to the pump. This arrangement may be considered as typical of a manually actuated means for adjusting the length of stroke of the pumps, and hence their effective deliveries.

I prefer to employ a clutch between the engine shaft and the load, whatever be its character, so that the engine, pumps, etc., can be operated independently of the load. This is important in many particulars for it enables me to start the power pumps as soon as a small amount of steam is generated and before there is steam enough to drive the vehicle or other load for which the engine is utilized.

In practice I may operate over a wide range of burner and boiler pressure. For example, the burner pressure may be as low as ten or fifteen pounds, or as high as one hundred and fifty pounds. The boiler pressure may also be varied between wide limits. The advantages of combining variable stroke pumps with automatic by-pass regulators is very marked. Assume for example, that the temperature of the boiler is lower than it should be while the amount of steam drawn therefrom is comparatively small. I can adjust the pumps to deliver large amounts of fuel and water, and since the supply of water is a function of the steam pressure the excess will be by-passed and

all of the fuel from the pump will enter the burner and continue to do so until the temperature of the steam increases to the proper point, when the thermostatic valve will open and by-pass fuel back to the tank. As soon as this action takes place, the length of the strokes of the pumps will be shortened by adjusting the lever 78. On the other hand, if the boiler is too hot and it be desired to increase the water supply, the lever 78 is adjusted to the proper position and the excess fuel will be by-passed by the thermostatic valve.

It will thus be seen that I have all of the advantages of a proportional feed of fuel and water, the pump plungers having a definite and proportional ratio to each other, yet at the same time, I can change the effective deliveries of the fuel and water by increasing the supplies of both and automatically by-passing the fuel when it is not needed, or the water when it is not needed. The regulators are so arranged that even in the hands of an unskilled person the temperature can never exceed a certain amount, nor can the pressure rise above a certain predetermined value.

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 power generating system, the combination of a boiler, a burner, pumps for supplying water to the boiler and fuel to the burner, gravity and pressure fuel-containing tanks both of which are connected to the burner, means for changing the effective strokes of the pumps, a bypass for the fuel pump discharging into the gravity tank, a thermostat sensitive to the changes in the steam temperature for controlling said bypass and thereby regulating the supply of fuel to the burner, and a regulator sensitive to changes in pressure of the steam generated by the boiler for controlling the supply of water to said boiler.

2. In a power generating system, the combination of a boiler, a burner, pumps for supplying water to the boiler and fuel to the burner, gravity and pressure fuel-containing tanks both of which are connected to the burner, a manually actuated means for simultaneously changing the lengths of stroke of the pumps, a thermostatic regulator responsive to changes in steam temperature for bypassing excess fuel back to the gravity tank, and a regulator sensitive to changes in pressure of the steam gen-

erated for bypassing the excess water from the pump.

3. In a power generating system, the combination of a boiler, a burner, pumps for supplying water to the boiler and fuel to the burner, gravity and pressure fuel-containing tanks both of which are connected to the burner, the said gravity tank also being connected to the fuel pump, means for simultaneously varying the lengths of the pump strokes, regulators responsive to different conditions of the steam generated for bypassing the excess water and fuel delivered by the pumps, a conduit conveying the excess fuel back to said gravity tank, an accumulator connected to the boiler on the pump side, which contains a gas and water under pressure, a check valve which opens toward the accumulator, and a manually actuated valve for controlling the discharge of water from the accumulator to the boiler.

4. In a power generating system, the combination of a boiler, a burner, pumps for supplying water to the boiler and fuel to the burner, means for varying the lengths of the pump strokes, a fuel tank under pressure and connected to the burner, a valve for closing the tank against the pressure of the fuel pump, a regulator for bypassing excess fuel from the burner, a regulator comprising a diaphragm sensitive to the steam pressure in the boiler, a valve controlled by the diaphragm for bypassing water from the boiler, an accumulator which contains water under pressure and is subjected to boiler pressure, and a valve for controlling the discharge of water from the accumulator into the boiler.

5. In a power generating system, the combination of a boiler, a burner, a water tank, a gravity fuel tank, a connection between the tank and the burner for feeding the latter by gravity to maintain a pilot flame, a fuel tank normally under pressure for feeding the burner under certain conditions, a connection for discharging fuel from the gravity to the pressure tank when the pressure on the latter is relieved, a fuel pump, a connection between the gravity tank and the pump and between the pump and the burner, a water pump, a means for driving the pumps, a device interposed between the driving means and the pumps for varying their strokes, a thermostatic device acted upon by the changes in temperature of the steam produced by the boiler, a valve controlled by the thermostat for by-passing fuel back to the tank, a regulator sensitive to steam pressure, and a valve for by-passing water back to the tank.

6. In a power generating system, the combination of a boiler, a burner, a source of water supply for the boiler, a source of fuel supply for the burner, water and fuel

pumps whose plungers bear a fixed relation to each other at all times and have corresponding lengths of stroke, a bypass regulator for the water supply which opens when
5 the steam pressure on the boiler exceeds a certain amount, a bypass regulator for the fuel supply which opens when the temperature of the steam exceeds a certain amount, the two regulators being capable of independent action, a means for driving the
10 pumps, a manually actuated means for simultaneously increasing or decreasing the effective strokes of the pumps to meet the demand for fuel and water, a gravity tank
15 and a pressure tank both of which contain fuel and are connected to the burner, and an automatic valve in the connection between the gravity tank and the burner.

7. In a power generating system, the combination of a boiler, a burner for heating the boiler, a source of water supply for the

boiler, a source of fuel supply for the burner, pumps for conveying water and fuel from said sources to the boiler and burner, manually controlled means for adjusting the
25 stroke of the pumps, means responsive to steam pressure for by-passing water from the water pump back to the source, means responsive to steam temperature for by-passing fuel from the fuel pump back to
30 the source, an accumulator connected to the water supply system, a manually controlled device for admitting water from the accumulator to the supply system, and means for supplying fuel to the burner independently
35 of the fuel pump under certain conditions.

In witness whereof, I have hereunto set my hand this eighth day of July, 1908.

ARTHUR M. STANLEY.

Witnesses:

JOHN A. McMANUS, Jr.,
HENRY O. WESTENDARP.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."