No. 784,068. PATENTED MAR. 7, 1905.

C. C. PECK.

POWER SYSTEM.

APPLICATION FILED FEB. 1, 1904.

2 SHEETS—SHEET 1.

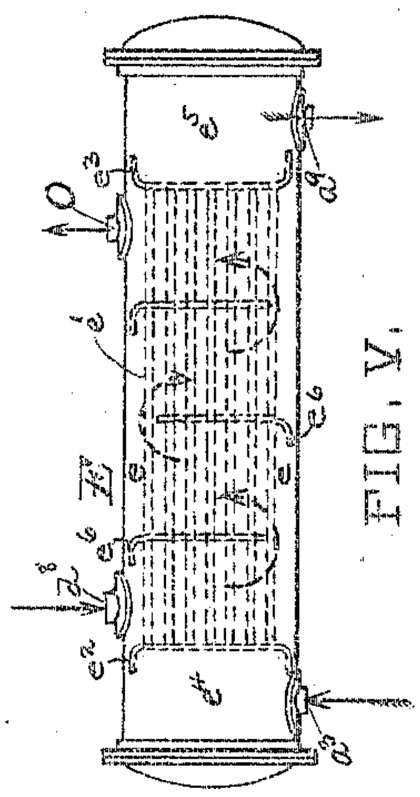

FIG. V.

FIG. 4.

WITNESSES:

William H. Whitmore.

L. D. Peck

INVENTOR

Cassius Carroll Peck

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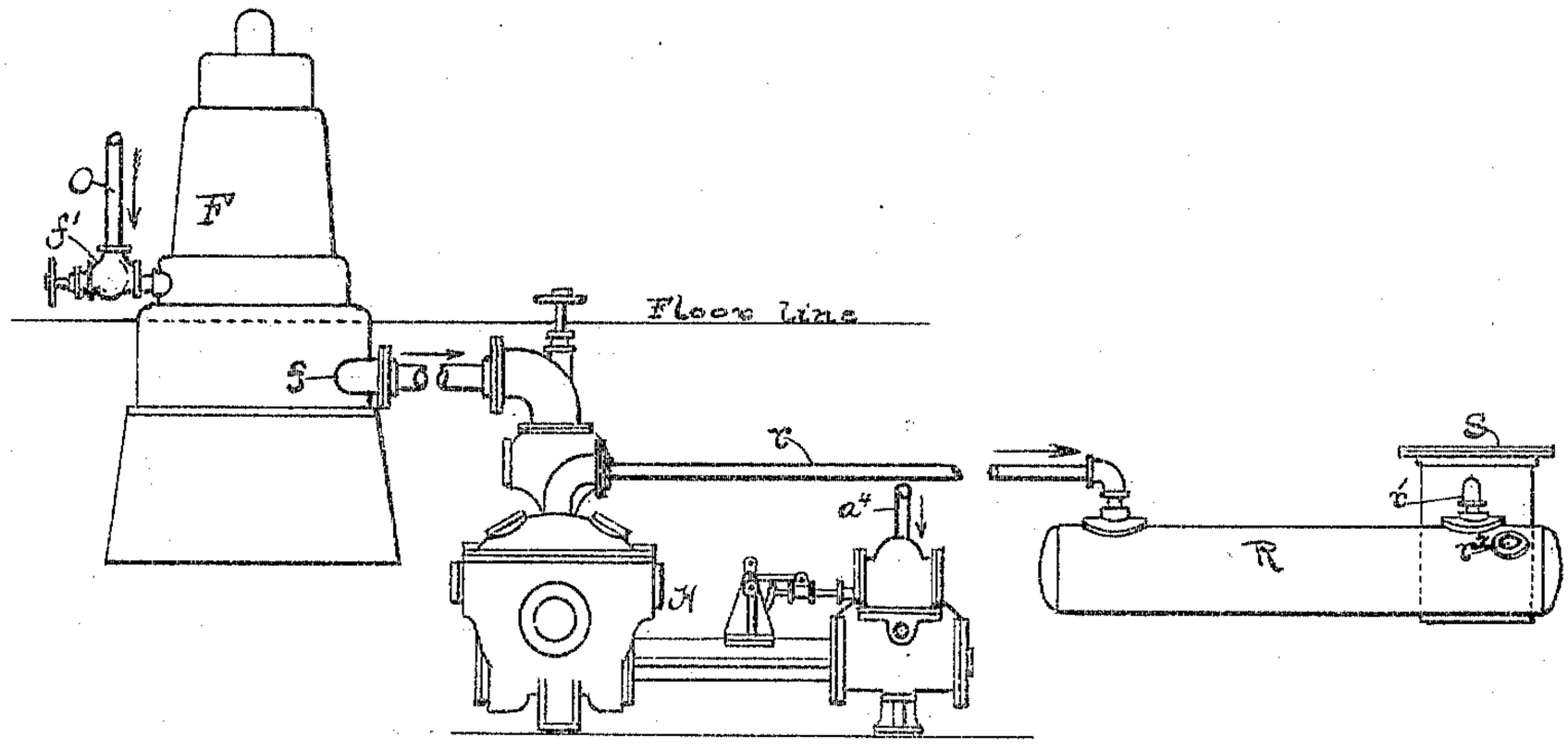

FIG. 11.

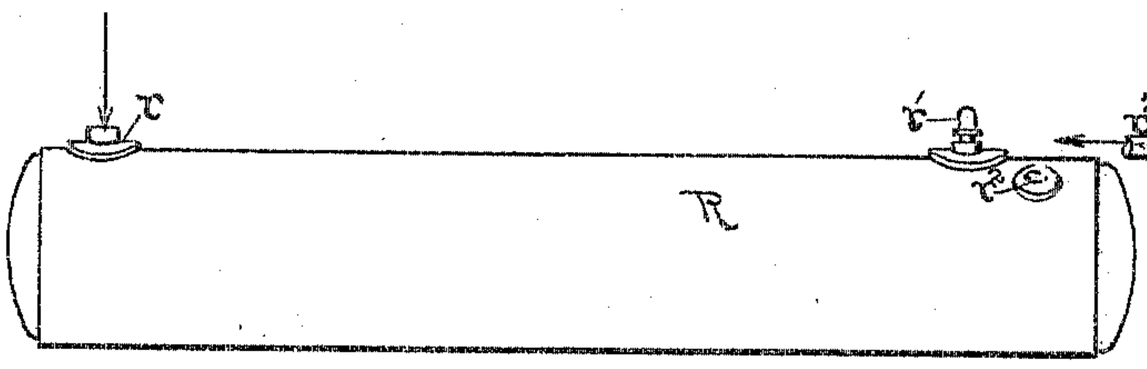

FIG. 111.

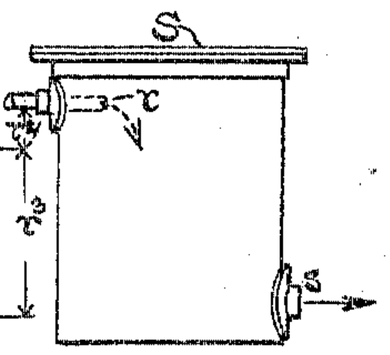

FIG. 1V.

WITNESSES:

William W. Whitmore.

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No. 784,068. Patented March 7, 1905.

UNITED STATES PATENT OFFICE.

CASSIUS CARROLL PECK, OF ROCHESTER, NEW YORK.

POWER SYSTEM.

SPECIFICATION forming part of Letters Patent No. 784,068, dated March 7, 1905.

Application filed February 1, 1904. Serial No. 191,505.

To all whom it may concern:

Be it known that I, CASSIUS CARROLL PECK, residing at Rochester, in the county of Monroe and State of New York, have invented a certain new and useful Power System, of which the following is a specification sufficient to enable others skilled in the art to which it appertains to make and use the same.

My invention relates to a power system in which live steam is used to evaporate a liquid having a lower boiling-point than water and wherein vapor from said liquid of low boiling-point is employed for driving a power-engine. In its most complete form it requires a condenser, preferably of the surface type, but susceptible of use with a jet-condenser, as hereinafter described, for condensing all vapor rejected from the engine and one or more pumps for returning the liquid of condensation from the condenser and hot-well to the vaporizing-chamber. In conjunction with these essential elements I employ a superheater for superheating vapor on its passage from the vaporizing-chamber to the engine, the superheating being effected by live steam delivered either from the boiler which supplies steam for vaporizing the liquid of low boiling-point or from a separate boiler, also a heater for the liquid of low boiling-point, from which heater the said vaporizing-chamber is supplied, preferably by overflow from the heater, the waste gases from the steam-boiler passing through fire-tubes in the heater, thus heating liquid therein.

The system is especially adapted for use with the turbine type of engine, but is also suited for use with reciprocating, rotary, and other styles of engine.

The principal object sought and attained is economy in fuel.

The system combines the well-understood advantages of high pressure, good vacuum, and superheating in convenient form for easily maintaining uniform conditions of pressure, temperature, and vacuum, of keeping all the apparatus free from deposits of solid matter, and securing the benefit of superheating the working vapor without use of excessive temperatures.

In the drawings, Figure 1 is a diagrammatic elevation showing the relation of the several elements of my invention to each other, the brickwork of the boiler-setting being shown in central section and the division-wall between boiler-room and engine-room in section. Fig. 2 is an elevation showing the relation of the turbine-engine in Fig. 1 to a jet-condenser and separating-tank for separating the liquid of low boiling-point from water. Fig. 3 is an enlarged side elevation of the aforesaid separating-tank. Fig. 4 is an end elevation of the separating-tank, showing the connection of said tank with the receiver or hot-well. Fig. 5 is an enlarged side elevation of the superheater, the internal parts being shown in broken lines.

In the figures like parts are represented by the same letters. Arrows feathered on both sides indicate the course of gases, those feathered on one side indicate steam; unfeathered, vapor.

In Fig. 1, A indicates a steam-boiler which is heated by furnace B, having inclosing walls b and grate b'. The boiler furnishes steam through pipe a, having a stop-valve a^5 and a pressure-regulating valve a^6, to steam-space d d' and tubes d^2 in vaporizer D. The steam heats and vaporizes the liquid of lower boiling-point than water contained in vaporizing-chamber d^5, the steam heat being mainly transmitted to said liquid through tubes d^2. Water of condensation formed from the steam flows by gravity through pipe a^7 and check-valve t into trap T and thence through pipe a^8, having a check-valve t' and a stop-valve t^3, into boiler A. The return-trap T and also return-trap T′ are typical of any mechanism for automatically returning water of condensation from vaporizer D and superheater E, respectively, to boiler A, as I do not confine myself to any specific apparatus for automatically returning water of condensation from the said vaporizer and superheater. Other forms of return-traps, a steam-loop, or a pump and receiver could be used, a return-trap being a convenient device when the vaporizer and superheater are located above the level of the boiler. The stop-valve a^5 and regulating-valve a^6 control the supply and pressure of steam admitted to vaporizer D. Said regu-

lating-valve prevents vapor-pressure in chamber d^5 from exceeding a predetermined amount and at the same time provides a constant and uniform steam temperature in contact with the heating-surfaces of tubes d^2. Said tubes and the tube-heads and the shell of the vaporizer are made of suitable metal for the liquid contained in chamber d^5. In a case where vaporizer D is not sufficiently large for the service required, as by sudden and extreme demands for power, chamber d^5 and pressure-regulator a^6 can be connected with a thermostat which will operate to increase the steam-passage through the regulator should vapor-pressure in chamber d^5 fall undesirably low. I do not, however, show the thermostat, as it is not a necessary part of my system. As steam-pressure is normally lower in vaporizer D than in boiler A, it is necessary to provide some means of automatically returning water of condensation from the vaporizer to the boiler. By such arrangement the boiler is constantly fed with its own condensed steam, thus avoiding the introduction of solid matter with fresh feed-water and keeping the heating-surfaces at maximum efficiency, as well as contributing to the safety and long life of the structure. From vaporizer D the vapor from space d^6 above the liquid-level in chamber d^5 is generally conducted by pipe d^7 and branch pipe d^8, having stop-valve d^9, to the vapor-space e in superheater E, where it is superheated by the steam-heating-tubes e'. These tubes are preferably expanded into tube-plates e^2 e^3, and the tubes, plates, and shell of the superheater are made of metal suited to the purpose. The tubes and steam-space e^4 e^5 are supplied with live steam through branch steam-pipes a' a^3, the former having stop-valve a^2 and the latter stop-valve a^4 and pressure-regulating valve a^7. By the latter any desired steam-pressure and temperature can be maintained in the steam-space of the superheater, thus providing for superheating the vapor from liquid in chamber d^5 to the required extent and to nearly uniform extent if superheater E be properly proportioned. Drain-pipe a^9 may be connected to any boiler, but is here shown as delivering water of condensation from the superheater into return-trap T', from which it is conducted by pipe a^{10}, having stop-valve t^6, to the water-space of boiler A. Pipes a^9 a^{10} have, respectively, check-valves t^4 t^5. In a power plant of considerable size a special boiler may be devoted to furnishing steam for superheating vapor from a number of vapor-generating units similar to chamber d^5; also, more than one vaporizer similar to D may be supplied from one boiler, or more than one boiler may be used for furnishing steam to a single vaporizer of same character as D. Deflecting-plates e^6, Fig. 5, cause the vapor from liquid of low boiling-point to pass in a circuitous course through chamber e of the superheater, as indicated by arrows, thus causing it to impinge effectively against steam-heating tubes e' and become sufficiently superheated before entering pipe O, which conducts it to the vapor turbine-engine F. Said pipe has a stop-valve o, and the engine has a throttle-valve f'. After doing the work of driving said engine the vapor is withdrawn through pipe f to surface condenser G (shown in Fig. 1) or to jet-condenser G', (shown in Fig. 2,) where it is reduced to liquid form and then delivered by air-pump H through pipe r to hot-well S in case the surface condenser is used, or first to separator R and then to hot-well S in case the jet-condenser is used, the latter arrangement being shown in Figs. 2 and 3. From the hot-well the liquid flows to pump Q through pipe s, and the pump forces it through pipe q either to heater K or by branch pipe q' to vaporizing-chamber d^5, said pipes being provided, respectively, with stop-valves q^2 q^3, which can be manipulated to suit either delivery. When heater K is in use, said delivery will be into chamber k, whence overflow-pipe k^4, having a stop-valve k^5 and a check-valve k^6, will convey it to vapor-chamber d^5 for reëvaporation. When the heater is in use, waste gases from boiler A pass through pipe L, connecting the smoke-box of the boiler with the smoke-box l of the heater, thence through fire-tube k' to smoke-box l', which is connected into stack l^2. Heater K therefore acts as an economizer for the conservation of heat from the flue-gases and increases the evaporative efficiency of vaporizer D by increasing the temperature of liquid fed into chamber d^5. Without stopping operation of the power system heater K can be shut off by closing valve q^2 in the liquid-supply pipe, valve k^5 in the overflow-pipe, and valve o in the vapor-pipe and opening valves q^3 and o^2 in branch pipe o' and liquid-pipe q', respectively. This provides for operating the system either with or without heater K, the heater being drained when not in use. In place of valve o^2 a pressure-regulator can be used, in which case I provide a by-pass with valve o^3. In case of accident to or repairs required by vaporizer D provision is made for operating engine F by steam delivered through branch pipe a^{10}, having stop-valve a^{11}.

In Figs. 2 and 3 I have shown an arrangement for adapting a jet-condenser to condensing the vapor from liquid of low boiling-point, so that this form of condenser may be used when deemed desirable in substitution for the more costly type of surface condenser. In order to make use of this arrangement, a liquid of low boiling-point which will quickly separate from water must be selected. The lighter distillates of petroleum, as an illustration, answer these requirements. The condensation from such liquid mixed with condensing-water is delivered by air-pump H through pipe r into one end of the separating-

tank R, Figs. 2, 3, and 4. At the opposite end of this tank are two overflow-pipes r' r^2, the latter of which has its intake end near the bottom of the tank and the outtake end near the top of the tank, the broken lines in Fig. 4 showing the water-outlet pipe. This provides for automatic discharge of water as fast as it is pumped into the tank, the water being usually allowed to run to waste. Pipe r' automatically discharges the lighter and more volatile liquid formed from condensation of vapor used for driving engine F into a receiver or hot-well S, whence it is withdrawn by pump Q and returned for reëvaporation. By reason of greater gravity water will quickly settle to the bottom of tank R and the lighter liquid rise to the top, so the latter liquid cannot get through the water-discharge pipe unless the water-level should get below the intake end of said pipe, which cannot occur when the condenser is in operation, as at such time there is always an excess of water as compared with the liquid of condensation. It is only necessary to make the distance r^3 equal to or superior to the distance r^4 to insure separate discharge of the two liquids, it being understood that the respective discharge-pipes turn neither upward nor downward between the tank and their discharge ends. If the lower end of the discharge-pipe r^2 be more deeply submerged in the tank R than the distance r^4, then said end will be covered with water, since the volatile liquid, which is lighter, must have a greater head than r^4 to displace the water sufficiently to enter the pipe r^2. This course can be reversed by use of a volatile liquid having greater specific gravity than water—such, for instance, as bisulfid of carbon. In a power system various liquids can be used to meet differing requirements. Thus where only moderate vapor-pressure is needed and a surface condenser is employed wood-spirit or some form of alcohol will meet the conditions, especially if the turbine type of engine be used.

My system is especially adapted to the turbine class of engines because of their requirement of superheated vapor and because in this class of engines no lubrication is required by surfaces in contact with the working vapor. It constitutes a convenient method of superheating and maintaining a uniform degree of superheat without detracting from steam-boiler economy or requiring a separate fire and allows of economizing the heat in flue-gases to the greatest practicable extent and in a more convenient way, requiring much less room as compared with usual forms and arrangements of economizers.

What I claim, and desire to secure by Letters Patent, is—

1. In a power system, the combination of a steam-boiler, a vaporizing-chamber containing a liquid having a lower boiling-point than water, a steam-pipe connecting the steam-space in the boiler with steam-heating surface submerged in the liquid contained in said vaporizing-chamber, an engine driven by vapor from said vaporizing-chamber, a steam-pressure-reducing valve in said steam-pipe, and means for discharging water of condensation from the aforesaid heating-surface in said chamber, substantially as set forth.

2. In a power system, the combination of a vaporizing-chamber containing a liquid of lower boiling-point than water, steam-heating surface in said liquid, a source of steam-supply connected with said surface, means of discharging the water of condensation from said surface, a superheater connected with the vapor-space of the liquid of low boiling-point, and heated with live steam from a boiler, and means of using the superheated vapor and returning its liquid of condensation to said vaporizing-chamber.

3. A power system, comprising, in combination, a steam-boiler, a vaporizing-chamber containing a liquid of lower boiling-point than water, and having steam-heating surface supplied with live steam from said boiler, and provision for discharging water of condensation from said surface, a superheater connected with the vapor-space of the liquid of low boiling-point in said vaporizing-chamber and adapted for superheating vapor from said liquid by live steam from a steam-boiler, a vapor-engine with pipe connection for conveying the superheated vapor from the superheater to said engine, and a condenser connected to the exhaust of said engine, essentially as shown and described.

4. In a power system, the combination of a vaporizing-chamber containing a liquid having a lower boiling-point than water, heating-surface, a source of steam-supply connected with said surface submerged in said liquid, means of discharging water of condensation from said surface, a superheater connected with the vapor-space of the liquid of low boiling-point and heated with live steam from a boiler, an automatic steam-pressure regulator in the steam-supply pipe from a steam-boiler to the superheater, and means for using the superheated vapor and returning its liquid of condensation to said vaporizing-chamber.

5. A power system comprising the following elements in combination, namely, a steam-boiler, a vaporizing-chamber containing a liquid of lower boiling-point than water, and having steam-heating surface supplied with live steam from said boiler, provision for discharging water of condensation from said heating-surface, a vapor-engine connected with the vapor-space in said chamber by a valved pipe, a surface condenser for condensing the vapor rejected from said engine, and a valved pipe connection from the steam-space of said boiler to said vapor-engine, substantially as set forth.

6. In a power system, the combination of a vaporizing-chamber containing a liquid having a lower boiling-point than water, steam-heated surface submerged in the liquid, a source of steam-supply connected with said surface, a turbine-engine driven by vapor from said vaporizing-chamber, a second chamber connected to the first chamber and adapted for receiving feed liquid and delivering it to the first chamber, means for using vapor from the first chamber and returning the liquid of condensation to the second chamber, and heating-surface, in the second chamber arranged for supplying heat to the liquid of low boiling-point before its entrance to the first chamber by contact of waste gases from a boiler with said heating-surface.

7. In a power system, the combination of a steam-boiler, a vaporizing-chamber for containing a liquid of lower boiling-point than water, steam-heating surface in said liquid supplied with live steam from said boiler, means for discharging water of condensation from said surface, a second chamber containing the same kind of liquid as the first chamber and having an overflow connection therefrom for supplying liquid from the second chamber, and fire-tubes submerged in said liquid of the second chamber, substantially as set forth.

8. In a power system, the combination of a steam-boiler, a vaporizing-chamber for containing a liquid of lower boiling-point than water, steam-heating surface in said liquid supplied with live steam from said boiler, means for discharging water of condensation from said surface, a second chamber for containing the same kind of liquid as the first chamber, an overflow connection from the second chamber to the first chamber whereby the first chamber is supplied with liquid from the second chamber, fire-tubes submerged in liquid of said second chamber and adapted for passage of waste gases from said boiler to a chimney, a vapor-engine connected with the vapor-space in the first chamber, a condenser connected with the exhaust from said engine, and one or more pumps and pipe connections for returning the liquid of condensation formed in said condenser to the second chamber, essentially as shown and described.

9. A power system having the following elements in combination, namely, a steam-boiler for supplying live steam to heating-surface submerged in liquid of a lower boiling-point than water, which liquid is contained in a separate chamber, means for draining the water of condensation from said heating-surface, a superheater connected with the vapor-space of the liquid of low boiling-point in said vaporizing-chamber and adapted for superheating vapor from said liquid by live steam, a vapor-engine with pipe connection for conveying the superheated vapor from said superheater to said engine, a second chamber containing the same kind of liquid as the aforesaid first chamber and having an overflow connection therefrom for supplying liquid from the second chamber to the first chamber, fire-tubes submerged in liquid of the second chamber and adapted for passage of waste gases from the boiler to a chimney, and one or more pumps and pipe connections for delivering the liquid of condensation from the aforesaid condenser to the aforesaid second chamber, substantially as shown and described.

10. In a power system, the combination of a vapor-engine operated by vapor derived from liquid having a lower boiling-point than water, and which will readily separate from admixture of water, a jet-condenser connected with the exhaust from said engine, a closed tank connected to the discharge from the condenser and adapted for receiving and separating the two liquids by action of gravity, and pipes connected onto said tank for conducting the two liquids into separate receptacles, the inlet end of the water-discharge pipe being at lower level in the tank than the inlet end of the pipe for discharge of liquid of low boiling-point, practically as shown and described.

11. In a power system, the combination of a vapor-engine operated by vapor derived from liquid having a lower boiling-point than water, and which will readily separate from admixture with water, a jet-condenser connected with the exhaust from said engine, a tank connected to the discharge from the condenser for receiving the mixture of condensing-water and liquid of condensation and separating the two liquids by action of gravity, a pipe for discharging condensing-water from the tank having the inlet end of the pipe more deeply submerged than the outlet end, and a discharge-pipe for the liquid of condensation having the intake sufficiently elevated above the lower end of the water-outlet pipe so that none of the liquid of condensation shall pass from the tank through the water-discharge pipe, both of said pipes being properly proportioned and arranged for discharge at level of the respective outlets.

12. In a power system, the combination of a steam-boiler, a vaporizing-chamber containing a liquid having a lower boiling-point than water, heating-surface in said chamber supplied with live steam from said boiler for vaporizing said liquid, an engine driven by vapor from said vaporizing-chamber, a steam-pipe connecting said boiler with said heating-surface, a pressure-reducing valve in said pipe for reducing the boiler-pressure of steam delivered to said heating-surface, and means for automatically returning water of condensation from said heating-surface to a boiler.

13. In a power system, the combination of a steam-boiler, a vaporizing-chamber containing a liquid having a lower boiling-point than water, heating-surface in said chamber supplied with live steam from the boiler for vap-

orizing said liquid, a superheater containing a vapor-chamber connected to the vapor-space of the first-named vaporizing-chamber, heating-surface in said vapor-chamber of the superheater supplied with live steam from a boiler, and means of automatically returning water of condensation from said heating-surface to a boiler.

14. In a power system, the combination of a steam-boiler, a vaporizing-chamber containing a liquid having a lower boiling-point than water, means for vaporizing said liquid by heat of live steam supplied from said boiler, a vapor-engine connected to the vapor-space of the liquid of low boiling-point by a valved pipe, and a valved pipe connecting said engine with the steam-space of said boiler whereby either steam or vapor of low boiling-point can be employed for operating said engine, substantially as set forth.

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Witnesses:
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JNO. H. MCANARNEY.