

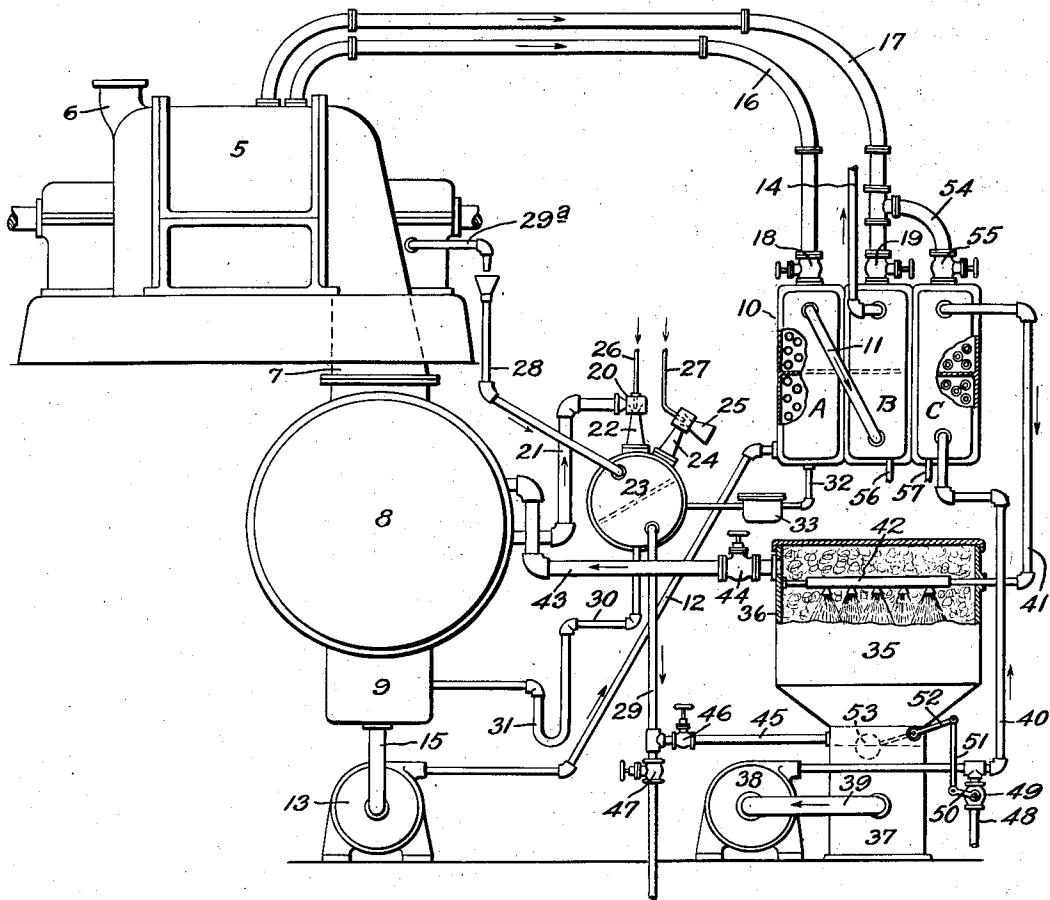
Feb. 16, 1926.

1,573,582

A. R. SMITH

POWER PLANT

Filed Nov. 5, 1921



Inventor:
Arthur R. Smith,
by *Albert B. Davis*
His Attorney.

Patented Feb. 16, 1926.

1,573,582

UNITED STATES PATENT OFFICE.

ARTHUR R. SMITH, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

POWER PLANT.

Application filed November 5, 1921. Serial No. 513,006.

To all whom it may concern:

Be it known that I, ARTHUR R. SMITH, a citizen of the United States, residing at Schenectady, in the county of Schenectady, State of New York, have invented certain new and useful Improvements in Power Plants, of which the following is a specification.

The present invention relates to power plants and has for its object to provide an improved power plant arrangement which will give a high thermal efficiency.

For a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and the claims appended thereto.

In the drawing, the figure is a diagrammatic view of a power plant embodying my invention.

Referring to the drawing, 5 indicates a prime mover, such as an elastic fluid turbine, having an inlet conduit 6 and a discharge conduit 7, the latter being connected to a condenser 8 at the bottom of which is a well 9 in which the condensate collects. 10 indicates a heater comprising three sections, A, B and C, the same being preferably of the type comprising tubes through which the water to be heated passes, and over which the heating steam passes. The tubes of sections A and B are connected in series with each other by a pipe 11 which connects the discharge end of the tubes in section A to the inlet end of the tubes in section B. The inlet end of the tubes in section A are connected by a pipe 12 to the discharge side of a condensate pump 13 and the outlet end of the tubes in section B are connected to a pipe 14 leading to the hot well (not shown) from which water is drawn to feed the boilers. The suction side of pump 13 is connected by a conduit 15 to well 9. Condensate from the condenser is thus taken by pump 13 and circulated first through the tubes of heater section A, then through the tubes of heater section B after which it is discharged through pipe 14 to the hot well. The casing of heater section A is connected by a conduit 16 to a low pressure stage of turbine 5, a stage being selected at which steam of suitable pressure and temperature will be furnished for initial heating purposes, and the casing of heater section B is connected by a conduit 17 to a stage of the turbine in advance of that to which conduit

16 is connected and from which steam at a pressure and temperature suitable for final heating purposes will be furnished. In conduits 16 and 17 are control valves 18 and 19.

For withdrawing air and non-condensable vapors from condenser 8, a two-stage steam operated air ejector is illustrated, the first stage 20 having its suction side connected by a pipe 21 to condenser 8 and its discharge pipe 22 connected to an intercooler condenser 23, and the second stage having its suction side 24 connected to intercooler condenser 23 and its discharge pipe 25 to any suitable point, preferably to some apparatus which will extract the heat in the discharge and return it to the system. Steam for operating the two stages of the ejector is supplied by pipes 26 and 27. Cooling water for intercooler condenser 23 is supplied by pipe 28 and led away by pipe 29, and this water may be the water which is previously circulated through the turbine bearings for cooling them being discharged by pipe 29. The condensate of condenser 23 is carried to well 9 by a pipe 30 provided with a goose neck 31, and from well 9 it is pumped to the hot well. The condensate formed in heater section A is conveyed by a pipe 32 to condenser 23 from whence it passes to well 9 by way of pipe 30. Pipe 32 is provided with a suitable trap 33.

At 35 is illustrated an evaporator or boiler for generating steam. It comprises a casing 36 provided at its lower end with a well 37 to which the suction side of a pump 38 is connected by a pipe 39. The discharge side of pump 38 is connected by a pipe 40 to the admission end of the heating tubes in heater section C, the discharge end of such tubes being connected by a pipe 41 to a spray head 42 in the upper portion of casing 36. The upper portion of casing 36 is connected by a pipe 43 to condenser 8, there being a suitable valve 44 therein. Make up water for the system is taken from pipe 29 by a branch pipe 45 leading to well 37. In pipe 45 is a suitable valve 46 and in pipe 29 beyond the connection of pipe 45 there-with is a valve 47. Connected to pipe 40 is a blow off pipe 48 in which is a valve 49 provided with an operating arm 50 connected by a link 51 to an arm 52 actuated by a float 53 which rides on the liquid in well 37. The arrangement is such that the float will automatically maintain a constant level

in well 37. The casing of heating section C is connected by a conduit 54 to a stage of the turbine from which steam of suitable temperature for heating purposes may be drawn, it being shown in the present instance as being connected to the same stage as conduit 17. In conduit 54 is a valve 55. The condensate of heating sections B and C is carried away by pipes 56 and 57 which may lead to the drip system of the plant, the water thus collected being again put back into the boilers.

In operation, condensate from condenser 8 is circulated by pump 13 through heater sections A and B from which it passes through pipe 14 to the hot well. Valves 18 and 19 are opened to admit sufficient steam to heater sections A and B to raise the water passing through them to the desired temperature. It will be noted that the heating is done in a plurality of stages, two in the present instance, the water being first heated by steam of lower temperature and then by steam of higher temperature. This gives the most economical heating. It will be understood, of course, that this heating may be carried out in more than two stages if found desirable. Valves 46 and 47 are set so slightly more water will be supplied to well 37 than is required for the make up water, the excess being automatically discharged through valve 49. This water is warmed more or less in passing through the turbine bearings and through condenser 23 before being delivered to well 37. From well 37 the water is taken by pump 38 and circulated through heater section C, valve 55 being set to admit sufficient steam to raise the temperature of the water to the desired degree. From heater C the water is discharged through pipe 41 to head 42 from which it is discharged in the form of a spray and flashed into steam, the pressure in evaporator or boiler 35 being such that a certain percentage of the heated water will vaporize or flash into steam as soon as it enters the boiler. The steam formed in the evaporator or boiler is conveyed by conduit 43 to condenser 8 where it is condensed and joins the condensate from turbine 5. The evaporator or boiler may have a pressure but little higher than that of condenser 8 so the steam formed therein will have a comparatively low temperature which means that the steam taken from the turbine to heat the raw water will be efficiently utilized in the formation of pure make up water. All the steam used for heating purposes does work in the turbine prior to being bled therefrom so that the energy of the steam is all made use of.

In accordance with the provisions of the patent statutes, I have described the principle 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 may 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 plant, the combination of a prime mover, a condenser therefor, a feed water heater, means for supplying elastic fluid which has done work in the prime mover to the feed water heater, means for circulating the condenser condensate through said heater, an evaporator, a conduit for conveying steam from it to the condenser, a second heater, means for supplying elastic fluid which has done work in the prime mover to said second heater, means for circulating water through said second heater, and means for conveying it from the second heater to the evaporator.

2. In a power plant, the combination of a prime mover, a condenser therefor, a feed water heater comprising a plurality of heating sections connected in series as regards the flow of water to be heated, means for supplying elastic fluid from different points in the prime mover to said heating sections, means for circulating the condenser condensate through said heating sections, an evaporator, a conduit for conveying steam from it to the condenser, a second heater means for supplying elastic fluid which has done work in the prime mover to said second heater, means for circulating water through said second heater, and means for conveying it from the second heater to the evaporator.

3. In a power plant, the combination of a prime mover, a condenser therefor, an evaporator, a discharge conduit connecting it to the condenser, a heater, means for supplying heating steam thereto from a point of intermediate pressure in the prime mover, and means connecting the heater to the evaporator.

4. In a power plant, the combination of a prime mover, a condenser therefor, an evaporator, a discharge conduit connecting it to the condenser, a heater, means for supplying heating steam thereto from a point of intermediate pressure in the prime mover, and a pump for circulating raw water through the heater to the evaporator.

5. In a power plant, the combination of a prime mover, a condenser therefor, an evaporator, a discharge conduit connecting it to the condenser, a heater, means for supplying heating steam thereto from a point of intermediate pressure in the prime mover, a well at the bottom of the evaporator, means for supplying make up water to said well, and means for circulating water from said well through the heater to the evaporator.

6. In a power plant, the combination of an elastic-fluid prime-mover, a condenser therefor, a heater through which condensate

from the condenser is passed, means supplying partially utilized elastic fluid from the prime mover to said heater, means connecting the heater with the condenser forming a drain for the condensate formed in said heater, an evaporator having a vapor space and a fluid-receiving well, a second heater, means supplying partially utilized elastic fluid from the prime mover to said second heater, a conduit for supplying fluid from the evaporator receiving well to the second heater, a conduit for supplying fluid from the second heater to the evaporator vapor space, an exhaust conduit for the evaporator connecting the vapor space thereof with the condenser, and means supplying liquid to the evaporator-receiving well.

In witness whereof, I have hereunto set my hand this 4th day of November, 1921.

ARTHUR R. SMITH.