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SURFACE CONDENSER.

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Fig. 1.

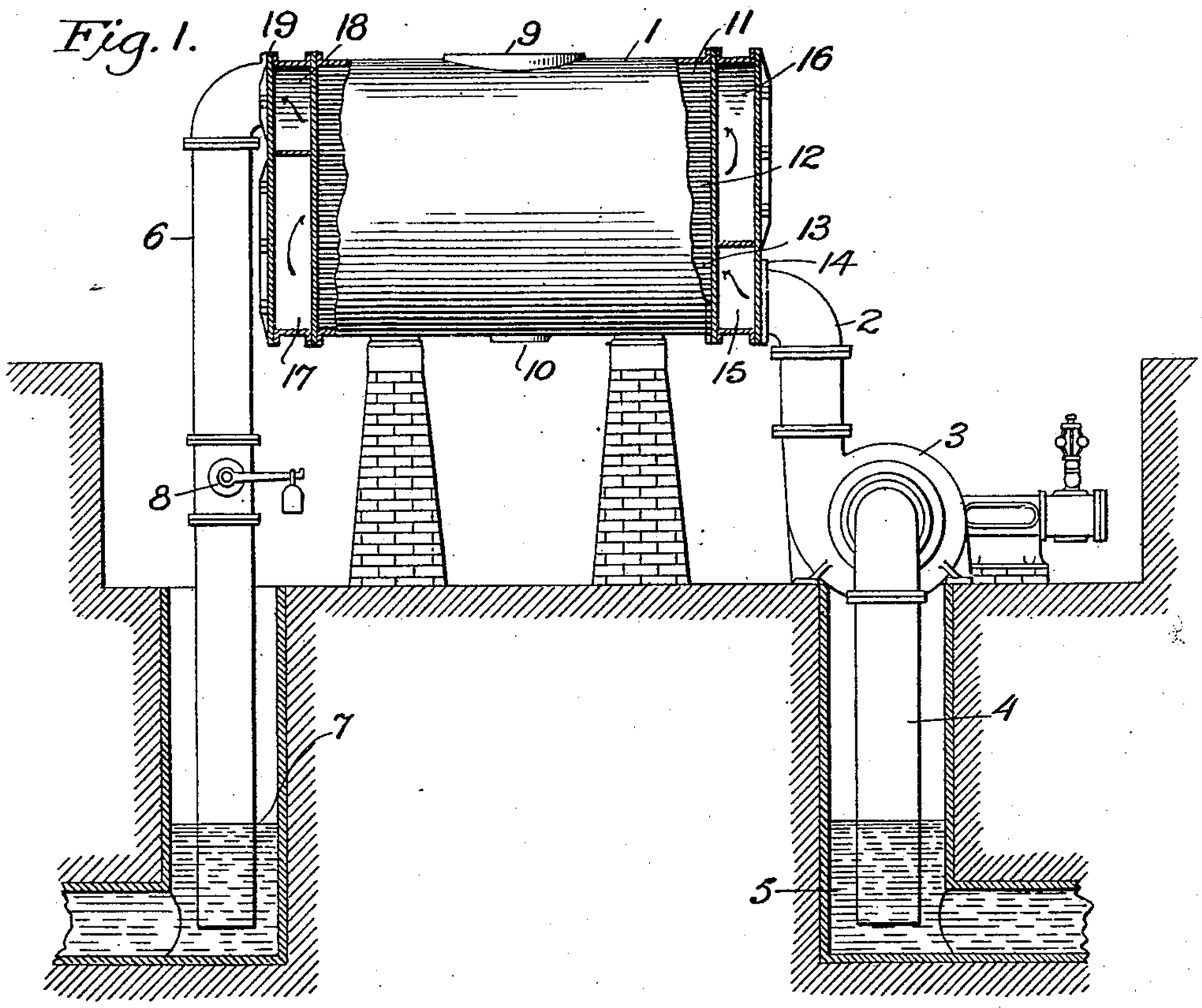


Fig. 2.

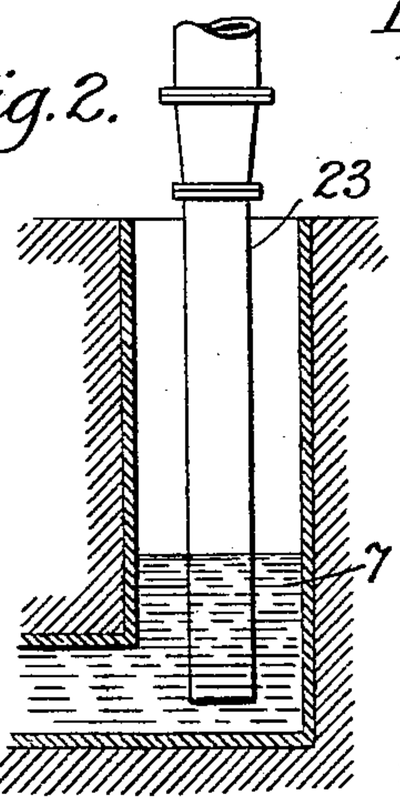


Fig. 3.

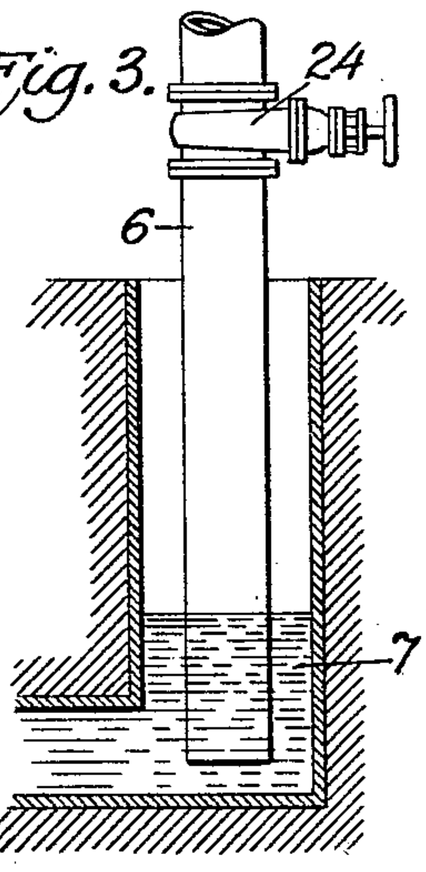


Fig. 4.

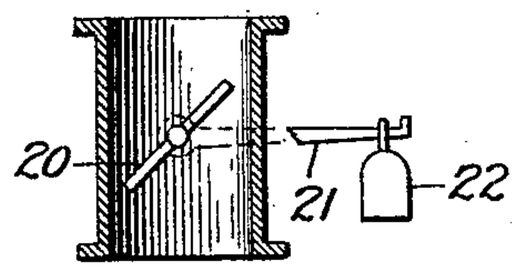
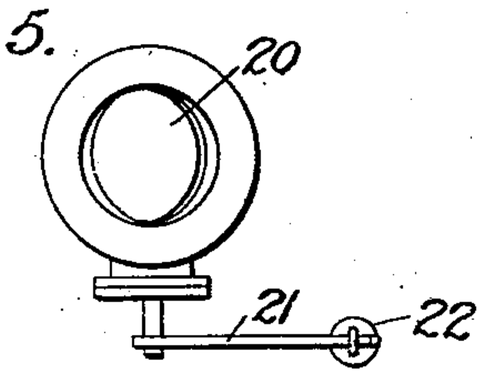


Fig. 5.



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UNITED STATES PATENT OFFICE.

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SURFACE CONDENSER.

No. 868,388. Specification of Letters Patent. Patented Oct. 15, 1907.

Application filed February 15, 1904. Serial No. 193,510.

To all whom it may concern:

Be it known that I, LOUIS R. ALBERGER, a citizen of the United States of America, and a resident of the city, county, and State of New York, have invented certain new and useful Improvements in Surface Condensers, of which the following is a specification.

This invention relates to certain improvements in the condensation of exhaust steam from engines and other steam motors, and more particularly to that class of apparatus known as surface condensers, in which the condensation is produced by the contact of the exhaust steam with metallic surfaces cooled by the water, and in which a vacuum is maintained by a vacuum or air pump; and it relates moreover to that subdivision of the general class of surface condensers, wherein the condenser is arranged to obtain a balanced column effect upon the circulating water passing through the condenser and its tubes, there being a circulating pump, an ascending column of cooling water, and a descending column of heated water, so that the actual work of the pump is greatly minimized, and economy in the operation subserved.

Heretofore it has generally been found desirable in using surface condensers in which a circulating pump draws the cooling water from a source of supply, and discharges it through the condenser, to submerge the lower end of the pipe that receives the heated water after its passage through the condenser in a hot well or discharge conduit whose level is the same or nearly the same as that of the cold well of the cold water supply, in order that a balanced column effect may be produced upon the circulating water passing through the condenser tubes, by which the descending column of water assists the ascending column of water, and the actual work exerted by the circulating pump is then only that due to the friction caused by the flow of the water through the piping and tubes of the condenser, and the energy required to put the water in motion. Aside from the economical feature of this method, the fact that a limited change in the levels of the hot and cold wells does not change the load upon the pump, makes the arrangement especially advantageous where there is a fluctuation in these levels, such as is caused by tides, freshets, or otherwise. This is preëminently so when centrifugal or turbine pumps are used to produce the circulation of the water, besides they operate to best advantage and with least attention under constant load.

There is a limit, however, to the extent to which the balanced column effect may be employed, which limit is determined by the height of the descending column of heated water from the condenser. The cooler this water and the greater the atmospheric pressure, the greater the length of the column or the height from which it may descend, and vice versa. Frequently in practice, on account of the overloads on the engines or turbines exhausting into the condenser, at which times steam greatly in excess of the normal amount may be condensed, or by reason of a partial stoppage of the flow of water by debris, it results that the discharging water, or the descending column, is heated to an abnormally high degree; and for this reason it becomes desirable for safe and unimpaired operation to have the descending column no longer than that which will insure it against breaking or separating on account of vaporization of the heated water; for if the descending column is too long vertically, or if the water be too highly heated for the vertical distance it has to fall, vaporization would take place on account of the vacuum, and the balanced column would be broken and the action impaired.

There are situations, however, where the water levels in the cold and hot wells are so far below a desirable location for the condenser, or where the temperature of the water in the descending column is so warm, or the atmospheric pressure on account of altitude is so light, that it is not practical to rely wholly upon the balanced column action, and consequently a certain excess of work must be performed by the circulating pump. This situation or condition, which occurs often, is attempted to be met by various expedients. One way of doing it consists in placing the hot well, or the body of the water constituting the hot well, into which the descending column of water descends after it leaves the condenser, at such a level above that of the cold water supply that said descending column will maintain itself under the height and atmospheric pressure, and will retain its integrity as an aqueous current, and not allow the water to vaporize on account of its heat, under the vacuum formed. The objection to this method, however, is that any fluctuation in the level of the source of supply, or cold well, until said level of the cold well rises to that of the hot well level, will put a varying load upon the pump, and require either constant attention or an automatic regulation of the circulating pump to obtain a constant flow of water. This latter is an extremely difficult thing to secure with a centrifugal pump, and it is not practicable with a centrifugal pump running at constant speed, which is desirable when the pump is driven by an electric motor.

The object, therefore, of the present invention is to provide a means or mechanism by which the balanced column action may be utilized to a considerable extent, and at the same time maintain a constant load upon the circulating pump under fluctuations of the level of the water in the cold well. This I accomplish by submerging the lower end of the descending column of water in a hot well located so that the level of the water in said hot well will be practically the same as that of the water in the cold well, and by providing in addition

to this a resistance to the downward flow of the current of water in the descending column. This resistance may be made in many different ways, either by employing a restricted pipe for the descending column, or one having a restricted portion, or interposing in the pipe a valve adjustable by hand, or by employing an automatic valve loaded by a weight or other means. The restricted pipe or other device by reducing the vacuum in it has the effect of shortening the height of the descending column of water so that the latter will not break and destroy the action under the existing height, temperature of water and pressure of atmosphere; or, to put it another way, the employment of a resistance means at some suitable point in the descending column of water, whichever form of resistance means may be used, has the effect of increasing the pressure at the top of said column to some small amount, whereby the water is saved from vaporization and a discontinuity of the column is prevented. The maintenance of continuity in this column is a most important desideratum, it being of the highest value to keep the column unbroken, for should it break, the whole system would be deranged and the condenser would be liable to be thrown out of action, or its function seriously disturbed.

It may here be remarked that generally the two wells, that is to say, the cold well from which the supply of circulating water is taken and the hot well into which it is discharged, are both a part of or connect with the same body of water, as for instance, a river, pond, or the sea, and hence the levels of both are virtually the same and subject to the same fluctuations. The levels being therefore practically the same, and when one fluctuates the other fluctuating similarly, it is evident that with the ascending and descending water columns there is a water system which is balanced statically or equilibrated. In speaking of hot and cold wells in connection with the present invention I have been employing terms well known in the art, but it is evident that cases may arise where the wells are omitted and where the supply and discharge pipes extend directly into the river, pond or other body of water, in which case there is merely a submergence or water-sealing of the ends of these pipes without the utilization of wells separate from but communicating with some main body of water, and my invention covers broadly all these modifications in the connection of the water columns with the water supply and the water body into which discharge is made. Furthermore, in cases where distinct wells are used, or distinct quantities of supply and discharge water, and where pipes connect them with a main body of water, the flow of the water through the pipe from the hot well to the main body is retarded by the friction in the pipe, and the result is that the water in the hot well may rise slightly higher than the level of the water in the cold well, in which case there is a slight difference of levels, thus accounted for, but both levels are subject to the same fluctuation and are practically the same or would be were it not for the circumstance explained. From the foregoing it will be understood that the water supply may be an ordinary cold well, or the main body of water in the river or pond; and that the hot well, or discharge body of water, or discharge as I sometimes call it, may be the usual hot well, or the main body of water in the river, or any other means for receiving the heated water from the heated column.

In the annexed drawing illustrating one example of my present invention or one specimen of means for carrying the same into practical effect, Figure 1 is a vertical, sectional view of a surface condenser constructed in accordance with my invention, the relative arrangement of the various parts being clearly indicated. Fig. 2 is a detail view of a portion of the pipe conveying the descending water-column, which pipe is restricted in size. Fig. 3 is a detail view showing the pipe for the descending water-column provided with a resistance to the flow in the shape of a gate valve, which valve may be at any point on the pipe, as, for example, on its lower end. Fig. 4 is a sectional side view of a different form of resistance valve. Fig. 5 is a plan view of the same.

Like characters of reference denote like parts throughout all the different figures of the drawing.

1 designates the shell of one form of the condenser, offered here only by way of example to illustrate the invention. Exhaust steam enters at the top through the inlet opening 9; and the water resulting from the condensation of the exhaust steam falls downward by gravity through the opening 10, where a connection is made with a wet vacuum pump, or to a condense water pump and dry vacuum pump. Within the shell 1 are the cooling tubes arranged in nests as 11, 12 and 13, so that the water may pass several times from one end of the condenser to the other, each pass being made through a separate nest of tubes. The circulating water reaches the condenser through the water inlet 14 near the bottom of the shell 1, to which inlet 14 is attached the water supply pipe 2 leading from the centrifugal or turbine pump 3. 4 designates a suction pipe extending vertically from the cold well 5 to the pump 3. Thus it will be seen that the circulating pump 3 when actuated delivers water to the cooling tubes, the delivery being made at or near the bottom of the condenser, and that the pipes 2 and 4 convey an ascending column of cold water from the cold well to the condenser.

The cooling water which enters the condenser through inlet 14 first enters the chamber 15 from which it passes through the lower nest of tubes 13 to the chamber 17 at the other end of the condenser. From the chamber 17 it flows through the middle nest of tubes 12 to the chamber 16, and from chamber 16 the cooling water passes through the upper nest of tubes 11 to the chamber 18, from which it has exit through the eduction opening 19. Attached to this opening 19 is a vertical pipe 6 which leads downward into the hot well 7. The levels of the water in the cold well 5 and hot well 7 vary very little normally and may be treated as remaining practically the same. It will be manifest that the circulating water reaches the condenser at the bottom thereof in an ascending column that flows upward from the cold well through suitable piping in which the circulating pump is situated, and that after passing back and forth through the nests of tubes exposed to the exhaust steam it leaves the condenser at the top thereof through suitable piping in a descending column, which passes downward from the top of the condenser to the hot well.

In Fig. 1 the pipe 6 through which the descending

column of water flows is provided at a suitable point with an automatic valve 8. This valve is shown in detail in Figs. 4 and 5, and it consists of a pivoted plate 20 provided with an arm 21, having a weight 22. The plate 20 offers a resistance to the flow of water through the pipe 6, as it is an obstruction or obstacle in the path of the water, the degree of resistance depending upon the angle of the plate, and the extent to which it closes the passage through the pipe, it being noted that the position of the plate is automatically controlled by the action of the water against it, and by the weighted arm.

The resistance to the flow of water in the descending column may be effected in a multiplicity of different ways. The automatic valve is one device; another device is to make the lower half 23 of the pipe that carries the descending column less in diameter than the other half, so that the restricted portion of the pipe will delay the flow. This is indicated in Fig. 2. In Fig. 3 still another means is shown for accomplishing the same result, the same consisting of a gate valve 24 adjustable by hand. If desired, the pipe that carries the descending column may be caused to make a number of more or less abrupt turns, or the water channel may be split up into a plurality of passages, and various other means may be devised for restricting or retarding the flow. Thus it will be seen that by interposing in the length of the pipe that carries the descending column of water some device which will offer a resistance to the flow of the water, or by changing the construction or arrangement of the pipe so as to effectuate the same result, it becomes possible to utilize the balanced column action to a considerable extent by preventing vaporization, and this even though the vertical height of the descending column is very long.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:—

1. The combination with a surface condenser located above the level of the water supply, of a pump circulating cooling water through a balanced water system comprising essentially the condenser, means containing a column of cold water ascending to the condenser, and means containing a column of heated water flowing away from the condenser, the ascending column being taken by the pump from the water supply and the descending column delivering into a discharge body of water, both said supply and discharge water being on substantially the same level, which level is subject to fluctuation, and the said means containing the column of heated water being provided with a resistance to the flow.

2. The combination with a surface condenser located above the level of the water supply, of a pump operating under a load, which is unchanged by fluctuation in the water level, said pump circulating cooling water through a balanced water system comprising essentially the condenser, means containing a column of cold water taken by the pump from the supply, and means containing a column of heated water flowing away from the condenser and delivering into a discharge body of water, said latter means containing the column of heated water being provided with a resistance to the flow, and both the supply and discharge bodies of water being on substantially the same level, which level is subject to fluctuation.

3. The combination with a surface condenser located above the levels of the water supply and the discharge, which levels are practically the same and subject to practically the same fluctuation, of a balanced water system comprising essentially the condenser, means containing an ascending column of cold water flowing to the condenser and means containing a descending column of heated water from the condenser, said latter means being provided with a resistance to the flow, and a centrifugal or turbine pump operating under a load which is unchanged by the fluctuation in the water level and circulating cooling water through the system.

4. The combination with a surface condenser located above the levels of the supply water and discharge water, both levels being practically the same and subject to the same fluctuation, of a centrifugal pump circulating water through an equilibrated system comprising essentially the condenser, means containing an ascending column of cold water to the condenser, means containing a descending column of heated water from the condenser, said means containing the descending column being provided with a resistance to the flow consisting of means reducing the vacuum in the latter.

5. The combination with a surface condenser located above the levels of the supply water and discharge water, both of said levels being practically the same and subject to the same fluctuation, of a centrifugal pump circulating water through a balanced system comprising essentially the condenser, means containing an ascending column of cool water to the condenser, means containing a descending column of heated water from the condenser, said latter means containing the descending column being provided with a resistence to the flow consisting of a valve.

6. The combination with a surface condenser located above the level of the water supply, of a balanced water system comprising essentially the condenser, means containing a column of cool water ascending to the condenser, means containing a column of heated water descending from the condenser, hot and cold wells on substantially the same level which is subject to fluctuation, a centrifugal pump operating under a load which is unchanged by the fluctuations in the water level for circulating the cooling water from the supply through the system, and resistance means for preventing vaporization in the descending column of water.

7. The combination with a surface condenser located above the level of the water supply, consisting essentially of a shell containing a plurality of nests or groups of tubes for the cooling water, of a balanced water system consisting essentially of the condenser tubes, means containing a column of cold water flowing upward to the condenser, and means containing a column of heated water descending from the condenser, a centrifugal pump operating under a constant load and circulating water through the system, and a resistance in the flow of the descending column to prevent vaporization.

8. The combination with a surface condenser located above the level of the water supply, of an equilibrated water system consisting of the condenser, means containing an ascending column of water flowing thereto, means containing a descending column of water flowing therefrom, forcing means for circulating the cooling water through the system, a water supply from which the ascending column rises, a discharge body of water into which the descending column falls, both supply and discharge being on substantially the same level which is subject to fluctuation, and means in the length of the descending column to prevent vaporization.

9. The combination with a surface condenser located above the levels of the supply water and the discharge water, which levels are practically the same and subject to practically the same fluctuation, of an equilibrated water system consisting essentially of the condenser, means containing a column of cool water flowing from the water supply, means containing a column of heated water flowing to discharge water, a circulating pump for the cooling water which operates under a constant load, that is unaffected by the fluctuations in the water level, and means for preventing vaporization in the descending column of water.

10. The combination with a surface condenser located above the levels of the water supply and the discharge, both levels being practically the same and subject to the same fluctuation, of a centrifugal or turbine pump circulating cooling water through the condenser, means containing an ascending column of cool water to the condenser, means containing a descending column of heated water from the condenser, and resistance means for preventing vaporization in the descending column of water.

11. The combination with a surface condenser employing circulating water so warm as to preclude the use of an ordinary balanced system under the existing conditions of height, of means for obtaining the benefit of an equilibrated system, consisting of supply and discharge bodies on virtually the same level which is a fluctuating one and below the surface condenser, a circulating pump operating under a load, unchanged by the fluctuation of level, means containing an ascending column of cool water, means containing a descending column of heated water, said latter means containing the descending column being provided with a resistance to the flow.

12. The combination with a surface condenser employing circulating water so warm as to preclude the use of a balanced system under the existing conditions of height, of means for obtaining the benefit of an equilibrated system, consisting of a centrifugal or turbine pump operating under a constant load for circulating the cooling water, means containing a column of cool water, a water supply from which it flows, means containing a column of heated water, a discharge into which it discharges, the two columns statically balancing each other, a resistance to the flow of the water in the heated column, and said supply and discharge bodies of water having substantially the same level below the condenser and subject to the same fluctuation.

13. The combination with a surface condenser located above the level of the water supply, of an equilibrated water system consisting essentially of a condenser, means containing an ascending column of water to the bottom of the condenser, means containing a descending column of water from the top of the condenser, a pump for the circulation of the water, a cold well from which the ascending column rises, a hot well into which the descending column flows, and means in the length of the descending column to prevent vaporization.

14. The combination with a surface condenser located above the level of the water supply, of a pump circulating cooling water through a balanced water system comprising essentially the condenser, means containing a column of cold water to the bottom of the condenser, means containing a column of heated water from the top of the condenser, said latter means being provided with a resistance to the flow, supply and discharge wells having the same water level which is subject to the same fluctuation.

15. The combination with a surface condenser located above the level of the water supply, of a centrifugal or turbine pump circulating cooling water therein, a balanced water system comprising essentially the condenser, means containing an ascending column of cold water to the lower part of the condenser, means containing a descending column of heated water from the upper part of the condenser, said means containing the descending column having a flow resistance, and supply and discharge bodies of water on virtually the same level which is subject to the same fluctuation.

Signed at New York this 4th day of February 1904.

LOUIS R. ALBERGER.

Witnesses:

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