No. 780,018. PATENTED JAN. 17, 1905.

L. R. ALBERGER.

CONDENSER SYSTEM.

APPLICATION FILED NOV. 28, 1902.

2 SHEETS—SHEET 1.

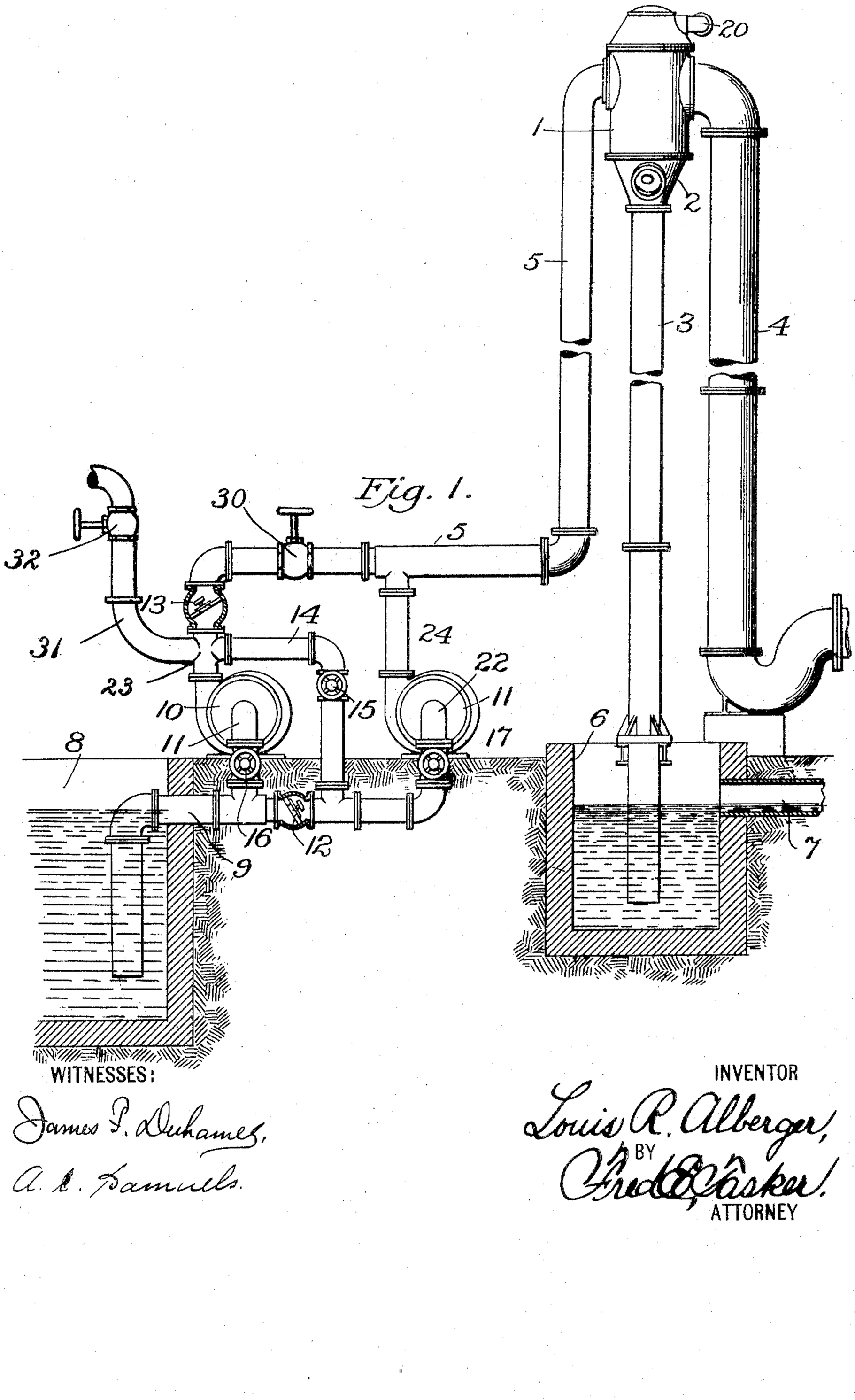

Fig. 1.

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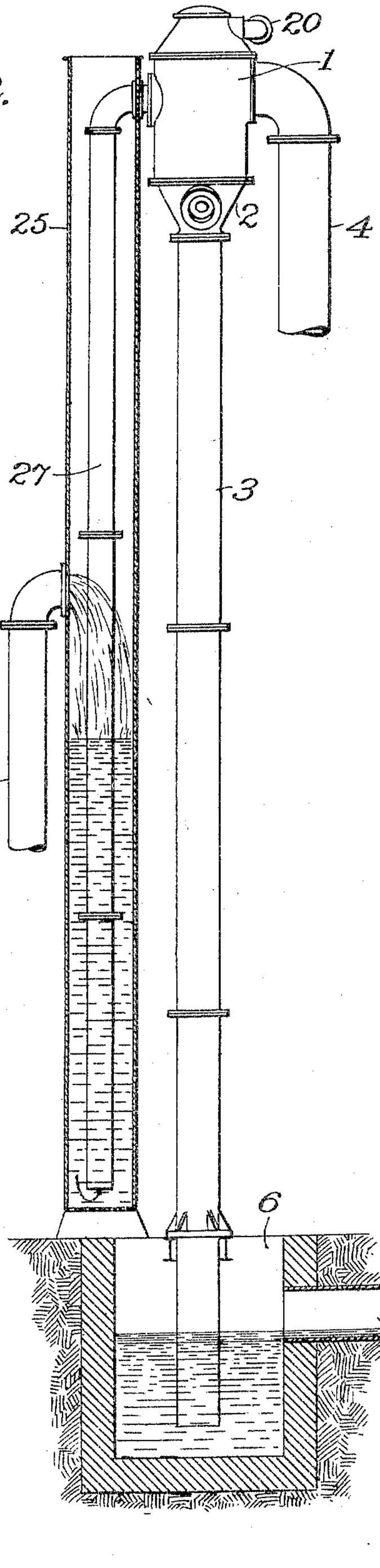
2 SHEETS—SHEET 2.

Fig. 2.



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No. 780,018. Patented January 17, 1905.

UNITED STATES PATENT OFFICE.

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CONDENSER SYSTEM.

SPECIFICATION forming part of Letters Patent No. 780,018, dated January 17, 1905.

Application filed November 28, 1902. Serial No. 132,980.

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 Greenwich, county of Fairfield, and State of Connecticut, have invented certain new and useful Improvements in Condenser Systems, of which the following is a specification.

My invention relates to a condenser system of the particular class employing an elevated or barometric jet or similar condenser wherein the flow of water or other liquid or fluid to the condenser is assisted by the vacuum and wherein the water or other fluid after performing its work of condensation of steam or other vapor is disposed of by gravity through a tail-pipe to the hot-well.

Although in the description the terms "water" and "steam" are employed, it will be understood that the invention is applicable for use with other liquids than water and other vapors than steam.

My principal object is to provide a simple and effective means of forcing the water the total required height into the condenser to enable the apparatus to promptly start up without the aid of a vacuum and then be readily adjusted to operate under normal conditions aided by the vacuum, all without changing the speed of the pumping means, except, of course, that the speed of the motor may be varied to suit changes of suction-lift, due to rise or fall of the level of the water-supply or on account of changes in temperature of the water from one season to the other or for various other causes.

Another object is that of enabling centrifugal or like pumps to be successfully employed with this class of condensers to supply the circulating water.

The invention consists, essentially, in the combination, with a condenser, of a plurality of centrifugal pumping members operated in series relation to each other at the start, also in a plurality of centrifugal pumping members operated in series relation to each other at the start and afterward in multiple relation during the normal operation—that is to say, centrifugal pumping members so arranged that in the first instance one takes suction from the water-supply and discharges into the suction of the other, the latter discharging into the condenser; but afterward when a vacuum is formed in the condenser a simple adjustment causes each centrifugal member to take suction directly from the water-supply and discharge independently into the condenser under the beneficial aid of the vacuum; and the invention also comprises manifold details and peculiarities in the construction, combination, and arrangement of the various parts, substantially as will be hereinafter more fully described and claimed.

In the accompanying drawings, illustrating my invention, Figure 1 is a front elevation of my present improved condenser system having two centrifugal pumps arranged in connection therewith. Fig. 2 is a partial elevational view showing a modification in the arrangement of the means of conveying the water to the condensing-chamber, said modified means including an elevated tank.

Like numerals of reference designate like parts in the different figures.

In the drawings I have delineated one form of barometric condenser for explanatory purposes merely and in order to illustrate the practical application of my present improvements. In this example, 1 denotes the main condenser-chamber; 2, its conical lower end; 3, the tail-pipe leading from the lower end 2 of the condenser and terminating in the hot-well 6, which has an overflow-pipe 7; 4, the steam-pipe entering one side of the condenser-chamber 1; 5, the condensing-water pipe, also entering the condenser-chamber 1, through which pipe the water is forced by pumping means from a suitable source of supply—as, for example, the tank 8, from which the water is withdrawn by pipe 9. In the present example of my invention the condensing-water is to be lifted through said condensing-water pipe 5 by means of centrifugal or like pumps, of which I have illustrated two in the drawings at 10 and 11. Should an air or vacuum pump be used, an air-pipe 20 would run there-

to from the top of the condenser, as shown. Attempts have heretofore been made to use centrifugal pumps with elevated condensers; but they have not been successful because of serious difficulties which were found to attend such use. If, for instance, the centrifugal is speeded so as to deliver the water to a point where it will be within the assistance of the vacuum, the vacuum must necessarily be obtained before this can be accomplished. In practice it is not found desirable or feasible to produce the vacuum before water is delivered into the condenser. Consequently it has been found necessary to provide means to temporarily speed up the centrifugal, forcing the water up and into the condenser without the assistance of the vacuum. This latter operation is, however, difficult with engine-driven centrifugal pumps on account of the greatly-increased speed that is required, and it is impracticable with centrifugal pumps driven by electric motors, on account of the extremely complicated and inefficient means that must be adopted to so greatly increase the speed of the electric motor above its normal working speed. The only reliable method heretofore known consists in running the centrifugal pump at all times at a speed that would deliver the water the full height of the condenser, whether there is a vacuum or not, and without deriving any assistance from the vacuum when it is formed. This is obviously a very uneconomical method, as hereinafter explained. In order to overcome these difficulties and avoid these objections to the use of centrifugal pumps and provide a way in which this kind of pump may be successfully employed with condensers, I have devised my present improvements. I employ two or more centrifugal or like pumps, which are either separate machines or are preferably both mounted on one shaft and driven by an engine or other motor. Examples of these machines are shown in the drawings at 10 and 11. They draw their water from a source of supply 8 and discharge it directly into the condenser through the condensing-water pipe 5. They operate in series at the commencement of the working of the apparatus, and when so operating one centrifugal so assists the other that they can readily discharge the water to the entire height. The speed of the centrifugal pumps may be so fixed that when operating normally in a multiple relation to each other they will discharge an amount of water sufficient to maintain a vacuum in excess of that corresponding to the aid they receive under the greatest overload of exhaust-steam. If the assistance decided upon is, say, fifteen feet, then there should be a water-supply sufficient to produce with the maximum quantity of steam a vacuum of about twenty inches. It is evident that a higher vacuum will cause a greater flow of water than is needed and an overload of steam will cause a fall in vacuum, but never to a sufficient extent to lose the vacuum.

The pump 10 has a suction-inlet 21, provided with a gate-valve 16, and it also has a discharge-outlet 23, provided with a check-valve 13. The pump 11 has a suction-inlet 22, provided with a gate-valve 17, and it also has a discharge-outlet 24. The discharge-pipes 23 and 24 both deliver into the condensing-water pipe 5, and the suction-pipes 21 and 22 are preferably, though not necessarily, both connected with the supply-pipe 9. The latter pipe has a check-valve 12 placed at a point between the two suctions. Under one aspect in which the relative positions of the two suctions may be viewed it will be seen that the suction 22 connects with the suction 21, there being the check-valve 12 between them.

14 denotes a pipe running from the discharge 23 of pump 10 to the suction 22 of pump 11, through which pipe the water discharged from pump 10 may be carried to the suction of pump 11, said pipe having a gate-valve 15, which may be opened to allow the flow of water through the pipe or closed to prevent it.

Upon first starting up the apparatus of my present improvements the gate-valves 16, 17, and 15 will be opened, while the check-valves 12 and 13 will be allowed to remain closed. The centrifugal pumps may be started simultaneously or separately after priming by well-known means. When they are in operation, the pump 10 will discharge the water which it lifts from the supply 8 into the suction 22 of pump 11, through the pipe 14, and past the gate-valve 15. As the latter pump 11 is assisted in this way by having its supply furnished by the pump 10, it will be evident that said pump 11 will discharge into condensing-water pipe 5 to the full height of the condenser. This is the more readily understood when it is considered that each centrifugal pump is proportioned and speeded to discharge at a height of twenty-three feet. Consequently when they are running in series their combined efforts will be equal to twice twenty-three feet, or forty-six feet; but the height of the injection-opening into the side of the condensing-chamber 1, where the end of the pipe 5 delivers into said chamber, is only thirty-eight feet. Consequently the machines so operated are fully capable for the work to be performed. As soon as a vacuum is formed in the condenser, either from the inductive action of the falling of water or by the starting up of the vacuum-pump, the flow of the water is assisted, and as soon as the vacuum reaches a point where it will assist to the extent of fifteen feet the gate-valve 15 in the pipe 14, that connects the discharge of the first centrifugal with the suction of the second, may be closed. It may be here stated that the vacuum can ordinarily be depended upon to assist to an amount equiva-

lent to fifteen feet of head, or about one-third of the total head through which the water is lifted. The closing of the gate-valve 15 will cause the check-valve 13 to open to allow the water discharging from the centrifugal pump 10 to pass directly to the condenser through the condensing-water pipe 5. At the same time check-valve 12 opens and allows the centrifugal pump 11 to obtain its own supply of water from the water-supply, which water it discharges directly into the condenser through the condensing-water pipe 5. Both centrifugal pumps now operating in multiple are assisted by the vacuum to deliver to the condenser against their normal working head of twenty-three feet. Obviously the assistance of the vacuum may be more or less than fifteen feet, and the normal head may be more or less than twenty-three feet, and the starting-head may be more or less than thirty-eight feet, according to the conditions of operation, the location of the water-supply, and the size of the condenser, these figures having been selected simply for the purposes of description in offering an illustration of one example of the invention.

A feature worthy of note is that either of the centrifugal pumps can be thrown out of service by closing the gate-valve on its suction-pipe or discharge-pipe, or both. Of course if there are two pumps and one is closed down the amount of water discharged will be reduced one-half, or the pump that is not needed may be used to pump water for other purposes—as, for instance, to lift the heated water from the hot-well and deliver it to cooling-towers when the latter are used. If after starting up the condenser by running the pumps in series it is found that the amount of exhaust-steam is not sufficient to call for over one-half the total quantity of water, then one of the centrifugal pumps can be shut down by stopping its motor if it is individually operated or by closing the water-supply pipe leading to it if it is on the same shaft with the other machine, and if it afterward becomes necessary to start up the additional pump it can be done by simply opening the valve controlling its water-supply. If, however, it should be considered objectionable to have a greater flow of water than is absolutely necessary to perform the work when such increased flow is due to the increased aid of the vacuum and without requiring the exertion of any more power, then I propose to make an opening to the atmosphere somewhere in the length of the passage leading from the pump to the condenser, so that the water may be exposed to atmospheric pressure. One way of doing this is to provide an intermediate tank or pipe, or its equivalent, from which the condenser can draw the water by the vacuum and into which the centrifugal pumping apparatus can discharge, the discharge of such centrifugal pumping apparatus being at such an elevation that under the normal working the vacuum will be required to aid at least to an extent equal to a certain definite head—say fifteen feet. The centrifugal will then discharge under a constant working head a constant quantity of water whatever degree of vacuum there may be in the condenser in excess of that equal to fifteen feet.

In Fig. 2 I show a tank 25, into the side of which at a suitable point the water is discharged by the pipe 26, which performs the same function as the pipe 5 in Fig. 1. A condensing-water pipe 27 leads from a point near the bottom of tank 25 upwardly and enters the outside of condensing-chamber 1 in like manner as the pipe 5 enters said chamber in Fig. 1. The sides of the tank 25 may be extended above the point of entrance of the water to the condenser, for a purpose to be presently explained. In this modification in Fig. 2, therefore, the water is discharged into a tank and then into the condenser. The only essential difference between it and the form in Fig. 1 is that at the point in the discharge-pipe where the assistance of the vacuum becomes zero and the pressure is equal to that of the atmosphere a tank is placed which is open to the atmosphere. The object is to render the head upon the centrifugal pump a fixed amount and not subject to the variations of the vacuum, the effect of the variation of the vacuum being to raise or lower the level of the water in the tank. For instance, when the assistance of the vacuum is just fifteen feet the water-level in the tank would be at the point where the water enters from the centrifugal pump—that is to say, where the pipe 26 discharges into the tank 25. When the assistance of the vacuum is twenty feet, the level of the water would be five feet below this discharge-point, and when the assistance of the vacuum is twenty-five feet the level of the water would be ten feet below said discharge-point, this rise and fall of the water-level serving to regulate the flow and to maintain it at practically a constant amount. In order to start up without the aid of the vacuum, I extend the sides of the open tank upward to a point above the point where the pipe 27 enters the condenser 1, so that when the centrifugal pumps, operating in series, force the water to that height it will flow into the condenser by gravity.

In order that while one pump is being operated to continue to discharge the condensing-water to the condenser, under the assistance of the vacuum, the other pump may be used to lift water for other purposes, I have shown in Fig. 1 a branch pipe 31 connected with the discharge-pipe 23 of pump 10, which pipe 31 may run to a cooling tower, tank, or other place where the water is to be delivered. Pipe 31 is provided with a gate-valve 32. Also I provide the condensing-water pipe 5 with a gate-valve 30, situated a short

distance from the check-valve 13. After the two centrifugal pumps have been operated in series to discharge the condensing-water the entire height of the condenser to start it the gate-valve 15 will be closed, after which the pump 11 will continue to discharge the condensing-water to the condenser, and if the gate-valve 32 is opened and the gate-valve 30 closed the pump 10 will then lift the water through the pipe 31 for any purpose for which it may be desired, it being noted, moreover, that if the pump 10 is not to lift the water above the level of the pipe 5 or above the level of the check-valve 13 the gate-valve 30 is not needed and may remain open.

Many changes in the combination and arrangement of the various parts may be made without exceeding the scope of the invention.

Other methods and constructions may be devised to change the open tank to the equivalent of a continuous passage from the centrifugal pumps to the condenser; but such modifications would not affect the principle of the invention. A constant head upon the centrifugal pumps might be maintained and a constant flow of water thereby secured by applying a pressure-regulating valve to the discharge-pipe from the centrifugal pumps to the condenser, which valve would be adjusted to preserve a given pressure; but this is not a preferred construction.

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

1. The combination with a condenser, of centrifugal pumps operating in series to supply the condensing-water to said condenser, and means for operating them in multiple, the flow of the water to the condenser being continuous.

2. The combination with a condenser, of centrifugal pumps for continuously supplying the condensing-water thereto, said pumps arranged to operate sometimes in series and sometimes in multiple.

3. The combination with a condenser in which the vacuum at times assists in lifting the condensing-water, of two or more centrifugal pumps operating at times in multiple and at other times in series, to give a continuous flow of water.

4. The combination with a condenser in which the vacuum assists in lifting the condensing-water, of two or more centrifugal or like pumps normally operating in multiple, and means to operate them in series when the assistance of the vacuum is not sufficient to enable them to operate in multiple, the flow of the water to the condenser being continuous.

5. The combination with an elevated or barometric condenser in which the vacuum assists in lifting the condensing-water, of two or more centrifugal or like pumps normally operating in multiple, and means to operate them in series at the time of starting up the apparatus, the flow of the water to the condenser being continuous.

6. The combination with an elevated condenser in which the vacuum assists in lifting the condensing-water, of centrifugal pumps operating in multiple when assisted by the vacuum, and operating in series when the assistance of the vacuum is insufficient to enable them to operate in multiple, the flow of the water to the condenser being continuous.

7. The combination with a condenser in which the vacuum assists in lifting the condensing-water, of two or more centrifugal or like pumps, each having its own separate suction and discharge, and means for temporarily connecting the discharge of one with the suction of the other, the flow of the water to the condenser being continuous.

8. The combination with a condenser in which the vacuum assists in lifting the condensing-water, of two or more centrifugal pumps for continuously supplying the condensing-water to the condenser, each having its own separate suction and discharge, means for conveying the water discharged from the pumps to the condenser, and means for temporarily connecting the discharge of one pump with the suction of the other, consisting of a valve-provided conduit.

9. The combination with a condenser in which the vacuum assists in lifting the condensing-water, of centrifugal pumping apparatus whose members normally operate in multiple but which operate in series when the assistance of the vaccum is insufficient to enable them to operate in multiple, and means for conveying the water from the pumping apparatus to the condenser, the flow of the water to the condenser being continuous.

10. The combination with the condenser in which the vacuum assists in lifting the condensing-water, of a centrifugal pumping apparatus whose members normally operate in multiple but which operate in series when the assistance of the vacuum is insufficient to enable them to operate in multiple, and means for conveying the water from the pumping apparatus to the condenser, said means allowing the water to be acted on by atmospheric pressure during its passage to the condenser.

11. The combination with a condenser, of centrifugal pumps operating sometimes in series and sometimes in multiple, and means for conveying the water from the pumps to the condenser, to give a continuous flow of water.

12. The combination with a condenser, of centrifugal pumps which operate sometimes in series and sometimes in multiple, and means for conveying the water from the pumps to the condenser, said means allowing the exposure of the water to atmospheric pressure in transit to the condenser.

13. The combination with a condenser in which the vacuum assists in lifting the condensing-water, of two or more centrifugal

pumps each having its own separate suction and discharge, and each having a valve for controlling its water-supply, and means for temporarily connecting the discharge of one with the suction of the other, consisting of a valve-provided conduit, the operation of the apparatus giving a continuous flow of water to the condenser.

14. The combination with a condenser, of two or more centrifugal or like pumps, each having its own separate suction and discharge, and each having a valve for controlling its water-supply, means consisting of a valve-provided conduit for connecting the discharge of one pump with the suction of the other, a check-valve between the two suctions, and a check-valve between the discharge of the one and the discharge of the other.

15. The combination with a condenser, of two or more centrifugal pumps each having its own suction and discharge, and each having a valve for controlling its water-supply, means for temporarily connecting the discharge of one with the suction of the other, means for conveying the water from the pumps to the condenser, a check-valve between the two suctions, and a check-valve between the discharge of the first pump and the means for conveying the water to the condenser.

16. The combination with a condenser in which the vacuum at times assists in lifting the condensing-water, of centrifugal pumps discharging at times one through another, and at other times directly to the condenser either singly or together, the flow of the water to the condenser being continuous.

17. The combination with an elevated condenser of two centrifugal pumps operated in series to discharge the condensing-water the entire height of the condenser to start it; and means to operate one pump to continue to discharge the condensing-water to the condenser under the assistance of the vacuum and the other pump to lift water for other purposes, the flow of the water to the condenser being continuous.

18. The combination with a condenser, of centrifugal pumps for continuously supplying condensing-water thereto, said pumps arranged so that one pump sometimes receives its water-supply from another pump and sometimes directly from the water-supply.

19. The combination with a condenser, of centrifugal pumps for continuously supplying the condensing-water thereto, said pumps arranged so that one pump operates sometimes in series with another pump and sometimes alone with the assistance of the vacuum.

Signed at New York city this 20th day of November, 1902.

LOUIS R. ALBERGER.

Witnesses:

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A. E. SAMUELS.