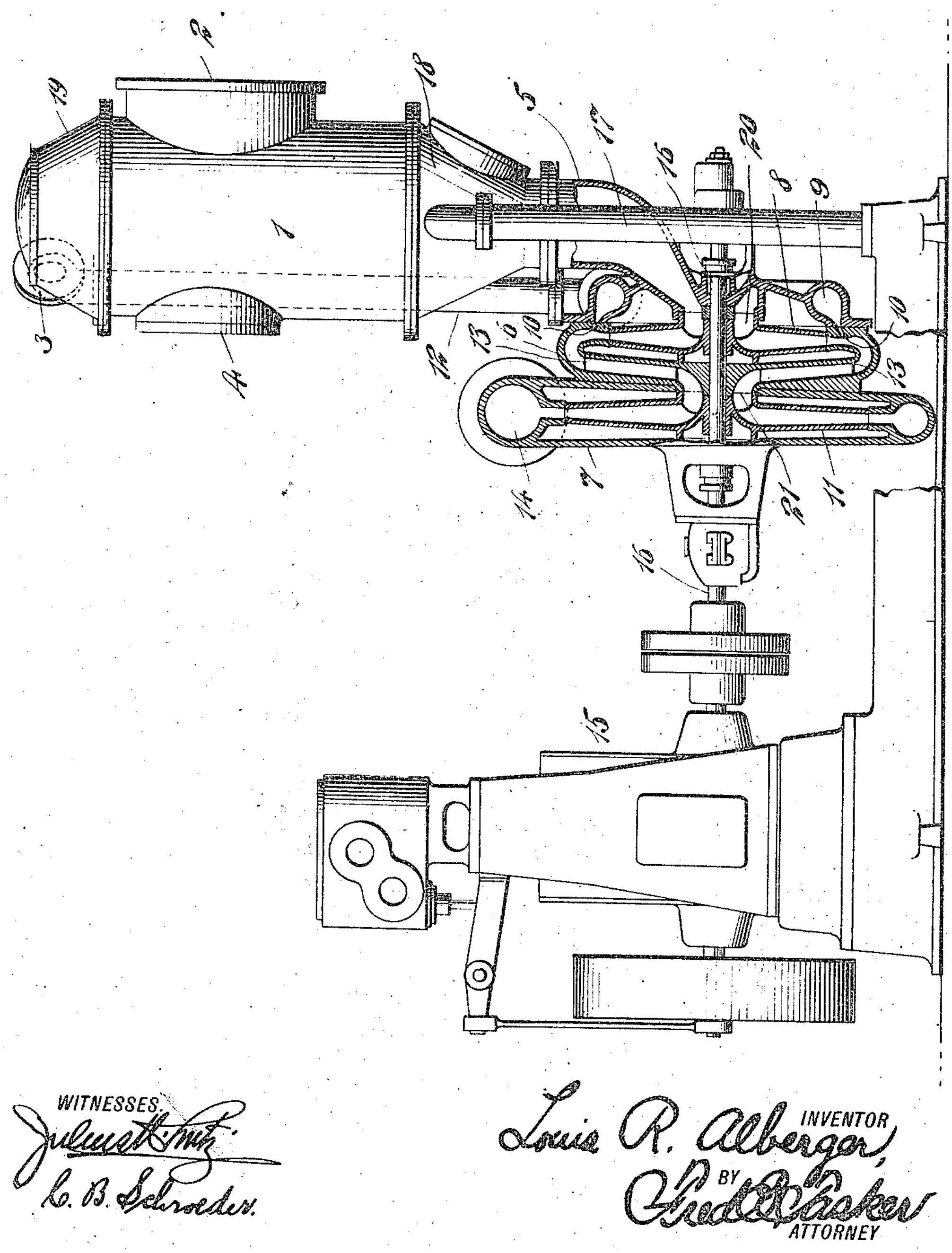
L. R. ALBERGER.

CONDENSER SYSTEM.

APPLICATION FILED NOV. 6, 1908.

976,245. Patented Nov. 22, 1910.



UNITED STATES PATENT OFFICE.

LOUIS R. ALBERGER, OF GREENWICH, CONNECTICUT, ASSIGNOR TO ALBERGER CONDENSER COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

CONDENSER SYSTEM.

976,245. Specification of Letters Patent. Patented Nov. 22, 1910.

Application filed November 6, 1908. Serial No. 461,374.

To all whom it may concern:

Be it known that I, LOUIS R. ALBERGER, a citizen of the United States of America, residing at Greenwich, in the county of Fairfield and State of Connecticut, have invented certain new and useful Improvements in Condenser Systems, of which the following is a specification, reference being had therein to the accompanying drawing.

My present invention relates to certain new and useful improvements in condensing apparatus for the condensation of steam and the maintenance of a vacuum, and it relates more especially to that class of condenser systems wherein a jet condenser is employed and a centrifugal pump utilized for the purpose of removing the condensing water and the water of condensation. My invention is conceived broadly, however, and is applicable to other forms of condensers and other combinations thereof, and is novel and useful when contemplated wholly apart from the condensing function, the invention in that case residing solely in the pumping mechanism and serving many useful purposes, while operating in that capacity especially in so far as the disposal of the air is concerned, said pumping mechanism therefore performing the function of the vacuum pump as well as doing its other duty.

One particular type of centrifugal condenser to which my present improvements primarily relate is shown and described in my co-pending application for Letters Patent upon improvements in condensing apparatus, filed June 24, 1905, Serial No. 266,886. In that application the water used to produce the condensation of exhaust steam in a jet condenser, as also the water of condensation, is removed by a centrifugal pump, while the air is withdrawn by a separate dry vacuum pump.

The object of the present invention is to dispense entirely with the dry vacuum pump, and to provide for the removal of the air remaining after the condensation of the steam, said air removal taking place with the water as the latter passes out from the condenser through the agency of the centrifugal removal pump.

Hitherto it has been found difficult and in practice virtually impossible to so entangle or combine the air with the water in a jet condenser as to completely and effectually remove it through the agency of a centrifugal removal pump and to maintain at the same time in a dependable manner the high degree of vacuum now required. This is due to the very large volume that this highly attenuated air occupies and also to the low velocity of the water leaving the condensing chamber. Both of these conditions are brought about by this high vacuum of, say, one pound or less absolute pressure which is sought to be maintained in the condenser. To attempt to increase the velocity of the water leaving the condensing chamber by restricting the passage or reducing the capacity of the chamber would reduce its condensing efficiency, besides at the same time endangering the safety of the apparatus with which the condenser is employed by modifying the free exit of the water.

In the use of centrifugal condensers of appropriate design, it has been found that when a separate dry vacuum pump is not used the air will be entangled in the condensation water and when the leakage is small a vacuum as high as about three pounds absolute pressure per square inch will be maintained. The reason that this vacuum is obtained is due to the fact that the volume of the air under such a pressure is not so great but that the water can carry it off in a commingled condition under the velocity head which is imparted to the water when it passes from a three pound absolute pressure influence to the suction of the pump. But an absolute pressure of three pounds is not satisfactory for present high vacuum practice, at least one pound being demanded. Air under one pound absolute pressure has a volume three times that of air under three pounds absolute pressure, and the velocity head of the water from the condenser can only be that due to the difference in pressure between that in the condenser and the suction of the pump, namely, one pound. It will thus be seen that the problem to be met is to carry off three times the volume of air with a very much reduced velocity head of the water.

In carrying my invention into practical effect, I provide a centrifugal removal pump built in such a manner as to secure an initial or preliminary pumping effect which will increase the velocity of the water which is being withdrawn from the condenser cham-

ber, this water being delivered to the main discharge impeller which pumps it out into the atmosphere, the pump mechanism being thus in two sections or in some sort of a plural or multiple pumping combination, one part discharging into the other and the last part discharging into the atmosphere; and in combination therewith I arrange means whereby the attenuated air which is withdrawn from the condensing chamber may be combined with the current of flowing water and thereby compressed; this entanglement or union of the air with the water being made to occur at a point between the preliminary impeller and the discharge impeller or between the two parts of the removal pump, or the two sections of whatever plural pumping agency may be utilized in the withdrawal of the water from the condenser. The construction is such at the point where the air is introduced to the pumping mechanism in the carrying out of my invention that the velocity of the water will be high, having this high velocity from the first impeller, and will be under a pressure which while above that in the condensing chamber is not as great as the final discharge pressure which is usually atmosphere, so that the inductive action of the water after it leaves the first impeller in passing the air admitting orifices will induce a flow of the air and compress and carry it with the water into the inlet of the second pump or the second part of a plural pumping mechanism with the resulting effect which I shall fully set forth.

The essence of the invention is therefore to impart to the water from a source of power outside of the condenser, the required increased velocity which is necessary to supplement the low velocity of the water, respecting which low velocity objection exists as above intimated, and to compress the air under one pound absolute pressure to three or more pounds absolute pressure before it is delivered to the removal pump or to that part of a plural pumping agency which is to be considered as the removal or discharge part; and in so increasing the velocity of the water before it is taken by the discharge impeller and in causing the faster flowing water to inductively absorb and compress within it the large volume of air taken from the condenser, I place the removal pump under the same conditions of operation as when a three pound vacuum is being maintained in the condenser which I have above indicated allows a successful entanglement of air with the condensation water, although I actually obtain the desired vacuum of one pound in the condenser in a very simple and effective manner.

The invention therefore consists essentially in the construction, combination and arrangement of the various parts substantially as will be hereinafter described and claimed.

In stating definitely the various pressures existing it is to be understood that they are only relative and for the purpose of clear description.

In the accompanying drawing illustrating my invention, a single figure is presented, the same being a side elevation of my improved condensing apparatus with a delineation in cross section of the pumping appliances for the withdrawal of the condensing water and the water of condensation.

In order to illustrate the practical application and working of my invention, I have represented in the drawing a form or type of jet condenser, offering the same simply as a single specimen or example with no idea of being restricted thereto, and reserving the liberty of employing the invention with any kind of a condenser with which it is found serviceable, and also of utilizing the pumping appliances if desired separately from a condenser system. In this specimen type, 1 denotes the main condensing chamber having the conical lower portion 18 connecting with a tail pipe 5. The condenser 1 is preferably carried on legs or supports 17. At some suitable point in the wall of the shell 1 is an opening 2 for the admission of the exhaust steam into the condenser coming from an engine, steam turbine, or other motor or apparatus with which the condenser may be connected. At another point in the wall of the shell 1, preferably opposite to the inlet 2, is an injection water inlet 4 running from some suitable water supply, so that the water may be transferred to the condenser to be used for condensing purposes. The upper part of the shell 1 is preferably provided with some suitable air cooling construction 19 having an outlet 3 from which an air pipe 12 leads to the pumping mechanism, as I shall presently more fully relate.

The discharge pipe 5 from the condenser connects with the inlet 20 of a pumping mechanism preferably situated close to the condenser. One part of this mechanism has a casing 6 and an impeller 8. The latter is carried on a horizontal shaft 16 of a steam engine or other motor 15, the latter being indicated herein simply by way of example. The impeller 8 of this first centrifugal device delivers water into a curved passage 13 which leads around to the inlet 21 of the main removal centrifugal or turbine pump having a casing 7 within which is the main impeller 11 which discharges into an outlet passage 14. Thus in the present example, I present, as it were, two centrifugal or turbine pumps or two sections of a single pumping mechanism, said pumping mechanism having the function of removing the water from the condenser, one part of the mechanism accelerating the flow of the removal

water and then discharging into the other; and it is evident that the construction of the pumping mechanism may be modified in a great variety of ways.

Alongside of the casing 6, and surrounding the inlet 20 and also the connection of the discharge pipe 5 to said inlet 20, is an annular passage 9, with which the air delivery pipe 12 connects so that the air that passes away from the top of the condenser through the air cooler and out through the eduction opening 3 into the pipe 12 is conveyed through the latter to the annular passage 9. This annular passage is provided with a perforation, slit, orifice, or small opening, or series of same, 10 extending around the circular side of said passage, and these orifices or openings 10 allow air to pass from the annular passage 9 into the water passage 13. Said orifices are therefore so placed in relation to the water passage 13 that the water traveling from the impeller 8 through said passage 13, and accelerated in its movement by said impeller 8, will act by an inductive action to withdraw the air in the annular ring 9 through the orifices 10 and compress and mix it with the water. The air thus mixed with the water in the passage 13 is carried on through said passage 13 to the inlet 21 of the impeller 11, where the air in the mixture is compressed by the action of the impeller 11 and the mixture finally discharged by said impeller 11 into the discharge passage 14, which latter may be connected by suitable piping with the waste water tunnel or any convenient point outside of the condenser.

The construction which I am describing is of such a nature that at the point where the air outlet orifices are located the velocity of the water is quite high and under a pressure less than atmospheric pressure, so that the inductive action of the water passing the orifices would readily cause a flow of the air and carry the same into the water, thoroughly commingling it therewith and compressing it, so that when it reaches the second impeller the latter may exert a still further compressing action upon the air and contribute to a more thorough intermingling of the air and water, and finally deliver them to the atmosphere. The difference in absolute pressure between the air in the condensing chamber and the water in the inlet of the second pump is considerably less than the difference between the pressure of the air in the condensing chamber and the atmosphere, and consequently a greater efficiency and capacity will be obtained in the inductive action of the water upon the air than if the attempt were made to withdraw the air from the condensing chamber and directly discharge it to the atmosphere. The compression of the air in the former case being, say, three volumes and in the latter case fifteen volumes. Thus it will be seen that I impart to the water when it is withdrawn from the condenser chamber a velocity by means of a preliminary impeller. The air is then brought into intimate contact with the swiftly moving water and is compressed thereby in consequence of the change of the velocity head to pressure head of the water. The mixture of water and air is then in condition to be received and discharged to the atmosphere by the main removal impeller in the usual manner.

It is obvious that many modifications in the construction which I have described may be made without deviating from the inventive idea I am seeking to embody, and without detracting from the efficiency of the construction. I am dispensing, as has already been stated, with a separate air pump, and am enabling the removal pump to not only withdraw the condensing water and the water of condensation, but to remove the air also, and in doing so, although I add another stage to the removal pump, or employ another impeller than is ordinarily required in a centrifugal condenser, yet this is a much simpler and economical thing to do than to use a separate air or vacuum pump.

It is manifest that in modifying the construction of pumping mechanism, the annular ring 9 may be made single, as in the present case, or of a multiple kind, and it may be variously applied and fitted in connection with the water passage into which the first impeller delivers. I therefore reserve the liberty of making such changes as may be found necessary to best adapt the invention for use in various locations, and with many different kinds of mechanism.

Heretofore there have been many attempts made to impart a velocity to the water by the removal impeller of a centrifugal pump, the velocity so imparted being so great as to withdraw the air from the condensing chamber under one pound pressure and discharge it to the atmosphere under fifteen pounds pressure. Of course this involves a compression of fifteen volumes and calls for a very high velocity head. The result is an expensive machine which is wasteful in the use of power. According to my present invention, however, the velocity head required is only that needed to withdraw the air from one pound pressure and compress it to three or four pounds pressure as the case may be. This pressure head which is put upon the inlet of the main removal portion of the pump, that containing the main or discharge impeller, assists said impeller in its work of discharging against the atmosphere so that the power required to produce this result is conserved to the greatest possible extent.

It must be remembered that in causing the

withdrawal of air by contact with water in motion, that the efficiency decreases very rapidly as the difference between the terminal pressures increases; consequently in the operation of an inductive jet or other similar device, the differences between the initial and terminal pressures should be kept as low as possible to obtain efficient results.

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

1. In a condenser system, in which the air is removed separately from the water, the combination with a condenser, of a centrifugal or turbine pump for withdrawing water from the condenser, means for increasing the velocity of the flow before the final discharge pumping takes place, means for commingling the air direct from the condenser with the accelerated water and compressing said air, and pumping means for discharging the mixture of air and water to the atmosphere.

2. In a condenser system, in which the air is removed separately from the water, the combination with a condenser, of a centrifugal or turbine pump for withdrawing water from the condenser, means for increasing the velocity of the flow before the final discharge pumping takes place, and means for commingling the air at practically condenser pressure with the accelerated water and compressing said air, and pumping means for discharging the mixture of air and water to the atmosphere.

3. In a condenser system, in which the water is removed separately from the air, the combination with a condenser, of a centrifugal or turbine removal pump for the condensing water and the water of condensation, said pump having a plurality of impellers, that which first acts on the water causing the latter to increase the velocity of its flow, and that which acts finally on the water pumping the combined air and water, and means whereby air is withdrawn from the condenser by the flowing water between the impellers.

4. In a condenser system, in which the water is removed separately from the air, the combination with a condenser, of a centrifugal or turbine pump for removing the water from the condenser, said pump having two or more impellers, one delivering to the other, and means whereby air is withdrawn from the condenser by the flowing water between the impellers to be commingled therewith and compressed for the purpose of reducing its volume and allowing it to be discharged to the atmosphere.

5. In a condenser system, in which the water is removed separately from the air, the combination with a condenser, of a centrifugal or turbine removal pump for the condensing water and the water of condensation, said pump having a plurality of impellers, that which first acts on the water causing the latter to increase the velocity of its flow, and means whereby the accelerated flow of water inductively withdraws air from the condenser and commingles it with the water between the impellers, so that said air may be compressed and the combined air and water may be pumped by the other impeller or impellers.

6. The combination with a jet condenser, of a centrifugal or turbine pump for removing the condensing water and the water of condensation, means for imparting to the outgoing water an increased velocity prior to the final pumping, means whereby the accelerated flow of the water may inductively withdraw the air from the condensing chamber and combine it with the water and compress it, and final pumping means for further combining and compressing the air and the water and for enabling a discharge to be effected.

7. In an apparatus for removing the condensing water and the water of condensation from a jet condenser, the combination with the condenser, of means for first pumping the outgoing water for the purpose of increasing the velocity of its flow, means for removing the air from the condenser separately from the water and causing the accelerated flow of water to inductively collect said air for the purpose of combining it with the water and compressing it, and means for pumping the mixture of air and water for the purpose of finally discharging the same.

8. In an apparatus for removing the condensing water and the water of condensation from a condenser, the combination with the condenser, of means for accelerating the flow of the outgoing water, means for causing said accelerated flow to inductively withdraw the air from the condenser, and means for pumping the mixture of air and water.

9. The combination with a jet condenser, of a plural pumping mechanism having two or more impellers, that which first acts on the outgoing water serving to accelerate its velocity, and means comprising a circular series of orifices alongside of the accelerated water, together with a connection between said orifices and the condenser for removing the air from the latter, all arranged so that the flow of the water past said orifices will inductively collect the air and combine and compress it with the water prior to the action of the other impeller or impellers to which it is delivered.

10. The combination with a jet condenser, of a plural pumping mechanism having two or more impellers, that which first acts on the outgoing water serving to accelerate its velocity, and means including an opening or openings alongside of the accelerated water,

together with a connection between said opening or openings and the condenser for removing air from the latter; all arranged so that the flow of the water past said opening or openings will inductively collect the air and combine and compress it with the water prior to the action of the other impeller or impellers to which it is delivered.

11. The combination with a jet condenser, of a plural pumping mechanism having two or more impellers, that which first acts on the water serving to accelerate its velocity, and means comprising a passage from the condenser to a point alongside of the accelerated water for removing the air from the condenser, so that the flow of the water by said passage will inductively collect the air and combine and compress it with the water.

12. In a condenser system, in which the water is removed separately from the air, the combination with a jet condenser, of means for withdrawing the condensing water and the water of condensation, means for imparting to the outgoing water a rotary movement for the purpose of accelerating its flow and inductively drawing the air from the condenser and combining it with the water whose flow has thus been accelerated, to enable the air to be compressed, and means for pumping the mixture of air and water for the purpose of further compressing the air and commingling the air and water so as to allow a final discharge to the atmosphere.

13. The combination with a jet condenser, of a centrifugal or turbine pumping mechanism for withdrawing the condensing water and the water of condensation, said mechanism having a pair of impellers, one of which imparts a preliminary or initial pumping action to the water for the purpose of increasing its velocity, and the other of which finally discharges to the atmosphere, and means for removing the air separately from the condenser and delivering it to the water after it leaves the initial impeller, said means including a circular series of openings through which the air is inductively drawn by the swiftly moving current of water so as to enable said air to be combined with the water and compressed thereby, after which the mixture is finally discharged to the atmosphere.

14. The combination with a jet condenser, of a centrifugal or turbine pumping mechanism for withdrawing the condensing water and the water of condensation, said mechanism having a pair of impellers, one of which imparts a preliminary or initial pumping action to the water for the purpose of increasing its velocity, and the other of which finally discharges to the atmosphere, and means for removing the air separately from the condenser and delivering it to the water after it leaves the initial impeller, said means including a circular passage having a direct connection with the condenser through which the air is inductively drawn by the swiftly moving current of water so as to enable said air to be combined with the water and compressed thereby, after which the mixture is finally discharged to the atmosphere.

15. The combination with a jet condenser, of a centrifugal or turbine pumping mechanism for withdrawing the condensing water and the water of condensation, said mechanism having a pair of impellers, one of which imparts a preliminary or initial pumping action to the water for the purpose of increasing its velocity, and the other of which finally discharges to the atmosphere, and means for removing the air separately from the condenser and delivering it to the water after it leaves the initial impeller, said means including a passage leading directly from the condenser and provided with one or more openings adjacent to the water between the impellers through which the air is inductively drawn by the swiftly moving current of water so as to enable said air to be combined with the water and compressed thereby, after which the mixture is finally discharged to the atmosphere.

In testimony whereof I affix my signature in presence of two witnesses.

LOUIS R. ALBERGER.

Witnesses:

FREDERICK A. BROCKMEIER,

FRANK WILLIAMS.