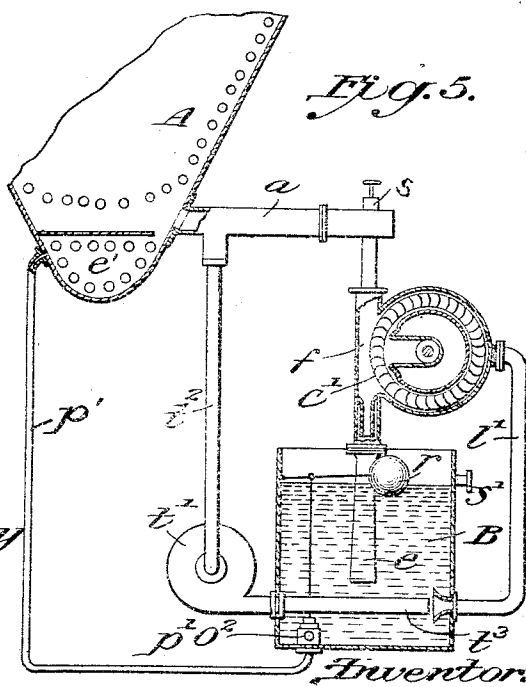
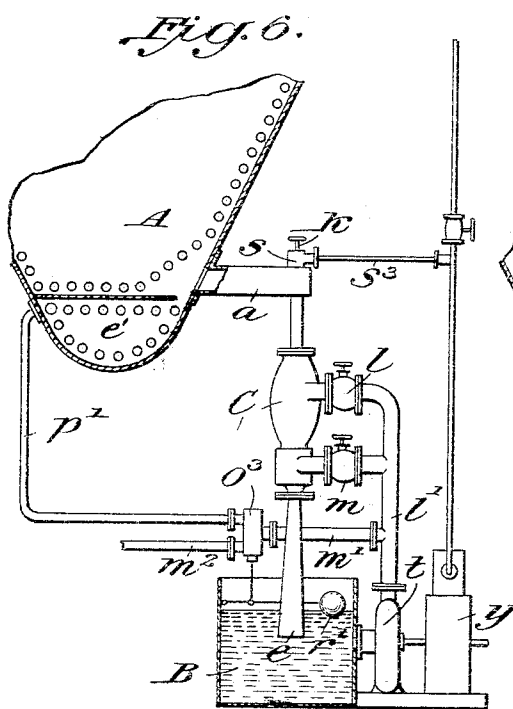
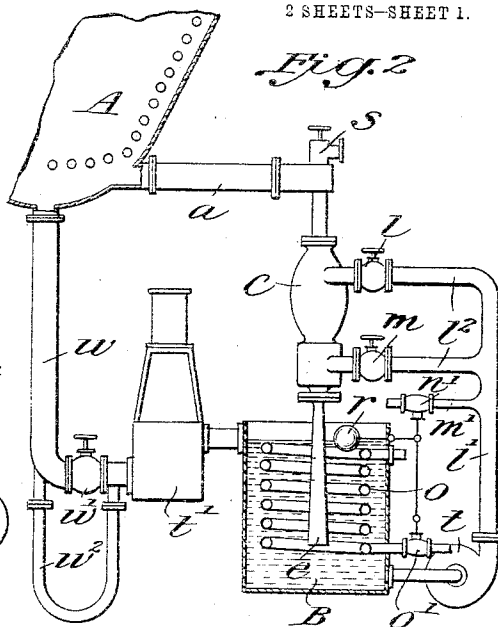
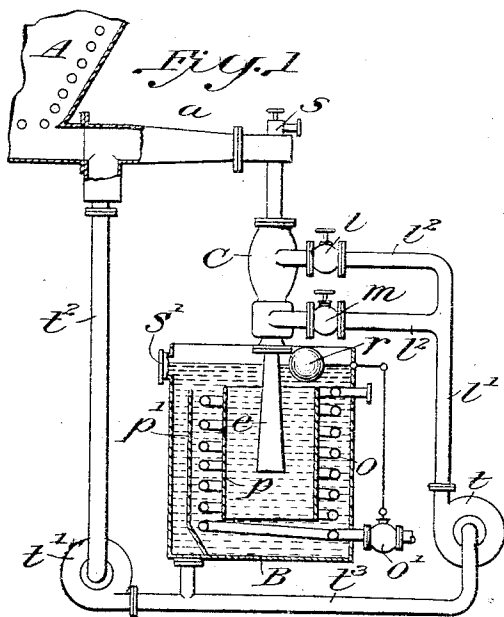


D. B. MORISON.
STEAM CONDENSING AND VACUUM PRODUCING APPARATUS.
APPLICATION FILED APR. 29, 1910.

1,059,899.

Patented Apr. 22, 1913.

2 SHEETS—SHEET 1.



witnesses:
L. L. Burket
C. P. Wright, Jr.

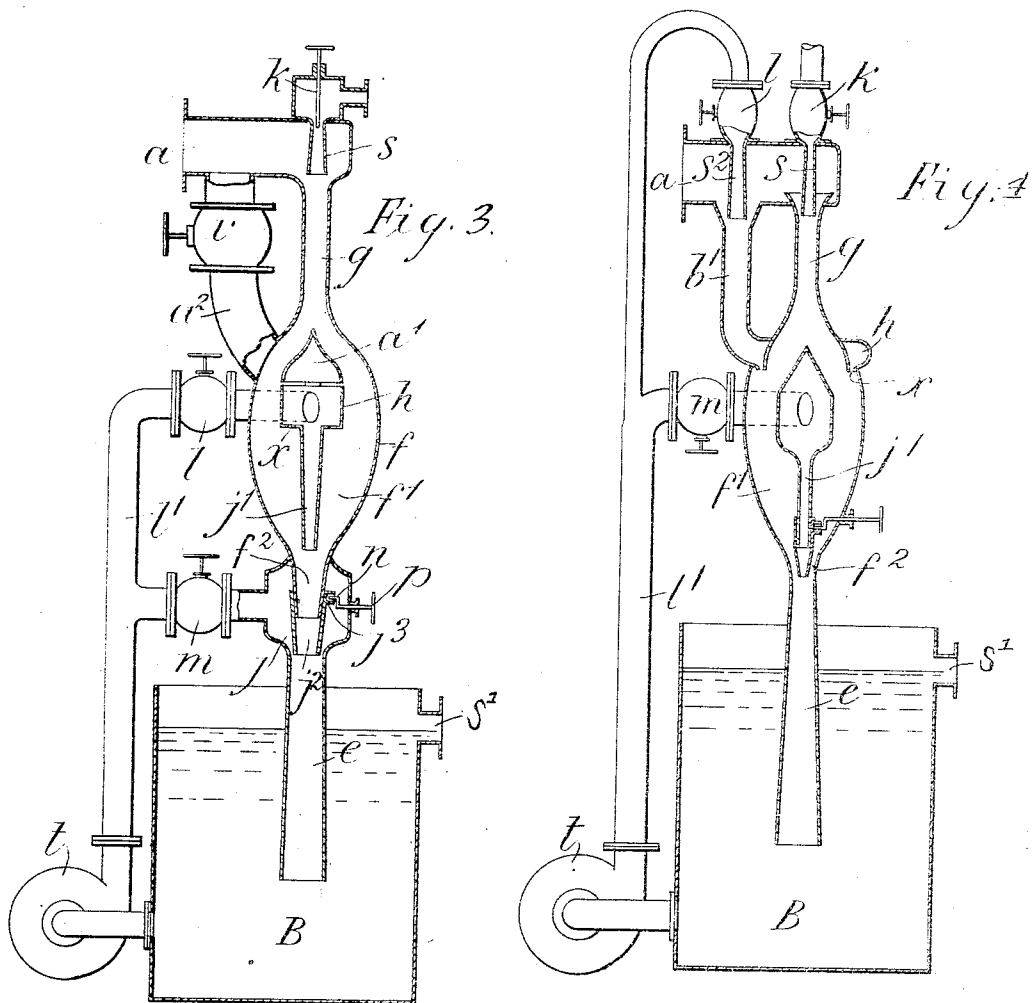
Inventor:
D. B. Morison
By A. S. Patton, Atty

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Witnesses.
 C. P. Wright Jr.
 H. F. Foster

Inventor.
 D. B. Morison,
 By A. S. Patterson,
 Att'y.

UNITED STATES PATENT OFFICE.

DONALD BARNES MORISON, OF HARTLEPOOL, ENGLAND.

STEAM-CONDENSING AND VACUUM-PRODUCING APPARATUS.

1,059,899.

Specification of Letters Patent.

Patented Apr. 22, 1913.

Application filed April 29, 1910. Serial No. 558,329.

To all whom it may concern:

Be it known that I, DONALD BARNES MORISON, a subject of the King of Great Britain and Ireland, residing at Hartlepool, in the county of Durham, England, have invented Improvements in and Relating to Steam-Condensing and Vacuum-Producing Apparatus, of which the following is a specification.

10 This invention has reference to steam condensing and vacuum producing apparatus of the kind in which air and vapor are withdrawn from a main condenser by or with the aid of water supplied under pressure
15 through a water jet ejector (hereinafter called an air ejector) arranged to deliver the water with the withdrawn air into a circulating tank or system into which water of condensation from the condenser is also delivered and from which the air can escape,
20 means being provided whereby an adequate supply of water to the air ejector is maintained under varying conditions of load in the main condenser. Apparatus of this kind is described in the specification of my former Patent No. 967,810.

Now the present invention has for object to provide improved constructions of steam condensing and vacuum producing apparatus of the kind referred to whereby the action of such apparatus can be adapted to suit varying quantities of air present in the main condenser, varying amounts of exhaust steam supplied to such condenser and the required degree of vacuum in the condenser, so that such apparatus can be used in a more advantageous manner, under varying conditions of working, than is possible with the constructions of apparatus described in my said former specification, whereby the scope and usefulness of such apparatus is increased. For this purpose, in steam condensing and vacuum producing apparatus of the kind referred to constructed according to the present invention, the air ejector
45 is so constructed that the supply of water, or water and steam, to its various parts is capable of being separately controlled, and there is provided in connection with the water circulating tank into which the air ejector discharges its water with the air withdrawn from the condenser, and into which water of condensation is directly or indirectly discharged from the condenser

and from which water is directly and continuously delivered back into the air ejector, means whereby the water that is directly delivered back into the air ejector, or another portion of water that is caused to pass from the tank through another by pass circuit to the air ejector, can, when required, be cooled and returned in its cooled state to the air ejector, the arrangement being such that the supply and thermal control of the water passing through the air ejector can be varied to suit the quantity of air, steam and required vacuum in the condenser and enable the apparatus to be worked in the most advantageous manner under varying working conditions.

In the accompanying illustrative drawings Figures 1 to 6 show, in sectional elevation, and more or less diagrammatically, various constructions of apparatus embodying the present invention.

In the arrangement shown in Fig. 1, A is a surface condenser, B a circulating tank and C an air ejector connected to the air and vapor outlet from the condenser by a branch *a*, the air ejector comprising, in this example, steam and water nozzles, such as hereinafter described, arranged in series, so as to discharge air and water through a discharge pipe *c* direct into the circulating tank B, so that upon the water and air being discharged into the tank, the air will ascend and be liberated at the top. *s* is a steam nozzle through which a jet of steam can be introduced into the air inlet end of the air ejector so as to mingle with the air therein and carry the same forward and into the water jets so that it will be effectually removed thereby, as described in my said former specification. The circulating tank is provided with an outlet branch *s*¹ through which heated water can flow for use as feed water. Under normal working conditions of the steam engine connected to the condenser A, the water level in the tank B will be at some distance above the lowest part of the outlet branch *s*¹ but it will of course fall as the supply of exhaust steam to the condenser diminishes with variations in the work done by the engine but cannot fall below the lowest part of the said outlet branch. *t* is a circulating pump for withdrawing water from the tank B and delivering it direct through a pipe *l*¹ with branches *l*² into

the air ejector C, so that water is caused to circulate continuously through the air ejector C and tank B. l and m are water controlling valves on the branches l^2 . t^1 is a pump for withdrawing water of condensation from the condenser A through a pipe t^2 and delivering it into the suction pipe t^3 of the circulating pump t which is connected to the tank B. The circulating tank B is provided with cooling means, such as a coiled pipe o , the supply of cooling water through the said pipe being regulated by a float r which controls a valve o^1 in such a way that when a normal or an excessive amount of steam is condensed in the condenser A, and the resulting water of condensation is delivered to the tank B by the pump t^1 , the water controlling valve o^1 of the cooling device o will be closed, so that the water supplied to the circulating tank B will not be cooled but will on the contrary be increased in temperature by reason of the water circulating through the air ejector C being heated by the steam jet, and by the vapor from the condenser, the excess of heated water passing through the outlet branch s^1 to a feed tank and thence to the feed pump at a considerably higher temperature than that of the water of condensation in the condenser, a great thermal advantage being thereby obtained. When, however, the quantity of feed water from the condenser A is less than the normal amount, the float r , by falling, causes cooling water to flow through the pipe o and prevents the temperature of the water in the tank B rising beyond the temperature desired for the efficient working of the air ejector C, the difference between the highest and lowest levels of the water in the tank B being sufficient to admit of the required movement of the float r for operating the valve o^1 . A vertical tube p , open at both ends, may be arranged between the coil o and discharge pipe e , and a division plate p^1 between the coil and the wall of the tank B for causing the water discharged into the tank by the pipe e to flow to the bottom of the tank and thence rise over and in contact with the coil o and over the top of the partition p^1 which is below the bottom of the outlet branch s^1 , to the suction pipe t^3 of the pump t .

In Fig. 2, which is a modification of the arrangement shown in Fig. 1, the pump t^1 used for withdrawing water of condensation from the condenser A is of the reciprocating air pump type, and can be made capable, at will, of withdrawing air and vapor and water, or water only, from the said condenser. The pump t^1 discharges into the circulating tank B into which the air withdrawn from the condenser is simultaneously discharged by the air ejector C. In order to prevent the air pump t^1 drawing free air from the condenser when the ejector C is in

use, a pipe w connecting the lower part of the condenser to the pump t^1 through a valve w^1 that is normally closed, may be water sealed by a pipe w^2 , but in order to enable the pump t^1 to withdraw and discharge air, vapor and water together from the condenser in the event of stoppage of the air ejector C, as by accident, or for any other reason, the water seal in pipe w^2 can be avoided by opening the valve w^1 , thus enabling the pump t^1 to withdraw air, vapor and water through the pipe w direct in the usual manner. This combination of apparatus is specially suitable and valuable for use on warships, as it provides for alternative air withdrawing methods, and when the ship is cruising or working at low powers, the air and water pump t^1 alone will be sufficient to produce the desired vacuum without the use of the air ejector C. The surplus water can be discharged from the water delivery pipe or conduit l^2 through a pipe m^1 arranged between the pump t and air ejector and controlled by a valve n^1 to a feed tank at a higher level than the water in the tank B. The valve n^1 may, as shown, be connected to the float r connected to the valve o^1 that controls the flow of water through the cooler o .

The air ejector C illustrated in Figs. 1 and 2 may be constructed as shown in Fig. 3 so that its exhausting action can be varied to suit requirement. In this example the said air ejector comprises a pipe or casing f adapted to be connected to the condenser by the branch a through which the mixture of air and vapor is withdrawn, and provided with a steam nozzle s arranged to discharge a jet of steam into the interior f^1 of such pipe or casing f through the tube g , a water spraying and steam condensing device h having orifices e for the discharge of water spray, and a water jet nozzle j^1 delivering into a combining cone f^2 . Another water jet nozzle j of the annular type is arranged coaxially with or in combination with the water spraying and steam condensing device h and water jet nozzle j^1 , the steam nozzle s , the water spraying and condensing device h together with the water jet nozzle j^1 and annular water jet j being provided with separate controlling means, or valves k , l , m respectively, so that each can be separately regulated or shut off in order to adapt the air ejector to effectively deal with the varying quantities of air in the condenser from time to time. The cross sectional area of the water passage through the water jet nozzle j may be varied by a tube j^2 that can be adjusted in an endwise direction by an eccentric n that engages a recessed boss j^3 on the tube j^2 and is operated by a hand wheel p . A non-return valve a^1 may also be provided, such valve, in the form of a float, acting, should water rise in the casing f , to auto-

matically close the tube g and so prevent water reëntering the condenser through the branch a .

It has been found by experiment, that in the case where a steam nozzle is provided in connection with the air ejector C, that when the condensing system is exceptionally air tight, or when the water jets are alone sufficient to dominate the condenser, at the desired vacuum, and the steam to the steam jet is shut off, that the flow of air and vapor through the tube g into which the steam jet discharges, may become throttled by reason of the comparatively small diameter of such tube. In order to obviate such detrimental effect, the apparatus may, as shown in Fig. 3, be provided with a by-pass pipe a^2 of adequate cross sectional area, such by-pass pipe being fitted with a valve v which is closed when the amount of air justifies the use of the steam jet s , and opened when the steam jet is out of use.

In Fig. 4, the water spraying device h consists of an annular water chamber arranged above the central nozzle j^1 and provided with an annular row of orifices or nozzles w . s^2 is a water ejecting nozzle fed from the pump t and which withdraws water from the condenser through the pipe a and discharges it through a pipe b^1 into the spraying chamber h whence it escapes through the spraying orifices w as already described.

The steam jet may, with great thermal advantage, be combined with a mechanically operated water spraying and ejecting device, shown in Fig. 5 as a turbine wheel C^1 , of the known kind, the combined apparatus according to my invention, enabling water to be used in the ejecting device f of a higher temperature, relatively to the temperature corresponding to the vacuum in the condenser, than can be used for the production of a given vacuum, with a given air leakage, with the mechanically operated apparatus when it is not combined with a steam jet. The float r in this example governs a valve o^2 controlling the supply of water from the tank B to a cooling device e^1 situated in the base of the condenser A, the arrangement being such that when the rate of condensation in the condenser A is below the normal, or when no steam is condensed, the float r by falling, opens the valve o^2 and water passes, under atmospheric pressure, from the circulating tank B through a pipe p^1 into the water cooler e^1 . The water after flowing through the cooler, passes into pipe t^2 and is discharged by pump t^1 into the tank B, thereby regulating the temperature of the water to that required for the efficient working of the air ejector C.

Fig. 6 shows another arrangement suitable for use in cases where the amount of air, the desired vacuum, or the thermal con-

ditions, justify or require the provision and the use of a steam jet and where the water pump t is driven by a steam engine y . In this example, to the water delivery pipe l^1 is connected a branch pipe m^1 through which water of condensation is passed to a double acting valve o^3 controlled by a float r^1 in the tank B in such a manner that normally a quantity of water, equivalent to the quantity continually being condensed in the condenser A, is delivered through the valve o^3 and pipe m^2 to a feed tank or elsewhere. Or, when the condensed steam water is insufficient in amount to maintain the desired temperature, the water passing through the ejector C can be artificially cooled. For this purpose, when the water level in the tank B falls, the double acting valve o^3 is arranged, through the operation of the float r^1 , to cause water in the pipe m^1 to flow through the pipe p^1 to the cooler e^1 situated in the base of the condenser A, the outlet from the cooler e^1 being into the ejector C through the branch a . By this arrangement it will be seen that when no steam is entering the condenser and when consequently there is no resulting water of condensation, a portion of the water from the tank B to the ejector C, is cooled and maintained in continuous circulation through the ejector C. The steam nozzle of the ejector C may advantageously be supplied through the pipe s^3 with exhaust steam from the steam engine y used to drive the pump t . The said steam nozzle may however be supplied with steam from any other source.

In some cases the valve controlling the supply of water to the water cooler or to the condenser, may be operated by hand, or any other suitable device may be employed for regulating the temperature of the water in the circulating tank when desired.

Having now particularly described and ascertained the nature of the said invention and in what manner the same is to be performed, I declare that what I claim is:—

1. In a steam condensing plant, the combination with a condenser, a water operated ejector adapted to withdraw air and vapor from said condenser, a tank into which said ejector discharges, and means for continuously withdrawing water from said tank and delivering it into said ejector, of means whereby water supplied from said tank to said ejector can be regulated in temperature, only as and when required, and means for determining when such temperature regulating means shall come into action.

2. In a steam condensing plant wherein air and vapor are withdrawn from a condenser by a water operated ejector which discharges into a tank from which the water supply to the said ejector is withdrawn by a pump, and water of condensation is conducted from the condenser to said tank in-

dependent of the ejector, means whereby water supplied from said tank to said ejector can be regulated in temperature only as and when required and means for determining when such temperature regulating means shall come into action.

3. In a steam condensing plant wherein air and vapor are withdrawn from a condenser by a steam and water operated ejector which discharges into a tank to which said ejector is connected by a return conduit provided with means for circulating water through said ejector, tank and connecting conduit, and wherein water of condensation from the condenser is delivered into the water circulating circuit, a water cooling device and controlling means whereby said cooling device can be put out of action or whereby it can be brought into action for cooling the water circulating through said ejector and tank when the water of condensation delivered from the condenser is insufficient in amount to maintain the desired thermal control of the apparatus.

4. In a steam condensing plant wherein air and vapor are withdrawn from a condenser by a water operated ejector which discharges into a tank to which it is connected by a return conduit provided with means for circulating water through said ejector, tank and return conduit, and wherein water of condensation from the condenser is delivered into the water circulating circuit, water cooling means whereby the water circulating through said ejector and tank can be cooled and means dependent upon the amount of water supplied from the condenser to the tank for automatically controlling the action of said water cooling means.

5. In a steam condensing plant wherein air and vapor are withdrawn from a condenser by a water operated ejector which discharges into a tank to which it is connected by a return conduit provided with means for circulating water through said ejector, tank and return conduit, and wherein water of condensation from the condenser is delivered into said tank and water circulating circuit, a water cooling device arranged in said tank and connected to a cold water supply pipe; a valve controlling the flow of cooling water through said water cooling device and a float connected to said valve and subject to the height of water in said tank.

6. In a steam condensing plant wherein air and vapor are withdrawn from a condenser by a steam and water operated ejector having a steam nozzle, and wherein said ejector discharges into a tank to which it is connected by a return conduit, a rotary device arranged to deliver water from said tank into said ejector through said conduit, means for delivering water from said con-

denser to the combined ejector, tank and conduit and means under the control of a valve and normally out of action whereby the temperature of the circulating water can be reduced only as and when necessary.

7. In a steam condensing plant wherein air and vapor are withdrawn from a condenser by a water operated ejector which discharges into a tank to which it is connected by a return conduit, a rotary pump arranged to deliver water from said tank to said ejector through said conduit, a pump connected to the water outlet of said condenser and to said tank, a water cooling device arranged in said tank and connected to a cold water supply pipe, a valve controlling the supply of cooling water through said cooler and a float in said tank connected to said valve.

8. In a steam condensing plant wherein air and vapor are withdrawn from a condenser by a water operated ejector which discharges into a tank from which the water supply to the said ejector is withdrawn, an air pump, capable of withdrawing air, vapor and water, having its delivery connected to said tank, a pipe connecting the condenser to the suction inlet of said air pump, said pipe being of a size adapted to allow of air, vapor and water flowing therethrough to said air pump, a water sealed pipe connected at its ends to the first mentioned pipe and a valve in said pipe between the parts thereof to which said water sealed pipe is connected, for the purpose set forth.

9. In a steam condensing plant wherein air and vapor are withdrawn from a condenser by a water operated ejector which discharges into a tank to which said ejector is connected by a return conduit and a pump for circulating water through said tank, conduit and ejector, and wherein the water of condensation from the condenser is delivered into the water circulating system, a water outlet pipe connected to the conduit between the circulating pump and the ejector, a valve controlling the flow of water through said pipe and a float subject to the water in said tank and connected to said valve.

10. In a steam condensing plant wherein air and vapor are withdrawn from a condenser by a water operated ejector which discharges into a tank from which the water is circulated through said ejector, and wherein the water of condensation from the condenser is delivered into the water circulating circuit, a water operated ejector having multiple water inlet branches, a return conduit connecting said tank to the multiple inlet branches of said ejector, a rotary pump in circuit with said conduit, means for separately controlling the supply of water through each water inlet branch, and means normally out of action whereby

the water circulating through said ejector and tank can be cooled as and when required.

11. In a steam condensing plant wherein
5 air and vapor are withdrawn from a condenser by a water operated ejector which discharges into a tank to which said ejector is connected by a return conduit so as to form a continuous system through which
10 water is caused to circulate, means for delivering air, vapor and water from said condenser into said circulating system, and means for delivering excess of water from the return conduit at a part thereof between
15 the water circulating means and ejector.

12. In a steam condensing plant wherein air and vapor are withdrawn from a condenser by a water operated ejector which

discharges into a tank from which water 20 is circulated by a pump through a return conduit connected to said tank and ejector, a water cooler arranged in said tank, means for controlling the flow of cooling water through said water cooler, an excess water 25 discharge pipe connected to said conduit between the water circulating pump and ejector and means for simultaneously controlling the flow of water through said water discharge pipe and of water through the 30 cooling device.

Signed at London England this 20 day of April 1910.

DONALD BARNS MORISON.

Witnesses:

R. WESTACOTT,
H. D. JAMESON.