H. FOTHERGILL AND J. GUNN.

BOILER FEED WATER SUPPLY AND STEAM CONDENSING PLANT.

APPLICATION FILED NOV 8, 1919.

1,408,574.

Patented Mar. 7, 1922.

4 SHEETS—SHEET 1.

Fig. 1.

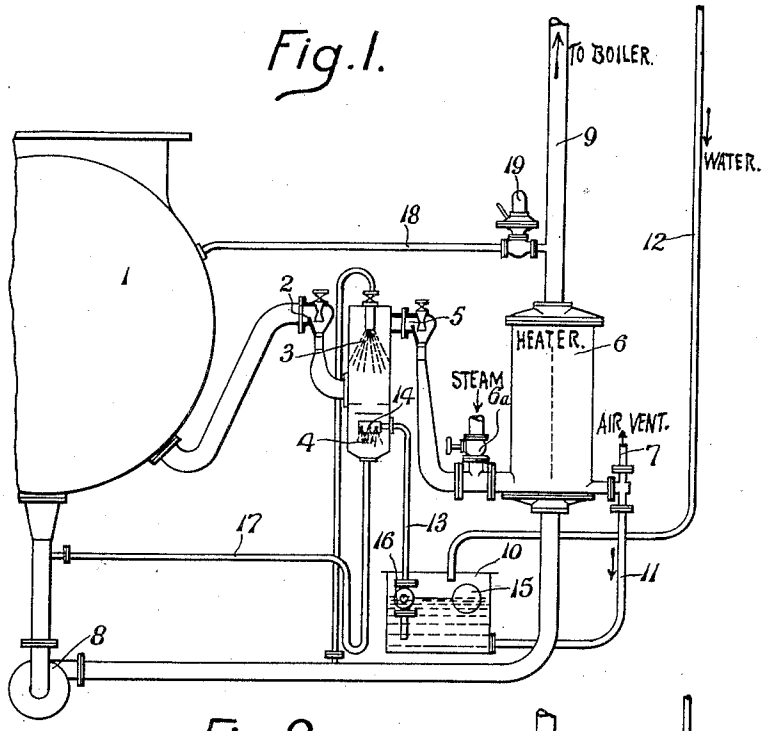
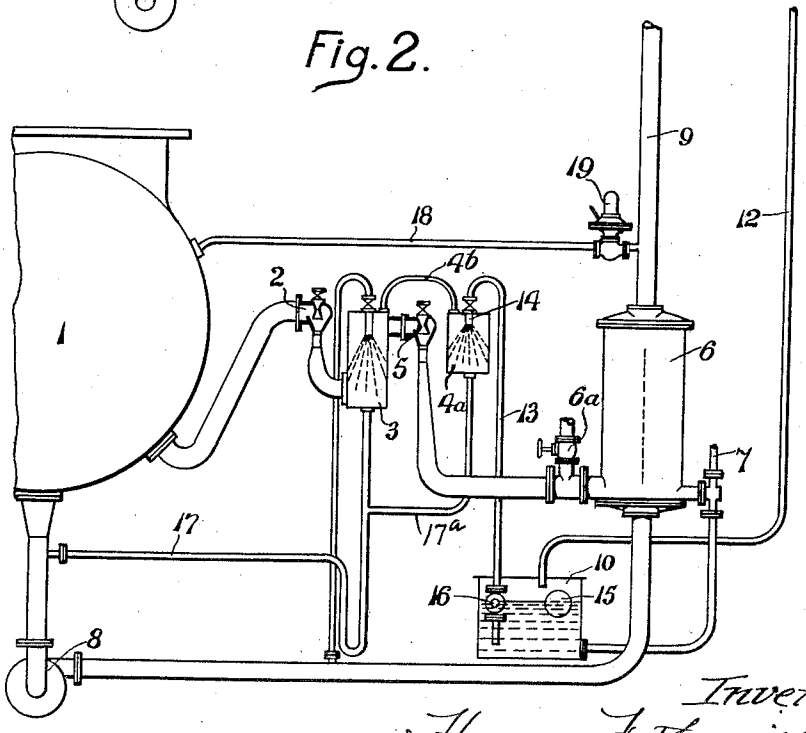


Fig. 2.



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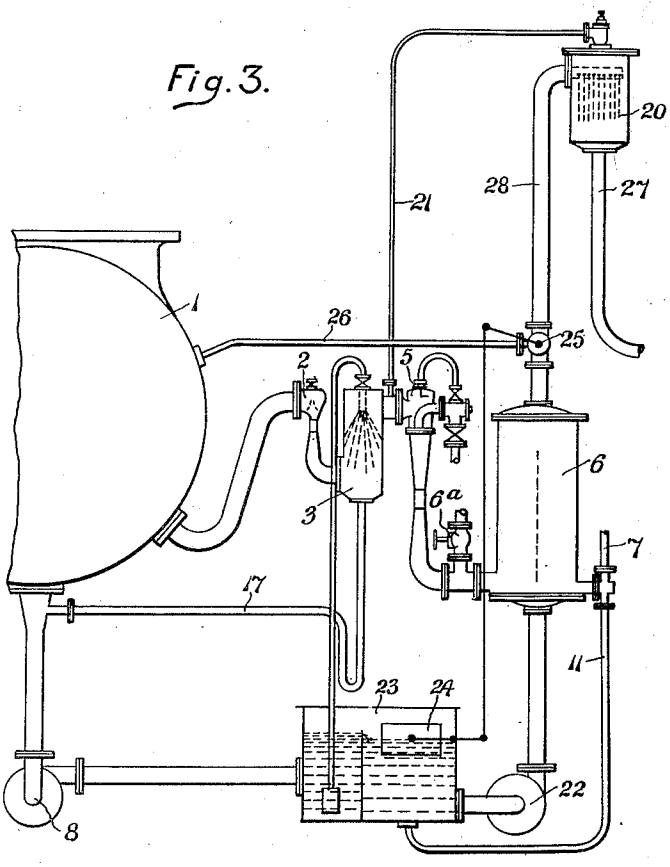
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4 SHEETS—SHEET 2.

Fig. 3.



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4 SHEETS—SHEET 3.

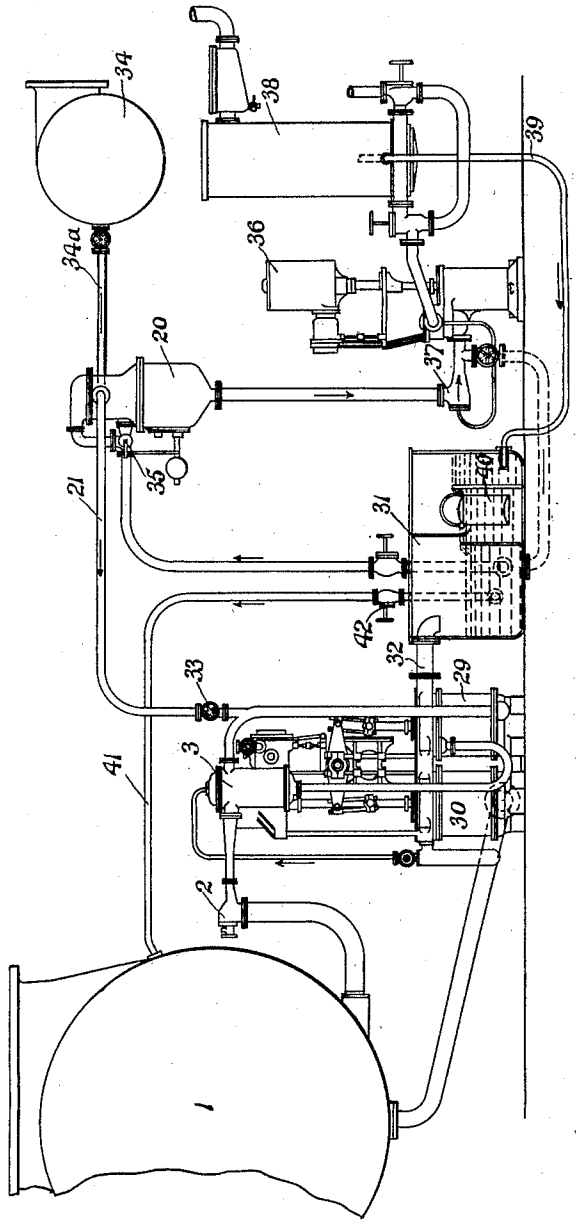


Fig. 4.

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4 SHEETS—SHEET 4.

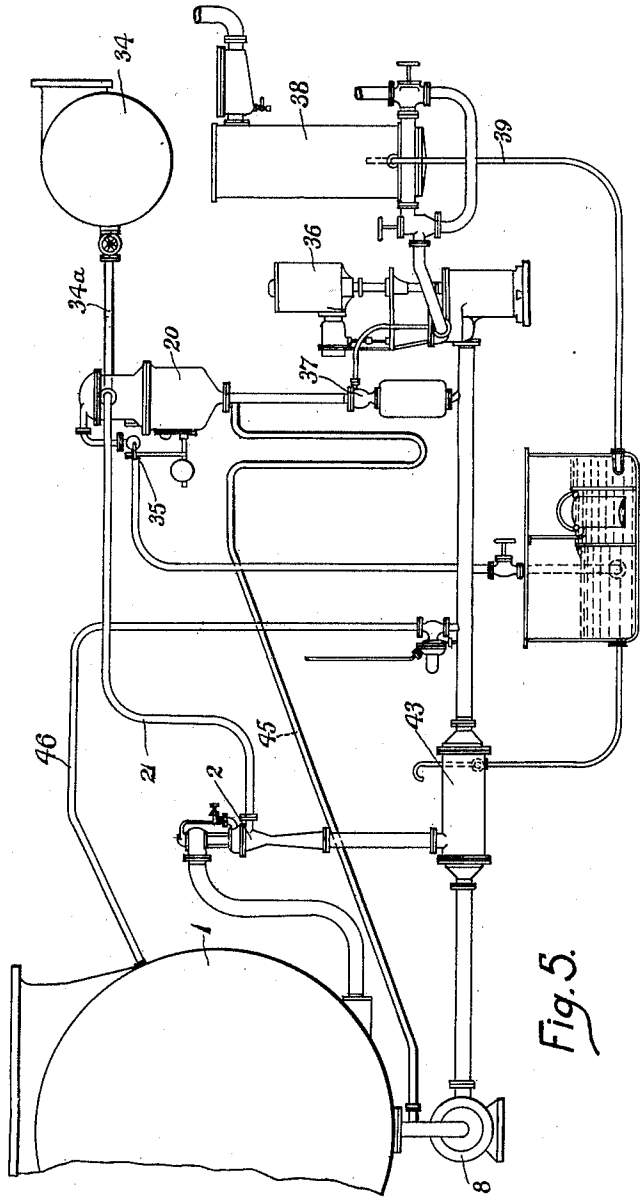


Fig. 5.

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UNITED STATES PATENT OFFICE.

HARRY FOTHERGILL, OF LONDON, AND JAMES GUNN, OF BARROW-IN-FURNESS, ENGLAND.

BOILER-FEED-WATER SUPPLY AND STEAM-CONDENSING PLANT.

1,408,574. Specification of Letters Patent. Patented Mar. 7, 1922.

Application filed November 8, 1919. Serial No. 336,699.

To all whom it may concern:

Be it known that we, HARRY FOTHERGILL and JAMES GUNN, both subjects of the King of Great Britain, and residents of London, England, and Barrow-in-Furness, England, respectively, have invented certain new and useful Improvements in Boiler-Feed-Water Supply and Steam-Condensing Plants, of which the following is a specification.

This invention relates to boiler feed water supply and steam condensing plants, and has particular reference to the deaeration of feed water.

In steam plants it is desirable that the water supplied to the boiler should be as free from air as possible, and it has been found from experiment that such water can be deaerated by delivering it into a vessel under a vacuum, or under a pressure less than the atmosphere.

The primary object of the present invention is to effect the deaeration in an efficient manner having regard both to the effectiveness of the deaeration and also the thermal efficiency of the condensing and deaeration system as a whole.

The present invention consists of improved means whereby this deaeration is effected and the primary feature of the invention is the provision of a deaeration chamber or vessel which is maintained under vacuum or a partial vacuum by being placed in communication with some part of the vacuum system of the plant other than the main condenser. The invention further comprises the particular construction and arrangement of plant as hereinafter described.

A convenient arrangement in plant where a steam jet ejector apparatus is used to withdraw aerated vapour from the main condenser and deliver it to an auxiliary condenser, is to place the deaeration vessel in communication with the vacuum system at some position on or beyond the ejector. Where an auxiliary condenser or a condensing receiver under vacuum is comprised in the air extracting apparatus, the deaeration chamber or vessel may be integral with the receiver or it may be a separate vessel and connected therewith as will hereafter more fully appear. The water to be deaerated may be heated prior to its entry into the deaeration vessel or may be heated within the deaeration vessel, and either the whole of the feed water or only that portion—such for instance as the drainage and feed make up water—which requires deaeration may be passed to the deaeration vessel, as desired. Alternative means may be provided for maintaining the deaeration vessel under vacuum and in marine plant in particular, where a separate condenser is provided for condensing the steam from the auxiliary engines, the deaeration vessel may be placed in communication with this auxiliary condenser under control of a valve so that when in harbour the vacuum of this auxiliary condenser may be made use of for the purpose, or a separate device such as an exhaust steam jet may be employed in harbour for producing the desired vacuum in the deaerator.

In the accompanying drawings we have illustrated embodiments of our invention, Fig. 1 being a diagrammatic view illustrating the invention as applied to apparatus in which aerated vapour is withdrawn from a main condenser by two steam operated ejectors in series with an intermediate condensing receiver, a part of which forms the deaeration chamber or vessel. Fig. 2 shows an arrangement identical with Fig. 1 except that the deaeration vessel is separate from the condensing receiver. Fig. 3 shows diagrammatically a modification of the arrangements shown in Figs. 1 and 2, the deaeration in this case being effected in a separate vessel located, however, on the discharge side of a heater. Fig. 4 shows diagrammatically the application of our invention to a marine condensing plant in which aerated vapour and condensate are separately withdrawn from the condenser by a steam jet operating in conjunction with reciprocating air pumps, and Fig. 5 illustrates diagrammatically the application of our invention to condensing plants in which aerated vapour is withdrawn from the main condenser and discharged to atmosphere by steam jets, the condensate being removed by a centrifugal pump.

Referring to these drawings and particularly to Fig. 1, the numeral 1 designates the main condenser from which aerated vapour is withdrawn by the steam jet ejector 2 and delivered thereby to the condensing receiver 3 which is under vacuum in accordance with the usual practice. The lower part 4 of this condensing receiver 3 forms the deaeration vessel. A second steam jet ejector 5 with-

draws from the condensing receiver 3 and discharges into a surface feed heater 6, the air finally escaping to atmosphere by way of the pipe 7. The condensate from the main condenser is delivered direct to the feed water system by the pump 8, passing on its way through the surface feed heater 6 and thence to the boiler feed system by way of the pipe 9. The feed heater 6 may be of any desired construction and may be provided with a valve 6ª by means of which any additional steam desired for raising the feed water to the required temperature may be introduced. The hot drainage or condensed steam from the feed heater 6 passes through the pipe 11, to the tank 10, into which feed make-up water is also delivered by way of the pipe 12, the water thus being raised in temperature before admission to the deaeration chamber 4 by way of the pipe 13 and sprayer 14. The water in the tank 10, which contains air, is admitted into the deaeration chamber 4 through a valve 16 under the control of a float 15 and being sprayed into the chamber 4 under vacuum becomes deaerated, the deaerated water passing by way of the looped pipe 17 to the suction side of the condensate pump 8 and mixing with the practically airless condensate from the main condenser 1 passes with it through the feed heater 6 to the boilers.

If desired, the deaerating chamber may be constructed separately from the intermediate condenser, and placed under vacuum by a pipe connecting the former to the latter. In order to ensure a constant supply of water to the centrifugal pump to provide for the reliable working of same, and for the condensing of the steam from the steam jets under all conditions of working a pipe 18 may be led from the discharge from the feed heater, and the flow through such pipe controlled by a hand operated valve, or a suitable automatic valve 19, for example, as described in the specification of British application No. 13616 of 1918, may be employed.

Fig. 2 shows how the deaeration vessel may be separate from the condensing receiver, this vessel designated 4ª being placed in communication with the condensing receiver 3 by a pipe 4ᵇ, the pipe 13 leading from the tank 10 to the sprayer 14 within the deaeration vessel, a pipe 17ª leading from the bottom of the deaeration vessel to the looped pipe 17 which connects up to the suction side of the condensate pump as before.

Referring to Fig. 3 the deaeration vessel 20 is a separate vessel arranged on the discharge side of the surface heater 6, this deaeration vessel being placed under the necessary vacuum by connection through the pipe 21 with the suction system of the second ejector 5. The condensate discharged from the main condenser 1 is all delivered into a tank 23 by the pump 8 and a second pump 22 discharges it through the feed heater 6 and thence by way of the pipe 28 to the deaeration vessel 20. The tank 23 contains a float 24, which by falling when the supply of water from the condenser is reduced, operates a valve 25 so that water is by-passed into the main condenser 1 through the pipe 26. It will be clear from the drawing that the deaerated water passes from the vessel 20 to the boiler feed system through the pipe 27, the liberated air passing off by way of the connection pipe 21. It will be noticed that this example differs from the foregoing example in that the whole of the feed water is passed through the deaeration vessel.

Referring to Fig. 4 we have shown there a marine condensing plant in which aerated vapour is withdrawn from the main condenser 1 by a steam jet ejector 2 and delivered to a condensing receiver 3 as before. Reciprocating pumps are, however, used in this example, and the aerated vapour and condensate are withdrawn from this receiver separately by means of the barrel 29, the condensate from the main condenser 1 being withdrawn by the other barrel 30. The air discharged from these pumps is allowed to escape to atmosphere and the condensate flows into a tank 31 by way of the discharge pipe 32. The tank 31 receives the whole of the water required for boiler feeding purposes.

The deaerating chamber 20 is separately formed, and is placed under vacuum by connecting it to a part of the vacuum system other than the main condenser. At sea it may be conveniently placed in communication with the vacuum system on the discharge side of the ejector where a vacuum of, it may be 24″ exists, the pipe 21 controlled by the valve 33 providing for this. In harbour, when the main condensing plant is not operating, the valve 33 may be closed and the deaerating vessel 20 placed under vacuum by communication through the valve controlled pipe 34ª with the ship's auxiliary vacuum condenser 34, or by other convenient means, such as an auxiliary steam jet. Feed water is sprayed into the deaerating chamber 20 from the tank 31 under the control of a valve 35 operated by a float in the deaerating chamber, so that a constant level is always maintained in the latter, and a head of water provided on the suction side of the feed pump 36. This head on the suction side of the feed pump may be increased, if desired, by an inducing nozzle 37 supplied with water from the discharge side of the pump. The feed pump 36 may discharge to the boilers through a surface heater 38 in a well-known manner, the drainage water or condensed steam from this heater being led into the tank by a pipe 39 preferably passing through filtering means such as the filter buckets 40, be-

fore mixing with the condensate discharged from the condenser. A pipe 41 controlled by a valve 42 is provided for by-passing water from the tank 31 into the main condenser when desired.

Fig. 5 illustrates our invention as applied to a condensing system in which aerated vapour is withdrawn from the condenser and discharged to the atmosphere by steam jets, the condensate being removed by a centrifugal pump. The arrangement is a modification of that shown in Fig. 3, but in this example the condensate is delivered direct to the feed pump through a small auxiliary surface condenser 43 in which the steam discharged from the steam jets is condensed. In this arrangement the deaeration vessel 20 is placed under vacuum by connecting it by means of the pipe 21 with the steam jet ejector apparatus 2, and the water which is passed through the deaeration vessel is the drainage water and other condensate which it is desired to deaerate, as for example, the condensate from the auxiliary condenser. Instead of the deaerated water flowing from the deaeration vessel to the feed pump 36 it may flow through the pipe 45, shown in dotted lines, to the suction side of the condensate pump 8. Provision is here again made for by-passing to the main condenser through a pipe 46 in which the controlling valve is operated by any convenient means, the drawing indicating by way of example the means described in the specification of British application No. 13,616 of 1918. The deaeration vessel may, when the main vacuum system is not in operation, be placed under vacuum by communication with other apparatus under vacuum, as for example, the auxiliary vacuum condenser 34 connected with it by the valve controlled pipe 34^a in the manner before described.

We wish it to be understood that in using the word "vacuum" we do not necessarily mean a high vacuum, but any pressure which is less than atmosphere.

What we claim and desire to secure by Letters Patent is:—

1. A steam condensing plant comprising a main condenser, a deaeration vessel, a connection between said deaeration vessel and a part of the vacuum system on the side of the steam jet ejector remote from the main condenser, means for introducing water to be deaerated to said deaeration vessel and means for discharging said water after deaeration to the boiler feed system.

2. A steam condensing plant comprising a main condenser, a steam jet ejector withdrawing aerated vapour from said main condenser and delivering it to a condensing receiver, a deaeration vessel maintained under vacuum by connection with the vacuum system at a position on the side of the steam jet ejector remote from the main condenser and means for delivering aerated water to and discharging water from said deaeration vessel.

3. A steam condensing plant comprising a main condenser, a steam jet ejector withdrawing aerated vapour from said main condenser and delivering it to a condensing receiver, a deaeration vessel separate from said condensing receiver, a pipe connecting said separate deaeration vessel with the vacuum system of the plant on the discharge side of the steam jet ejector, and means for delivering water to be deaerated to and withdrawing the aerated water from said deaeration vessel.

4. A steam condensing plant comprising a main condenser, a deaeration vessel, a pipe connection between said deaeration vessel and a part of the vacuum system on the side of the steam jet ejector remote from the main condenser, means for introducing water to be deaerated to said deaeration vessel, means for heating said water prior to its introduction to said deaeration vessel, and means for discharging said water after deaeration to the boiler feed system.

5. A steam condensing plant comprising a main condenser, a steam jet ejector withdrawing aerated vapour from said main condenser and delivering it to a condensing receiver, a deaeration vessel maintained under vacuum by connection with the vacuum system at a position on the steam jet ejector, and means for delivering aerated water to and discharging de-aerated water from said deaeration vessel.

6. A steam condensing plant comprising a main condenser, a deaeration vessel, a connection between said deaeration vessel and a part of the vacuum system on the side of the steam jet ejector remote from the main condenser, means for introducing water to be deaerated to said deaeration vessel, a filter through which said water passes prior to its entry into said deaeration vessel, and means for discharging said water after deaeration to the boiler feed system.

7. A steam condensing plant comprising a main condenser, a deaeration vessel, means for maintaining said deaeration vessel under vacuum, means for delivering to said deaeration vessel only that portion of the boiler feed water which requires deaeration, a filter through which said water passes prior to its entry into said deaeration vessel, and means for delivering the condensate from the main condenser directly to the boiler feed system without passage through said deaeration vessel.

8. A steam condensing plant comprising a main condenser, a deaeration vessel, alternative means for maintaining said deaeration vessel under vacuum, means under control of the operator for selecting either of said alternative means at will, means for

introducing water to be deaerated to said deaeration vessel, and means for discharging said water after deaeration to the boiler feed system.

9. A steam condensing plant comprising a main condenser, a deaeration vessel, a valve controlled pipe connection between said deaeration vessel and a part of the vacuum system on the side of the steam jet ejector remote from the main condenser, a second valve controlled pipe connection between said deaeration vessel and a second independent condenser whereby when the main condenser is not operating, the deaeration vessel can be maintained under vacuum from said independent condenser, means for delivering water to be deaerated to said deaeration vessel, and means for discharging the deaerated water from said deaeration vessel to the boiler feed system.

In witness whereof we affix our signatures.

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JAMES GUNN.