D. B. MORISON.

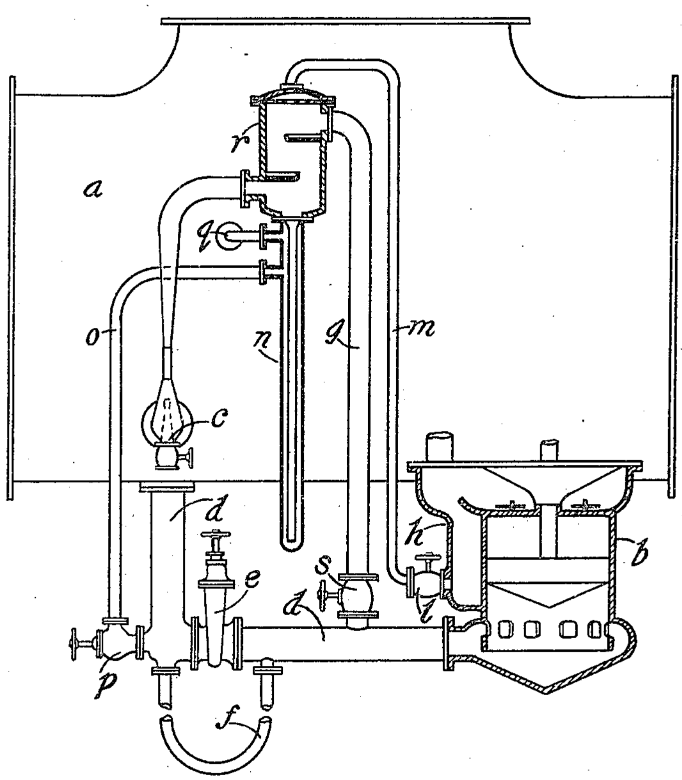
METHOD OF PRODUCING LOW VACUUM IN STEAM CONDENSERS.

APPLICATION FILED JUNE 12, 1917.

1,265,480. Patented May 7, 1918.

2 SHEETS—SHEET 1.

Fig. 1.



Inventor:

Donald Barns Morison,

by [signature] Attys.

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2 SHEETS—SHEET 2.

Fig. 2.

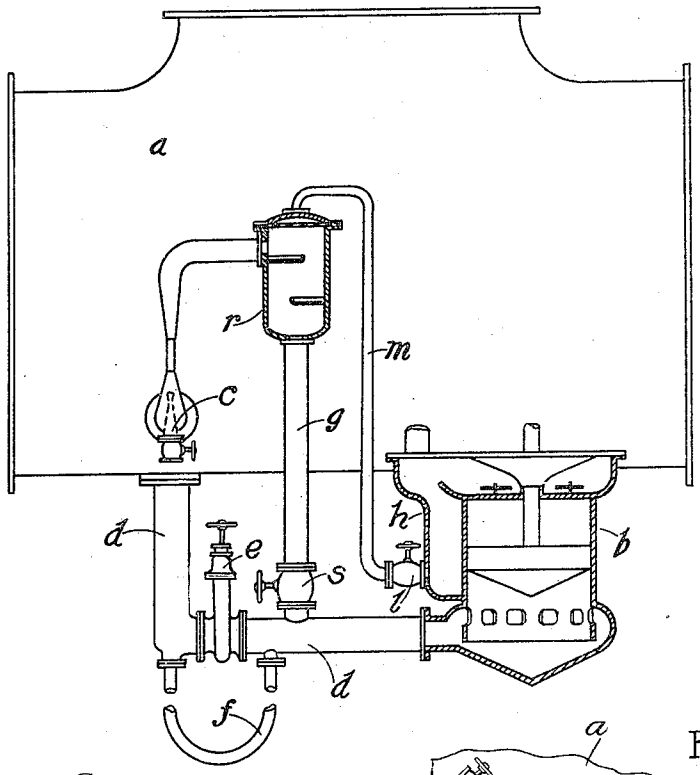


Fig. 3.

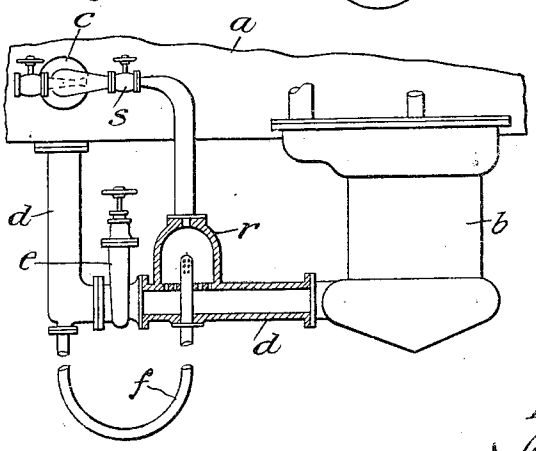
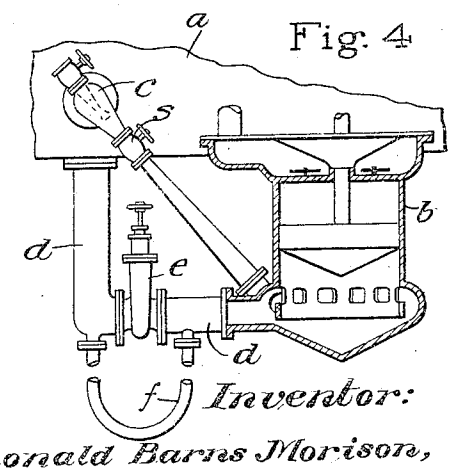


Fig. 4



Inventor:

Donald Barns Morison,

Spear Middleton Madden & Spear

Atty's.

UNITED STATES PATENT OFFICE.

DONALD BARNS MORISON, OF HARTLEPOOL, ENGLAND.

METHOD OF PRODUCING LOW VACUUM IN STEAM-CONDENSERS.

1,265,480. Specification of Letters Patent. Patented May 7, 1918.

Application filed June 12, 1917. Serial No. 174,391.

To all whom it may concern:

Be it known that I, DONALD BARNS MORISON, a subject of the King of Great Britain and Ireland, residing at Hartlepool, in the county of Durham, England, have invented a Method of Producing Low Vacuum in Steam-Condensers, of which the following is a specification.

This invention relates to steam condensing plants designed to work under low vacuum at normal power, and comprising a main condenser of the surface or jet type, and means for circulating water through and for withdrawing air from the main condenser. The invention relates particularly to surface condensing plants such as are in general use on steamships driven by reciprocating engines, and in which the vacuum ranges from about 24 to 28 inches of mercury (barometer 30 inches).

One of the objects of my invention is to secure greater economy in working a given condensing plant, operating under given conditions and maintaining a given low vacuum such as is maintained under full power conditions on an average steamship propelled by reciprocating engines. My invention also has for object to provide improved combinations of apparatus, whereby this increased economy may be conveniently and beneficially obtained.

The method usually adopted in the working of low vacuum plants, such for example as the surface condensing plant on a cargo boat propelled by reciprocating engines, is to circulate through the condenser such a quantity of condensing water as is necessary to maintain the desired vacuum, which is usually an average of about 26 to 27 inches of mercury, and to withdraw from the condenser about 5 to 7 pounds of vapor per one pound of air withdrawn, which air is generally near 1.5 cubic feet per minute per 10,000 pounds of steam condensed per hour. In such plants it is usual to combine with the condenser a reciprocating air pump of practically standard displacement per horse power (which is usually about one sixteenth of the displacement of the low pressure cylinder).

In the course of prolonged research on vacuum production I have found that low vacuum can be very economically produced as follows:—

In accordance with my invention, I withdraw from the main condenser, when worked under normal full power conditions, in addition to the air which enters the vacuum system, a relatively much larger volume of condensable vapor than is withdrawn according to existing practice. The quantity of vapor I prefer to withdraw from the condenser under normal working conditions is not less than fifteen pounds of vapor per one pound of air withdrawn, and I recommend that as much more than this quantity be withdrawn as practical considerations will allow with thermal gain to the entire plant. This vapor with its associated air I withdraw by means of one or more steam jets, and the vapor so withdrawn is condensed by means of condensate, or other water, such as water intended for boiler feeding purposes, in a steam condensing device of the surface or direct contact type (hereinafter called the condensing device) in which a vacuum lower than that in the main condenser is maintained by any suitable air discharging apparatus. The steam jet or jets is, or are, constructed in the known manner, but must be constructed and arranged so as to be capable of withdrawing from the main condenser the relatively large volume of vapor above mentioned. By means of the above arrangement less surface is required in the condenser, less circulating water, and as compared with present practice the power required to drive the circulating pump is considerably reduced, moreover the temperature of the condensate withdrawn from the main condenser is increased, and the size and cost of the plant reduced, whereby greatly increased overall efficiency of the condensing plant is secured.

In the case of low vacuum jet or direct contact main condensers my invention produces the additional beneficial effect that when the condensing water which is delivered into the condensing device into which the large quantity of condensable vapor is delivered by the steam jet, is water intended for boiler feeding, such boiler feed water is augmented by the distilled water resulting from the condensation of this relatively large quantity of vapor, and as a large proportion of this distilled water is due to the method of obtaining low vacuum hereinbefore described, the advantage is obvious.

I am aware that it has already been proposed to employ in high vacuum condensing plant, steam jet air ejectors for the purpose of intensifying the vacuum in the condenser,

and although some vapor has of a necessity been withdrawn from the condenser with the air, the object in every such case was to withdraw by means of the steam jet a mixture in which the vapor had been designedly reduced to a minimum. According to my invention, however, I employ a steam jet or jets to withdraw a mixture in which the vapor is designedly maintained many times greater than that in the mixture hitherto dealt with by the steam jet, the weight of air in the mixture in each case being the same.

My invention can be carried out with apparatus of the kind herein referred to, provided that a steam jet or jets capable of withdrawing the desired large volume of condensable vapor is or are employed, and the vapor so withdrawn is condensed in a condensing device; but I prefer to use apparatus in which air from the condensing device and water from the condensing device and water from the main condenser are together admitted to the discharging apparatus, as for example to the cylinder of an air pump below the pump piston, the discharging apparatus being connected to the condenser by a pipe having a valve which is by-passed by a water seal or other equivalent resistance.

The accompanying drawings, Figures 1, 2, 3 and 4, illustrate diagrammatically convenient forms of apparatus in accordance with my invention, the same letters of reference being used to denote similar parts.

Fig. 1 represents my invention as applied to an ordinary condensing plant on a vessel such as a cargo carrying vessel propelled by reciprocating engines. In accordance with this example of my invention I combine with the air pump *b* and the main condenser *a* a steam jet *c* which discharges aerated vapor from the condenser *a* into a receiver *r*, from which the air is withdrawn through a pipe *g* connected to the suction of the air pump *b*. I also place in the air pump suction pipe *d* a shut-off valve *e*, and on this valve being closed condensate passes to the air pump by a looped pipe or water seal *f*. From the compartment *h* on the discharge side of the air pump *b* condensate is taken through the valve *l* and pipe *m* to the receiver *r*. The heated water from the receiver is withdrawn by means of the water seal *n* from which it passes through the pipe *o* and valve *p* into the air pump suction pipe *d*, or on the valve *p* being partially or wholly closed, water from the receiver flows through the pipe *q* into the condenser.

In Fig. 2 which is a modification of Fig. 1, the air and heated water from the receiver *r* pass together through the pipe *g* and valve *s* into the air pump suction *d*.

Fig. 3 shows another arrangement in accordance with my invention, and in which the condensing receiver *r* is placed on the upper side of the air pump suction pipe *d*. The whole of the condensate from the condenser passes through the water seal *f* into the receiver *r*, it may be through perforations in an extension of the discharge end of the pipe *f* as shown in the drawing, and in which receiver the condensate condenses the steam from the steam jet *c*, either wholly or partially, the aerated vapor and water from the receiver flowing into the air pump suction *d*.

In a modification of this arrangement the receiver is constructed integral with the air pump, as for example it may be at one side of or surround the air pump barrel.

In Fig. 4 the steam jet *c* discharges direct into the suction receiver of the air pump which also forms the device for condensing the steam from the steam jet.

When the apparatus in any of the arrangements described is worked under normal conditions, that is, when the valve *e* is closed, the steam jet *c* employed and condensate delivered through the water seal *f* to the air pump *b*, very large volumes of vapor can be withdrawn from the condenser *a* in accordance with my method of working; while on opening the valve *e* and shutting off the steam jet *c* and valve *s* the condensing plant can then be operated in accordance with known practice.

What I claim is:—

1. The method of working low vacuum condensing apparatus at normal power conditions, consisting in withdrawing from the condenser, in addition to the air which enters the vacuum system, a relatively much larger volume of condensable vapor than is withdrawn according to existing practice.

2. The method of working low vacuum condensing apparatus comprising steam ejecting apparatus in combination with a condensing device and an air discharging apparatus, consisting in withdrawing from the condenser under normal power conditions by the steam ejecting apparatus, in addition to the air which enters the vacuum system, a relatively much larger volume of condensable vapor than is withdrawn according to existing practice.

3. The method of working low vacuum condensing apparatus at normal power conditions, consisting in withdrawing from the condenser not less than 15 pounds of vapor per one pound of air withdrawn, for the purposes herein set forth.

4. The method of working low vacuum condensing apparatus comprising a steam jet or jets in combination with a condensing device and an air discharging apparatus, consisting in withdrawing from the condenser under normal power conditions by the steam jet or jets not less than 15 pounds of vapor per one pound of air withdrawn, for the purposes herein set forth.

5. The method of working low vacuum

condensing apparatus comprising a steam jet or jets, a condensing device, air discharging apparatus and means for circulating water through the main condenser, consisting in withdrawing from the condenser under normal power conditions by said jet or jets not less than 15 pounds of vapor per one pound of air withdrawn, and condensing said vapor in said condensing device in which a vacuum lower than that in the main condenser is maintained by said air discharging apparatus.

Signed at London, England, this 25th day of May, 1917.

DONALD BARNS MORISON.

Witnesses:

HARRY FOTHESRGUIL,

EDWARD JANSON BREIVIS.