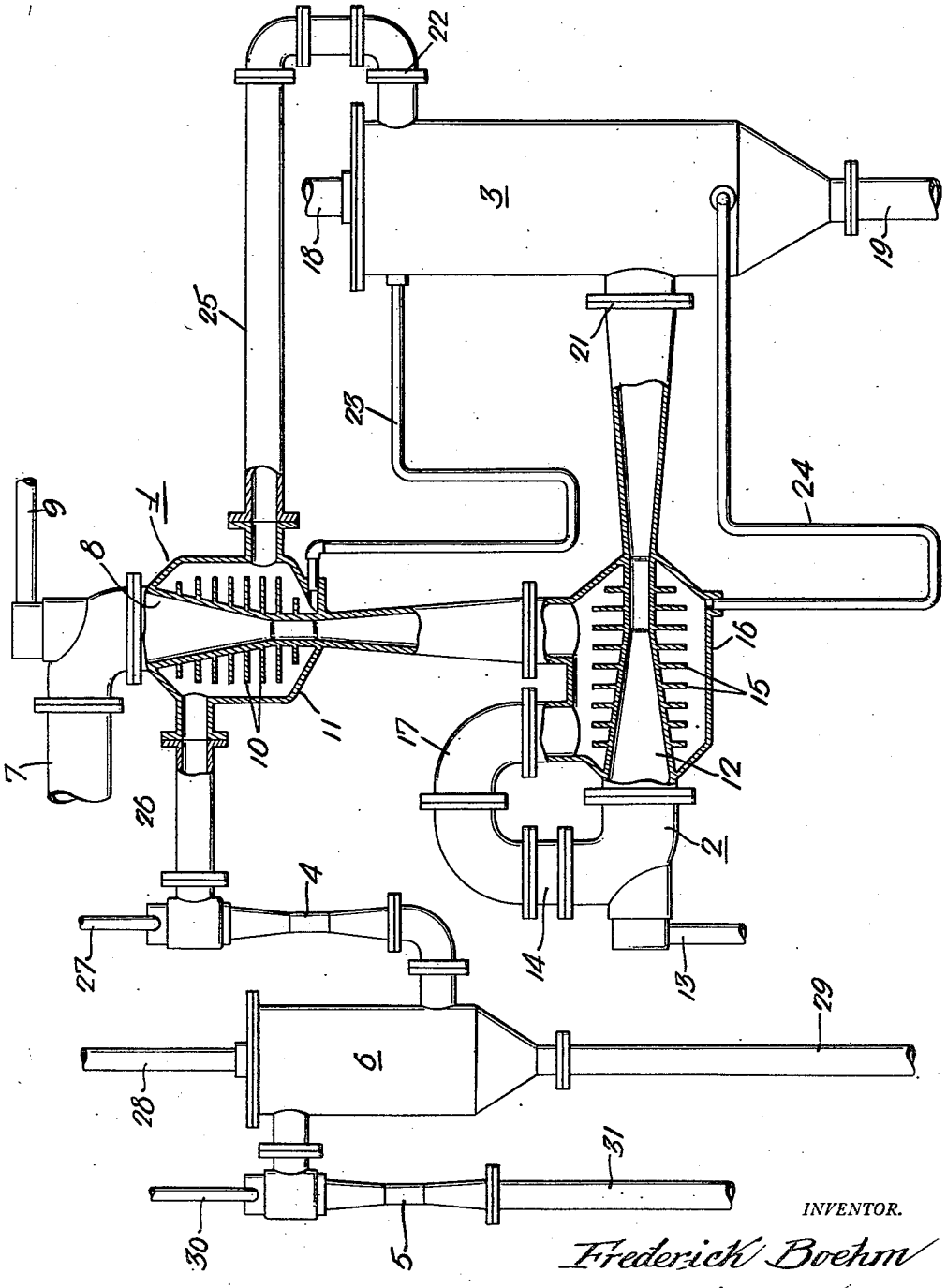
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STEAM JET VACUUM PUMP SYSTEM

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INVENTOR.

Frederick Boehm

BY Howson & Howson

ATTORNEYS

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STEAM JET VACUUM PUMP SYSTEM

Frederick Boehm, Philadelphia, Pa., assignor to Schutte and Koerting Company, Cornwells Heights, Pa., a corporation of Pennsylvania

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This invention relates to improvements in steam jet vacuum equipment and a principal object of the invention is to increase the efficiency of apparatus of this class by reducing steam consumption to a practical minimum.

The invention relates more particularly to that class of steam jet vacuum equipment which employs a booster jet or jets ahead of a booster condenser together with a single or multiple stage exhauster unit downstream from and serving said condenser. In a system of this type, the invention contemplates a novel means for sub-cooling the non-condensibles, air and water vapor mixture passing from the booster condenser in advance of the downstream units to condense the said vapors or a substantial part thereof and to thereby reduce the load on the subsequent steam jets.

The invention contemplates also a double use of the said mixture passing from the booster condenser to elevate the temperatures in the operational cold zones in the booster unit or units and the use of this cooling action to sub-cool the said mixture as previously set forth.

The invention will be more readily understood by reference to the attached drawing the single figure of which illustrates diagrammatically a steam jet vacuum pump utilizing the principle of the invention.

The steam jet vacuum pump system shown in the drawing consists of a primary booster unit 1, a secondary booster unit 2, a booster condenser 3, and a two-stage exhauster unit downstream from and connected to the booster condenser and comprising a high vacuum exhauster 4, a low vacuum exhauster 5, and an inter-condenser 6 between and connecting said exhausters.

The primary booster connects with the main suction line through the vapor inlet 7. A steam jet projected into the diffuser 8 from a supply pipe 9 tends to evacuate the inlet 7 in conventional manner. As illustrated the diffuser is provided externally with fins 10 for thermal transfer purposes, as hereinafter described, and the diffuser is jacketed at 11, said jacket embracing the finned portion of the diffuser. The function of this jacket is described below.

The diffuser 8 of the primary booster discharges in the present instance to a secondary booster 2. This booster comprises the usual diffuser 12, a steam admission port 13 for the operating jet, and a suction port 14. In this case also the diffuser 12 is provided with thermal conduction fins 15, and the finned area of the diffuser is enclosed by a suitable jacket 16. The jacket 16 receives the discharge from the primary booster 1 as illustrated and the jacket is connected also with suction port 14 by way of a duct 17.

The secondary booster discharges to the booster condenser 3 which may be of conventional design comprising an inlet 18 at the top for condensing water and a condenser water outlet 19 at the bottom. The secondary booster is connected to the booster condenser casing by way of a port 21 and discharge from the booster condenser is by way of a port 22 adjoining the upper end of the casing. As illustrated, the jacket 11 of the primary

booster and the jacket 16 of the secondary booster are connected with the condenser 3 by way of pipes 23 and 24 respectively, these pipes extending from the bottoms of the respective jackets and each comprising a trap in the form of a depending loop which affords self-sealing of the connection between the booster and the condenser.

In accordance with the invention, the discharge port 22 of the condenser 3 is connected by a pipe 25 to the jacket 11 of the primary booster. The jacket is also connected through pipe 26 with the high vacuum exhauster 4 which is actuated by a steam jet from operating steam inlet pipe 27. Discharge from the exhauster 4 is to the inter-condenser 6, and from this condenser to the low vacuum exhauster 5. Condensing water is brought to the condenser through pipe 28, and the water discharge from the condenser is through pipe 29. Operating steam for the exhauster 5 comes to the latter by way of pipe 30, and exhauster discharge is through pipe 31.

The finned and jacketed areas of the diffusers 8 and 15 of the boosters 1 and 2 constitute the operational cold zones of the diffusers wherein the temperatures approach freezing and which, if not provided with heat from an external source, may produce ice in the throat of the diffuser. To prevent such ice formation it has been customary to feed live steam to the diffuser jackets. In the aforedescribed system the air-water vapor or other mixture from the booster condenser 3 passing to the jacket 11 through the pipe 25 functions in lieu of such live steam to elevate the temperature in the cold zone of the diffuser 8 to an extent precluding ice formation. In this function of giving up its heat to the diffuser the said mixture is cooled with consequent condensation of the water vapors, the condensate being withdrawn from the bottom of the jacket 11 through the pipe 23. Since the obtainable economy of steam on the system is in part a function of the amount of non-condensibles, air and saturant condensible vapors which the exhauster unit serving the booster condenser is required to handle, the aforedescribed reduction in the water vapor content of the mixture passing from the condenser 3 will by reducing the load on the exhauster unit comprising the exhausters 4 and 5 and condenser 6, which maintain the vacuum in the condenser 3, reduce the amount of operating steam for this unit and thereby effect a material economy.

In the present system which employs the secondary booster 2, the use of the discharge from the primary booster as a temperature-elevating medium for the cold zone of the secondary booster, and the resulting condensation of residual operating steam of primary booster plus any water vapor entrained through suction pipe 7 and withdrawal of the condensate from the mixture passing to the condenser 3, correspondingly reduces the ultimate water vapor content of the mixture required to be handled by secondary booster 2, reducing the amount of operating steam for the secondary booster.

The aforesaid economies in the operating steam requirements for the exhauster unit and the secondary booster, plus the saving of live steam previously required to preclude ice formation in the throats of the booster diffusers, results in a practical minimum steam consumption in the system as a whole.

I claim:

1. In a steam jet vacuum pump system, a steam jet vacuum booster unit comprising a diffuser having a vapor inlet, a discharge port, and a steam jet means connected at said inlet, said diffuser exhibiting an operational cold zone intermediate said inlet and said discharge port; a jacket enclosing said zone; a booster condenser; duct means connecting said discharge port to said condenser; a steam jet exhauster for said condenser; and a duct means including said jacket as a part thereof for connecting said exhauster with said condenser.

2. A steam jet vacuum pump system as defined in claim 1 including a pipe connecting said jacket with said condenser for withdrawing condensate from said jacket and conveying the same to said condenser.

3. A steam jet vacuum pump system as defined in claim 2 wherein said pipe includes a trap in the form of a depending loop which affords self-sealing of the connection between said jacket and said condenser.

4. A steam jet vacuum pump system as defined in claim 1 including a second steam jet vacuum booster unit intermediate said condenser and the first named booster unit and in tandem with the latter, said second booster unit comprising a diffuser having an inlet, a discharge port, and a steam jet means connected at said inlet, said last named diffuser exhibiting an operational cold zone intermediate said last named inlet and said last named discharge port; a jacket enclosing said last named zone; duct means including said last named jacket as a part thereof connecting the discharge port of the diffuser of the first named booster unit to the inlet of the diffuser of the second named unit; and duct means connecting the discharge port of the last named diffuser with said condenser.

5. A steam jet vacuum pump system as defined in claim 4 including pipes connecting said first named and said last named jackets with said condenser for withdrawing condensate from the jackets of both of said diffusers and conveying the same to said condenser.

6. A steam jet vacuum pump system as defined in claim 5 wherein said pipes each include a trap in the form of a depending loop which loop affords self-sealing of the connection between each of said jackets and said condenser.

7. A steam jet vacuum pump system as defined in claim 1 wherein said exhauster means comprises high vacuum and low vacuum steam exhauster units, and an intercondenser between and connecting said exhauster units, the said high vacuum exhauster unit being connected to said jacket-including duct means.

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