March 16, 1948. J. H. COX ET AL 2,437,849

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Fig. 1.

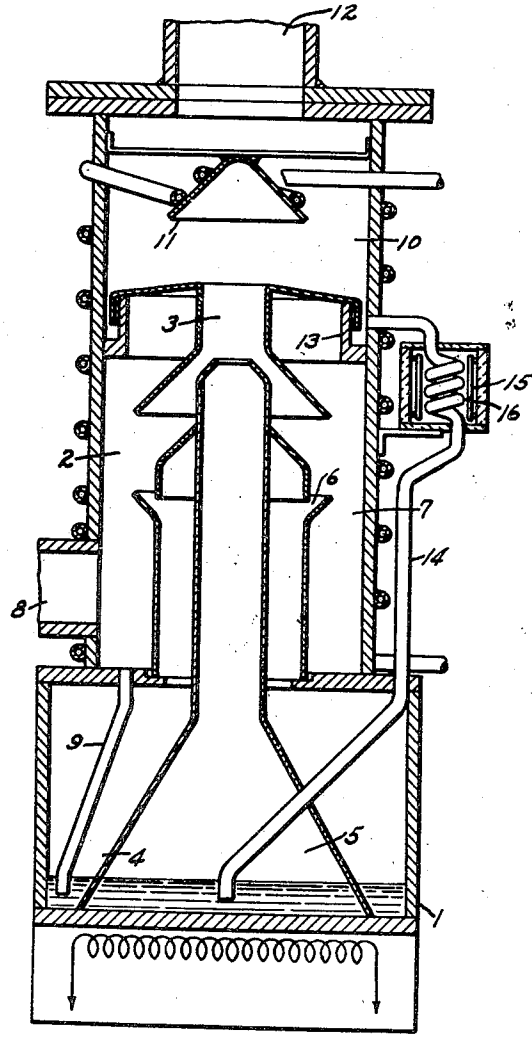
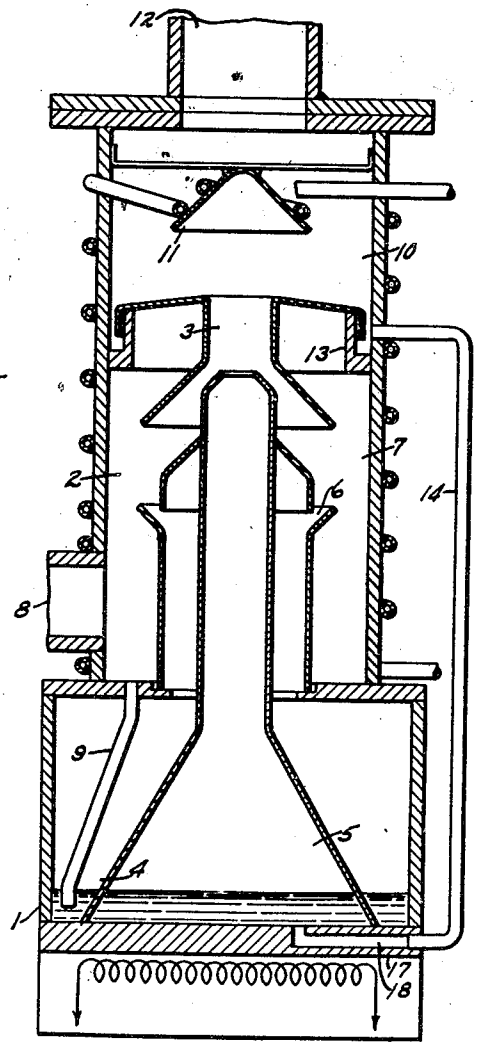


Fig. 2.



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7 Claims. (Cl. 230—101)

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Our invention relates to a pump and, particularly, to a high efficiency multistage pump of the diffusion type.

In the operation of vapor diffusion pumps it has heretofore been customary to collect the condensate from the various pump stages and return the condensate as a whole to the preliminary or high vacuum pumping stage of the pump. This return of all of the condensate to a single portion in the boiler produces a cool spot which reduces the efficiency of the pump by preventing evaporation from a portion of the surfaces of the liquid in the boiler. Also, since the various stages of the pump are at different pressures, it was heretofore found desirable to use liquid traps to prevent back diffusion between the various stages of the pump.

In a pump according to our invention, the various pump stages are connected to various boiler jets and the condensate from the various stages is returned to the boiler compartment from which it came. The return connections are extended below the surface of the liquid in the boilers so that it is unnecessary to use a liquid trap to prevent vapor passing through the condensate return connection. To further eliminate cold spots in the boiler, preliminary heating devices are connected to preheat the condensate before returning it to the boiler chambers. While the condensate from all stages may be preheated as desired, we have found that the condensate from the preliminary stage is of such small quantity that it does not produce an appreciable cold spot in the boiler and may be returned to the associated boiler compartment.

It is an object of our invention to provide a high efficiency diffusion pump.

It is a further object of our invention to provide a diffusion pump in which the condensate is returned to the boiler compartment from which it originated.

It is a further object of our invention to provide a condensate return which does not require liquid traps.

It is a further object of our invention to provide preheating means for the condensate returned to the boiler.

It is a further object of our invention to eliminate cold spots in the pumping boilers.

It is a further object of our invention to provide a pump boiler in which there is substantially uniform evolution of vapor over the entire liquid surface.

It is a further object of our invention to provide a pump which is operable against higher back pressures.

Other objects and advantages of our invention will be apparent from the following detailed description taken in conjunction with the accompanying drawing, in which:

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Figure 1 is a sectional elevation of a two-stage pump according to our invention; and

Fig. 2 is a modification according to our invention.

In the embodiment of our invention according to Fig. 1, the pump boiler 1 is divided into a plurality of compartments, the area of the various compartments being proportioned to provide the quantities of vapor required in the various stages of the pump. For simplicity of operation, we have shown and described a two-stage pump following the pattern of our invention which is applicable to any number of pumping stages. The boiler 1 drives vapor to a plurality of pumping stages 2 and 3, the preliminary pumping stage 2 being at relatively low pressure and requires a relatively small volume of vapor; therefore, it is connected to a relatively small boiler chamber 4, herein shown as the external boiler chamber. The working vapor passes through a jet 6 into the condensing chamber 7 drawing the non-condensive gas through an intake pipe 8 and forcing them into the upper part of the condensing chamber 7. The condensate from the first pumping stage 2 collects in the bottom of the condensing chamber 7 and returns through a condensate-return connection 9 to a point below the surface of the liquid in the boiler 4, so that the differential of pressure between the boiler and the pumping stage will produce an elevation of liquid in the return connection 9 and eliminate the passage of vapor or gas between the boiler 4 and the first condensing chamber 7.

The second pumping stage 3 operates against a relatively higher back pressure and consequently requires a larger amount of vapor at a higher pressure and is, therefore, connected to a boiler compartment 5 having a large evolution area. The second pumping stage 3 also is provided with a condensing chamber 10 which also includes a cooled baffle 11 largely to prevent direct-flow of the pump vapor into the exhaust passage 12. The condensate from the second stage 3 is collected in a trough-like member 13 secured to the wall of the pump and passes through a return connection 14 to a point below the surface of the liquid in the boiler compartment 5 from which it originated. By returning the condensed vapor directly to the boiler compartment from which they originated, it is possible to use pump fluids of different volatility in the respective pumping stages. Also since there is no return connection between the boiler compartments, the boiler compartments 4 and 5 may operate at different pressures as may be best to secure the maximum efficiency in the pump.

In order to prevent the returning condensate from producing a cool spot in the boiler chamber, a heating element 15 is applied to the return connection 14, any suitable heat element 15 may be

utilized, but we have found it convenient to provide a coil-like pipe 16 in the return connection 14 and to apply an electric heater 15 about this portion 16 of the return connection.

Instead of applying an auxiliary heater to the return connection 14, the return connection 14 may be made through a heated portion 18 of the boiler wall such as the bottom plate 17 and thereby be preheated before emerging into the boiler compartments.

While we have shown our auxiliary heater 16 or 18 as applied only to the secondary stages of the pump, it is apparent that this preheater 16 or 18, may, if desired, be applied to the preliminary stage 2 as well, although we have discovered that the small quantity of vapor condensed in the preliminary stage 2 does not have a particularly deleterious influence on the boiler 4 of that stage. While for simplicity of illustration we have shown and described our invention as applied to the so-called up-draft pump, it will be quite apparent that the invention is applicable to other types of pumps either of a lateral or down draft variety.

It will be apparent that changes and modifications can be made without departing from the true spirit of our invention.

We claim as our invention:

1. A multistage diffusion pump comprising a boiler compartment for each pump stage, a condensing chamber for each pump stage, a separate condensate return from each condensing chamber to the respective boiler chamber and heating means associated with one of said condensate returns.

2. A multistage diffusion pump comprising a boiler compartment for each pump stage, a condensing chamber for each pump stage, a separate condensate return from each condensing chamber to the respective boiler chamber, and means associated with one of said returns for preheating the condensate before returning it to the boiler.

3. A vapor diffusion pump comprising a plurality of pumping stages, a boiler compartment for each pumping stage, separate condensing chambers for each pumping stage, a return connection for returning condensate from each section to the associated boiler compartment, said return connections terminating below the surface of the liquid level in the boiler, and heating means associated with one of said return connections.

4. A vapor diffusion pump comprising a plurality of pumping stages, a boiler compartment for each pumping stage, separate condensing chambers for each pumping stage, a return connection for returning condensate from each section to the associated boiler compartment, said return connections terminating below the surface of the liquid level in the boiler, and a heating element applied to the return connection of the high pressure stage.

5. A vapor diffusion pump comprising a plurality of pumping stages, a boiler compartment for each pumping stage, separate condensing chambers for each pumping stage, a return connection for returning condensate from each section to the associated boiler compartment, said return connections terminating below the surface of the liquid level in the boiler, a portion of the return connection of the high pressure stage being embedded in a heated portion of the boiler chamber.

6. An oil diffusion pump comprising a plurality of pumping stages, a boiler compartment for each pumping stage, a condensing area for each pumping stage, means for collecting the condensate for each pumping stage, independent oil returns from each pumping stage to its respective boiler compartment, and heating means associated with one of said oil returns.

7. An oil diffusion pump comprising a plurality of pumping stages, a boiler compartment for each pumping stage, a condensing area for each pumping stage, means for collecting the condensate for each pumping stage and independent oil returns from each pumping stage to its respective boiler compartment, and means for preventing the returning oil from producing cold spots in the boiler.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,080,421	Hickman	May 18, 1937
2,153,189	Hickman	Apr. 4, 1939