March 23, 1948. A. P. COLAIACO 2,438,387

PUMP

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Fig. 1.

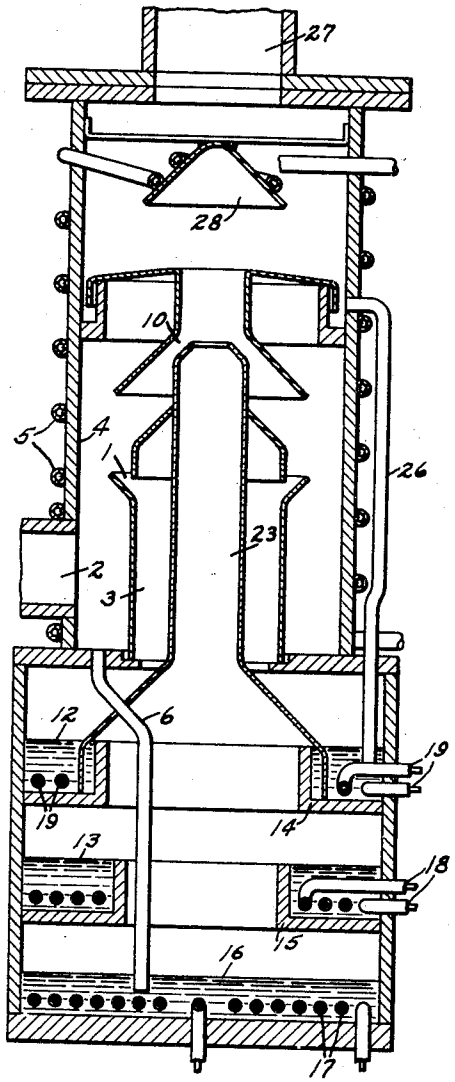
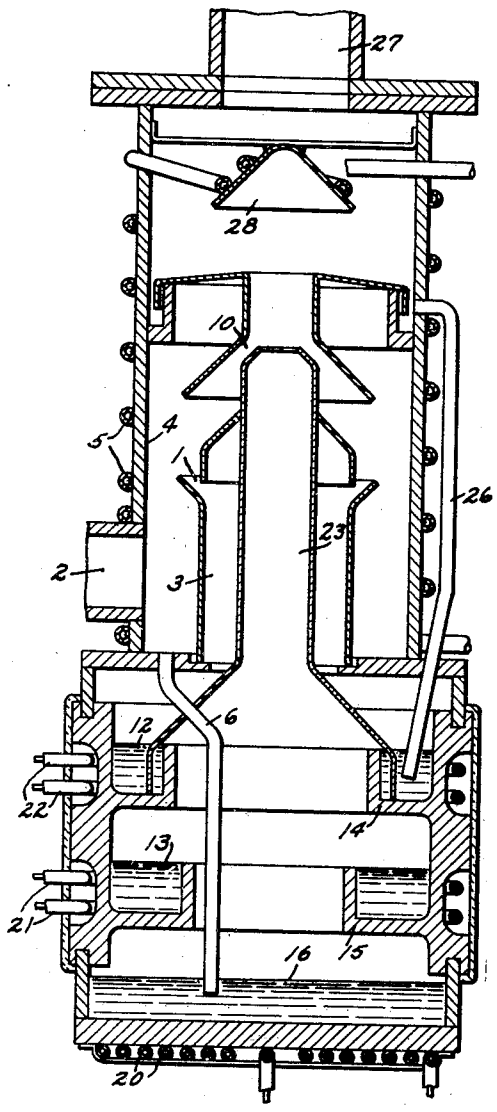


Fig. 2.



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My invention relates to a pump and particularly to a vapor pump for operating against high back pressures.

In the operation of evacuating systems, it is customary to use a primary or high-vacuum pump, usually of the vapor jet or diffusion type which is backed up by a secondary pump usually of the mechanical rotary type. In order to evacuate large volumes of gas at high speed, it is necessary to increase the efficiency of the mechanical pump by placing a so-called booster pump between the initial or high-vacuum pump and the mechanical pump.

In order to produce a vapor pump which will operate against high back pressures, it is necessary to supply the pump jets with a large volume of pumping fluid at a boiler pressure considerably higher than that required by primary type of pumps. This can be done by increasing the area of the boiler surface and by increasing the heat input to the fluid in the boiler. It is highly impractical to increase the boiler surface area by increasing the diameter of the boiler as such boiler becomes too bulky and takes up too much valuable space. On the other hand, it is difficult to increase the boiler capacity by putting more heat into a fixed area because of the physical limitations of the heater elements. Another limitation to increasing the heat input into a fixed area is that the heat transfer to the fluid is a function of the heater temperature which would naturally raise the temperature at the contact surface of the pumping medium and the heater to a point where harmful fractionation at the pumping medium (i. e. oil) occurs.

According to my invention, I have provided a pumping boiler with a capacity for producing a large volume of vapor without increasing the liquid temperature or increasing the diameter of the boiler. I have increased the evaporating or vapor evolving surface in the boiler by supplying a plurality of superimposed vapor evolving surfaces. I prefer to provide these superimposed surfaces by providing a main boiler area of normal dimensions and one or more terrace-like receptacles placed above the main boiler area.

Where more than one pumping jet is utilized, the chimneys carrying vapor to the various jets may be connected to various portions of the boiler area and preferably the condensate from one or more of the jets is returned to the upper boiler terrace and allowed to overflow to the various terraces on down to the main boiler level. If necessary, the condensate from the high pressure jet may be returned directly to the main or lower

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pump level by means of a separate return connection which is led to a point below the normal surface of the liquid so that it will provide a standpipe to offset the vapor pressure in the boiler and thereby prevent a reverse vapor flow through the condensate return.

It is accordingly an object of my invention to provide a high pressure pump of normal dimensions.

It is a further object of my invention to provide a boiler pump producing a large volume of vapor without increasing the dimensions or temperatures in the pump boiler.

It is a further object of my invention to provide a pump boiler having a plurality of superimposed vapor evolving surfaces.

It is a further object of my invention to provide a multiple stage pump in which various pressures or temperatures may be provided in the various stages.

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

Figure 1 is a sectional elevation of a multistage high pressure pump embodying my invention; and

Fig. 2 is a similar view showing a modification according to my invention.

In the exemplary embodiment of my invention, according to Fig. 1, a multistage up draft pump is provided having, for purposes of illustration, two serially operating jets. The low pressure jet 1 receives vapor through an intake 2 below the low pressure jet 1 and the low pressure jet 1 is provided with vapor by a chimney 3 connected to a portion of the vapor evolving area of the pump boiler.

The low pressure jet 1 is surrounded by a condensing surface 4 cooled in any suitable manner, such as by cooling coils 5 applied to the exterior surface of the condenser 4. The condensate from the low pressure jet 1 is returned to the pump boiler and is preferably returned through a standpipe 6 terminating below the liquid surface in a boiler compartment sufficiently lower than the condensing chamber 4 so that the weight of the oil in the standpipe 6 will offset the difference in pressure between the condensing chamber and the boiler area.

The gases compressed by the low pressure jet 1 are delivered to a high pressure jet 10 which is supplied with pumping vapor from another and larger area of the pump boiler. Since the high pressure jet 10 must have a considerably

larger flow of vapor to produce efficient pumping action, a relatively large pumping boiler area is provided by providing a plurality of superimposed liquid holding trays or boiler areas 12 and 13, the superimposed areas being shown in the form of terraces 14 and 15 supported above a main boiler area 16.

While for simplicity of illustration, I have shown only two superimposed boiler areas or boiler terraces, it is obvious that any desired number of superimposed areas may be utilized. Each of the boiler areas 12 and 13 is provided with an individual heating element 17, 18, 19 preferably in the form of an immersed heater which may or may not be separately controlled.

Instead of utilizing an immersed heater, external heaters may be applied to any or all of the pump areas as is shown at 20, 21, 22 in Fig. 2. While the immersed heater 17, 19 has a greater efficiency the external heater 20, 22 has an advantage in that the heating element can be replaced without disturbing the construction of the boiler itself.

Since the high pressure jet 10 of the pump has a materially larger volume of vapor than the low pressure jets, it is desirable to return the condensate from the condenser of the high pressure jet 10 to the topmost of the superimposed boiler areas 12, 13 from which it may be allowed to overflow to the lower boiler areas so that no boiler area will be permitted to run dry. For convenience, I have shown the successive boiler areas or terraces as being of decreasing dimensions so that the overflow will readily flow into the lower terrace. However, it is obvious that all of the terraces may be of any desired dimensions and the overflow or supply of liquid be controlled in any suitable manner.

In the operation of the pump according to my invention, heat is applied to all of the areas 12, 13, 16 of the pump and since the low pressure jet 1 requires only a small amount of vapor, the chimney 3 supplying vapor to the low pressure jet 1 is connected to a relatively small area 12 of the pump boiler herein illustrated as the topmost terrace 14 or vapor evolving area.

In order to secure sufficient standpipe length to prevent reverse flow from the boiler to the condensing chamber, the standpipe 6 is connected to the lowermost boiler area 16 and extends sufficiently below the surface of the liquid in the boiler to provide a liquid trap to prevent vapor entering the return connection. As the high pressure jet requires a much larger volume of pumping vapor, the chimney 23 therefor is connected not only to the main gas evolving area 16 in the pump but to one or more supplemental or terrace levels in the boiler. The large amount of condensate produced from this high pressure jet is returned through a standpipe 26 to the uppermost level 12 in the boiler and extends below the surface of the liquid in this terrace so as to provide a liquid seal for the return connection.

In order to prevent the pumping vapor from passing into the gas outlet connection 27, I prefer to provide an auxiliary cooled condenser or baffle 28 between the pumping jet 10 and the gas outlet passage 27.

While for purposes of illustration, I have shown and described specific embodiments of my invention, it will be apparent that changes and modifications can be made therein without departing from the true spirit of my invention or the scope of the appended claims.

I claim as my invention:

1. A vapor pump for operation against high back pressures comprising a pumping jet, a boiler for supplying large quantities of vapor to said jet, said boiler including a main boiler area and a superimposed boiler area and individual heating means for each of said boiler areas.

2. A vapor pump comprisng a plurality of pumping jets, a small diameter high volume boiler for supplying vapor to said jets, said boiler including means for retaining liquid at various levels and means for heating all of the liquid in said boiler.

3. A diffusion pump comprising a plurality of pumping jets, a boiler for supplying vapor to said jets, said boiler including a plurality of superposed liquid containing compartments, means for supplying heat to each of said compartments and chimney means for carrying vapor from said compartments to said jets.

4. A vapor pump comprising a plurality of sequentially operating pumping jets, a vapor evolving chamber including a plurality of superposed vaporizing areas, chimney means for conducting vapor from said areas to said jets and heating means for each of said vapor evolving areas.

5. In a vapor pump a vapor evolving boiler comprising a main liquid chamber, a plurality of superimposed liquid retaining trays, there being a series of progressively enlarging vapor passages from said main chamber through said liquid retaining trays and heating elements for each of said liquid retaining means.

6. In a vapor pump a vapor evolving boiler comprising a main liquid chamber, a plurality of superimposed liquid retaining trays, there being a series of progressively enlarging vapor passages from said main chamber through said liquid retaining trays and heating elements for each of said liquid retaining means, and means for returning liquid to the topmost of said superimposed trays.

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