Oct. 8, 1946. W. B. ALTSHELER 2,408,721

PNEUMATICALLY-OPERATED LIQUID-RECIRCULATING DEVICE

Filed July 1, 1944

Fig. 1

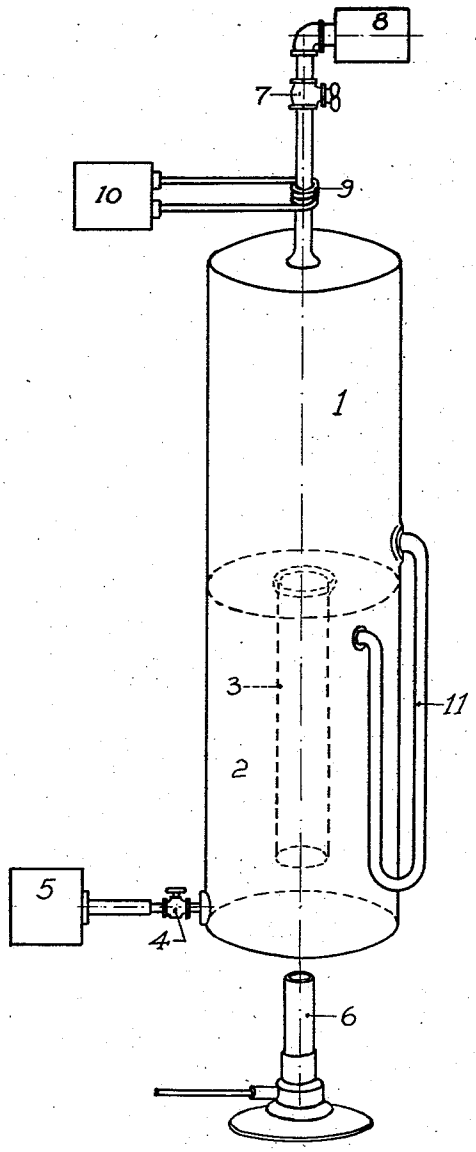


Fig. 2

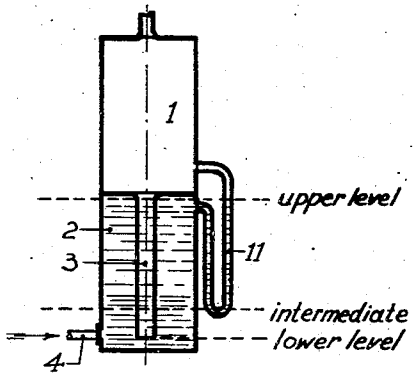


Fig. 3

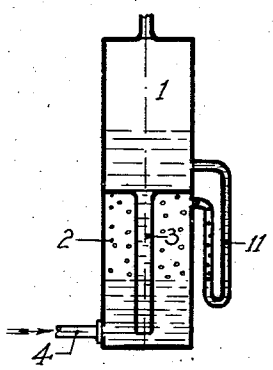


Fig. 4

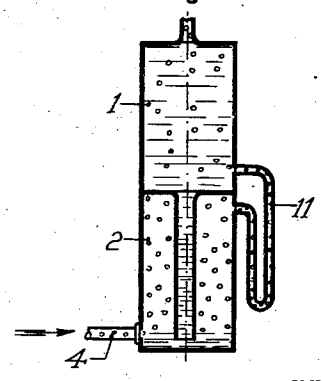


Fig. 5



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PNEUMATICALLY-OPERATED LIQUID-RECIRCULATING DEVICE

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4 Claims. (Cl. 23—252)

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This invention relates to a pneumatically operated liquid recirculating device which is useful for a variety of purposes, such as a gas absorber, a gas scrubber, an extractor, etc.

The principal object is to provide a novel, inexpensive and simply constructed device for recirculating liquid by forcing it from a lower chamber into an upper chamber at intermittent intervals and permitting it to drain back into the lower chamber at intermediate intervals and for performing these operations automatically in an extremely simple manner.

Another important object is to provide a compact device which, being capable of bringing gas into contact with a large wetted surface area for a comparatively long time, is highly efficient in performing any of a variety of operations, such as gas scrubbing, gas absorbing and extracting.

Specifically, the device comprises: an upper chamber; a lower chamber having upper, intermediate and lower liquid levels and a pressure zone extending from the intermediate level upwardly to its top, the chamber being adapted to receive liquid up to its upper level; a drain placing the bottom of upper chamber in open communication with the lower chamber at its lower level below the pressure zone; means for building up a gas pressure in the pressure zone of the lower chamber so as to depress the liquid level therein and thereby force liquid therefrom thru the drain into the upper chamber; a control tube extending from the top of the pressure zone downwardly to the intermediate level and thence upwardly to the bottom of the upper chamber, said tube being operative, when the depressed liquid in the lower chamber reaches the intermediate level, to conduct the gas from the lower chamber into the upper chamber and thereby release the pressure in the pressure zone permitting the liquid in the upper chamber to drain back into the lower chamber; and means associated with the upper chamber to prevent the building up therein of an undesirable back pressure.

With this arrangement, the gas pressure can be built up in the pressure zone either by boiling the liquid therein or by feeding a stream of air or gas under pressure thereto. As the gas pressure builds up in the lower chamber pressure zone, the liquid level therein is depressed, displacing liquid which passes upwardly thru the drain into the upper chamber. When the liquid is depressed to the intermediate level, the gas pressure becomes effective to blow the remaining liquid out of the control pipe where-

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upon the gas passes through such pipe to the liquid in the upper chamber. Since the gas pressure in the lower chamber is thus released, the liquid in the upper chamber is free to drain into the lower chamber and, by making the drain large, drainage occurs rapidly. To avoid building up an objectionable gas pressure in the upper chamber, this gas is either condensed at or discharged from the top of the upper chamber. When a constant source of gas pressure is established, it will be appreciated that the device will operate automatically to force liquid at regular intermittent intervals from the lower chamber to the upper chamber and to permit such liquid to drain at intermediate intervals from the upper chamber back into the lower chamber. Also by filling both chambers with a packing material, such as short lengths of glass tubing, the gas will be brought into contact with the large wetted surface area for relatively long periods of time. For extraction purposes the tubing can be replaced with a packing composed of the material to be extracted.

An embodiment of the invention is illustrated in the accompanying drawing, wherein:

Figure 1 is a perspective of the device;

Figures 2, 3 and 4 are schematic views indicating different stages of operation; and

Figure 5 is a perspective of a glass tube element, with which either or both chambers of the device may be filled.

As illustrated; the device is made of glass in one more or less unitary assembly but it will be understood that it may be made of plastic, metal or other suitable materials and may be fabricated in separate parts to facilitate such assembly and disassembly as may be required in normal use. The device comprises: an upper chamber 1; a lower chamber 2, having upper, intermediate and lower levels, as indicated in Figures 2–4, and a pressure zone extending from the intermediate level upwardly to the top of the lower chamber; and a relatively large drain 3 extending downwardly from the bottom of the upper chamber to the lower level of the lower chamber. The lower chamber has a valved inlet 4 by which it may be connected to a suitable source of air or gas pressure which is schematically indicated at 5. This connection is closed when the gas pressure is formed by boiling liquid in the lower chamber, a heat source 6, being indicated for this purpose. The gas inlet 4 may be located at any point, except it should not be so positioned as to discharge into the drain 3. Where the device is to be used for bringing gas

into contact with the liquid, the inlet 4 preferably is placed near the bottom so that the incoming gas will bubble upwardly thru the liquid as it travels toward the pressure zone.

The upper chamber has a valved outlet 7 at its top from which it may discharge gas into the atmosphere or into a suitable gas receiving system which is schematically indicated at 8. This connection is closed when the gas pressure is formed by boiling liquid in the lower chamber and such gas or vapor is condensed by a cooling coil 9 extending around that portion of the outlet 7 between its valve and the adjacent part of the upper chamber. The cooling coil 9 may be connected to any suitable source of refrigerant 10. Naturally any other suitable vapor condensing arrangement may be employed.

A control tube 11, preferably of a diameter which is relatively small in comparison to the diameter of the drain 3, communicates with the lower chamber at its upper level and extends downwardly therefrom to the intermediate level and thence upwardly to communicate with the upper chamber at its bottom.

In operation as an absorber or scrubber, both lower and upper chambers are preferably filled with a multitude of glass tube elements 12, while the lower chamber is filled with water or other gas scrubbing liquid up to its upper level. The gas to be scrubbed is conducted thru the inlet 4 and the rate of flow adjusted to provide the proper or desired rate of recirculation. This gas bubbles up thru the liquid and in so doing contacts the large surface area provided by the glass elements 12. The gas collects in the pressure zone of the lower chamber and as it collects, it depresses the liquid level in that chamber and also in the control tube 11. The liquid displaced by this action passes upwardly through the drain 3 and tube 11 into the upper chamber. When the liquid is depressed to the intermediate level, the gas pressure becomes effective to blow the remaining liquid in control tube 11 upwardly into the upper chamber thereby permitting the gas to flow into the bottom of the upper chamber where it again bubbles upwardly through the liquid and around the large surface area provided in the upper chamber by the elements 12. The gas pressure in the pressure zone is thus released; hence the water from the upper chamber drains rapidly thru the drain 3 and again fills the lower chamber up to its upper level. In this way the device reconditions itself for a repetition of the same operation.

Where the device is to be used in a cold extraction operation, the same operation takes place except the solid matter containing the element to be extracted may be placed in either or both upper and lower chambers in place of the glass elements 12, while air or any desired gas may be fed into the inlet 4.

When a hot extraction is to be performed both inlet and outlet valve connections may be closed and heat applied to the lower chamber to boil the liquid therein. Ordinarily, as the vapor pressure is built up in the pressure zone, the liquid will be displaced into the upper chamber and when the depressed liquid reaches the intermediate level, the vapor pressure will be released through tube 11 into the upper chamber. When such vapor reaches the top of the upper chamber there will, of course, be a tendency to build up a vapor or back pressure, since the valved outlet 7 is closed. If left uncontrolled, the vapor or back pressure in the upper chamber would soon render the device inoperative. Where it is not desirable to vent the vapor from the upper chamber, it becomes necessary to condense it to avoid objectionable back pressure and this may be done by operating the condensing arrangement shown.

Having described my invention I claim:

1. A pneumatically operated liquid recirculating device for gas absorbing, gas scrubbing and like purposes comprising: means providing an upper chamber; means providing a lower chamber adapted to receive an initial charge of liquid up to a predetermined upper level; a drain tube connecting the lower part of the upper chamber to the lower portion of the lower chamber; and a control tube, of small diameter in relation to the diameter of the drain tube, extending from the lower chamber adjacent its upper level downwardly to an intermediate elevation above the lower end of the drain tube and thence upwardly into the lower part of the upper chamber, said control tube also being adapted to receive liquid of said initial charge up to a level corresponding to said predetermined upper level; the upper part of said lower chamber being constructed and arranged to receive a progressive accumulation of gas in its upper portion to force said initial charge of liquid through the drain and control tubes into the upper chamber as it simultaneously depresses the liquid level in both the lower chamber and the control tube whereby, when the depressed level reaches said intermediate elevation, the gas accumulation immediately becomes effective to flush the liquid remaining in the control tube upwardly into the upper chamber and to escape from the lower chamber through the control tube into the upper chamber thereby releasing the gas pressure in the lower chamber and permitting the liquid in the upper chamber automatically to gravitate rapidly back through said drain tube into the lower chamber and back into the control tube and thus recondition the device automatically for a repetition of its operation.

2. The device of claim 1 wherein: the lower chamber has, adjacent its bottom, an inlet to receive gas for gas accumulation purposes; and the upper chamber has, adjacent its top, an outlet for discharging the gas received from the lower chamber.

3. The device of claim 1 wherein: means are associated with the lower chamber to boil the liquid therein and thereby build up a vapor pressure for gas accumulation purposes; and means are associated with the upper chamber to condense the vapors received from the lower chamber.

4. The device of claim 1 wherein: the lower chamber is provided with a multitude of gas contacting elements presenting extensive gas contacting surfaces which are progressively submerged as the liquid in the lower chamber rises to its uppermost level and which are progressively exposed to the atmosphere of such chamber as the liquid therein falls from its uppermost level.

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