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FLUID PUMPING ARRANGEMENT

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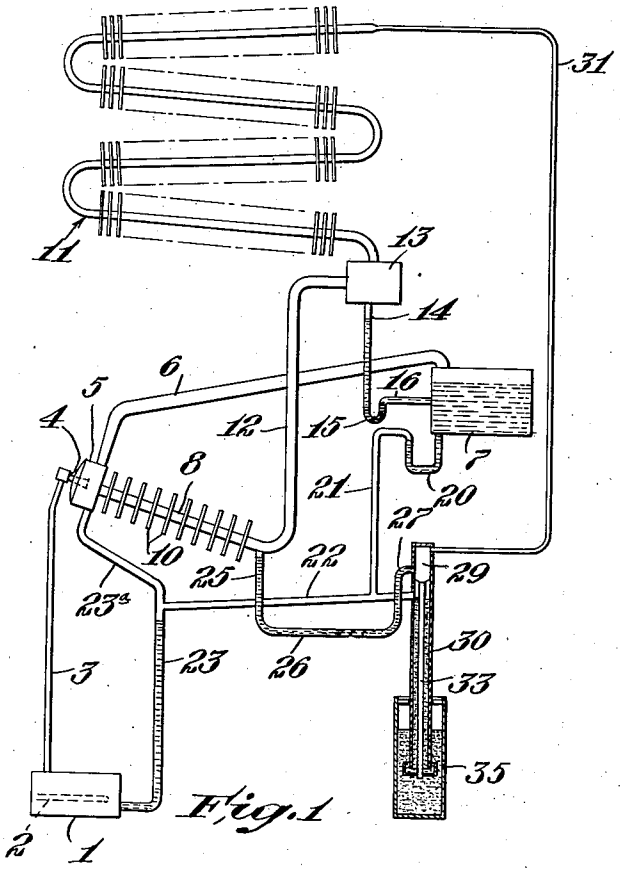


Fig. 1

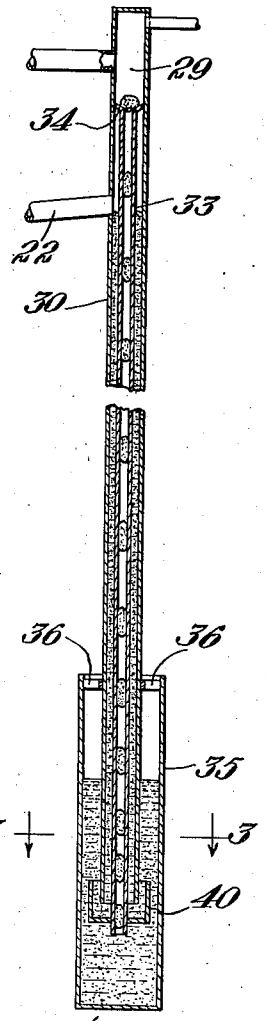


Fig. 2

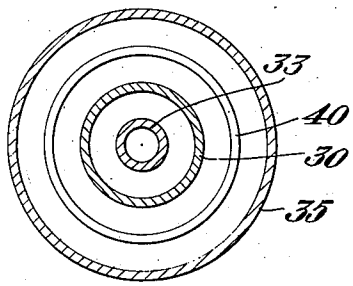


Fig. 3

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FLUID PUMPING ARRANGEMENT

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6 Claims. (Cl. 62—115)

This invention relates to a drop tube assembly wherein globules or bodies of a liquid pump lighter fluid bodies. More particularly, this arrangement may be employed in conjunction with a refrigerating system of the type disclosed in United States Patent No. 1,761,551, issued June 3, 1930, to Eastman A. Weaver, and United States Patent No. 1,892,869, issued January 3, 1933, to Daniel F. Comstock. These patents disclose refrigerating systems wherein a heavy propellant having a relatively high boiling point pumps a refrigerant vapor from an evaporator or cooler to a condenser by aspiration. Preferably such systems may operate at a low pressure; for example, the pressure in the cooler may be of the general order of four millimeters of mercury absolute, so that there may be some tendency for gases to leak into the system. Furthermore, under certain operating conditions, particularly when an aqueous refrigerant is employed, such as water or water mixed with an anti-freeze ingredient, there is a tendency for certain gases to be received from the walls of the system even if the same is perfectly sealed against the leakage of atmospheric air.

Accordingly, as set forth in the above-identified Comstock patent, it is desirable to provide a purger which is effective in compressing non-condensable gases and exhausting the same to the atmosphere. Such a purger as taught in that above-identified patent may conveniently comprise a drop tube in which successive bodies or globules of the propellant liquid, e. g., mercury, entrain bodies of the non-condensable gases, compressing the same and venting the same into a liquid-containing well or vat. The liquid in this vat has its upper surface exposed to the atmosphere and the non-condensable gases may rise through the liquid to the atmosphere, thus being exhausted.

The above-identified Comstock patent discloses an arrangement of the tubes and ducts associated with the purger assembly which is satisfactory and operative for the indicated purposes, but, in a commercial refrigerating system, it is desirable to afford a more compact assembly which may be more easily supported. For this purpose, the drop tube may be arranged concentrically within the return duct through which the liquid propellant rises from the lower part of the purger assembly to a spill-over connection from which the mercury is fed back to the boiler. Thus the drop tube is disposed within the outer duct and it is only necessary to afford supporting means for one tube or duct rather than two spaced ducts. Such an arrangement also protects the relatively small drop tube against injury from accidental blows or the like. The arrangement of the return duct about the drop tube permits the former to be non-capillary while having a small capacity, thus reducing the quantity of mercury required in the system, while, as more fully disclosed in the copending application Serial No. 167,402, filed October 5, 1937, of Lyman F. Whitney, such an arrangement permits the purger tube to be readily removed, if desired. It is also desirable to arrange the vat or well which contains the liquid body of mercury that is exposed to the atmosphere so that this well is disposed concentrically about the lower end of the drop tube and the lower end of the return duct.

Such an assembly, while having distinct advantages from the point of view of manufacture and assembly, provides an arrangement which, without further qualification, results in a tendency of the compressed gases to return to the low pressure portion of the system by rising in the return duct rather than being exhausted to the atmosphere.

The present invention affords an air deflector arranged about the lower end of the return duct to prevent such a short circuiting of the gases, so that the gas bubbles may rise past the lower end of the return duct and may pass into the atmosphere while the liquid mercury may return from the vat through the return duct to the spill-over. To permit the satisfactory arrangement of such a deflector, the drop tube preferably may extend slightly below the lower end of the return duct and the deflector may be in the form of a cup-like member secured to the lower extremity of the drop tube but spaced somewhat below the lower end of the return duct, the side wall of this cup-like member, however, being spaced outwardly from the lower end of the duct and extending somewhat above its lower extremity. Thus gas bubbles or bodies released from the drop tube may rise about the lower part of the cup and may pass upwardly between its outer wall and the inner wall of the well, being directed by the cup past the lower end of the return duct. On the other hand, the lower extremity of the duct is spaced from the interior of the cup so that mercury will readily find its way into the lower part of the duct, from which the mercury may rise to the spill-over connection.

In the accompanying drawing:

Fig. 1 is a diagrammatic view of a refrigerat-

ing system including a purger arrangement exemplifying the principles of this invention;

Fig. 2 is a broken, vertical, sectional view of the purger assembly; and

Fig. 3 is a section on line 3—3 of Fig. 2.

The accompanying drawing, for purposes of illustration, shows a simple type of refrigerating system with which my purger arrangement may be associated, it being understood that in practice this arrangement may be employed in more highly developed systems of the same general character, such, for example, as disclosed in the copending application Serial No. 171,325 of Lyman F. Whitney, filed October 27, 1937.

Such a system may comprise a boiler 1 which contains a body of liquid mercury and is provided with a heating element 2 such as an electrical resistance factor. A vapor duct or riser 3 extends upwardly from the boiler 1 to the aspirator nozzle 4 which is arranged to emit mercury vapor at high velocity into a mixing chamber 5. The latter is connected by a vapor duct 6 to the upper part of an evaporator or cooler 7. This cooler contains a body of liquid refrigerant such as water or a suitable mixture of water and an anti-freeze agent. A funnel 8 is aligned with the nozzle 5 and is provided with suitable cooling means such as fins 10.

The mercury vapor issuing from the nozzle 4 is effective in drawing refrigerant vapor from the cooler 7 through the duct 6, the mixed vapors passing into the funnel 8 where the refrigerant vapor is compressed and the major portion of the propellant vapor is condensed. The refrigerant vapor rises through the duct 12 to the separating chamber 13, passing from the latter into the condenser coil 11 where the refrigerant is condensed. The liquid refrigerant returns to the separating chamber 13 and passes into the drain 14, the lower end of which communicates with a mercury containing trap 15 connected by a duct 16 to the cooler 7. Thus as liquid refrigerant piles up in the pipe 14, the pressure on the mercury in trap 15 is sufficient to cause some of the refrigerant to pass through the trap and the pipe 16 back to the cooler.

Some of the propellant vapor may stray into the refrigerant condenser, there being condensed and draining back to the trap 15 which is thus kept suitably filled with mercury. Excess mercury from the trap 15 passes through pipe 16 into the cooler 7. A trap 20 is connected to the lower part of this cooler receiving mercury therefrom so that when mercury fills this trap it may overflow into the duct 21. The lower end of this duct is connected to a downwardly inclined pipe or tube 22 which is joined to a standpipe 23. An upper continuation 23a of the latter affords a drain to receive any condensed mercury which may appear in the mixing chamber 5. Condensed propellant from the lower end of the funnel 8 is received by a drain 25 which forms one leg of a trap 26, the opposite leg 27 of which is arranged to emit liquid propellant into the chamber 29 at the upper part of tubular member 30 (Fig. 2).

A tube 31 is connected to the upper part of the condenser 14 to receive non-condensable gases therefrom and to direct the same into the chamber 29. A drop tube 33 of restricted internal diameter is disposed within the tubular member 30, having its upper end flared outwardly, as designated by numeral 34, substantially to close the lower end of chamber 29 except for the opening provided by the upper end of the bore of the tube. The flared end 34 of tube 33 preferably may have a tight sliding fit in the tubular member 30, as more fully explained in the above-identified Whitney application.

The drop tube 33 receives globules of mercury with successive bodies of non-condensable gas therebetween. The restricted internal diameter of the tube 33 permits the globules to act as liquid pistons so that the successive bodies of gas are compressed as they approach the lower end of the tube.

A well or vat 35 is disposed about the lower end of the drop tube 33 and contains a body of liquid mercury in which the lower end of the tube and the lower end of the tubular member 30 are immersed. The upper part of the vat 35 may be open to the atmosphere, being, for example, connected to the tubular member 30 by radial struts 36 extending from a ring which has a firm frictional engagement with the member 30.

In accordance with this invention, a cup-like deflector 40 is secured to the lower end of the tube 33, the end of this tube extending somewhat below the end of the tubular member 30 and the cup-like member 40 having a lower wall spaced above the lower extremity of the tube but below the lower extremity of the tubular member 30, while the side wall of the member 40 is spaced outwardly of the outer surface of the tubular member but extends upwardly above its lower extremity, as shown particularly in Fig. 2.

Since the surface of the body of liquid mercury in vat 35 is exposed to atmospheric pressure, this column will balance a higher column of mercury in the tubular member 30 which is the return duct through which mercury passes from the vat 35 to the spill-over connection with the end of the duct 22. Accordingly, as the mercury is received from the drop tube 33 by the vat 35, the level of the mercury in the vat tends to rise, but since the surface of this mercury body is exposed to atmospheric pressure, the mercury is forced upwardly into the return duct 30. Mercury fills this duct until it reaches a level even with the connection with pipe 22, whereupon the mercury will spill over into this pipe and thus be received by the standpipe 23. The latter contains a column of liquid mercury which balances the boiler pressure and serves as a boiler feed pipe.

It is evident that the arrangement of the deflector 40 permits gas bubbles to pass upwardly about the end of the return duct afforded by tubular member 30 so that the gas does not pass back into the system by rising through the mercury column in the duct 30. Accordingly the gas rises to the surface of the liquid body in vat 35 and is thus exhausted to the atmosphere. On the other hand, since the lower end of the return duct is spaced from the inner and lower walls of the deflector 40, the mercury can pass between the deflector and the lower end of the duct to enter the latter.

It is evident that this invention permits a simple, compact purger assembly to be provided which may be conveniently supported and which may be conveniently assembled with the other parts of a refrigerating system of the character disclosed herein.

While the present invention has particular utility when employed in conjunction with such a refrigerating system for removing non-condensing gases therefrom, it is evident that this arrangement may also be found advantageous in various other environments where a drop tube receives

liquid globules which are effective in pumping lighter fluid bodies.

I claim:

1. In a system of the class described which contains circulating fluids, a purger for exhausting non-condensable gases from the system, said purger including a drop tube of small diameter into the upper end of which successive liquid globules are fed to pump and compress bodies of gas, the lower end of the tube having an outlet opening, an upwardly extending duct having an open lower end juxtaposed to the outlet opening, a receptacle surrounding the lower ends of the tube and duct and containing a body of liquid in which the lower ends of the tube and duct are immersed, said body of liquid having its surface exposed to the atmosphere, and a gas deflector secured to the lower end of the tube but being arranged to deflect gas bodies from rising into the duct and thus returning to the system, whereby liquid may rise from said body into the duct but gas may rise to the surface of said liquid and be exhausted to the atmosphere.

2. In a system of the class described which contains circulating fluids, a purger for exhausting non-condensable gases from the system, said purger comprising a drop tube of small diameter, the system being arranged to supply successive liquid globules to the upper end of said tube to pump and compress bodies of gas, the lower end of the tube having an outlet opening, an upwardly extending duct surrounding the tube and having an inlet opening at its lower end spaced above said outlet opening, a receptacle disposed about the lower ends of the tube and duct, said receptacle containing a body of liquid in which the lower ends of the tube and duct are immersed, the surface of the liquid body being exposed to the atmosphere, and a gas deflector secured to the lower end of the tube and extending outwardly below the lower end of the duct, said deflector being arranged to deflect gas from the lower end of the duct, whereby liquid may rise in the duct while gas is deflected to rise in the liquid body and be exhausted to the atmosphere.

3. In a system of the class described which contains circulating fluids, a purger for exhausting non-condensable gases from the system, said purger comprising a drop tube of small diameter, the system being arranged to supply successive liquid globules to the upper end of said tube to pump and compress bodies of gas, the lower end of the tube having an outlet opening, an upwardly extending duct surrounding the tube and having an inlet opening spaced above said outlet opening, a receptacle disposed about the lower ends of the tube and duct, said receptacle containing a body of liquid in which the lower ends of the tube and duct are immersed, the surface of the liquid body being exposed to the atmosphere, and a gas deflector secured to the lower end of the tube above its outlet opening, said deflector being of cup-like form and having a lower wall below the lower end of the duct and having a side wall disposed outwardly of the outer surface of the lower end of the duct, whereby liquid from the liquid body may pass between the side wall of the deflector and the outer surface of the lower end of the duct and may rise into the duct while air is deflected from the lower end of the duct to rise in the liquid body and be exhausted to the atmosphere.

4. In a system of the class described which contains circulating fluids, a pumping assembly including a drop tube pump in which successive liquid bodies entrain and pump bodies of a lighter fluid, a return duct surrounding the tube, a receptacle communicating with the lower parts of the tube and duct, said receptacle containing a body of the pumping liquid, the lower end of the tube extending below the lower end of the duct, said tube having an outlet opening below the duct, said duct having an inlet opening above the lower end of the tube, and a deflector at the lower end of the tube to prevent the lighter fluid from rising to said inlet opening, whereby the pumping liquid from said tube may pass into the liquid body and liquid from the latter may pass into said duct, while the lighter fluid may rise to the surface of said liquid body.

5. In a system of the class described which contains circulating fluids, a pumping assembly comprising a drop tube in which successive liquid bodies entrain and pump bodies of a lighter fluid, a tubular member surrounding said tube and extending above the same, an annular wall between the open upper end of the tube and the wall of the tubular member, ducts to supply the pumping liquid and the lighter fluid to the chamber provided in said tubular member above said wall, a receptacle at the lower end of the tube to receive the liquid and fluid therefrom, the tubular member having an inlet opening through which liquid may pass from said receptacle, a deflector to prevent the lighter fluid from entering said inlet opening, and an outlet duct connected to said tubular member below the annular wall to receive liquid flowing upwardly in said member, the lower part of the tubular member providing a duct for the liquid and the upper part thereof providing an inlet chamber for the drop tube.

6. In a system of the class described which contains circulating fluids, a pumping assembly including a drop tube pump in which successive liquid bodies entrain and pump bodies of a lighter fluid, a return duct surrounding the tube, a receptacle communicating with the lower parts of the tube and duct, said receptacle containing a body of the pumping liquid, the lower part of the tube being disposed below the lower end of the duct, said tube having an outlet opening within the receptacle, said duct having an inlet opening above said part of the tube, and deflecting means at the lower end of the tube to prevent the lighter fluid from rising to said inlet opening, said means providing a surface extending beneath the wall of said duct and outwardly beyond the same to deflect the lighter fluid past the inlet, whereby the pumping liquid from said tube may pass into the liquid body and liquid from the latter may pass into said duct, while the lighter fluid may rise to the surface of said liquid body.

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