Aug. 25, 1942. N. S. SERINIS 2,293,922

CAPILLARY SIPHON FEED

Original Filed June 8, 1938

Fig. 1.

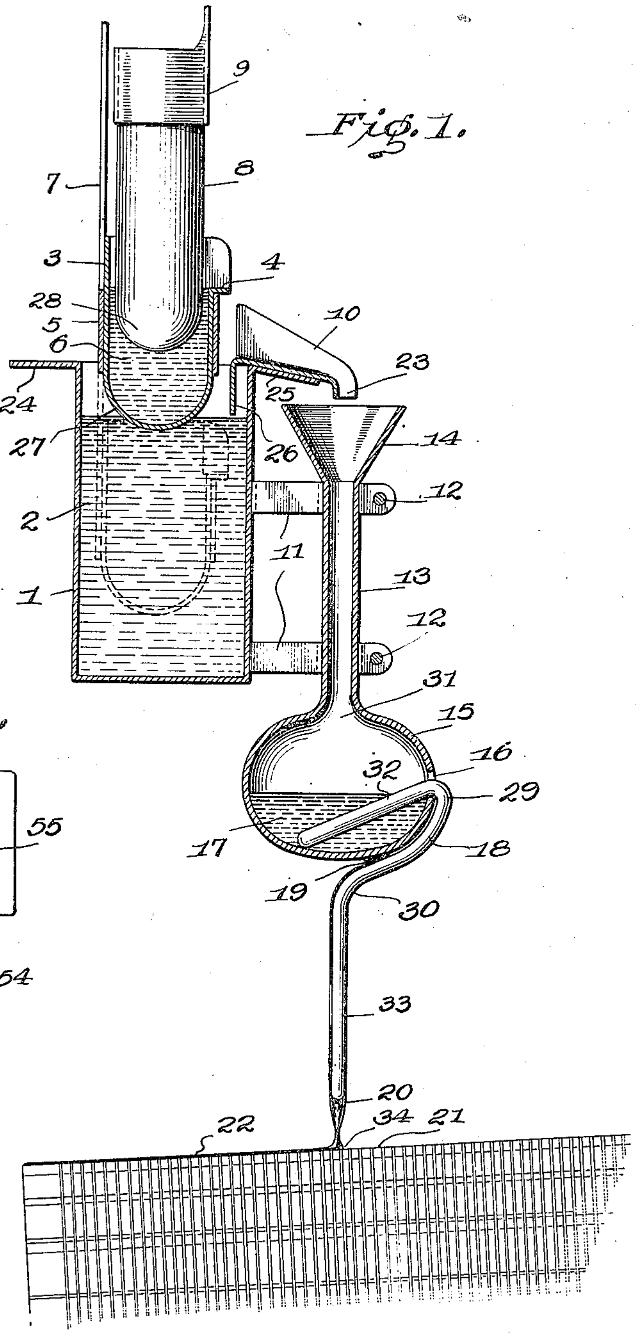
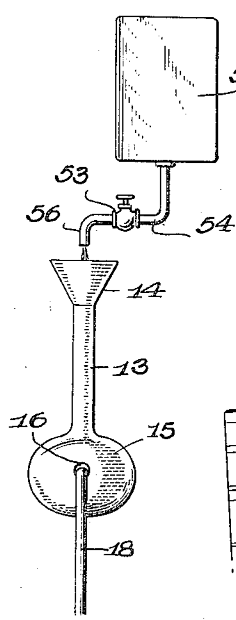


Fig. 2.



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CAPILLARY SIPHON FEED

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4 Claims. (Cl. 221—148)

The present invention relates to a device for feeding liquids such as chemicals or solutions thereof or the like at a small but practically uniform rate to a location at which such solution or liquid is to be utilized, and to an apparatus including such device.

More specifically, it relates to a means for feeding liquids, particularly corrosive liquids or such as might harden, crystallize, or otherwise obstruct small conduits or orifices.

The device embodies a pump having a displacement member, a reservoir for the liquid to be fed and reciprocating dipper for feeding the liquid to be pumped, together with a suitable outlet for the liquid and a device for providing a uniform speed of flow of such liquid.

In one embodiment, for example, it may comprise also a receiving reservoir or vessel which has a substantially constant level of liquid maintained therein and a discharge guiding element which feeds the liquid out of the vessel by the combined action of capillarity and gravitation.

The apparatus is of general application in the art of feeding liquids, particularly where small flows of corrosive liquids are involved.

In the specific instance illustrated in the present case it is shown as applied to an acid drip device for rayon or other artificial fiber.

For a clear understanding of the invention reference is to be had to the accompanying drawing wherein:

Figure 1 illustrates one embodiment of the apparatus as applied to acid treatment for rayon and the like, and

Figure 2 illustrates a modified form.

In the drawing, 1 represents a container made of any suitable material, for example metal, for holding the acid or other chemical or liquid which is to be applied to the rayon.

In order to pump or feed the acid or liquid 2 from said container 1, use is made of a dipper 3 here shown as a vessel having advantageously a convex lower end and which is made small enough to be submerged bodily within the liquid in the container 1. The dipper has a discharge lip as shown at 4 from which liquid may drip or flow by gravity.

The dipper is supported in a holder here shown as a tubular member 5 which is connected with an operating member 7. Means will be provided for reciprocating the member 7 in a vertical direction, and such means may be of any desired well-known mechanical form. This has not been illustrated as it does not form a part of the present invention.

Cooperating with the dipper 3 there is a plunger or displacement member 8 which may be supported by any suitable clamp or the like, here shown as a cylindrical clamp 9, which releasably grasps the member 8 to permit vertical adjustment of the displacement member 8 if desired. Attached to the container 1 there are supports 11, 11 with clamping screws 12, 12 which will engage the stem 13 of a vessel 31 and hold said vessel in proper position so that its funnel-top 14 will come below the downwardly bent end 23 of a pouring spout 10 which is also secured to the vessel 1. This spout may conveniently rest upon and be secured to one of the flanges 24, 25 formed at the top of the container 1.

The vessel 31 also has at its lower end a body or bulb 15 having laterally thereof an opening 16 into which fits loosely the upper downwardly bent end 32 of a rod 18 which is further bent at 29 in a curve so as to make the rod conform rather closely to the curvature of the outer surface of the bulb 15 for a certain distance, whereupon the rod bends reversely as at 30, so as to provide a substantially vertical lower portion 33 which may be roughly in vertical alignment with the stem 13.

Below the lower end of the rod 18 is the material to be treated, here illustrated as rayon or the like, wound upon the spinning cage or drum 21.

In operation, upon reciprocation of the operating member 7 the dipper 3 will be depressed below the surface of the acid or other liquid 2 in the container 1 so that the dipper will become filled with such liquid.

Thereupon, when member 7 raises the dipper, the latter will first discharge the excess of its contents above the level of its discharge lip 4, which will have taken place before the dipper has risen far enough to bring the liquid therein into contact with the lower end 28 of the plunger 8. This lower end may conveniently be made convex, as illustrated, so as to make it easy to keep clean, although its exact shape is not an important feature of the present invention.

Upon further ascent of the dipper the plunger 8 will begin to become immersed in the liquid contents of said dipper, in other words, it will begin to displace some of said contents which will thereupon discharge through the pouring spout 4. Immediately below this pouring spout and advantageously in vertical alignment with its discharge edge, there is a drip member 26 forming part of the pouring spout 10 which will graze the lip 4 when the dipper ascends and strike off any excess liquid therefrom. The plane of the drip member or baffle 26 also serves as a defining or reference plane in that any liquid falling to the right of said plane will flow down the incline of the discharge spout 10 and through its downwardly bent discharge end 23 into the funnel 14. It is clear that the dipper 3 will continue to discharge some of its liquid contents 6 as long as it continues to rise, that is, as long as the plunger 8 continues to become immersed more deeply in the said liquid.

Because of the fact that the liquid flows with a certain horizontal velocity from the outlet spout 4, that is, it does not merely drip down therefrom, the flow of such liquid will overshoot the plane of the baffle 26 and, therefore, said liquid will flow down the inclined discharge spout 10 instead of dripping or flowing back into the container 1.

Upon the next movement of the member 7 the dipper will again become submerged in the container 1 and will take up a new charge of liquid, whereupon the action above described will be repeated, and so on.

The liquid which flows into the funnel 14 will find its way down through the neck 13 into the bulb or body portion 15. The discharge opening 16 formed in the side wall of the bulb 15 is preferably located at approximately the portion of largest diameter of such bulb, that is, approximately at the half-way point of the bulb shown so that a large upper surface of liquid is exposed in the bulb. This assists in maintaining the level of liquid in the bulb more nearly uniform by reason of its large area so that the intermittent or pulsating feeds of liquid into the bulb from the spout 10 will produce only minor fluctuations in the level of liquid in said bulb. This produces the first compensation of the pulsating flow, tending to iron out the fluctuations and produce a certain initial degree of uniformity.

The flow is further smoothed out by making use of capillarity in providing the final flow and this is accomplished by means of the rod 18. As shown, the rod is hooked in the lip of the opening 16 and has an internal portion projecting within the bulb 15. Since the liquid to be used in the apparatus has capillary attraction to both the rod and bulb, the level of the liquid may rise slightly above the level of the lip of opening but be deterred from flowing through the opening except by the rod loosely passing therethrough and such flow as does pass through the opening is regulated by the capillary flow of liquid down the outer side wall of the bulb in the space between the rod and bulb forming a capillary slot. The level of liquid within the bulb may vary appreciably above and below the level of the opening and under such circumstances the liquid flowing in the external capillary slot between the bowl and the rod, by reason of an inverted siphon action will actually lift the liquid within the bowl up over the lip from whence it will flow by gravity down the outside. There is in effect a short capillary slot between the inner side wall and internal rod portion, where the two converge. This rod may be made of any suitable material and ordinarily a glass rod will be found highly satisfactory. It is clear, however, that if for any reason it should be desirable or preferable, the rod may be made of other materials such as metal, phenolic resin, or any other material whose characteristics are compatible with the liquids being used or with the necessary resistance to breakage or heat or with the need of electrical insulating properties or the like which may exist in any given apparatus or machine.

The liquid 17 in the bulb 15 will, of course, rise to a point near the bottom of the outlet aperture 16 and will creep along the rod 18 by reason of the surface tension phenomena commonly embraced by the general term "capillary attraction" with the result that a thin film 19 of liquid will form between the outer surface of the bulb 15 and the adjacent upper edge of the rod 18. From this point the liquid will follow the rod 18 downwardly through its bend 30, and then along its vertical portion 33, finally dripping off at 20 upon the surface of the revolving drum 21. This drum is here shown as having its axis slightly inclined downwardly to the left and because of said inclination, in cooperation with the rotation of the drum, the dripping acid or other liquid will form a film 22 evenly covering the material on the drum to the left of the point 34 at which the liquid first reaches the revolving drum.

It is obvious that upon each vertical reciprocation of the dipper 3 the same amount of liquid will be discharged from its spout 4 into the pouring spout 10, this amount being equal to the volume of the submerged portion of the plunger 8. This affords a simple and convenient means for adjusting the rate of feed of liquid, for it is necessary merely to raise or lower the plunger 8 within its clamp 9 so as to vary such submerged volume.

Referring to Figure 2, it will be seen that it is possible to substitute some other supply means in place of the pump, to feed liquid to the vessel 31.

In Figure 2, which is purely diagrammatic, the flow of liquid is controlled by a simple stopcock or tap, 53, in a supply pipe 54 leading from a reservoir or other source of liquid 55. By proper adjustment of tap 53 the flow from the downwardly bent end 56 of the pipe 54, which enters into the funnel 14, may be made to equal the desired rate of fluid discharge from the rod 18, so as to keep the level of the liquid in the bulb 15 at its proper height.

The capillary discharge from the rod 18 will in this case take care of slight inequalities in the flow from the tap 53, so as to provide a practically constant flow.

A difficulty encountered in pumps or feed devices of the conventional types is that where the feeds are relatively small or where the liquids being fed are corrosive chemicals or solutions thereof or such as may solidify or produce deposits of any kind, the small passages necessary in such pumps readily become clogged so as to obstruct the flow and eventually stop it altogether or become eaten away so as to increase their size and produce a gradually increasing flow, or else certain vital parts of the pump mechanism such as valves or the like may become corroded and stuck or leaky as a result, and various other disadvantages only too well known to those skilled in the art may occur therein.

The present device obviates all these disadvantages in the first place by providing a pump which has no valves whatever, and which has no parts which fit closely on any others to produce a pumping effect such as a pressure or a suction, with the further incidental advantage that it is not necessary to do any accurate machining or fitting of parts whereby consequently friction also is eliminated entirely so that no wear takes place and no "sticking" can result. The parts of the present pump are all very simple and are readily accessible for cleaning and repair or replacement.

It will be noted that in the vessel 31 the outlet opening 16 is of a relatively large size, and this is possible here because the liquid does not flow directly through the opening 16 by gravitation, so that the opening 16 need not have any definite size to produce a prescribed or standardized flow. Because of the large size of the opening 16, it does not clog readily and moreover if it should at any time clog, it can be cleaned very easily. The rod 18 fits very loosely through the opening 16 and if any mishap should occur to this rod, it can be removed readily and a duplicate substituted without loss of time and thus without materially disturbing the discharge of liquid upon the material being treated, or interrupting the operation of the machine or process, as it is necessary merely to have a new rod at hand when taking out the defective one, since the rod is held only by its own weight and not by any screws or clamps or the like where it passes into the bulb 15.

The capillary flow from the substantially uniform level of the liquid in the bulb 15 will be practically constant regardless of such relatively slight variations in said liquid level as may occur due to the pulsations of liquid fed into the bulb.

A further advantage of the device is that all the parts are relatively simple in shape and structure and may be readily made with sufficient uniformity by ordinary manufacturing processes.

While the device has been herein described as intended mainly for the feeding of chemicals, and particularly of corrosive chemicals, such as acid or alkaline solutions, or such as might produce obstructions, it is, of course, also of general application and may serve also for the feeding of water or other harmless, neutral or nonclogging liquids with equal efficiency.

The rod 18 and bulb 15, or at least that external portion of the bulb 15 which is adjacent the bent portion of the rod, should, of course, be made of, or coated with, material which will have the proper capillary affinity for the liquid being dispensed, for example if it should be desired to feed mercury, the bulb and the rod would be made at least superficially of a metal which will amalgamate with the mercury. Aside from such limitation, namely the limitation that the outer surface of the bulb and the surface of the rod should not be repellent to the liquid being fed, and that it should have the necessary mechanical and chemical resistance, there is no restriction as to the nature of the bulb and the rod.

While the present invention has been described as embodying a definite type of pump for feeding the liquid to the vessel 31, it will be clear that it is not necessary that this particular type of pump be used and if in any instance it should be desirable to employ other means for supplying the liquid to the said vessel, it is readily possible to do so. In general the flow of the pump or other supply means will, of course, be adjusted to correspond substantially to the rate of final flow desired from the apparatus and within this limitation any other means can be employed to feed the liquid to the vessel so as to maintain the level of the liquid 17 therein at a substantially constant elevation.

It is likewise possible that the pump comprising the displacement member and the dipper might be used to discharge its contents to some other mechanism than the vessel 31 and where such conditions exist, it will be evident that the pump may be used independently.

Although the pump has been disclosed and described in detail in the present case, it is not claimed herein, but in applicant's Patent No. 2,167,690, Displacement dipper pump, issued August 1, 1939, on application Serial No. 212,523, filed of even date herewith. The present case is restricted to claims on the capillary feed device and on the general combination of the latter with a liquid supply means.

While a specific embodiment of the device has been disclosed herein, it is obvious that this embodiment merely represents one particular form of the invention, which is not limited thereby but is understood to be defined only by the following claims.

I claim:

1. A feeding device for liquid, comprising a vessel, means for maintaining an approximately uniform level of liquid therein, said vessel having a discharge orifice therein at a level near the top of the liquid, and capillary discharge means traversing said orifice and cooperating with the side wall of the vessel, to guide liquid from said vessel to the exterior thereof downward between the means and the vessel.

2. A device as in claim 1 wherein the means for maintaining an approximately uniform level of liquid in the vessel comprises a device for feeding the liquid at a constant mean rate.

3. A feed device for liquid comprising a vessel having an orifice in its wall, and a rod having a portion of a size smaller than said orifice and passing therethrough, said rod having a portion of its length external to the vessel and shaped to conform substantially to the shape of the external wall contiguous thereto and a portion inside the vessel hooked over the lip of the orifice.

4. A feed device for liquid comprising a vessel having an orifice in its wall, and a rod having a portion of a size smaller than said orifice and passing therethrough, said rod having a portion of its length external to the vessel and shaped to conform substantially to the shape of the external wall contiguous thereto and an internal portion hooked over lip of the feed orifice, said rod and wall, at least at such contiguous portions and around the lip, having surfaces possessing capillary attraction for the liquid to be fed whereby liquid is drawn over the lip by a capillary inverted siphon.

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