Nov. 10, 1942. C. F. VAUGHN 2,301,722

PUMP

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Fig. 1,

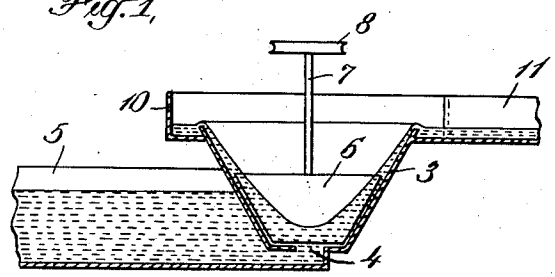
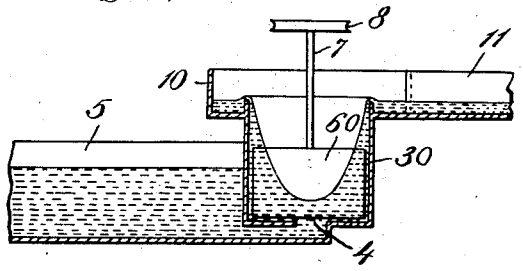


Fig. 2,



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3 Claims. (Cl. 103—103)

This invention is concerned with lifting mercury (which term I use to include liquid amalgams as well as pure mercury) over relatively small elevations such, for example, as those encountered in the operation of mercury cathode electrolytic cells for the production of chlorine and caustic. To this end, my invention provides an improved method and apparatus for pumping mercury.

Agitation of an amalgam in contact with air tends to oxidize metal dissolved in the mercury and thus to form thereon an oxide scum. Excessive oxidation may cause the amalgam to lose, in large part, its continuous liquid character. In fact, excessive agitation and consequent oxidation may cause the amalgam to separate into a granular mass of discrete particles, as contrasted with a continuous body of liquid, that is difficult, if not impossible, to pump in conventional apparatus. For this reason, a mercury pump should operate at low speed with minimum agitation of the mercury, should have large openings, and should be easily cleaned. The mercury pump I have invented fulfills these requirements and may be employed conveniently in the method of my invention which comprises revolving a pool of mercury in a bowl around an upwardly extending axis at a velocity sufficient to cause the upper surface of the pool to conform approximately to a paraboloid of revolution with its upper edge extending slightly above the rim of the bowl, while feeding additional mercury into the lower portion of the pool in the bowl and withdrawing mercury spilling over the rim of the bowl. In the preferred practice of my invention, the bowl is so shaped and proportioned that a relatively slow speed of revolution will bring about the formation of the desired paraboloid of revolution at the upper surface of the mercury without, however, inducing undue turbulence at the exposed upper surface of the mercury.

The mercury pump of my invention comprises a chamber or bowl, means (for example, a conduit) for supplying mercury to the lower portion of the chamber, means (for example, a rotatable paddle impeller) for imparting revolution to a pool of mercury in the bowl around a substantially vertical axis whereby the central portion of this body of mercury is depressed while the upper portion is elevated, and means for discharging mercury from the bowl by overflow from the elevated outer portion of the revolving body of mercury. As indicated hereinbefore, when the laterally confined body of mercury in the bowl or chamber is revolved the upper portion of the body takes approximately the form of a paraboloid of revolution, the upper edge of which is adjacent the overflow at the rim of the bowl and substantially above the level or "head" of the mercury flowing into the bowl. The centrifugal force imparted to the mercury by revolution causes the spinning mercury in the bowl to be elevated or lifted.

The action within the pump chamber should be primarily one of revolution. Agitation should be minimized so that there is a minimum of turbulence at the upper surface of the mercury. The exposed surface of the mercury in normal operation of the pump remains relatively smooth and undisturbed so that the tendency toward oxidation of metal dissolved in the amalgam is reduced to a minimum.

All parts of the mercury pump of my invention are immediately accessible and easily cleaned. All openings are large and the impeller imparting the motion of revolution to the pool of mercury in the pump bowl can be as simple as a single flat paddle; and in any case should be designed to avoid agitation of the mercury.

I have illustrated two advantageous forms of the mercury pump of my invention in the accompanying drawing. One form is illustrated in Fig. 1 and another form is illustrated in Fig. 2. The same reference characters are used to designate the same or corresponding parts in both figures. Both figures are diagrammatic fragmentary sectional elevations.

The particularly advantageous form of mercury pump illustrated in Fig. 1 comprises a chamber 3, a supply trough 5 opening into the lower part of the chamber 3 through port 4, an impeller 6 carried by shaft 7 and positioned to revolve within the pump chamber 3, a pulley 8 for driving the shaft 7, a casing 10 surrounding the upper rim of the pump chamber 3 and a discharge trough 11. The annular wall of the pump chamber 3 is symmetrical about the same vertical axis as that on which the impeller 6 revolves. This annular wall flares outwardly toward its upper rim, being frusto-conical in configuration with its upper diameter larger than its lower diameter. The impeller 6 is a simple flat paddle fitting the lower part of the interior of chamber 3 and adapted to impart a motion of revolution around its own axis to mercury within the pump chamber with a minimum of disturbance. This impeller 6 itself imparts no direct vertical force to mercury within the pump chamber; the outer portion of the mercury is elevated as a result of revolution of the body of mercury

in the pump chamber by the impeller but this elevation is the result of revolution and not of direct agitation by the impeller. The body of mercury within the pump chamber revolves at substantially the same speed as the impeller.

In the operation of my mercury pump, in the form illustrated in Fig. 1, the body of mercury in the pump chamber 3, supplied from trough 5, is rotated, by means of the impeller 6, at a speed sufficient to cause its upper surface to assume substantially the configuration illustrated in the drawing. The elevated outer portion of the revolving body of mercury then overflows the upper rim of the annular wall of the pump chamber 3 and is discharged through the annular trough 11 while additional mercury, supplied through the trough 5, flows into the pump chamber 3 through port 4 at the same rate. The head of mercury in the trough 5 acts to maintain the same mean head in the pump chamber 3 and thus to maintain the same volume of mercury in the pump chamber 3 as the revolving mercury overflows the upper rim of the pump chamber. The mercury is thus lifted from the elevation indicated in trough 5 to the elevation indicated, in trough 11.

The form and operation of mercury pump illustrated in Fig. 2 are the same as the form and operation of the pump illustrated in Fig. 1 except that the annular wall of the pump chamber 30 is cylindrical instead of frustoconical and that the impeller 60 is correspondingly changed in shape. The form illustrated in Fig. 2 is just as effective as a pump as the form illustrated in Fig. 1 but is somewhat less easily cleaned and requires somewhat more mercury for operation.

The operation of the mercury pump of my invention is not to be confused with the operation of a conventional centrifugal pump or a lifting screw. The conventional centrifugal pump depends, for operation, upon confined discharge from the plane of rotation of the impeller, and with a lifting screw the impeller, if it can be called that, exerts the lifting force directly on the liquid lifted. The pump of my invention depends, for operation, solely upon the fact that revolution of the body of mercury in the pump chamber changes the configuration of the free upper surface of this body of mercury.

I claim:

1. A mercury pump comprising a stationary chamber having an annular wall symmetrical about a vertical axis through said chamber, a supply connection to the lower part of said chamber, an overflow discharge connection adjacent the upper rim of said wall, and an impeller having substantially the shape of the vertical cross-section of the lower portion of the interior of said chamber and revolving around said axis adapted to impart a motion of revolution around said axis to mercury within said chamber.

2. A mercury pump comprising a stationary chamber having a cylindrical annular wall symmetrical about a vertical axis through said chamber, a supply connection to the lower part of said chamber, an overflow discharge connection adjacent the upper rim of said wall, and an impeller revolving around said axis having substantially the shape of the vertical cross-section of the lower portion of the interior of said chamber and adapted to impart a motion of revolution around said axis to mercury within said chamber with a minimum of disturbance of the mercury.

3. A mercury pump comprising a stationary chamber having an annular wall flaring upwardly and outwardly symmetrical about a vertical axis through said chamber, a mercury supply connection to the lower part of said chamber, an overflow discharge connection for mercury adjacent the upper rim of said wall, and an impeller having substantially the shape of the vertical cross-section of the lower portion of the interior of said chamber and revolving around said axis adapted to impart a motion of revolution around said axis to mercury within said chamber with a minimum of disturbance to the mercury.

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