Oct. 31, 1939. F. W. GAGE 2,177,706

APPARATUS FOR PROCESSING MOTION PICTURE FILM

Filed May 31, 1938 3 Sheets-Sheet 1

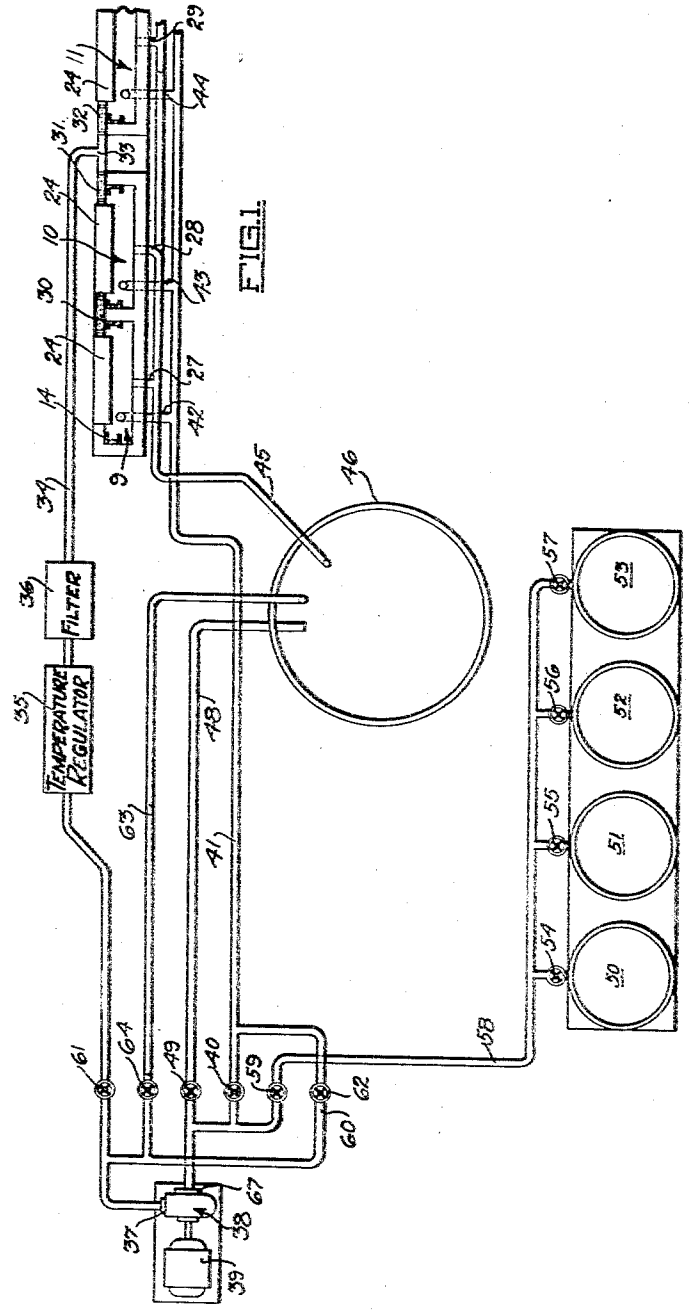


FIG. 1.

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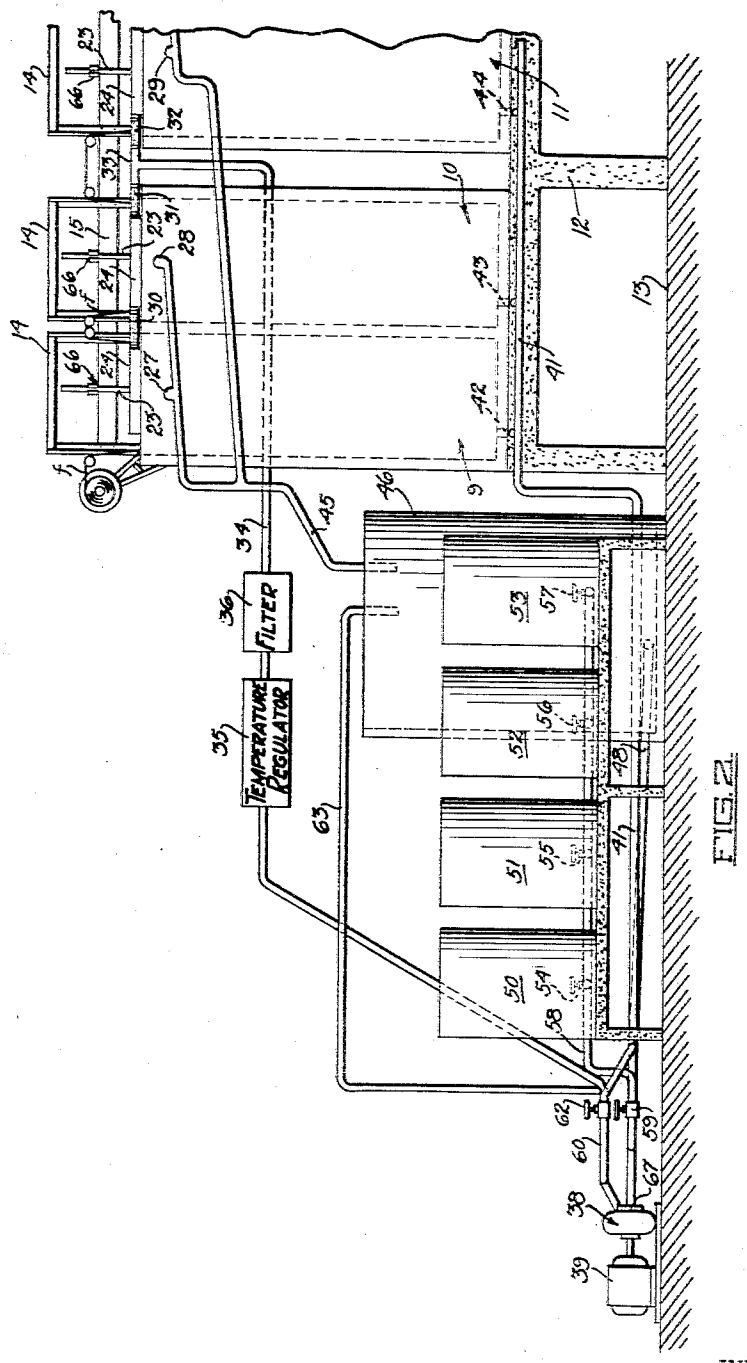


FIG. 2

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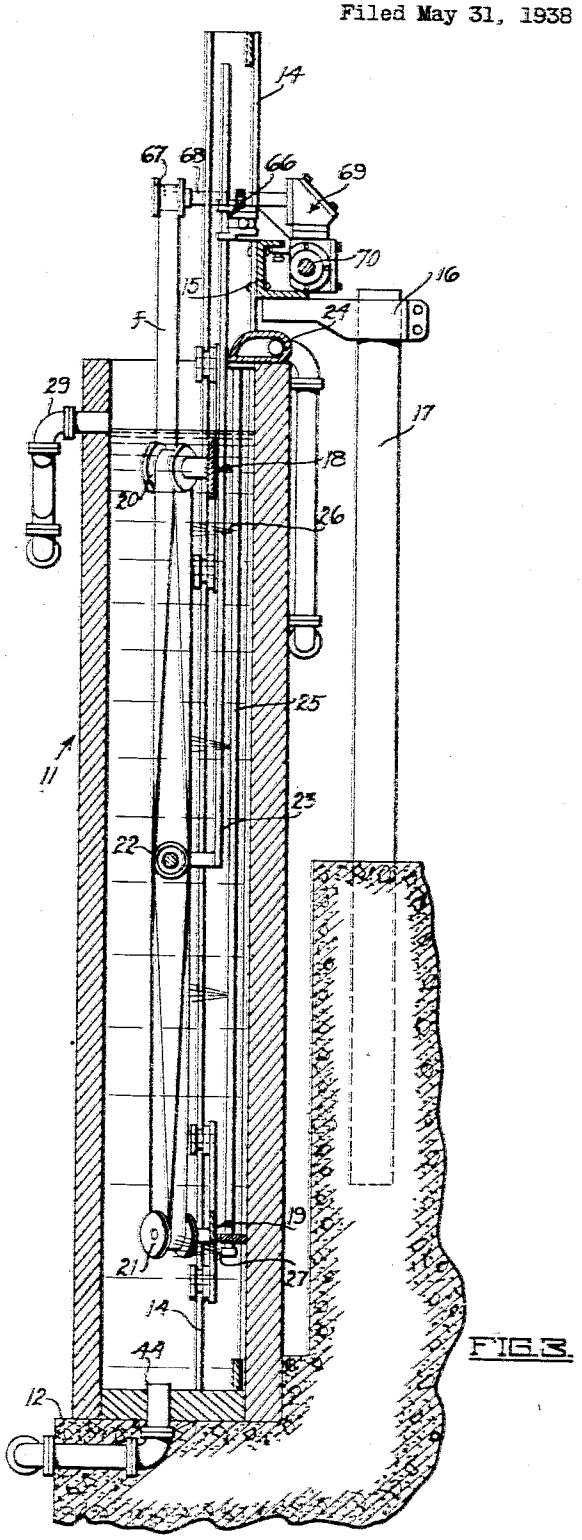


FIG. 3.

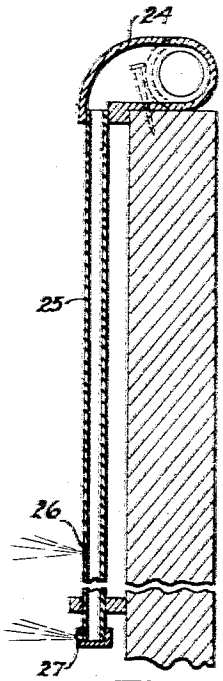


FIG. 4

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UNITED STATES PATENT OFFICE

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APPARATUS FOR PROCESSING MOTION PICTURE FILM

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Application May 31, 1938, Serial No. 210,847

11 Claims. (Cl. 95—94)

This invention relates to apparatus for the treatment of motion picture film and has special reference to film treating apparatus of the jet type, such as that disclosed and claimed in copending application S. N. 205,577, filed May 2, 1938 in the name of Albert W. Tondreau, wherein the film treating liquid is directed onto the surface of the film in a plurality of jets while the film is traversed in a bath of the treating liquid. The jets of treating liquid impinging on the surface of the film reduce the effects of chemical drag and the effects of saturation of the liquid with the reaction compounds directly adjacent the film surface. In this type of apparatus the treating liquid is sprayed or directed onto the film through various jets submerged under the level of a body of the same liquid to prevent oxidation thereof. This submersion of the various jets is especially valuable in employing present day commercial developing solutions which rapidly break down when aerated or oxidized.

One object of the present invention is to reduce oxidation of treating solutions in circulating systems for motion picture film treatment.

A further object is to prevent during the course of development, rapid change of the chemical composition of a treating solution in a film treating tank due to reaction with the film.

A further object of the invention is to prevent recirculation of concentrated or diluted portions only of a film treating solution due to settling of such solution in a film treating tank.

A further object is to facilitate filling of a developing tank employing the jet type of film treating system.

A further object is to reduce the number of pumping units required to conduct film treating solution through a film treating system.

The invention contemplates film treating tanks wherein the film to be treated is progressed in a continuous manner therethrough. Treating liquids such as developer, rinsing and fixer solutions, are continuously circulated and/or recirculated through the various tanks. Each solution is removed from its tank or tanks at different levels to prevent the removal of only concentrate or diluted portions of the whole body of the solution, bearing in mind that film treating solutions tend to vary in density at different levels, especially after standing a short period of time. The solution thus removed from the various tanks is re-circulated and fed through suitable jet forming devices located within the various tanks. A reservoir, having a capacity in excess of the capacity of the various tanks, is provided through which at least a portion of the recirculated treating liquid is passed whereby the degree of change of the chemical composition of the treating liquid due to the chemical reaction between the liquid and the film is reduced to prevent rapid breakdown of such liquid.

The invention further contemplates means for filling the various tanks, when empty, without oxidation by passing the treating liquid through the normally discharging pipe lines of the tanks and not through the jet forming devices.

The manner in which the above and other objects of the invention are accomplished will be readily understood on reference to the following specification read in conjunction with the accompanying drawings.

Fig. 1 is a schematic plan view of a film treating system embodying the present invention.

Fig. 2 is an elevational view of the system illustrated in Fig. 1.

Fig. 3 is a transverse sectional view in detail of a film treating tank to which the present invention is applicable.

Fig. 4 is a sectional view, with parts broken away, through a manifold and jet tube connected thereto.

Although the invention is not limited to use with any particular type of film treating system of the jet or spray type, I preferably employ the system disclosed and claimed in the hereinbefore mentioned copending application S. N. 205,577, a portion of which is shown in Figs. 3 and 4.

As shown in Figs. 1 and 2 the various film treating tanks 9, 10, 11, etc., through which the film is successively passed, are aligned with each other and supported upon a foundation 12 extending upwardly from a floor 13. Each of these tanks 9, 10 and 11 etc. is rectangular in cross section and extends vertically.

A rectangular frame 14 is mounted within each tank and is supported by a horizontally extending channel 15 (Fig. 3). Channel 15 is supported at spaced points on arms, one of which is shown at 16, vertically adjustable in a suitable manner along posts, one of which is shown at 17, embedded in the foundation 12. Spool heads 18 and 19 are spaced vertically within each tank section. Spool heads 18 are fixed and spool heads 19 are adjustably stationed along the side members of the rectangular frame 14. Rows of film guiding spools, two of which are shown at 20 and 21, are rotatably mounted on the spool heads 18 and 19, respectively, to guide the film *f* being treated in a plurality of elongated vertically extending loops through each tank. A film separating roller 22,

rotatably mounted on the lower end of a vertical rod 23 which is secured by means of a clamp 66 to the cross channel 15, is provided to separate the adjacent opposing strands of the film in the various loops, preventing the sprays from jets 26, 27 etc. from forcing opposite sides of the loops of film into contact with each other during traverse of the film through the treating solution. The film *f* is driven in a continuous manner through the treating apparatus by sprockets, as at 67, individual to each tank. Each sprocket 67 is mounted on a sprocket shaft 68 driven through a gear unit, generally indicated at 69, by a horizontal drive shaft 70 extending throughout the length of the treating apparatus. A suitable motor (not shown) is provided to drive shaft 70.

The above mentioned film driving and guiding mechanism is disclosed and claimed in the copending patent application Serial No. 193,966, filed March 4, 1938 in the name of A. W. Tondreau.

A jet manifold 24 rests on the upper and rear edge of each tank and extends longitudinally thereof. A plurality of jet tubes, one of which is shown at 25, are connected side by side to the manifold 24 and depend therefrom into the interior of the respective tanks. These tubes 25 have jet orifices as at 26 and 27 (Fig. 4) spaced therealong in vertical alignment with each other to direct the film treating solution from these various jet tubes in the form of a spray or jet on the surface of the film passing through the tanks. These various tubes are situated directly adjacent the rear strand of each loop of film.

The film treating liquid, on impinging on the film surface, mixes with the remainder of the liquid within the tank and overflows adjacent the top of the tank, through overflow pipes. These various pipes are shown at 27, 28 and 29 for the various tanks 9, 10 and 11, respectively.

It will be noted that the system shown in Fig. 1 is to supply the three film tanks 9, 10 and 11 with the same kind of treating solution. However, another similar system may be provided to supply other film tanks (not shown) with a different kind of treating solution. These various film tanks may be aligned with each other to permit the film being treated to be successively progressed in a continuous manner through the various film tanks.

Referring now to Figs. 1 and 2, the various manifolds 24 for the tanks 9, 10 and 11 are connected together through hose couplings 30, 31 and 32. A T-connection 33, intermediate and connected to the hose couplings 31 and 32, is connected to a jet supply pipe line 34 which receives film treating liquid under pressure. A second series of jet manifolds (not shown) with jet tubes depending therefrom, may also be positioned in the various tanks by supporting the same on the front edges of the tanks. These manifolds in the second series may be connected together in a manner similar to the connections between the manifolds 24. A line may be provided between this second series and the jet line 34.

A temperature regulator 35 and filter 36 are provided in the pipe line 34 to maintain the treating liquid at a constant and proper temperature and to filter any impurities within the liquid. The jet line 34 is connected to the discharge end or opening 37 of a pump 38. Pump 38 is driven by a motor 39 and is preferably of the centrifugal type. The suction end 67 of pump 38 is normally connected through a valve 40 to a suction pipe line 41 which is connected to the various tanks 9, 10, 11 etc. through the branch lines 42, 43 and 44, respectively to discharge the film treating liquid from those tanks. These lines 42, 43 and 44 open into the bottoms of the various tanks as shown in Fig. 3.

The overflow pipes 27, 28 and 29 are connected to a main overflow line 45 which feeds by gravity into a reservoir 46. Reservoir 46 has a capacity which is much greater than the combined capacities of the various tanks 9, 10, 11 etc. A suction line 48 opening into the bottom of the reservoir 46 is connected through a valve 49 to the suction end 67 of pump 38.

In normal operation, the treating solution is recirculated by simultaneously drawing the same from the film tanks 9, 10, 11 and reservoir 46, respectively, through the suction lines 41 and 48, through the pump 39 and thence under pressure through the jet line 34 to the various manifolds in the tanks 9, 10 and 11. The valves 40 and 49 in the suction lines 41 and 48, respectively, are only partly opened so that a portion of the solution to be passed through the jet line 34 is obtained from the bottoms of the various tanks and the remainder obtained from the overflow thereof. This provision permits the liquid to be withdrawn from the tanks at different levels and therefore prevents only concentrated or only diluted portions of the liquid from being re-circulated. Furthermore, the valves are preferably so opened that a large portion of the liquid is drawn through the suction line 41 to reduce as far as possible the aeration of the liquid caused by overflow through the overflow line 45, it being noted that, since the level of the liquid in each tank is usually below the top (but always above the bottom) of the outlet opening of the respective overflow pipe line, as shown in Fig. 3, a considerable amount of air will be mixed with the liquid while passing through the overflow pipe 45. It has been found that best results have been obtained when the valves 40 and 49 are so opened that approximately 75% of the liquid is passed through the suction pipe line 41, the remainder being drawn through the pipe line 48.

A plurality of mixing tanks 50, 51, 52 and 53 are provided to mix the various chemicals of the treating solutions or liquids before passing the same into the reservoir 46 and tanks 9, 10 and 11. These various tanks 50–53, inclusive, are connected through valves 54, 55, 56 and 57, respectively to a feed line 58. Line 58 is connected through a valve 59 to the suction end 39 of pump 38.

A by-pass line 60 is connected to the jet line 34 intermediate the exhaust end 37 of pump 38 and a valve 61 in line 34. Line 60 is connected through a valve 62 to the suction line 41 intermediate the valve 40 and the lower discharge openings of the various tanks 9, 10 and 11. A reservoir filling line 63 empties into the reservoir 46 and is connected to the by-pass line 60 at a point intermediate the valve 62 and the jet line 34.

When the various tanks 9, 10 and 11, as well as reservoir 46, are to be filled with a fresh treating liquid they are emptied in a suitable manner and the various different chemicals to produce such treating liquid or solution are mixed in the different tanks 50 to 53, inclusive. For example, borax may be dissolved in one tank, hydroquinone may be dissolved in a second, etc. in amounts determined by the formula for that particular treating liquid. After these various solutions have been thoroughly mixed the valves

of the respective tanks containing the same are opened allowing the same to be drawn through the feed line 58. The valves 59 and 62 are opened while the remaining valves 40, 49, 61 and 64 are closed. In this condition, the pump 38 draws the new solution through the line 58 and passes it under pressure from the discharge end 37 thereof, through the by-pass line 60 and into the normally suction line 41 to the various tanks 9, 10 and 11. This provision permits the treating solution to fill the various tanks from the bottoms thereof, without going through the jets 26, 27, thus reducing to a large extent aeration which would be caused if the same were fed through the various jet tubes 25 into the empty tanks. When the tanks 9, 10 and 11 are filled, the solution runs through the various overflow pipes 27, 28 and 29 and into the reservoir 46. This indicates to the valve operator that the various tanks are filled to their proper heights with solution. The valve 60 is thereafter closed and the valve 64 is opened, permitting the remainder of the solution passing through the line 58 to be forced through the reservoir filling line 63 and into the reservoir 46. When the solution in the reservoir 46 reaches a proper height or when the various tanks 50 to 53, inclusive, are emptied, valve 64 is closed and the system set in normal recirculating operation by opening the jet line valve 61, the suction line valve 40, and the suction line valve 49, the valves 59, 62 and 64 being closed.

The pressure of the various jets upon the film as it passes through the treating tanks may be varied by adjusting the jet line valve 61.

I claim:

1. Film treating apparatus comprising a film tank, means for guiding a film through said tank, means forming jets to direct a flow of film treating liquid against the film in said tank, a suction pipe line connected to said tank, a pump having its inlet connected to said suction line and having its outlet connected to said jet means, a reservoir having a capacity large in relation to the capacity of said tank, an overflow line between said tank and said reservoir for conducting overflow from said tank to said reservoir, and a suction line between said reservoir and said inlet of said pump.

2. Film treating apparatus according to claim 1 comprising valve means for regulating the flow of liquid through said suction lines.

3. Film treating apparatus comprising a film tank, means for guiding a film through said tank, means forming jets in said tank adapted to direct a flow or film treating liquid against the film in said tank, a suction line and an overflow line connected to said tank for normally removing liquid therefrom, a pump having an inlet and an outlet, means connecting said suction line and said overflow line to the inlet of said pump, means connecting said jet forming means to the outlet of said pump at certain times to pass said film treating liquid from said suction line and said overflow line to said jet forming means, a liquid supply, means for connecting said liquid supply to the inlet of said pump at other times, and means for connecting said suction line to the outlet of said pump at said other times whereby said tank may be filled from said liquid supply through said suction line.

4. Film treating apparatus comprising a film tank, means for guiding a film through said tank, means forming jets adapted to direct a flow of film treating liquid against the film in said tank, an overflow line and a suction line connected to said tank for normally removing liquid therefrom, a reservoir adapted to receive liquid overflowing through said overflow line from said tank, a chemical tank, a pump, means connecting said reservoir and said suction line to the inlet of said pump, means connecting said jet forming means to the outlet of said pump, connections adapted to disconnect said suction line from said inlet of said pump and connect said suction line to said outlet of said pump, and means adapted to connect said chemical tank to said inlet of said pump tank, whereby said film tank may be quickly filled from said reservoir or from said chemical tank through said suction line.

5. Film treating apparatus comprising a film tank, means for guiding a film through said tank, means forming jets adapted to direct a flow of film treating liquid against the film in said tank, a pair of pipe lines communicating with said tank for normally removing liquid therefrom, a reservoir for receiving liquid passing through one of said lines from said tank, a pump, means communicating said reservoir and the other of said lines with the inlet of said pump, means connecting said jet forming means with the outlet of said pump, and means adapted to disconnect said other line with said inlet of said pump and to connect the same with said outlet of said pump whereby said tank may be quickly filled with said liquid from said reservoir.

6. Film treating apparatus comprising a film tank, means adapted to pass a film in a predetermined path through said tank, means in said tank forming jets directed toward said film path to direct a flow of film treating liquid onto film passing through said path, a suction line connected to said tank for normally removing film treating liquid therefrom, a pump having its suction end connected to said suction line, said pump having its pressure end connected to said jet forming means, a reservoir, means connecting said reservoir to said suction end of said pump, and means adapted to connect said suction line to said pressure end of said pump whereby said tank may be quickly filled.

7. Film treating apparatus according to claim 6 comprising means adapted to connect said reservoir to said pressure end of said pump when said suction line is connected to the inlet of said pump whereby film treating liquid may be transferred from said tank to said reservoir.

8. Film treating apparatus comprising a film treating tank adapted to contain film treating solution wherein certain ingredients of said solution tend to settle whereby to form a concentrated solution in the lower part of said tank and a diluted solution in the upper part of said tank, a pump, means communicating the outlet of said pump with the interior of said tank, means communicating the inlet of said pump to the interior of said tank at one level, and a second means communicating said inlet of said pump to the interior of said tank at a different level whereby both said concentrated and said diluted solutions are passed through said pump.

9. Film treating apparatus comprising a film treating tank adapted to contain a film treating solution wherein certain ingredients of said solution tend to settle whereby to form a concentrated solution in the lower part of said tank and a diluted solution in the upper part of said tank, a pump, means communicating the outlet of said pump with the interior of said tank, an overflow conduit on said tank, means communi-

cating said overflow conduit with the inlet of said pump, and a second means communicating the interior of said tank adjacent the bottom thereof with the inlet of said tank whereby both said concentrated and said diluted solutions are passed through said pump.

10. Film treating apparatus comprising a film treating tank adapted to contain a film treating solution susceptible to detrimental effects when aerated and wherein certain ingredients of said solution tend to settle whereby to form a concentrated solution in the lower part of said tank and a diluted solution in the upper part of said tank, means for guiding a film through said tank, means forming jets in said tank adapted to direct a flow of said solution against the film in said tank, a reservoir, an overflow line connected between said tank and said reservoir for conducting overflow from said tank to said reservoir, a pump having its inlet connected to said reservoir and its outlet connected to said jet forming means, a suction line connected at one end thereof to said tank below the opening of said overflow line into said tank and at the other end thereof to said inlet of said pump for aiding said overflow line in removing said solution from said tank, and means adapted to disconnect said suction line from said inlet of said pump and connect the same to said outlet of said pump whereby said tank may be filled from said reservoir through said suction line.

11. Film treating apparatus comprising a plurality of film treating tanks adapted to contain a film treating solution susceptible to detrimental effects when aerated and wherein certain ingredients of said solution tend to settle whereby to form a concentrated solution in the lower parts of said tanks, and a diluted solution in the upper parts of said tanks, means for guiding a film through said tanks, means forming jets in said tanks adapted to direct a flow of said solution against the film in said tanks, a reservoir, an overflow line connected between each of said tanks and said reservoir for conducting overflow from said tanks to said reservoir, a pump having its inlet connected to said reservoir and its outlet connected to said jet forming means, a line connected between said tanks and said inlet of said pump for aiding said overflow line in removing said solution from said tanks, the openings of said last mentioned line into said tanks extending below the openings of said overflow line into said tanks, and means adapted to disconnect said last mentioned line from the said inlet of said pump and connect the same to said outlet of said pump whereby said tanks may be filled from said reservoir through said last mentioned line.

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