This invention pertains to liquid handling apparatus, and more particularly to means for feeding a liquid to apparatus for operating on the same.

One of the objects of this invention is to provide an apparatus which will feed a liquid in such a manner as to provide a sheet flow.

Another object is to provide such apparatus which will compensate for irregularities in the rate of flow of the liquid supply.

Another object is to provide such an apparatus which will feed the liquid to the handling mechanism in such a manner as to insure a uniform flow through such mechanism.

Another object is to provide such apparatus which will feed the liquid in a single unbroken sheet and at a substantially uniform rate.

Another object is to provide such apparatus which may be combined with a liquid handling mechanism and which may be adjusted relatively to such mechanism.

Further objects will appear from the following description taken in connection with the accompanying drawing, in which:

Figure 1 is a side view of a liquid handling device such as a filtering screen equipped with liquid feeding apparatus in accordance with this invention.

Figure 2 is a front view of Figure 1.

Figure 3 is an enlarged sectional view of the feed box; and

Figure 4 is an enlarged detail view of Figure 1 showing the angle of approach of the liquid sheet to the handling mechanism.

This invention may find its application in apparatus for handling juices, syrups, or other liquids. In such an apparatus it is desirable to feed the liquid to the handling means, such as vibrating screens, lawns, mixers and the like, in the form of an unbroken sheet of liquid. For instance in feeding such a liquid to a vibrating screen it is advantageous to feed the liquid in a single sheet extending the full width of the screen so that a layer or pad of material completely covering the screen may be formed. This material flows down the screen in a stream of substantially uniform depth. In screening operations whose purpose is to separate suspended matter from the liquid, the pad of material on the screen collects the suspended matter which eventually forms a mat which itself provides a filtering medium. In such operations it is important that the pad or mat of material flowing down the screen should remain unbroken particularly when solids approaching colloidal fineness are handled. Accordingly the feeding device should form a continuous sheet and avoid any tendency to form jets tending to channel this pad of material. When such channelling action takes place the filtering mat is broken and the efficiency of the apparatus is greatly reduced.

Another application of this invention may be in feeding liquids to mixers. For instance with two or more feeders feeding material into a trough, mixer, or similar apparatus, the arrangement of the incoming ingredients in sheets provides for a very rapid and thorough blending of the ingredients.

In the accompanying illustration a vibrating screen is shown equipped with a feed box adapted to feed liquid in a sheet flow in accordance with this invention. The drawing, however, simply illustrates one application of the invention which is capable of many other uses and is not limited to this particular application.

Referring to the drawing 1 designates a suitable base or frame upon which is mounted a screen frame 2 which has suspended therein a screening medium 3, such as wire mesh cloth or the like. Mechanism 4 is provided for vibrating the screening medium 3 in any desired manner. The details of the screening mechanism are not a part of the present invention, and may be of any suitable construction.

Mounted on suitable upright supports 5 on the base 1 is a feed box 6. This feed box may be of rectangular construction as illustrated in the drawing, and may be built of sheet metal or other suitable material. When sheet metal is used the various joints may be welded so that a tight construction is provided which is free from leakage and easy to clean. Entering the rear wall of the box 6 is a supply pipe 7 adapted to convey the liquid to be operated upon to the feed box from any suitable source of supply not shown. Mounted within the box 6 and extending lengthwise thereof is a vertical partition 8. This partition extends the full length of the box and divides the same into two compartments, a receiving compartment 9 and a dispensing compartment 10. The upper edge of the partition 8 rises substantially above the inlet 7 and provides a weir over which the liquid may flow from the compartment 9 to the compartment 10. The box may be provided with a loose lid or cover 11 to keep foreign matter from entering the box. This lid is loose, that is, it is not fixed to the box in an air tight manner and accordingly the liquid within the box is not under pressure other than that due to its own hydrostatic head.
A regulating valve 12 is provided in the inlet to regulate the inflow of liquid to the compartment 9. Such a valve is useful under certain conditions, as for instance when the pump pressure is considerably in excess of that necessary to pass the liquid through the feeding device. Excessive pump surges can be kept within such limits by the use of a valve of this kind that they can be handled and smoothed out in the feed box.

The lower portion of the front wall of the compartment 10 is formed to a rearwardly sweeping curve as indicated at 12. This portion serves to guide the downward flow of the liquid so as to direct the liquid laterally out of the compartment. This outlet is at the terminus of the curved portion 12 and is provided with a swinging gate 13 fixed to a shaft 14 extending longitudinally of the feed box and journalled in suitable bearings on the end walls thereof. The shaft 14 projects through one of these end walls and has fixed thereto an arm 15 which has a counterweight 16. It will be clear from the figures that the weight of the counterweight 16 is applied to the gate 13 so as to tend to close the gate. The flowing stream of liquid forces the gate open against the pressure produced by the counterweight. The bottom 17 of the compartment 9 is extended forwardly into the compartment 10 to provide a baffle 18. This baffle extends toward the sweeping portion 12 of the front wall so as to cause the flow of liquid downwardly through the compartment 10 to be thrown against said front wall in order that the flow may follow the sweep 12.

A drain cock 19 may be provided for emptying the compartment 9 when the operation of the apparatus is shut down. Liquid is supplied through the pipe 7 to the inlet in the compartment 9. The inflowing liquid impinges on the partition 8 and is directed upwardly thereby. One or more horizontal baffles 20 may be provided on the partition 8 so as to dissipate any direct current which might tend to be set up from the inlet up over the partition 8. Accordingly the liquid rises in the compartment 9 in a relatively quiet flow and spills over the top of the partition 8 and into the compartment 10, thereby filled with the liquid to such a depth as to cause the pressure thereof to force open the gate 13. When this gate opens a long narrow slot is formed to provide an outlet from the compartment 10 through which the liquid flows in a continuous unbroken sheet. When the flow of liquid has been established it runs downwardly along the front wall of the said box and then sweeps rearwardly against the gate 13 and out at the outlet opening. The baffle 18 serves to maintain the flow along the front wall of the feed box. The feed box 21 is mounted above the screen 3 and may be supported on the uprights 5 by adjustable fastenings such as the bolts 21 whereby its relation to the screen 3 may be adjusted. "Arrangements may be made so that this adjustment may be made both vertically and laterally. The sheet of liquid issuing from the gate or outlets is, therefore, directed generally to the screen 3 and then flows down along said screen in a uniform stream. It will be noted that the rearward sweep of the partition 12 is effective to direct the flow of liquid against the swinging gate 13. The flow impinging on this gate is redirected therein in a downward direction. The flow issues in a direction substantially along the gate or in the plane thereof. Accordingly the direction in which the liquid is fed to the screen can be accurately adjusted by adjusting the counterweighting etc. of the gate 13.

The angle at which the liquid impinges on the screen 3 is usually important in determining the manner in which the liquid flows over said screen. If the flow of liquid approaches the screen at right angles thereto, a certain portion of the liquid will be deflected upwardly along the screen while another portion is deflected downwardly. The first portion will have to flow inwardly through the outlet from the sheet of liquid being fed. This is liable to cause disturbance of the even flow over the screen. If the liquid being fed, approaches the screen at too steep an angle, that is, with too great a component directed along the screen, there is a tendency for the energy of the approaching liquid to be directed downwardly along the screen so as to force the flow at a greater rate than would be imposed by gravity alone. This is liable to cause a disturbance of the even flow over the screen, such as cutting or channeling or the said gate.

It is desirable, therefore, that the impinging sheet of liquid be caused to approach the screen at such an angle as to avoid the disturbance caused by a right angle approach as described above and at the same time avoid directing the energy of approach downwardly along the screen. By proper adjustment of the angle of the gate 13 such an angle of approach can be obtained as to insure the most uniform flow of the liquid along the screen. This condition is obtained when the direction of approach of the new liquid is such as to strike a balance between the two undesirable effects mentioned above—namely, those of a right angle approach on one hand, and too steep an approach on the other. When such an adjustment is obtained an even and uniform flow over the screen may be maintained.

It will be seen that the relation of the feed box to the screen 3 is such that the gate 13 opens in an upstream direction as related to the direction of flow on the screen. When the gate is nearly closed the sheet of liquid approaches the screen 3 in a substantially vertical direction. Under these conditions the sheet flow makes with the screen is a minimum under these conditions and this minimum is determined by the setting of the screen 3. As the gate opens under pressure of the issuing liquid it takes a position more nearly at right angles to the screen 3 and as the direction of approach of the sheet of liquid to the screen is determined by the position of the gate 13, it will be seen that as the gate opens this angle of approach to the screen is increased. This angle can never actually reach a right angle since that would require a gate opening sufficiently large as to accommodate a greater flow than the feed box is capable of.

It will be seen, therefore, that by this arrangement of the feeder with relation to the screen the angle of approach of the liquid to the screen is kept below certain limits. The minimum angle is fixed by the inclination of the screen and may be so adjusted that the impinging velocity under a vertical fall will be sufficient to cause channeling or cutting of the sheet of liquid on the screen. As the gate opens wider the liquid issues under a slightly greater pressure and a correspondingly greater velocity. To counteract the tendency of such
increase in velocity to approach a condition where cutting or channeling would be caused, the angle of approach of the liquid is automatically increased as the velocity of approach and volume of flow are increased. In this way a uniform
unbroken sheet of flow is maintained under all conditions of operation by adjusting the angle of approach of the sheet of liquid to the screen to remain minimum and maximum limits in accordance with the volume of flow. It will be seen that this angle can never approach so near to ninety degrees as to cause a tendency toward upstream flow.

It will be seen, therefore, that this invention provides a liquid feeding device adapted to accomplish the purposes set forth. The flow of the liquid entering from the supply 7 is broken up and changed to a uniform upward movement of the liquid in the compartment 9. This is an enlarged compartment as compared with the inlet pipe 7. Accordingly the velocity of movement of the liquid is greatly reduced while traveling through the compartment 9. Furthermore as the liquid in said compartment normally stands at a level slightly above the upper edge of the partition 8 any variation in the rate of inflow to the compartment 9 is greatly reduced in its effect. The result will be simply a slight change of level above the partition 8 and this change will take place gradually as compared with the rate of change in the pipe 7.

In the compartment 9 the current variations due to pump surges are taken up by the expansion of the outlet volume in the liquid flow as it enters this chamber which serves to reduce the velocity of flow and to stabilize the pressures. Spillage at a uniform rate, except for surges takes place over the top of the partition 8 which presents a smooth slope between its upper edge and the top of the box to allow not only uniform flow but also any occasional surges. From this weir the liquid falls by gravity into the compartment 10 where it fills up to a given depth established by the swinging gate and the adjacent guide wall 11. Any increase in depth of liquid in this compartment produces a corresponding change in head or pressure which is compensated for by the automatic action of the swinging gate 13 while only manifesting slight changes in the discharge rate and carrying such fluctuations of pressures over a long compensating period. The partition 8 may, of course, be made in any form or arrangement within the scope of the appended claims, consistent with its function of providing a regulated flow from the receiving compartment into the dispensing compartment.

It is interesting to note that when the intake supply diminishes or the pumps are shut off at the termination of an operating period, the self-compensating pressure of the swinging gate 13 is such as to work against the falling pressure of the liquid at the discharge slot which constantly decreases the discharge opening in proportion to the volume of liquid seeking exit and thus maintains distribution in a sheet flow across the entire distributor. Thus any breaking of the streams into jets is eliminated and when the liquid is entirely out of the distributing box the liquid flows against the lip or edge of the opening so that all flow is cut off.

While a certain theory of operation has been included in the above description this is simply for the purpose of a clear explanation and it is not intended that the invention shall be limited by any theory of operation.

Furthermore while the device has been described as a unitary piece of mechanism it is obvious that individual features or sub-combinations may be useful by themselves without reference to other features or the rest of the structure. It is understood, therefore, that the employment of such individual features or sub-combinations is contemplated by this invention and within the scope of the appended claims. It is further obvious that various changes may be made in details, within the scope of the appended claims, without departing from the spirit of this invention. It is, therefore, to be understood that this invention is not to be limited to the specific details shown and/or described.

Having thus described the invention what is claimed is:

1. A liquid feeding apparatus, comprising, a feed box having an enlarged receiving compartment provided with a liquid inlet thereto, a dispensing compartment communicating with said receiving compartment to receive liquid therefrom and having a dispensing outlet for the liquid adapted to provide a sheet flow therefrom, and a self-adjusting swinging gate counterweighted to automatically regulate the flow from said outlet.

2. A liquid feeding apparatus, comprising, a feed box having an enlarged receiving compartment provided with a liquid inlet thereto, a dispensing compartment communicating with said receiving compartment to receive liquid therefrom and having a dispensing outlet for the liquid adapted to provide a sheet flow therefrom, and a self-adjusting swinging gate counterweighted to automatically regulate the flow from said outlet.

3. A liquid feeding apparatus, comprising, a feed box having an enlarged receiving compartment provided with a liquid inlet thereto, a dispensing compartment communicating with said receiving compartment to receive liquid therefrom and having a dispensing outlet for the liquid, and an approach to said outlet formed to define a path of flow for the liquid sweeping toward said outlet.

4. A liquid feeding apparatus, comprising, a feed box having an enlarged receiving compartment provided with a liquid inlet thereto, a dispensing compartment communicating with said receiving compartment to receive liquid therefrom and having a dispensing outlet for the liquid, and an approach to said outlet formed to define a path of flow for the liquid sweeping rearwardly toward said outlet.

5. A liquid feeding apparatus, comprising, a feed box having an enlarged receiving compartment provided with a liquid inlet thereto, a dispensing compartment communicating with said receiving compartment to receive liquid therefrom, a dispensing outlet for said dispensing compartment, said latter being formed to provide a path of downward flow sweeping rearwardly toward said outlet.

6. A liquid feeding apparatus, comprising, a feed box having an enlarged receiving compartment provided with a liquid inlet thereto, a dispensing compartment communicating with said receiving compartment to receive liquid therefrom, a dispensing outlet for said dispensing compartment, said latter being formed to provide a path of downward flow and having a flow-guiding wall sweeping toward said outlet.
outlet, and means adapted to direct the flow toward said wall.

7. A liquid feeding apparatus, comprising, a feed box having an enlarged receiving compartment provided with a liquid inlet thereto, a dispensing compartment communicating with said receiving compartment to receive liquid therefrom, a dispensing outlet for said dispensing compartment, said latter compartment being formed to provide a downward flow and having a flowing wall sweeping toward said outlet, and means adapted to direct the flow thereto.

8. A liquid feeding apparatus, comprising, a feed box having an enlarged receiving compartment provided with a liquid inlet thereto, a dispensing compartment communicating with said receiving compartment to receive liquid therefrom, a dispensing outlet for said dispensing compartment, a self regulating gate for said outlet, said latter compartment being formed to provide a downward flow and having a flowing wall sweeping toward said gate.

9. A liquid handling apparatus comprising, a feed box having an enlarged receiving compartment provided with a liquid inlet thereto, and a dispensing compartment communicating with said receiving compartment to receive liquid therefrom, flow-controlling means between said compartments adapted to regulate the flow from said outlet for the liquid adapted to provide a sheet flow therefrom, a device for processing the liquid during a sheet flow thereof, means for mounting said box above said device to feed liquid thereto, means for adjusting said feed box relatively to said device, and a flow-controlling gate for said outlet.

10. Liquid handling apparatus, comprising, a feed box having an enlarged receiving compartment provided with a liquid inlet thereto, and a dispensing compartment communicating with said receiving compartment to receive liquid therefrom, flow-controlling means between said compartments adapted to regulate the flow from said outlet, a device for processing the liquid while flowing in a sheet therethru, and means for mounting said feed box above said device to feed liquid thereto adapted to support and position the box to feed the liquid at an angle of approach to said device such as to insure a low rate of flow in the device.

11. A liquid feeding apparatus, comprising, a feed box having an enlarged receiving compartment provided with a liquid inlet thereto, means for regulating the volume of inflow at said inlet, means in said receiving compartment adapted to dissipate a direct current from said inlet, a dispensing compartment communicating with said receiving compartment to receive liquid therefrom and having a dispensing outlet for the liquid adapted to provide a sheet flow therefrom, and means adapted to regulate the flow from said outlet.

12. In a liquid handling apparatus, in combination with a device for processing the liquid having means receiving the liquid to flow in a sheet thereover, a feed box having a dispensing outlet positioned to deliver the liquid to said receiving means, and a regulating gate for said outlet, constructed and arranged to regulate the angle of approach of the liquid to said receiving means so as to increase said angle as the volume of flow increases.

13. In a liquid handling apparatus, in combination with a device for processing the liquid having means receiving the liquid to flow a sheet thereover, a feed box having a dispensing outlet positioned to deliver the liquid to said receiving means, and a regulating gate for said outlet, constructed and arranged to regulate the angle of approach of the liquid to said receiving means so as to increase said angle as the volume of flow increases.

14. In a liquid handling apparatus, in combination with a device for processing the liquid having means receiving the liquid to flow in a sheet thereover, a feed box having a dispensing outlet positioned to deliver the liquid to said receiving means, and a regulating gate for said outlet, constructed and arranged to regulate the angle of approach of the liquid to said receiving means so as to maintain said angle above a predetermined minimum and to increase said angle as the volume of flow increases.

15. In a liquid feeding apparatus, a feed box having a receiving compartment provided with 35 a liquid inlet thereto, means for regulating the volume of inflow at said inlet, a dispensing compartment having a dispensing outlet for the liquid, a partition between said compartments over which the liquid flows from one to the other, a flange on said partition in said receiving compartment adapted to quiet the flow of the liquid, and means controlling the outflow of the liquid from said outlet.

16. In a liquid feeding apparatus, a feed box having a receiving compartment provided with a liquid inlet thereto, means for regulating the volume of inflow at said inlet, a dispensing compartment having a dispensing outlet for the liquid, a partition between said compartments over which the liquid flows from one to the other, a swinging gate at said outlet against which the liquid flows, and means for adjusting the resistance of said gate.

17. In a liquid handling apparatus, a device for processing the liquid having means receiving the liquid to flow in a sheet thereover, a feed box having an inlet and an outlet, means in said box adapted to control and quiet the flow, outlet means for said box formed and positioned to deliver the liquid in a sheet flow to said receiving means, and a flow-controlling gate for said outlet.

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