May 13, 1941. G. W. RATHJENS 2,241,646

CLEANSING APPARATUS

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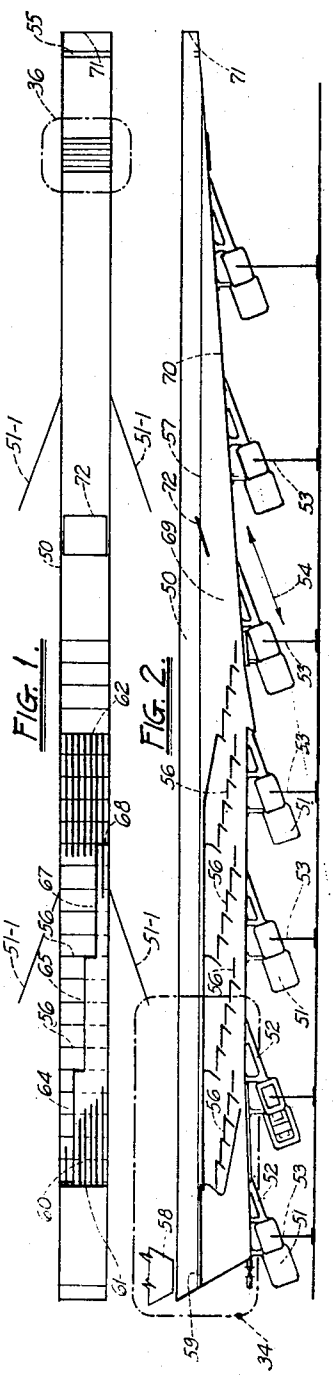


FIG. 1.

FIG. 2.

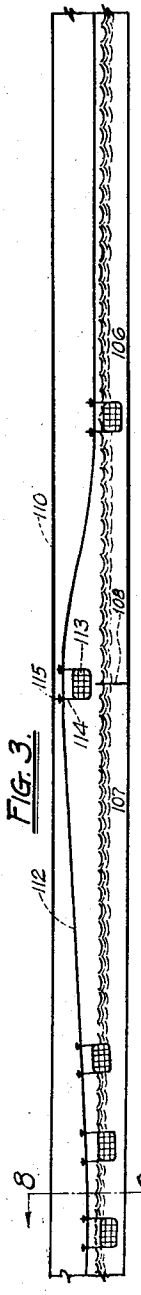


FIG. 3.

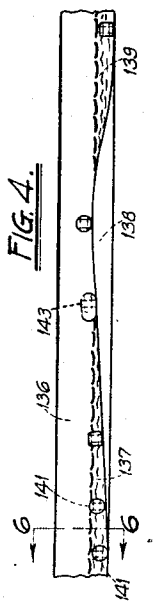


FIG. 4.

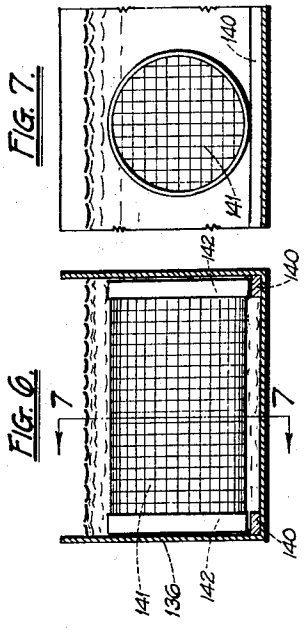


FIG. 7.

FIG. 6.

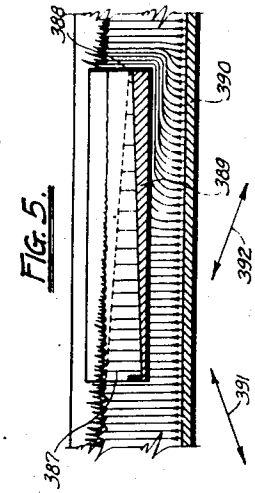


FIG. 5.

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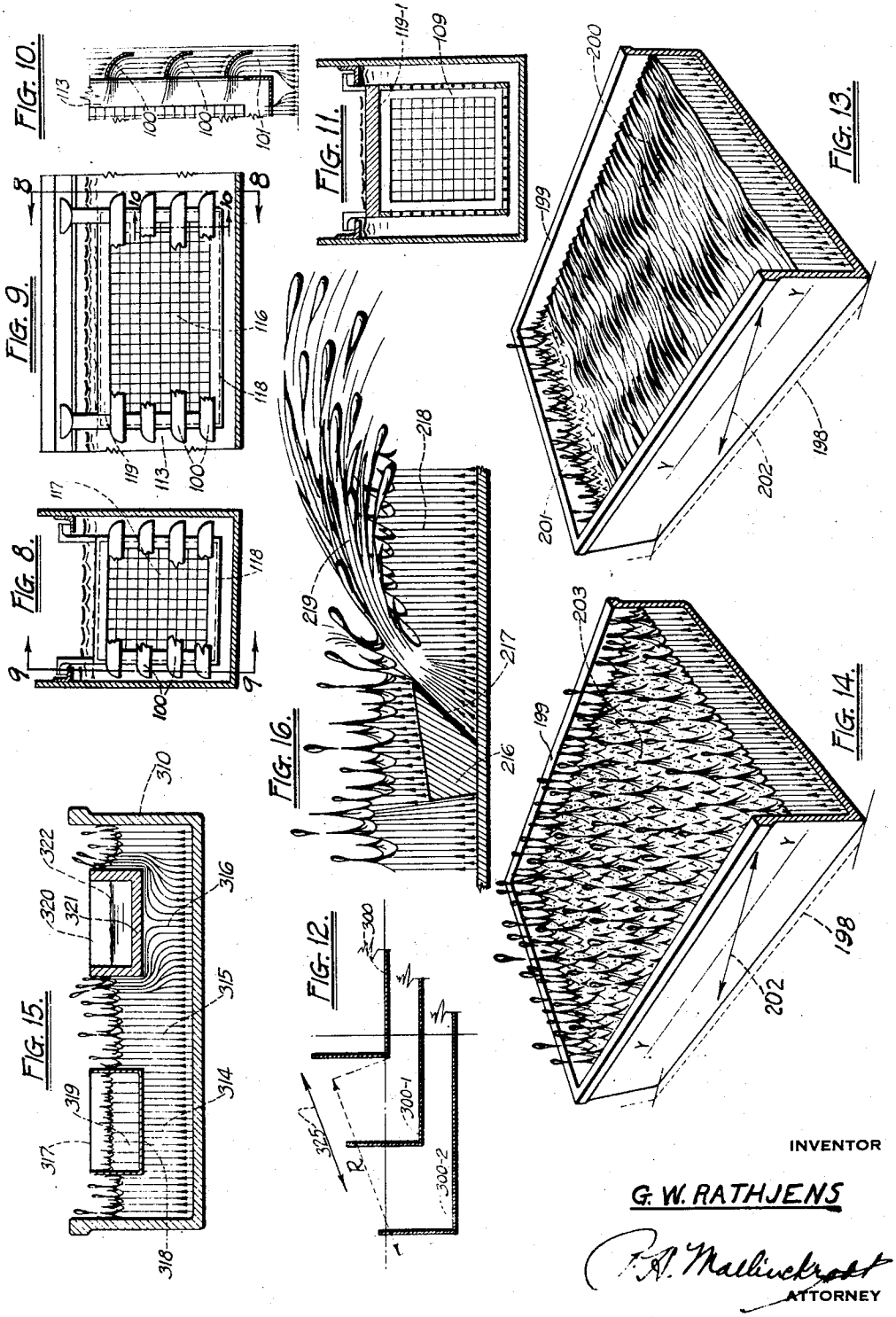
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CLEANSING APPARATUS

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CLEANSING APPARATUS

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Original application May 6, 1935, Serial No. 20,043. Divided and this application September 28, 1937, Serial No. 166,191

9 Claims. (Cl. 68—10)

This invention relates to a cleansing apparatus, and constitutes a division of the disclosure embodied in my U. S. Patent No. 2,097,422.

The principal objects of the invention are to provide:

First. Apparatus for effectively and quickly cleansing articles dispersed in a peculiarly motivated cleansing liquid.

Second. Apparatus in which the cleansing effect of the motivated liquid is varied in intensity.

Third. Apparatus for accomplishing cleansing actions upon articles dispersed in a liquid, the liquid being confined in a container, and the container being reciprocated principally along an inclined line at least so rapidly that the cleansing liquid descends through a down-stroke faster than would be its fall through the same down-stroke because of the action of gravity alone.

Fourth. Apparatus for cleansing articles having interstices extending therethrough, principally by causing extremely active circulation of at least a portion of the cleansing liquid through the interstices of the articles.

Fifth. Apparatus having multiple compartments for performing successive cleansing operations, with means for automatically transferring the articles from compartment to compartment.

Sixth. Apparatus in which the cleansing operation in a liquid and subsequent de-watering, are performed successively without removing the articles being cleansed.

Seventh. Apparatus whose operation effects conservation of the cleansing liquid to a maximum extent, because of a tendency to continually clarify the cleansing liquid.

The characteristic features of the invention are, that a cleansing liquid is confined in a container which is closed on all sides and the bottom, but open at the top, the liquid being caused to exert a peculiarly effective washing action upon articles disposed in the liquid. This action is obtained by reciprocating the container along a line having both a vertical and a horizontal component, the rate of reciprocation being at least so rapid, that the liquid descends through a down-stroke faster than would be its descent through the same down-stroke due to the action of gravity alone, wherefore the liquid descends through the down-stroke faster than does at least a part of the material dispersed in the liquid.

In the drawings,

Fig. 1 represents a plan in diagrammatic form, of a container suitably mounted and powered for the practice of this process;

Fig. 2, a diagrammatic elevation thereof;

Fig. 3, a fragmentary, diagrammatic side elevation of a trough or container whose near side wall, for convenience, is omitted, the said container confining a liquid, and being provided with receptacles, such as baskets, which are motivated along bearing rails, while the articles within the receptacles are subjected to a suitable vibratory motion, which motion at the same time provides the motive power for moving the receptacles along the bearing members.

Fig. 4, a fragmentary portion of the side elevation of a container, near side wall being omitted, which shows another arrangement for motivating the receptacles.

Fig. 5, a fragmentary, vertical section, in diagram, of a device for developing certain force effects;

Fig. 6, a cross-section taken on the line 6—6 in Fig. 4, drawn to an enlarged scale;

Fig. 7, a cross-section taken on the line 7—7 in Fig. 6;

Fig. 8, a cross-section taken on the line 8—8 in Fig. 3; drawn to an enlarged scale;

Fig. 9, a longitudinal, vertical section, taken on the line 9—9 in Fig. 8;

Fig. 10, a vertical section taken on the line 10—10 in Fig. 9, drawn to an enlarged scale;

Fig. 11, a cross-section similar to that shown in Fig. 8, but embodying certain modifications;

Fig. 12, a diagram indicating a fragmentary portion of a container in three different positions in one cycle of its reciprocative, vibratory motion.

Fig. 13, a fragmentary portion, in perspective, of a container confining a liquid medium, and illustrating approximately the effect upon the medium when lines of force V_f, of relatively low intensity, are developed therein;

Fig. 14, a view similar to that in Fig. 13, but illustrating the effect of increasing the intensity of V_f to the point where the container is reciprocated so rapidly that the liquid descends through a down-stroke faster than would be its descent through the same down-stroke due to the action of gravity alone, whereby a prolific spouting is produced within and upon the liquid medium;

Fig. 15, a vertical cross-section taken through a main container, in which two smaller containers are afloat on the liquid medium confined in the main container, to illustrate the transformation of certain force effects; and,

Fig. 16, a fragmentary vertical section taken through a container having a liquid medium confined therein, and showing the transverse spouting accomplished by certain deflecting elements.

This invention depends for its operation upon the development in the liquid medium of a force, which for convenience is termed V_f. Briefly, this force comes into action when a liquid is confined in a container which is closed on all sides and the bottom, but having its upper surface free from confinement, this container, with the liquid medium, being reciprocated along a line having both a vertical and a horizontal component, at least so rapidly, that the liquid medium descends through a down-stroke faster than would be its descent through the same down-stroke due to the action of gravity alone.

The development of the force V_f and its behavior, are more fully disclosed and discussed in the aforesaid U. S. Patent No. 2,097,422.

Referring to the drawings, Figs. 1 and 2, the numeral **50** indicates a container arranged for the practice of the process. Suitably disposed below the bottom of the container is a reciprocating means of any well known kind which may consist of a plurality of electromagnetic elements **51** provided with brackets **52**, the latter being rigidly connected with the bottom of the container. The container may be mounted on vibrators **53**, or other suitable supports, so that the magnets, which in this example act in the direction of the double-pointed arrow **54**, when energized, cause the container to vibrate back and forth, and at the same time, up and down. The axes of the electromagnetic motivating elements **51**, in their horizontal projections, may ordinarily lie in a longitudinally vertical plane of the container, but frequently it is desirable to introduce various transverse components into the motion of the container in order to bring about certain compound lines of travel of articles in the liquid medium. In order to accomplish the latter, the axes of one or more of the motivating elements may be placed in such relation to the longitudinal axis of the container, that the axes of the motivating elements form suitable angles therewith, in their horizontal projections, as indicated for example, at **51**—1 in Fig. 1.

By varying the line of application of the motivating power, various articles placed in the liquid medium are made to follow various characteristic spiral or other irregular paths occupying a space of three dimensions. This feature renders it possible to expose articles to a prolonged cleansing action. The area of the bottom **70** of the container in Fig. 2, which lies between the point where the bottom is intersected by the surface **57** of the liquid, and the mouth **71** of the container, may serve as a de-watering area.

The interior arrangement of the apparatus shown in Figs. 1 and 2, does not relate particularly to the subject of this invention so that the reference numerals **34, 36, 55, 56, 58, 59, 60, 61, 62, 63, 64, 65, 67, 68, 69** and **72** are not of interest in the present discussion, these two figures being here included more particularly to show the nature in general of a container and its motive mechanism. For the purpose of the present invention, the interior arrangement of the container shown in Figs. 1 and 2, may be patterned after the order shown in Figs. 3 and 4, reference to which will be had more particularly hereinafter.

In general, the cleansing of clothes makes it desirable that the initial operation should take place in one compartment of a container, and the clothes be transported through successive compartments where other operations are performed, such as extracting moisture, by means of the same vibratory force which causes the cleansing action to be developed in the liquid. The extraction of moisture is due to the rapidity with which the clothes follow a serrated path through the air, thereby shaking out the moisture. Afterwards, the clothes may be transported into another compartment containing clear water for rinsing, and then into still another compartment where moisture is extracted from the clothes before being discharged. In these operations, the apparatus may be adjusted to accomplish the particular object in view.

The nature of the vibratory force developed in the liquid, can be so regulated that the loosened particles of dirt, as well as soap or other compounds incidental to washing operations, may be segregated in or on certain portions of the medium, and are ready to be drained off while the liquid itself is thereby clarified.

The process and apparatus may also be used in washing dishes, in which case, detached food and grease particles can likewise be segregated within the medium, and then be skimmed off in one mass, for incineration, or be transported through the medium and be de-watered. By eliminating food and grease particles from dish water, the clogging and stoppage of drains may be largely averted.

A container **110** in Fig. 3, in which various operations may be carried on, has a track **112** suitably disposed along the inner surface of its side walls. To travel on this track, baskets **113**, or other receptacles, may be provided with hangers **114** having shoes **115** at their upper ends, the latter being adapted to ride along the rails **112**, as indicated in detail in Figs. 8 and 9. The baskets may have perforated or screen side walls **116**, and end walls **117**, and in many cases, may also have a screen bottom **118** and screen top **119**. In other cases, baskets **109** may be provided with a top consisting of a heavy plate **119**—1, Fig. 11, made of glass, metal or other suitable material, which is effective to suppress the effect of the force V_f, which normally acts upward. If desired, deflectors **100** may be provided to direct the force V_f inwardly of the baskets **113**, as indicated in Fig. 10.

In Fig. 4 is shown the fragmentary portion of a container **136** which confines a liquid **137**. In the bottom of the container may be disposed a ramp member **138**, which separates the liquid into individual portions, one of which is indicated at **139**. Extending longitudinally along the container **136** may be disposed a pair of rails **140**, Fig. 6, and adapted to ride on these rails may be a cage or cylinder **141**, having screen walls, and provided with tires **142** which may travel along the rails due to the vibrations imparted to the container. These vibrations at the same time, cause the development of V_f, which is effective to agitate the liquid **137**, portions of which latter pervade the inside of the cylinder **141** through the screen, and percolate through any articles which may be contained in the cylinder. It is understood that the cylinder has a door (not shown) or other device, by means of which the inside thereof may be reached.

In Figs. 3 and 9, the receptacles **113** immersed in liquids **106** or **107**, are suspended from shoes **115** by means of hangers **114**. The shoes are

pinched along the rails 112, because of the transportative component of the motive force, thereby propelling the receptacles 113 through the liquids 106 and 107 in the container.

In the instance of the cylindrical receptacles 141, Figs. 4 and 7, the transportative component of the motive force causes the receptacles to roll along the bottom of the container in a succession of short steps which subtend correspondingly small angles between successive radii originating at the rotative axes of the receptacles 141.

The general movement of a container is indicated in Fig. 12, the two extreme positions and one intermediate position being represented. The container passes through the reciprocative strokes very rapidly, for example, where an alternating electric current having a frequency of 60 cycles, is employed to energize the electromagnet, there are 120 reciprocations of the container and the liquid in one second.

In Figs. 13, 14 and 16 are illustrated some of the motion effects which take place during the actual operation of this process. It is assumed that the container 199, Figs. 13 and 14 is vibrated along a line represented by the double-pointed arrow 202. The dotted line 198 indicates the lowermost position reached by the container. When the motive power input is small, the surface or normal mirror plane of the medium is caused to assume a wavy or rippled pattern, somewhat as indicated at 200 in Fig. 13. At a point near an end wall of the container, there is a concentration of the force V_f sufficient to overcome the surface tension of the liquid medium, and a slight spouting takes place at 201. As the power input is increased, the lines of force V_f break through the tensioned surface of the medium, resulting in innumerable jets of liquid being projected upwardly from the surface to produce a prolific spouting thereof, indicated at 203, Fig. 14, over substantially the entire surface. The intensity of the spouting can be made to assume any degree of vigor, and even violence, desired. The spouting, if not interfered with by obstructing elements or modifying means, asserts itself along substantially vertical lines. In Fig. 16, is represented a side spouting resulting from the action of the lines of force V_f when locally modified by the inclined undercut face 217 of a riffle 216, which results in a spray such as 219. The normal spouting outside the field of influence of the undercut riffle, is naturally straight up, as indicated at 218. Where the spray 219 crosses the upwardly directed spouting 218, there is an especially efficient scrambling, mixing or washing action which can be localized within the liquid, as required.

Other ways in which the force V_f can be manipulated to produce localized effects, are noted in Fig. 15, where a main container 310 confining a medium 315, is shown in conjunction with two smaller containers 317 and 320, the latter being afloat on the medium 315. Confined in these respective smaller containers, are mediums 319 and 322. The container 317 has a relatively thin bottom 318, and may be made of elastic or flexible material such as rubber or sheet metal, while the container 320 has a relatively thick bottom 321 made of non-flexible or non-elastic material, such as glass or the like. The normal lines of force V_f developed in the liquid of the main container are indicated at 315. The lines of force 319 developed simultaneously in the smaller container 317, are somewhat less in their intensity than are the lines at 314, which latter produce the former. On the other hand, where the bottom of a smaller container is inelastic, as exemplified at 321, the lines of force 316 are bent aside, and the force effect within the container 320, is practically nil.

In Fig. 5, a tapered modifying member 389 located between the bottom surface of the liquid medium and its normal mirror plane has the force effect uniformly diminished from the thin end 387 to the thick end at 388. The container 390 in which the tapered member is located, may be reciprocated along an inclined arrow 391 or along an oppositely inclined arrow 392. The lines of force between points 387 and 388 in either case, are the same.

In the process, localized violent agitation of the liquid acts directly on the clothes without causing any injury to the finest fabrics, because the clothes do not come into injurious contact with any wood, metal or other material surfaces.

The exact speed of the reciprocations resulting in the development of the force V_f, is not fixed for all purposes, but varies with different mediums and with different articles passing through the medium. The ratio between the rate at which any medium is falling, and $\frac{1}{2}gt^2$, must be at least greater than unity in order that the force V_f may be of practical value. The greater the speed of the medium through a down-stroke with respect to $\frac{1}{2}gt^2$, the greater will be the intensity of the force V_f thereby developed.

What I claim is:

1. Apparatus for cleansing materials having interstices extending therethrough, comprising a container adapted to substantially confine a cleansing liquid on all sides and the bottom and to leave a free top surface therefor: means for causing vigorous, substantially vertical spouting of the cleansing liquid, said means comprising a motor capable of reciprocating the said container along a line having both a vertical component and a horizontal component, in up-strokes and down-strokes at least so rapidly that the said cleansing liquid will descend through a down-stroke faster than would be its descent through the same down-stroke because of the action of gravity alone; and a freely perforate receptacle adapted to confine the material for cleansing, the said perforate receptacle being disposed to roll longitudinally along the said container so that every part of the perforate portion of the said receptacle shall admit the spouting jets of the cleansing liquid to the interior of the receptacle at least once during every revolution thereof, all by reason of the said reciprocation of the container.

2. Apparatus as recited in claim 1 wherein the stated container includes track rails disposed along the bottom of the container for the purpose of maintaining the perforate portion of the receptacle in spaced relation to the bottom of the container during the travel of the receptacle along the container.

3. Apparatus for cleansing articles having interstices extending therethrough, including in combination, a container having a compartment adapted to confine liquid and another compartment in which liquid is extracted from the said articles, the said compartments being in longitudinal alignment with each other, ramp members between the said compartments, a motor operative to impart reciprocative motion to the container in up-strokes and down-strokes along a line having both a vertical and a horizontal component, the said motion being at least so rapid

that the said cleansing liquid is caused to descend in a down-stroke faster than would be its descent in the same down-stroke because of gravity alone, a perforate receptacle adapted to confine articles to be cleansed, and track rails extending longitudinally along the said container, the said track rails being disposed to support the said receptacle in spaced relation to the bottom of each of the said compartments; the said reciprocative motion being effective to cause the said receptacle to travel along the said track rails.

4. Cleansing apparatus for articles having interstices extending therethrough, including in combination, a container for cleansing liquid in which the said articles are dispersed, means operative to reciprocate the container along an inclined line at least so rapidly that the cleansing liquid in the container descends through a down-stroke faster than would be its fall through the same down-stroke because of the action of gravity alone, whereby a force is generated which causes the cleansing liquid to be circulated through the interstices of the said articles, and a body, at least a portion of which is solid, disposed between the bottom of the said container and the articles dispersed in the cleansing liquid for the purpose of diminishing the intensity of circulation of at least a portion of the cleansing liquid through the interstices of the articles.

5. Cleansing apparatus as recited in claim 4, wherein the said body, at least a portion of which is solid, is at least partially composed of elastic material.

6. Cleansing apparatus as recited in claim 4, wherein the said body, at least a portion of which is solid, is at least partially composed of inelastic material.

7. Cleansing apparatus as recited in claim 4, wherein the said body, at least a portion of which is solid, is of non-uniform thickness.

8. Cleansing apparatus, including in combination, a container for confining cleansing liquid, a motor disposed to reciprocate the container in up-strokes and down-strokes along a line having both a horizontal and a vertical component at least so rapidly that the cleansing liquid descends in a down-stroke faster than would be its fall because of gravity alone during the same down-stroke, thereby causing upward spouting of the cleansing liquid, track rails extending longitudinally along the said container as integral parts thereof, and a perforate receptacle adapted to confine articles to be cleansed, the said receptacle being adapted to travel along the said track rails as a result of the reciprocation of the said container, the said track rails and the said receptacle further, having such mutual relationship that at least the perforate portion of the receptacle is spaced apart from the bottom of the container for the purpose of causing the spouting cleansing fluid to enter the said receptacle through the perforations thereof.

9. Cleansing apparatus as recited in claim 8, in which a rail track is located at a considerable elevation above the bottom of the container, and the perforate receptacle is suspended from the rail track by means of hangers.

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