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WASHING MACHINES HAVING MAGNETICALLY ACTUATED DIAPHRAGMS

Original Filed Aug. 22, 1944

2 Sheets-Sheet 1

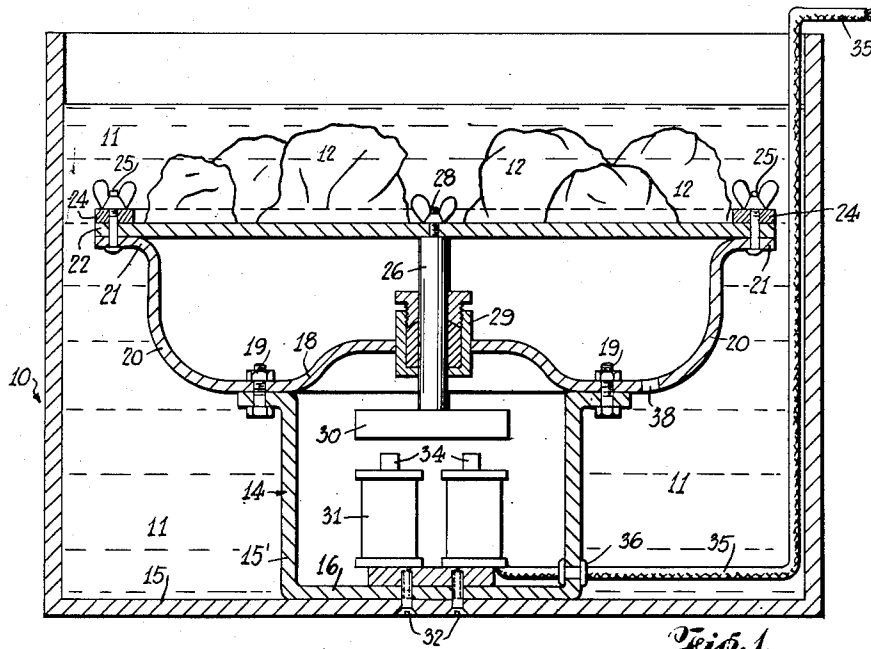


Fig. 1.

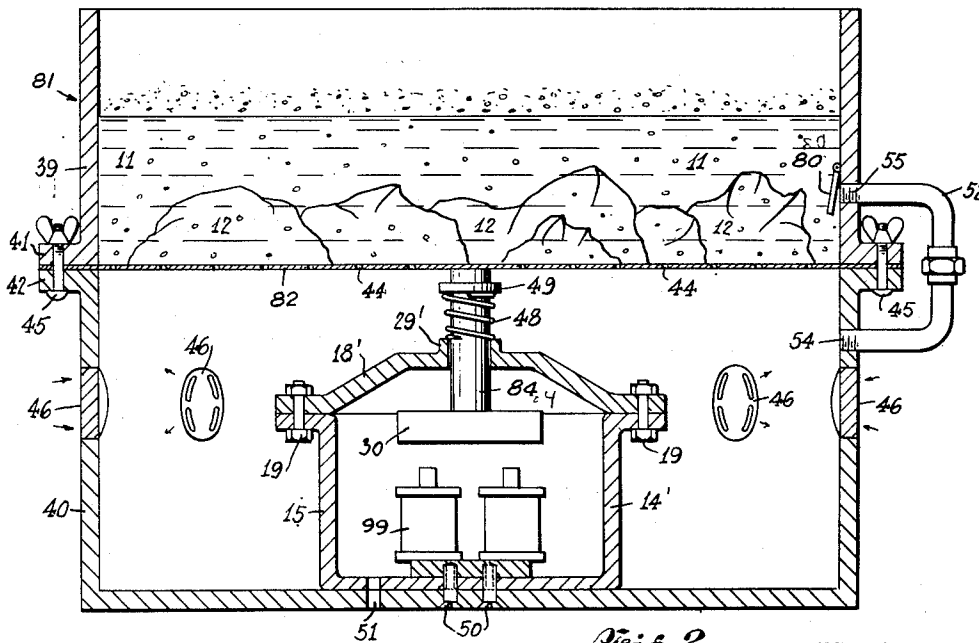


Fig. 2.

INVENTOR
ALFRED VANG.
BY *Peter M. Boesum*
ATTORNEY

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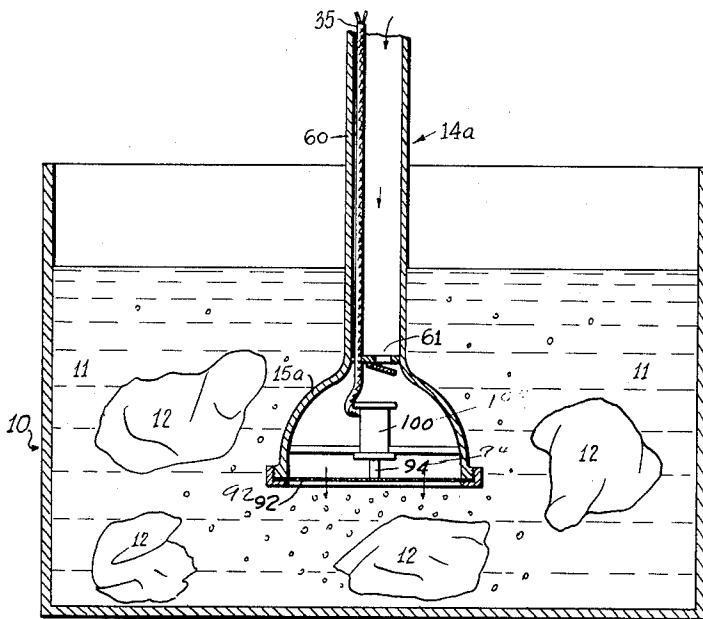


Fig. 3.

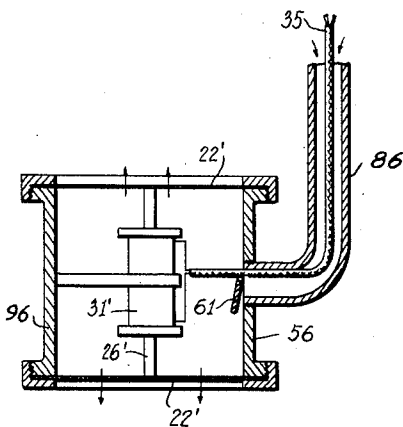


Fig. 4.

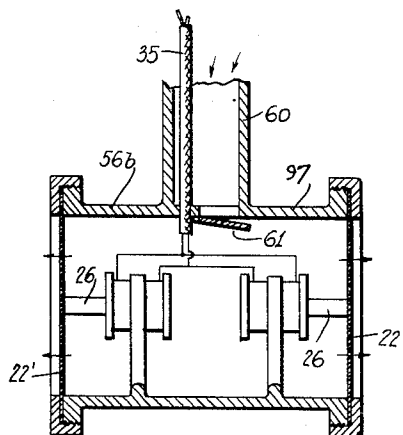


Fig. 5.

INVENTOR
ALFRED VANG.

BY *Peter M. Boesman*
ATTORNEY

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WASHING MACHINES HAVING MAGNETICALLY ACTUATED DIAPHRAGMS

Alfred Vang, Carmel, Calif., assignor of one-half to George Hart, Carmel, Calif.

Substituted for abandoned application Serial No. 550,521, August 22, 1944. This application August 6, 1953, Serial No. 372,633

5 Claims. (Cl. 68—53)

This is a substitute application for the abandoned application, Serial Number 550,521, filed August 22, 1944, which became abandoned prior to the filing of this application.

This invention relates to washing machines having magnetically actuated diaphragm, and to means and methods for enhancing the cleaning action of solvents and emulsifiers, and more particularly it pertains to apparatus and devices for subjecting articles to be cleansed and a cleansing liquid, to rapid agitation by a standing wave, though it may be noted that in some of the claims the invention is not limited to cleaning machines.

One object of the invention is to provide an improved device or apparatus of this kind which completely eliminates the use of rotating parts, thereby preventing delicate fabrics from being torn and which does not in any way subject the article to a gritting or tearing action.

Other objects of the invention are to provide an improved device of this kind which will simultaneously vibrate the liquid and articles, and force a number of fine streams of air through the liquid, so as to fluff the articles.

Additional objects of the invention are to effect simplicity and efficiency in such methods and apparatus, and to provide an extremely simple device or apparatus of this kind, which is economical, durable, and reliable in operation, and economical to manufacture and install.

Still other objects of the invention will appear as the description proceeds; and while herein details of the invention are described in the specification and some of the claims, the invention as described in the broader claims is not limited to these, and various changes may be made without departing from the scope of the invention as claimed in the broader claims.

The inventive features for the accomplishment of these and other objects are shown herein in connection with a device for imparting motion to a mixture of articles and liquid, which briefly stated, includes means for confining a liquid in intimate contact with articles to be cleaned, and means for imparting vibratory motion to the liquid. The device may be used wherever relative motion between solid articles and liquids is desired, such as the aforesaid cleaning, as well as dyeing operations, solution of solids in liquids, the washing of solids having dissolved material occluded or associated therewith, or the impregnating of solids with liquids.

In the accompanying drawing showing, by way of example, several of many possible embodiments of the invention, and wherein similar characters of reference indicate corresponding parts:

Figure 1 is a vertical sectional view, partly in elevation, showing a portable agitator and tub.

Figure 2 is a vertical sectional view, partly in elevation, showing the agitator mounted in a tub to produce a flow of air.

Figure 3 is a vertical sectional view, partly diagrammatic, showing another form of portable agitator.

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Figure 4 is a sectional view, partly diagrammatic, showing an agitator having two diaphragms; and

Figure 5 is a modification of the invention as shown in Figure 4.

The invention, as shown in Figure 1, comprises a laundry tub 10 adapted to contain a cleaning liquid 11, such as a soap solution or dry-cleaning fluid, and articles 12 to be cleaned, immersed therein. An agitator 14 disposed on the bottom 15 of said tub and immersed in the liquid for the agitation of the articles and liquid. The said agitator 14 comprises a cylindrical housing body 15', having a bottom 16 and covered by a cover piece 18 fastened water-tight on the upper end of said body as by bolts 19. The peripheral portions 20 of the cover piece 18 are extended upwardly and outwardly and terminate as an annular horizontal flange 21, upon which a diaphragm 22, either solid as shown in Figure 1 or perforated, as later shown, of rubber, metal, plastic, or other suitable material is disposed. A mounting ring 24 is disposed on the peripheral margin of the diaphragm and the flange; the diaphragm and ring are secured together as by bolts 25, provided with wing nuts for the facile removal of the diaphragm to permit removal of dirt thereunder.

A reciprocatory actuating rod 26, depending from the center of the diaphragm is secured to the latter by any suitable means, such as a stud bolt 28 and wing nut, and passes downwardly through a stuffing box 29, provided in the central portion of the cover piece 18. An armature 30 secured to the lower end of the rod 26 is actuated by an electromagnet 31 disposed within the housing 15' and mounted on the bottom 16 thereof, as by screws 32; said electromagnet having upwardly projecting poles 34 near and under said armature 30, whereby the magnet may attract or repel the armature, and thus cause the latter to vertically reciprocate the rod and cause the diaphragm to vibrate, so that the cleaning fluid may be caused to vibrate in a standing wave and subject the article to be cleaned to a continuous agitation. Current is applied to the magnet by a suitable waterproof cable 35, connected to the coils of the magnet and passing via a water-tight seal through the housing as at 36.

It is, of course, preferable that all surfaces coming in contact with the articles be smoothly finished, so that there is substantially no danger of articles becoming caught on projections when the articles are being agitated or removed from the tub. The peripheral extensions 20 may be circumferentially continuous, in which instance the articles to be cleaned will be prevented from coming in contact with the rod 26 and stuffing box 29, thus eliminating any danger of the articles being caught or damaged. A hole 38 may be provided, preferably at the lowest point of the cover piece 18, to equalize water pressure on both sides of the diaphragm and to prevent the accumulation of slime. Alternatively, the extensions 20 may take the form of several arms.

In another form of the invention, as shown in Figure 2, the tub 81 may be divided into upper and lower sections or compartments 39, 40; the upper section being provided with an outstanding flange 41 at its lower end, the lower section with a mating similar flange 42 at its upper end. A diaphragm 82 provided with fine perforations 44 is disposed intermediate of the two compartments, and the three are tightly fastened together by bolts 45, so that the diaphragm 82 serves as a "false" bottom for the tub.

The perforations 44 of the diaphragm are very small and serve to permit a passage of air through the diaphragm from the lower compartment 40, which may be air-tight and contain air under pressure. The perforations are so small that liquid in the upper compartment 39 will not appreciably permeate the diaphragm, es-

pecially against the air pressure from below. Fine meshed molybdenum wire gauze, which may also be used as diaphragm material, will not allow an appreciable passage of water even under relatively high pressure. The side walls of the lower compartment may be provided with air inlet valves 46, such as of the Borsig type or any other suitable valve for controlling a unidirectional flow of air from the exterior of the tub to the lower compartment 40. A Bersig valve is illustrated and described in Marks-Mechanical Engineers' Handbook, first edition, McGraw-Hill Book Company Inc., New York, pages 1518 and 1519.

The vibrator 14' of Figure 2 is in general similar to that of Figure 1. The extensions 20 of Figure 1 of the housing cover may be omitted from the cover piece 18; and since the vibrator is normally not immersed in water, a stuffing box is not altogether necessary herein, but may be replaced by a rubber lined bearing 29' to exclude moisture from the interior of the housing. Of course, any suitable means may be provided to allow passage of rod 26 through the cover 18', such as those described in Figure 1. In the modification of the invention, according to Figure 2, the actuating rod 84 is preferably not fixed to the diaphragm 82, but is continuously urged against the latter by means of a compressed helical spring 48, disposed about the upwardly projecting end portion of the rod 26; one end of the spring being disposed against the outer end of the bearing 29' and the other against a collar 49 fastened on the upper end of the rod 84. The vibrator housing is preferably fixedly mounted on the tub bottom, as by screws 50, and a hole 51, may be provided in said bottom to drain any liquid from the housing to the exterior of the tub.

In operation, a suitable source of current, preferably alternating, is connected to the magnet 99, thereby causing the diaphragm to vibrate vertically. On an upward movement of the diaphragm 82, a partial vacuum is caused in the lower compartment 40, due to the high resistance of air flow through the perforations, thereby opening the valves 46 and allowing air to enter therein; on the downward movement of the diaphragm, the valves close and air is forced through the perforations 44 and enters the liquid 11 thereabove. Simultaneously, the liquid 11 is vibrating and being impacted and agitated against the articles 12. Since liquids are substantially incompressible and their inertia to rapid vibration is great, the energy of the vibrator is largely transmitted to all surfaces of the articles, and particles of dirt are removed mechanically in a manner somewhat similar to conventional rubbing.

The passage of air up through the diaphragm 82 greatly enhances the formation of foam on the liquid above the diaphragm, so that when dirt particles are dislodged from the articles they may be removed from the vicinity thereof by flotation. Should the perforations 44 become stopped or blocked, or should a solid diaphragm, such as 22 in Figure 1 be used, the air may be by-passed to the upper compartment 39, by means of a tube 52, establishing through ports 54, 55 communication between both compartments. The tube is provided with a check valve 80 to prevent loss of liquid from the upper compartment. Of course, the tube and ports may be omitted if desired.

The described washing machines, while particularly adapted to home use and operating on a 60 cycle alternating current, may also be used to considerable advantage by commercial cleaners and on high frequency current. A number of tubs may be charged with individual lots of material to be cleaned and placed on conveyor belts and successively passed under soap streams and then under rinsing streams, so that separate lots may be handled in a continuous operation with a minimum of labor. The embodiment, according to Figure 2, is also especially adapted to the fluffing and partial drying of clothing, as after the liquid has been

removed from the tub, the impacts of the diaphragm will cause the clothing to vibrate and the passage of air will aid in the drying.

In another form of the invention, as shown in Figure 3, the agitator 14a may be manually held and handled somewhat as a mop in an ordinary tub, so that the articles may be generally stirred about in the liquid to expose various surfaces to the vibratory agitation. However, cleaning action may also be accomplished by merely disposing the agitator within the liquid in any convenient manner.

In such a modification, a substantially water-tight cylindrical hollow housing 15a, preferably of light material, is open at one end over and on which a vibrating diaphragm or membrane 92, provided with perforations, is secured. A reciprocatory rod 84 suitably mounted, engages the inner face of said membrane and is adapted to be actuated by magnetic means 100, secured within the housing, whereby said membrane may be vibrated. A long hollow handle 60 is mounted on said housing; the hollow of the handle being in communication with the hollow of the housing 15a, to permit a passage of air through the handle into said housing and out through the membrane. Suitable valve means, such as a check valve 61 renders said passage substantially unidirectional. Lead wires 35 to the magnetic means pass through the hollow handle, so that the handle serves the triple function of supporting the housing, enclosing the leads, and forming an air duct. The upper end of the handle may be finished off in any suitable manner for convenience, which still permits air to enter the handle, so that air may be continually drawn into the housing both for producing an air spray through the diaphragm and for cooling the magnetic means 100.

Only one end of the housing may be covered by a diaphragm, so that the handle may be mounted on the opposite end, as shown in Figure 3, or each end may be provided with a membrane 92, as in Figures 4 and 5, and the handle mounted on the side walls 56 of the housing 96 in the housing Figure 4 and 97 in the housing 5. The handle may assume any suitable shape and may be curved as at 86 in Figure 4, or straight as in Figures 3 and 5. The actuating rod may engage opposite diaphragms, as shown by 94 in Figure 4, or two mechanically independent rods 26 may be used, as shown in Figure 5.

It is obvious that slight changes may be made in the form, construction, and arrangement of the several parts, as shown, within the scope of the appended claims, without departing from the spirit of my invention, and I do not therefore, wish to limit myself to the exact construction and arrangement shown and described herein.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. In combination, a tub divided into upper and lower sections, the upper section being provided with an outstanding flange at its lower end, the lower section with a mating flange at its upper end, a perforated horizontal diaphragm disposed fluid-tight intermediate of the two flanges and forming a "false" bottom for said tub, and side walls of the lower section being provided with one way air valves for permitting a unidirectional flow of air through the valves from the exterior to the interior of the lower section, a hollow housing body in the lower section and having a bottom secured to the true bottom of the tub and open at the upper end, a cover-piece water-tight on the upper end of the body and provided with an axially vertical bearing opening therethrough substantially under the center of the diaphragm, means to reciprocate said diaphragm comprising an actuating rod, said actuating rod passing through said bearing and adapted to be vertically reciprocated therein, a collar on the outer end portion of said rod, a compressed spring having one end engaging said cover piece for urging the

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outer end of the rod against the lower face of the diaphragm, and means within the housing for reciprocating the rod and diaphragm.

2. In combination, a laundry tub having an upstanding wall portion provided with a horizontal annular flange, a substantially cylindrical housing body on the bottom of said tub; said body being open at the top, a cover piece provided with an axially vertical bearing and mounted on said body and having an upstanding peripheral portion provided with a horizontal annular flange, an electromagnet having upwardly projecting poles in said body and mounted on the bottom thereof, an actuating rod passing substantially water-tight through said bearing and adapted to reciprocate vertically therein, an armature fast on the inner end of said rod and above said poles, a horizontal circular diaphragm of molybdenum wire gauze having a weave tight enough to prevent a passage of water therethrough within the tub and engaging the outer end of the rod substantially at the center of the diaphragm and having the peripheral marginal portion of the diaphragm mounted on the flange of one of said upstanding portions.

3. A washing machine comprising a tub divided into upper and lower sections, the upper section being provided with an outstanding flange at its lower end and the lower section with a mating flange at its upper end, a diaphragm disposed fluid-tight with respect to and intermediate of the two flanges and forming a false bottom for said tub, said diaphragm being provided with fine perforations small enough to prevent a passage of water therethrough and large enough to permit a passage of air, valve means in the side walls of the lower section of the tub enabling unidirectional flow of air from the exterior to the interior of the lower section, and means within the lower section for reciprocating the diaphragm.

4. A washing machine comprising a tub divided into upper and lower sections, the upper section being provided with an outstanding flange at its lower end, the lower section with a mating flange at its upper end, a

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diaphragm intermediate of the two flanges and forming a false bottom for said tub, bolts having wing nuts passing through said diaphragm and flanges, a vertically reciprocatory rod in the lower section engaging the lower face of the diaphragm and separable therefrom, and means for reciprocating the rod, whereby upon removal of the bolts, the upper section and the false bottom may be lifted from the lower section and rod, and the upper section dumped of its contents.

5. A washing machine comprising in combination a tub divided into upper and lower sections, the upper section being provided with an outstanding flange at its lower end, the lower section with a mating flange at its upper end, a diaphragm disposed fluid-tight with respect to and intermediate of the two flanges and forming a false bottom for said tub, said diaphragm being provided with fine perforations small enough to prevent a passage of water therethrough and large enough to permit a passage of air, the side walls of the lower section of the tub being provided with air check valves for a unidirectional flow of air from the exterior to the interior of the lower section, and reciprocatory means within the lower section for reciprocating the diaphragm.

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