

Dec. 1, 1942.

G. KUHN

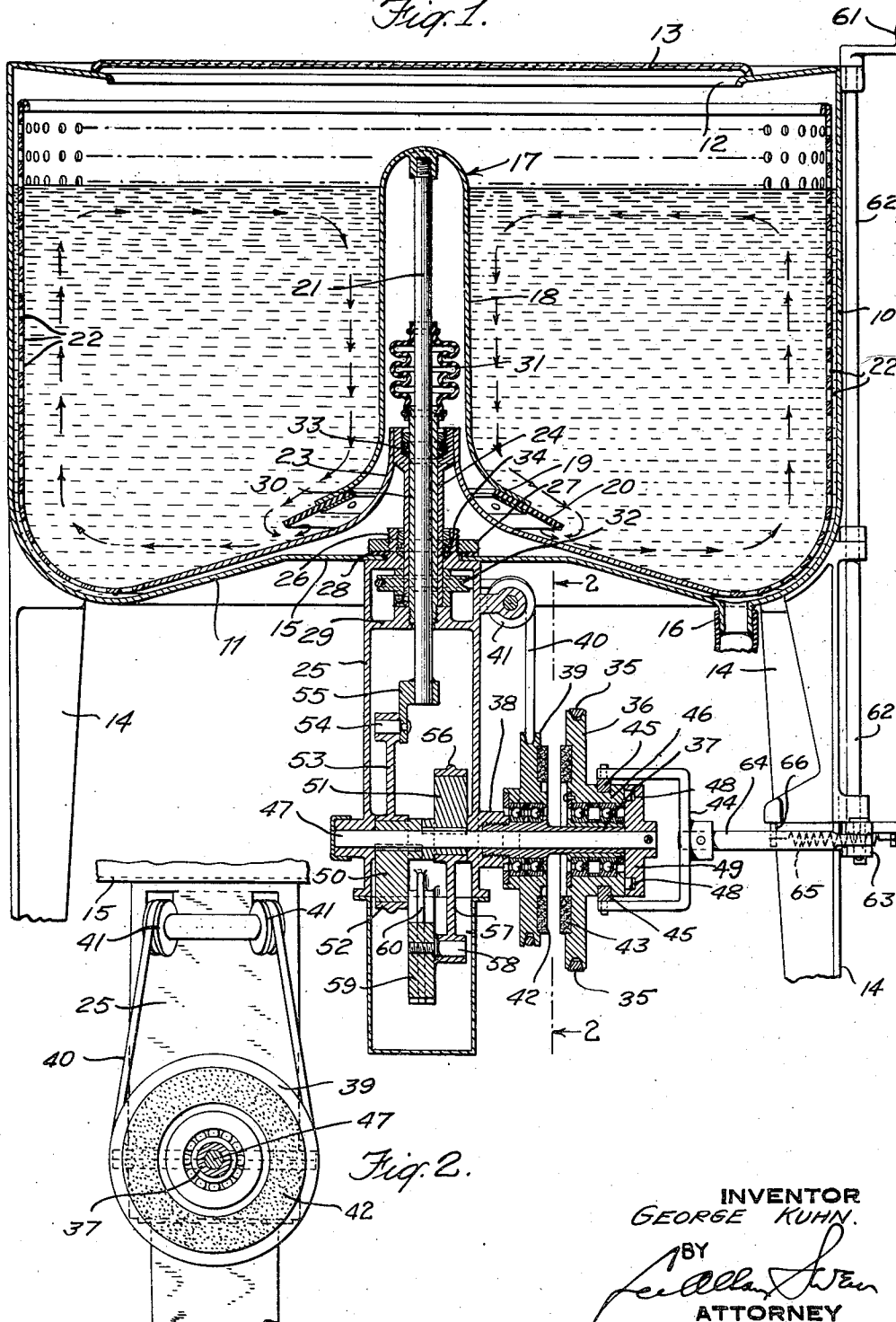
2,303,940

FLUID TREATING APPARATUS

Filed March 28, 1938

4 Sheets-Sheet 1

Fig. 1.



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Fig. 3.

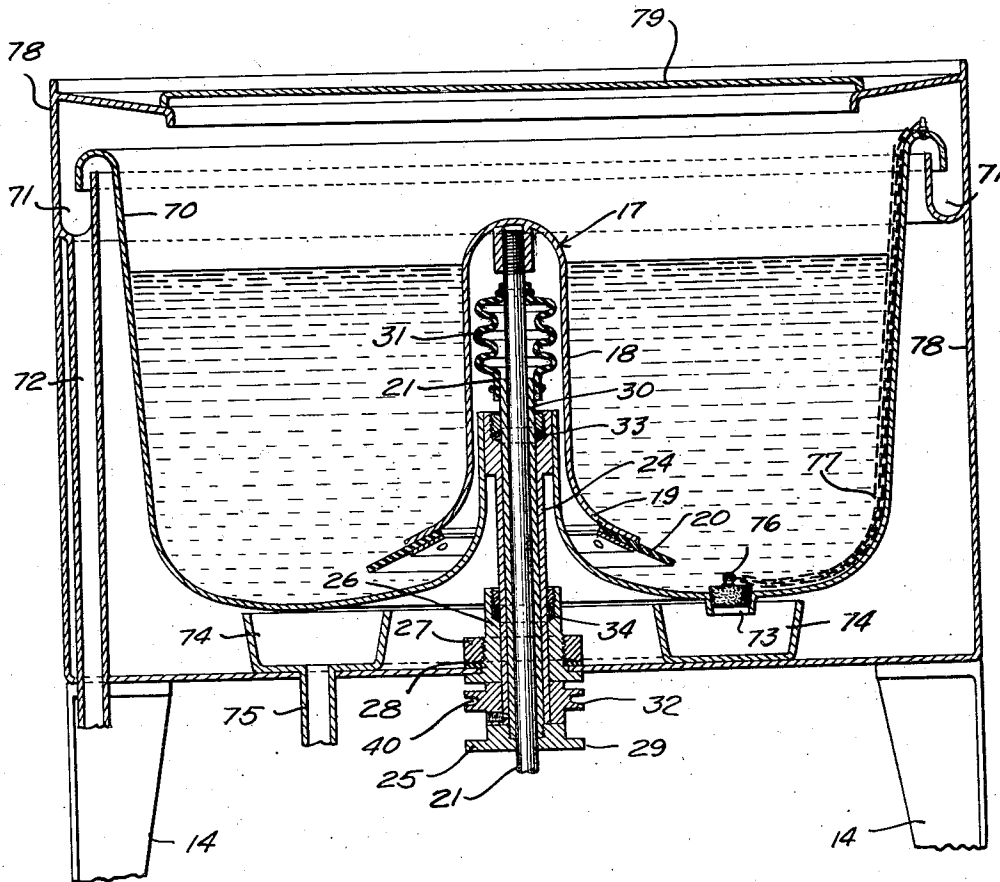
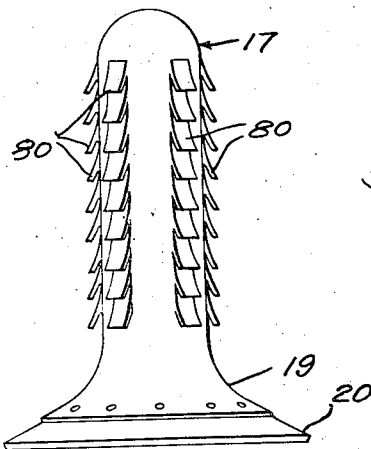


Fig. 4.



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FLUID TREATING APPARATUS

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Fig. 5.

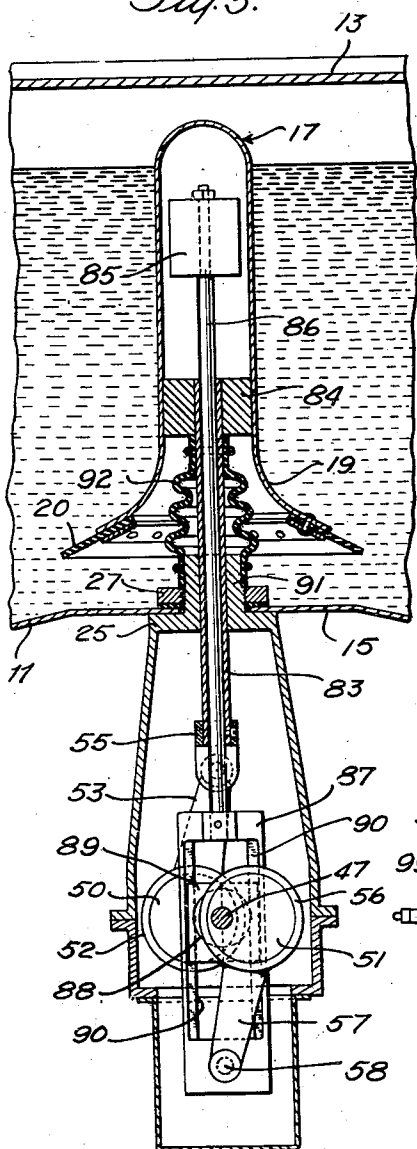
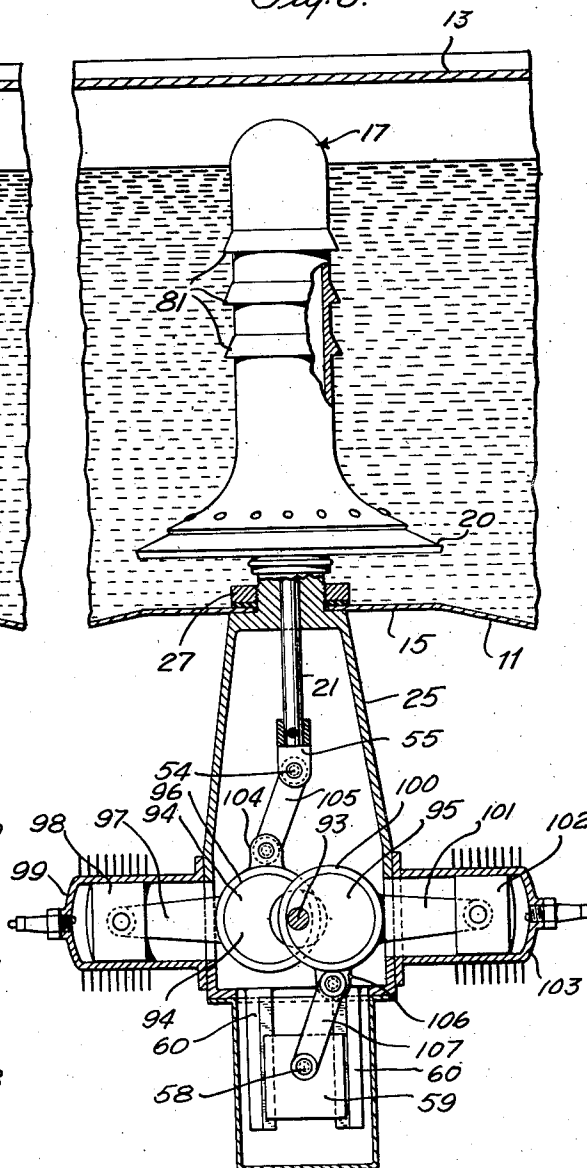


Fig. 6.



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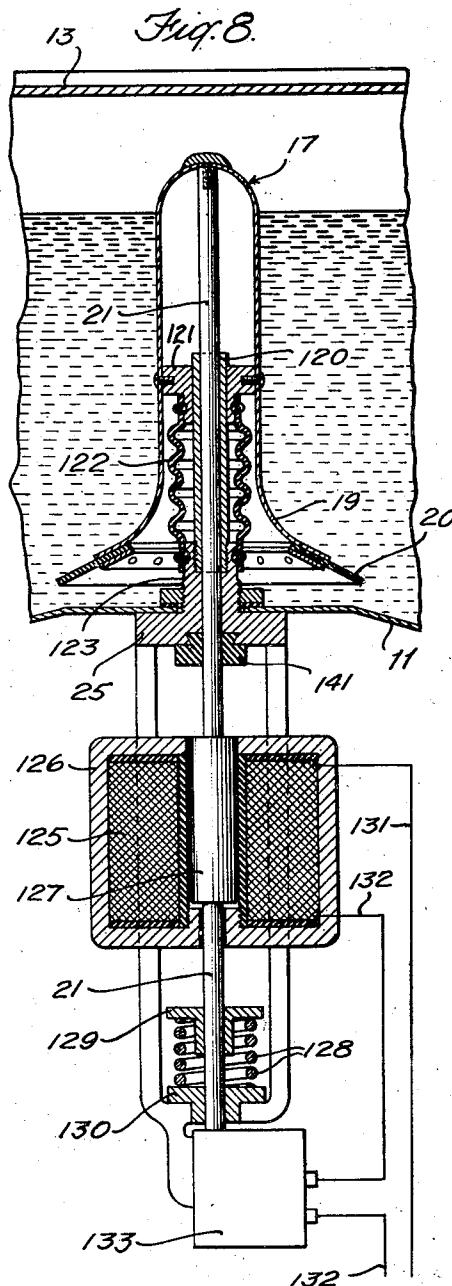
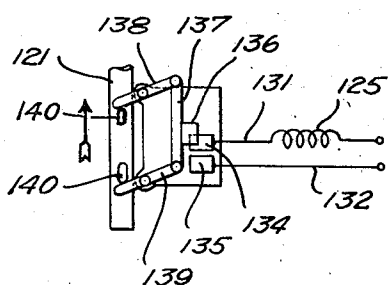
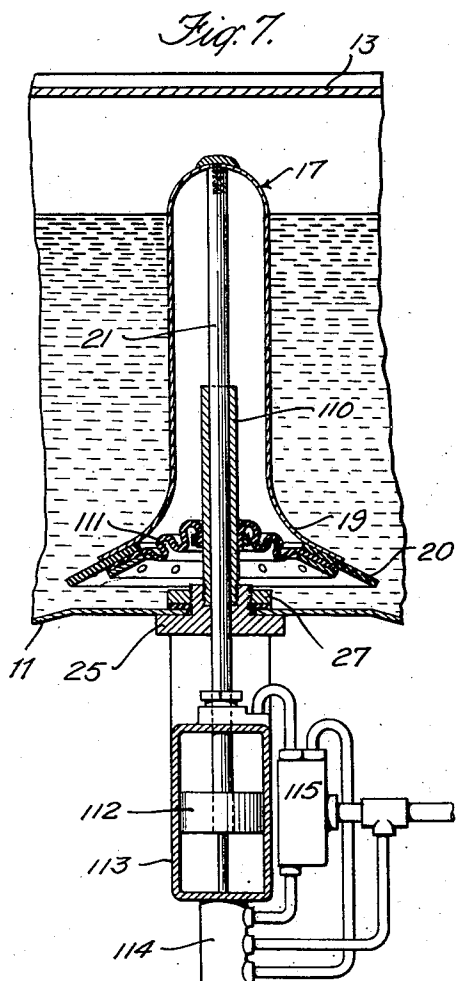
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FLUID TREATING APPARATUS

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4 Sheets-Sheet 4



UNITED STATES PATENT OFFICE

2,303,940

FLUID TREATING APPARATUS

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Application March 28, 1938, Serial No. 198,346

17 Claims. (Cl. 68—184)

This invention relates to the washing and cleaning of fabrics and articles and more particularly pertains to power driven washing and cleaning machines.

The invention provides a washing and cleaning machine which performs all essential operations to effect a rapid and thorough cleaning or washing of the articles, including circulation of the articles in the washing fluid, scrubbing and shaking of the articles, agitating and flexing of the fabric of the articles and rapidly pulsating the fluid through the fabric.

The features and advantages of the invention will be understood from the following description when considered in connection with the accompanying drawings, forming a part thereof, and in which:

Fig. 1 is a vertical sectional view of a washing machine embodying the invention;

Fig. 2 is a vertical sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a vertical sectional view showing another form of machine embodying the invention;

Fig. 4 is an elevational view of another form of pulsator;

Fig. 5 is a partial vertical sectional view similar to Fig. 1 showing another form of pulsator and balancing arrangement;

Fig. 6 is a view similar to Fig. 5 illustrating a further form of pulsator and an internal combustion engine drive therefor;

Fig. 7 is a view similar to Fig. 5 but showing a fluid motor drive;

Fig. 8 is also a view similar to Fig. 5 but illustrating a solenoid drive for the pulsator, and

Fig. 9 is a diagrammatic view of an automatic switch mechanism for the solenoid drive illustrated in Fig. 8.

Like characters of reference refer to the same or to similar parts throughout the several views.

The forms of the invention illustrated in Figs. 1 and 3 include spinners, but these may be omitted if desired, in which event the pulsator of any of the forms shown in Figs. 1 and 3 to 8 will be the only mechanism within the tub of the machine.

Referring to Figs. 1 and 2 of the drawings, reference character 10 designates the tub of the washing machine which is preferably cylindrical in form with a closed bottom 11 and an opening 12 at the top which is closed by a cover 13. The tub is supported on a suitable pedestal indicated 14. The bottom of the tub has a raised portion 15 and a drain 16 connects with the lowermost part of the bottom 11.

The fluid circulating or propelling means or pulsator designated generally 17, is axially disposed in the tub 10 and comprises a rigid substantially bell-shaped body portion 18 having a closed upper end and an open outwardly and downwardly flaring lower end or skirt or fluid propelling projection 19, to which is secured at its outer peripheral portion, a flexible annular fin 20, preferably of rubber, but other suitable flexible materials may be used. The pulsator 17 is secured by threaded means on the upper end of a reciprocable shaft 21 and is so proportioned that the upper end of the body portion 18 is always above the fluid level in the tub, and with the wall thereof disposed substantially parallel to the axis of reciprocation of the pulsator, splashing due to movement of the pulsator will not occur. The pulsator 17 is further proportioned so that the skirt 19 and fin 20 will be disposed and will operate in the lower portion of the tub 10 and close to the bottom thereof.

The spinner basket 22 is perforate and is of the same shape as the tub 10 but is somewhat smaller. The central bottom portion 23 of basket 22 is raised and the upper end thereof is secured to the upper end of a rotatable sleeve 24. In the form of the invention shown, the raised bottom portion 23 extends into the lower portion of the pulsator 17.

The mechanism for translating the rotary driving motion into reciprocating motion, the counterweight and its operating device, as well as the pulley for driving the spinner, are enclosed in a housing 25 having a threaded neck 26 on its upper end which extends through a central opening in the bottom 11 of the tub 10. A nut 27 threaded on the neck 26 secures the housing to the bottom of the tub and a gasket 28 prevents leakage from the tub at this point. The housing 25 has a wall 29 in its upper portion into which is threaded a sleeve 30 which extends upwardly into the tub 10 to a point just above the upper end of the raised bottom portion 23 of the spinner basket 22. A bellows 31 has its lower end sealed to the upper end of the stationary sleeve 30 and has its upper end fixed to shaft 21 in fluid tight relationship. Rotatable sleeve 24 to which the spinner basket 22 is fixed, has a smooth running fit with the sleeve 30 and its lower end bears on a boss on wall 29 in the housing 25. A pulley 32 fixed to the lower end of the sleeve 24 drives the sleeve and the spinner basket. Packing 33 prevents leakage between the stationary sleeve 30 and the rotatable sleeve 24, and packing 34 prevents leak-

age between rotatable sleeve 24 and the housing 25.

In the form shown in Fig. 1, the pulsator and spinner basket are driven by an electric motor (not shown) through mechanism which is mechanically balanced and the parts of which move with complete symmetry of motion during all phases of the operating cycle. A belt 35 driven by the aforesaid electric motor, drives the freely running drive pulley 36 which has an anti-friction bearing on a steel sleeve 37 which is threaded into a boss 38 on housing 25. Spinner drive pulley 39 has an antifriction bearing on sleeve 37 and runs freely thereon and drives a belt 40 which runs over a pair of idler pulleys 41 on housing 25 and drives the pulley 32 fixed to the spinner sleeve 24. Belt 40 passes through suitable openings provided in the housing 25 for the purpose. Pulleys 36 and 39 are provided with cooperating friction faces 42 and 43 respectively which, when in engagement, cause the pulley 36 to drive the spinner pulley 39 and to rotate the spinner basket 22. Drive pulley 36 is moved axially on sleeve 37 by a fork 44 having opposed pins 45 which run in a groove in the hub 46 of the pulley 36.

Pulsator drive shaft 47 is driven by pulley 36 through pins 48 which are received in corresponding recesses in a disc 49 which is fixed to an end of the shaft 47. Shaft 47 extends through sleeve 46 and has bearings in the walls of the housing 25. Eccentrics 50 and 51 are keyed to shaft 47 within housing 25 in such manner that their maximum points of eccentricity are diametrically opposed. Eccentric 50 has a strap 52 which carries a connecting rod 53 extending upwardly from strap 53 and shaft 47 and which is connected at its upper end through a wrist pin 54 to an extension 55 fixed to the lower end of pulsator shaft 21. Eccentric 51 has a strap 56 which carries a connecting rod 57 extending downwardly from the strap and the shaft 47 and which is connected at its lower end through a wrist pin 58 to a counter-weight 59 which moves between spaced guides 60 in housing 25, similar to the arrangement shown in Fig. 6. The weight of the counter-weight 59 will be equal to the weight of the pulsator 17, shaft 21 and the parts which reciprocate therewith.

Fork 44 which moves drive pulley 36 axially on shaft 47 may be operated from the top of the machine. In the form shown, a handcrank 61 at the top of the tub 10 operates a vertically disposed rod 62 at the side of the tub, the lower end of which operates a link 63 which is pivotally connected at one end to rod 64 disposed in axial alignment with shaft 47, and with its other end fixed to the fork 44. A coil biasing spring 65 extending between a pin 66 on the frame of the machine and a properly located arm on link 63, retains the friction faces of the pulleys 36 and 39 in engagement after they have been brought together. It will be perceived that the arrangement of the pulleys and the parts associated therewith constitute clutch means by which independent operation of the pulsator and the spinner may be achieved.

The pulsator 17 is rapidly reciprocated with relatively short strokes at a rate of speed which is materially faster than the articles being treated can follow the movement of the pulsator. Good results are obtained with a speed of the pulsator drive shaft 47 of 500 R. P. M. with strokes of the pulsator of $1\frac{1}{2}$ " to $1\frac{3}{4}$ ", but satisfactory results will be obtained at speeds be-

tween 400 and 650 R. P. M. with the same stroke. The stroke of the pulsator may be varied between 1 inch and $1\frac{3}{4}$ inches with satisfactory results.

During operation of the machine, drive pulley 36 will be connected to the pulsator drive shaft 47 with the parts in the position shown in Fig. 1. The spinner basket 22 will be stationary. With rapid reciprocation of the pulsator, the fluid is subjected to a series of unidirectional, intermittent jerks or pushes which result in the fluid and the clothes or other articles being treated being continually moved in the tub about the pulsator in a series of unidirectional circulatory paths lying substantially in planes disposed radially with respect to the axis of rectilinear reciprocation of the pulsator, as indicated by the dash lines in Fig. 1. With the shape of the pulsator skirt disclosed in Fig 1 and in the other figures of the drawings, greater resistance to movement in the fluid in the tub is encountered on the downward stroke than on the upward stroke. On the upstroke of the pulsator, fluid is drawn under the skirt 19 and on the downstroke, fluid is expelled from under the skirt and radially outwardly thereof along the bottom or lower portion of the tub. In consequence of this movement of the fluid, as the articles being washed move downwardly about the pulsator and reach the edge of the flexible fin 20, a portion of each cloth piece or article is drawn by suction under the fin on the upstroke of the pulsator, and is forcibly ejected from under the skirt and is scrubbed by the fin on the downstroke of the pulsator. On the next succeeding upstroke, a new portion of each piece is sucked under the skirt and is thereafter forcibly ejected and scrubbed on the following downstroke of the pulsator, with this sequence of steps being repeated until the whole length of each piece or article has passed through the scrubbing zone and is finally released to be carried by the circulatory motion of the fluid radially outwardly of the pulsator to the outer portion of the tub whence it moves upwardly along the wall of the tub, or the spinner basket, to the upper portion of the fluid, after which it is carried radially inwardly toward the pulsator, and then downwardly along the cylindrical portion of the pulsator until its leading portion again reaches the skirt and fin and the scrubbing zone and passes again through the sequence of steps and movements described. Since it is a well known fact that liquids are incompressible, a much smoother action is produced if free communication is permitted between the fluid in the tub and the air trapped inside the hollow interior of the pulsator, as shown in Figs. 1 and 3, the air serving as a shock absorbing cushioning means. On the downstroke, the fluid enters the lower portion of the air chamber, compressing the air therein, and at the end of the downward stroke, the air compressed in the chamber expels the liquid from the interior of the pulsator, thereby extending the effective duration of the downward stroke of the pulsator and relieving the strains on the actuating mechanism which otherwise would be present due to the incompressibility and inertia of the liquid. These problems do not arise in any other fluid treating machines which operate at speeds below the minimum speed required for the effective operation of the present invention. Since the top of the pulsator is above the fluid level, it will function to separate the articles being treated, or to keep them separated, as they

reach the central portion of the tub in moving inwardly at the upper portion of the fluid. Due to the flexibility and downward inclination of the fin 20 on skirt 19, the fin will pump fluid toward the bottom of the tub in the upper portion of the downward stroke of the pulsator, while in the lower portion of the downward stroke, the fin flattens out due to the radially outward flow of the fluid from under the skirt, thus allowing free escape of the fluid from under the skirt. The use of the fin also makes it possible to bring the skirt almost into contact with the bottom of the tub at the end of the downward stroke without danger of injury to one who might put his hand under it, thereby providing a safety feature. The short, fast fluid jerks, pushes or squirts which originate at the edge of the skirt set up a series of rapid pulsations in the fluid which spread throughout the body of the fluid and result in the pulsing or forcing of the fluid through the fabric of the articles being treated. These rapid pulsations also cause rapid shaking and flexing of the articles being treated with consequent scrubbing due to the rubbing of the articles on one another and rubbing of parts of each article on other parts in the active zone at the edge of the fin.

After the washing operation has been completed, the pulsator is stopped and the fluid is drained from the tub through drain 16. Hand crank 61 is then moved to bring the friction faces of the drive pulley 36 and the spinner drive pulley 39 into engagement so that the spinner basket will be rapidly rotated. The articles which have just been washed or otherwise treated will thus be rotated with sufficient speed to cause the fluid to be removed therefrom by centrifugal force. The fluid thus extracted from the articles will pass through the openings in the spinner basket into the tub 10 and will drain from the tub through the opening 16.

It will be readily seen that with the above arrangement for imparting a fast rotary motion to the spinner basket, any other rotary motion of the basket may be produced by simple mechanical means. For instance, the basket may be slowly rotated in one direction, or first in one and then in the opposite direction during the process of washing. This action would assist in rearranging the relative positions of the articles being washed and help in keeping them separated from each other.

The "opposed" relationship of the connecting rods 53 and 57, that is to say, the arrangement of the operating mechanism so that the connecting rod 53 extends above and is connected to pulsator rod 21 above a horizontal plane passing through the axis of shaft 47, and so that connecting rod 57 extends below and is connected to counterweight 59 below such plane, results in absolute symmetry of motion through all phases of the operative cycle of the oppositely reciprocating parts and the parts connected to and moving with them, with complete mechanical balance being obtained with resultant freedom from vibration. It will be understood that complete symmetry of motion would not be obtained if both of the connecting rods 53 and 57 extended in the same direction, that is, if they were both connected to the respective parts which they operate at the same side, either above or below, of a horizontal plane passing through the axis of the shaft 47. Also since the pulsator and counterweight move in axial alignment and the eccentrics 50 and 51 are located and operate

equidistantly from the axis of movement of the pulsator and counterweight, and also operate in "opposed" relationship as previously mentioned, no unbalanced couples or forces will be produced during operation. So arranged, or similarly arranged the fluid circulating or propelling means and its operative mechanism is in absolute mechanical balance so that no vibration results which originates in a mechanical source.

As an illustrative example, but without limiting effect, a washing machine embodying the form of the invention heretofore described and having the dimensions hereinafter set forth, when operated at speeds between 450 and 500 R. P. M. with a full load of eight pounds of clothes, completed the wash in ten minutes without previous soaking of the clothes. Tub—standard washing machine tub. Depth of water in the tub 11". Pulsator—13" overall axial length; upper portion 3" in diameter; skirt including fin 9" overall diameter and 5" in axial length to cylindrical portion of pulsator. Fin extending from edge of skirt 1½" wide. Pulsator stroke—1¾ inches. With previous soaking of the clothes, the washing time would be less than ten minutes. Actual tests with this machine have produced washings at least 33⅓% faster than the washing time required by conventional washing machines now on the market in a ten minute washing test, with 20% less wear on the washed clothes, measured by the amount of lint collected after two hours of continuous washing.

In the arrangement illustrated in Fig. 3, the tub of the machine is utilized also as the spinner basket for extracting the fluid from the articles after treatment has been completed. In this arrangement, the tub 10 is imperforate and has a raised central bottom portion which is secured to the upper end of rotatable sleeve 24. The side wall of the tub is flared outwardly from the bottom so that the side wall is slightly inclined to the vertical to cause the water which has been extracted from the articles in the tub to move upwardly of the wall and over its upper edge when the tub is rotated at a sufficient angular velocity. The water spilling over the upper edge falls into a trough 71 surrounding the upper portion of the tub, and flows from the trough through a drain 72. After the washing operation has been completed and before the spinning is begun, the washing fluid is drained from the tub through an opening 73 into an annular pan 74 from which the fluid drains through a pipe 75. A stopper 76 on the end of a chain 77 closes the drain opening 73. The upper end of the chain may be fixed to the upper edge of the tub 10 if desired. The tub and associated parts may be enclosed in an ornamental cabinet 78 having a top opening which is closed by a cover 79.

In some instances it may be desirable to provide scrubbing and fluid propelling elements in addition to the pulsator skirt and fin shown in Figs. 1 and 3. This may be accomplished in the manner illustrated in Figs. 4 and 6, or by other equivalent means. In Fig. 4, the cylindrical portion of the pulsator 17 is provided with a plurality of spaced rows of scrubbing and fluid propelling elements 80 disposed parallel to the longitudinal axis of the pulsator. Elements 80 consist of spaced outwardly and downwardly extending lips of suitable, preferably elastic material such as rubber, or the like, which extend for substantially the entire length of the cylindrical portion of the pulsator. In Fig. 6 the cylindrical portion of the pulsator is provided

with a plurality of spaced annular elements 81 extending circumferentially about the pulsator, having their outer faces extending outwardly and downwardly of the outer surface of the cylindrical portion of the pulsator. Elements 81 may be of metal and integral with the pulsator or they may be of other suitable material such as rubber and secured to the pulsator. During the washing operation, the elements 80 and 81 will function to propel fluid downwardly along the cylindrical portion of the pulsator toward the skirt 19 and will also contact the articles being treated as they move downwardly about the pulsator and scrub them by a rapid reciprocatory scrubbing contact.

In the arrangement illustrated in Fig. 5, the space within the pulsator 17 is utilized for the pulsator counterweight. The pulsator 17 is supported on a sliding sleeve 83 through a mounting block 84 fixed to the upper end of the sleeve. The lower end of sleeve 83 is connected to connecting rod 53 through a fitting 55 which is fixed on the lower end of sleeve 83. The counterweight 85 is disposed within the pulsator 17 and is carried on the upper end of a rod 86 which passes through sleeve 83 and is connected at its lower end to a yoke 87 which straddles the eccentric shaft 47 and is connected to the lower end of connecting rod 57 through wrist pin 58. Eccentrics 50 and 51 have abutting hub portions 88 which bear in a vertically split block 89 having oppositely disposed recesses which receive guides 90 extending vertically along the inner side walls of the yoke 87. This eccentric-block-yoke organization is arranged similarly to the equivalent organization disclosed in my copending application Serial No. 164,820, filed September 20, 1937. Housing 25 has an upwardly extending neck portion 91 which passes through an opening in the bottom 11 of the tub 10 and to which it is secured by nut 27. A bellows 92 having its lower end sealed to the neck portion 91 and its upper end sealed to the sleeve 83 prevents leakage of fluid from the tub in the region of the pulsator operating mechanism. The operation of this form of the invention will be apparent from the foregoing disclosure of other forms.

In Fig. 6, the fluid treating machine is driven by an internal combustion engine of the double opposed type. The engine may be operated by any suitable fuel such as gasoline, gas, fuel oil or the like, and may be a two-cycle or four-cycle engine, or it may be arranged for Diesel operation. Eccentric shaft has eccentrics 94 and 95 keyed thereto in such manner that their maximum points of eccentricity are diametrically opposed. Strap 96 on eccentric 94 carries connecting rod 97 and piston 98 which operates in cylinder 99. Strap 100 on eccentric 95 carries connecting rod 101 and piston 102 which operates in cylinder 103 which is oppositely disposed with respect to the cylinder 99. Strap 96 on eccentric 94 has an ear 104, or a spaced pair of ears, which extends or extend upwardly from a horizontal plane passing through the shaft 93. A connecting rod 105 connects ear or ears 104 with the fitting 55 on the lower end of pulsator rod 21. An ear 106, or a spaced pair of ears, extends or extend downwardly from the strap 100 on eccentric 95 below said horizontal plane, and a connecting rod 107 connects ear or ears 106 with counterweight 59 through wrist pin 58. This arrangement provides a very compact driving and operating organization with

few parts. And with the "opposed," previously described, relationship of the engine rods 97 and 101 and the pulsator and counterweight rods 105 and 107, with the engine rods and the pulsator-counterweight rods being disposed substantially normal to each other, a completely balanced mechanism is provided.

As illustrated in Fig. 7, a rigid sleeve 110 is utilized to provide support for the pulsator shaft 21. The lower end of the sleeve 110 is threaded into the neck of housing 25 and is of adequate length to provide the degree of support desired. In this form of pulsator a diaphragm 111 extends between and is secured in fluid tight relationship to, the outer edge of the skirt 19 and the sleeve 110 to prevent fluid leakage around the pulsator shaft 21. In this instance the diaphragm is corrugated and its inner portion is connected to the sleeve 110 at a higher elevation than its outer portion is connected to the skirt of the pulsator. If desired however, the diaphragm may be "straight" or plane, and its inner and outer portions may be secured at the same or at different elevations. The pulsator may be driven by mechanism of the character shown in Fig. 1 with a counterweight operating below the pulsator drive shaft 47.

Fig. 7 also illustrates a compressed air or steam drive for the pulsator which is particularly applicable to stationary installations such as in laundries, dry cleaning establishments, etc. With installations of this character, no balancing of the pulsator is necessary because the machines are generally installed on cement or concrete floors and are bolted down. In the arrangement illustrated, the pulsator rod 21 carries a piston 112 on its lower end which operates in cylinder 113. A pilot valve 114 controls the operation of the master valve 115 which controls the flow of steam or compressed air to opposite ends of the cylinder 113. Another form of motor useful for this purpose is disclosed in my Patent No. 2,029,240, granted January 28, 1936. A water drive may be used in lieu of steam or compressed air but in some instances it may be objectionable on account of high speed with resulting water hammer in the water pipes, but this may be overcome by using an adequate air cushioning chamber in the water pipe line.

In Fig. 8 there is illustrated another pulsator arrangement in which a stationary sleeve is utilized to support the pulsator rod 21. In this arrangement, the sleeve 120 has its lower end threaded into the upper end of the neck of the housing 25. A collar 121 attached to the inner wall of the pulsator 17 receives the sleeve 120 in its central opening, and the required fluid seal is effected by a bellows 122 having its upper end sealed to the collar 121 and its lower end sealed to the upper portion of neck 123 on housing 25. This pulsator may be driven by mechanism like that shown in Fig. 1 with balancing effected by a counterweight such as weight 59.

In Fig. 8 there is illustrated also a combination of a solenoidal and electromagnetic drive for the pulsator. A single electromagnet coil 125 is enclosed in a soft iron shell 126 which completes the magnetic circuit produced by the coil thereby increasing the intensity of the magnetic field and preventing losses. Pulsator shaft 21 carries an armature 127 which is arranged and disposed for cooperative action with the coil 125 in such manner that when the coil is energized, the arma-

ture and pulsator are moved downwardly into the position shown in Fig. 8. A coil spring 128 surrounds the pulsator shaft and is disposed between a spring seat 129 on shaft 21 and a support member 130 with the spring acting to urge the pulsator shaft upwardly. Electric current is supplied to the coil 125 through a circuit including leads 131 and 132 and a single pole, single throw switch 133 which is operated by the movement of the pulsator shaft 21. One effective arrangement for this purpose is shown in Fig. 9 which illustrates the switch in "off" position so that the coil 125 is deenergized. Leads 131 and 132 are connected to switch plates 134 and 135 respectively which are electrically connected to energize the coil 125 by a switch plate 136 mounted on a bar 137 having its ends connected to levers 138 and 139 which are fulcrumed intermediate their ends. Pulsator shaft 21 carries spaced pins 140 which engage the levers 138 and 139 and swing them about their pivots upon movement of the pulsator shaft. Any other type of switch which performs the same or a similar function may be utilized for the purpose. A rubber stop or shock absorber 141 is placed in the housing 25 to limit the upward movement of the armature 127. The coil 125 and the parts associated therewith will be proportioned to overcome the force exerted by spring 128 and the resistance to downward movement of the pulsator. With this arrangement, it will be perceived that as the pulsator reaches the upper limit of its upward stroke by virtue of the action of coil spring 128, switch plate 136 will be moved downwardly into contact with both switch plates 134 and 135 thus completing the solenoid circuit and energizing the coil 125, which will move the armature 127 and the pulsator downwardly. As the pulsator reaches the limit of its downward stroke, switch plate 136 will be moved upwardly, thus breaking the coil circuit and deenergizing the coil 125. Spring 128 will then act to move the pulsator upwardly until it reaches the upper limit of its stroke when the coil will again be energized and the described cycle will be repeated. The rectilinear reciprocations will be sufficiently rapid to provide the circulatory motion of the fluid and articles in the tub 10 and the treating and scrubbing action heretofore described.

A solenoid drive for the pulsator may be utilized if desired. A drive of this character may include two coils in axial alignment with an armature on the pulsator shaft normally disposed so as to be equally acted upon by the coils and a single pole, double throw switch actuated by the movement of the pulsator shaft in a manner similar to the operation of switch 133 in Figs. 8 and 9, alternately causing the energization and deenergization of the coils to rapidly reciprocate the pulsator shaft and the pulsator. Springs may also be utilized with this arrangement to free the armature and pulsator to return to the "normal" position after one coil has been deenergized, to bring it within the influence of the other coil.

An electromagnetic drive may also be utilized. Such a drive may include two laterally spaced electromagnet coils in the space between which operates an armature on the pulsator shaft, with a single pole, single throw switch operated by the pulsator shaft in the manner in which the switch 133 in Figs. 8 and 9 is operated. The switch will be closed at the top of the upward stroke of the pulsator and will be opened at a point about halfway down on the downstroke of the pulsator. A spring disposed below the armature will return

the shaft and the pulsator to its upper position after the switch has been opened, after which the cycle will be repeated.

Although the pulsator is disclosed herein as centrally or axially disposed in the tub 10, it will be understood that other positions in the tub will produce satisfactory results, such as any suitable off-center position and in some instances it may be disposed closely adjacent the wall of the tub.

Due to the unique character of the circulatory motion of the fluid and articles obtained by the use of my invention, the shape of the tub is immaterial except as otherwise mentioned herein, and rounded corners or inclined walls or the like are unnecessary.

It will be apparent to those skilled in the art that changes may be made in the form, location, relative arrangement and the materials of the several parts of the machine disclosed, and that variations in the steps of the method or their sequence may be made without departing from the principles of the invention. Accordingly, the invention is not to be limited excepting by the scope of the appended claims.

What is claimed is:

1. A fluid treating element for a fluid treating machine adapted to be disposed in a tub of the machine for rectilinear reciprocation therein, comprising a hollow, elongated, substantially smooth, rigid body, open at one end, said end having a fluid propelling annular flange extending outwardly at an acute angle to the axis of the body portion and joining the body portion with a smooth curve, and a flexible, annular, relatively short, extension for the flange normally positioned at substantially the same angle to the axis of the body portion as the flange, the body portion being of such length that its other end portion will project above the normal level of the fluid in the tub during operation of the element, the outer wall of said other end portion being disposed substantially parallel to the axis of reciprocation of the element, thereby preventing splashing of the fluid in the tub due to movement of the element.

2. A fluid treating element for a fluid treating machine adapted to be operatively disposed in a tub of the machine and arranged to be rectilinearly reciprocated with relatively short strokes therein and free of the wall thereof, comprising a body portion, a fluid propelling annular flange extending outwardly of the body portion at an acute angle to the axis of reciprocation, and a flexible, annular, relatively short extension for the flange normally positioned at substantially the same angle to the axis of reciprocation as the flange.

3. A fluid treating element for a fluid treating machine adapted to be operatively disposed in a tub of the machine and arranged to be rectilinearly reciprocated with relatively short strokes therein and free of the wall thereof, comprising a substantially bell-shaped rigid body, and a flexible, annular, relatively short extension for the flange at the open end of the body.

4. A fluid treating element for a fluid treating machine adapted to be operatively disposed in a tub of the machine, comprising a hollow, vertically elongated, rigid body, open at its lower end, said end having a fluid propelling annular flange extending outwardly and downwardly at an acute angle to the axis of the body portion and joining the body portion with a smooth curve, and a flexible, annular, relatively short extension for the

flange normally positioned at substantially the same angle to the axis of the body portion as the flange and operative free of the vertical wall of the tub.

5. A fluid treating element for a fluid treating machine adapted to be operatively disposed in a tub of the machine and arranged to be rectilinearly reciprocated with relatively short strokes therein and free of the wall thereof, comprising a substantially bell-shaped rigid body, a flexible, annular, relatively short extension for the flange at the open end of the body, and a fluid propelling and scrubbing lip on the body portion of the element arranged to propel fluid along the body toward the open end thereof.

6. A fluid treating element for a fluid treating machine adapted to be operatively disposed in a tub of the machine and arranged to be rectilinearly reciprocated with relatively short strokes therein and free of the wall thereof, comprising a substantially bell-shaped rigid body, a flexible, annular, relatively short extension for the flange at the open end of the body, and rows of fluid propelling and scrubbing lips on the body portion of the element, said rows being disposed substantially parallel to the axis of reciprocation, the lips being arranged to propel fluid along the body toward the open end thereof.

7. A fluid treating device for a fluid treating machine adapted to be operatively disposed in a tub of the machine, comprising a hollow elongated, substantially bell-shaped, rigid body, open at its lower end, said body having fluid propelling and scrubbing means, a rectilinearly reciprocable shaft for supporting the body, a stationary tubular member through which the shaft passes for guiding the shaft, means secured to the interior of the body and in sliding engagement with the tubular member, stationary means for supporting the tubular member, and an expansible and contractible sealing member extending between and connected in fluid-tight relationship to the means secured to the interior of the body and the means for supporting the tubular member.

8. A fluid treating element for a fluid treating machine adapted to be operatively disposed in a tub of the machine and arranged to be rectilinearly reciprocated with relatively short strokes therein and free of the wall thereof, comprising a body portion, a fluid propelling annular flange extending outwardly of the body portion at an acute angle to the axis of reciprocation, and a flexible, annular, relatively short extension for the flange.

9. A fluid treating element for a fluid treating machine adapted to be operatively disposed in a tub of the machine, comprising a hollow, vertically elongated, rigid body, open at its lower end, said end having a fluid propelling annular flange extending outwardly and downwardly at an acute angle to the axis of the body portion and joining the body portion with a smooth curve, and a flexible, annular, relatively short extension for the flange.

10. Fluid treating apparatus having a fluid treating element adapted to be operatively disposed in a tub of the apparatus and arranged to be rectilinearly reciprocated with relatively short strokes therein and free of the wall thereof, comprising a body portion, a fluid propelling annular flange extending outwardly of the body portion at an acute angle to the axis of reciprocation, a flexible, annular, relatively short extension for the flange, rectilinearly reciprocable means for supporting the body, stationary means for guid-

ing the supporting means, and an expansible and contractible seal of relatively thin and flexible material extending between and connected at its terminal portions in fluid tight relationship to the supporting means and the guiding means, the seal being corrugated between its terminal portions.

11. Fluid treating apparatus having a fluid treating element adapted to be operatively disposed in a tub of the apparatus and arranged to be rectilinearly reciprocated with relatively short strokes therein and free of the wall thereof, comprising a body portion, a fluid propelling annular flange extending outwardly of the body portion at an acute angle to the axis of reciprocation, a flexible, annular, relatively short extension for the flange, rectilinearly reciprocable means for supporting the body, stationary means for guiding the supporting means, and an expansible and contractible seal of relatively thin and flexible material disposed within said hollow body and extending between and connected at its terminal portions in fluid tight relationship to the supporting means and the guiding means, the seal being corrugated between its terminal portions.

12. Fluid treating apparatus having a fluid treating element adapted to be operatively disposed in a tub of the apparatus and arranged to be rectilinearly reciprocated with relatively short strokes therein and free of the wall thereof, comprising a body portion, a fluid propelling annular flange extending outwardly of the body portion at an acute angle to the axis of reciprocation, a flexible, annular, relatively short extension for the flange, rectilinearly reciprocable means for supporting the element, stationary means for guiding the supporting means, and an expansible and contractible seal of relatively thin and flexible material extending between and connected at its terminal portions in fluid tight relationship to the element and said stationary means, the seal being corrugated between its terminal portions.

13. Fluid treating apparatus having a fluid treating element adapted to be operatively disposed in a tub of the apparatus and arranged to be rectilinearly reciprocated with relatively short strokes therein and free of the wall thereof, comprising a body portion, a fluid propelling annular flange extending outwardly of the body portion at an acute angle to the axis of reciprocation, a flexible, annular, relatively short extension for the flange, rectilinearly reciprocable means for supporting the body, stationary means for guiding the supporting means, and an expansible and contractible seal of relatively thin and flexible material extending between and connected at its terminal portions in fluid tight relationship to the supporting means and the flange on said body portion, the seal being corrugated between its terminal portions.

14. Fluid treating apparatus having a fluid treating element adapted to be operatively disposed in a tub of the apparatus and arranged to be rectilinearly reciprocated with relatively short strokes therein and free of the wall thereof, comprising a body portion, a fluid propelling annular flange extending outwardly of the body portion at an acute angle to the axis of reciprocation, a flexible, annular, relatively short extension for the flange, rectilinearly reciprocable means for supporting the body, stationary means for guiding the supporting means, and a corrugated annular diaphragm extending between and connected in fluid tight relationship to the supporting means and the flange on said body portion.

15. A fluid treating element for a fluid treating machine adapted to be operatively disposed in a tub of the machine and arranged to be rectilinearly reciprocated with relatively short strokes therein and free of the wall thereof, comprising a body portion, a fluid propelling annular flange extending outwardly of the body portion at one end thereof at an acute angle to the axis of reciprocation, and a flexible, annular, relatively short extension for the flange, the body portion being of such length that its other end portion will project above the normal level of the fluid in the tub during operation of the element, the outer wall of said other end portion being disposed substantially parallel to the axis of reciprocation of the element, thereby preventing splashing of the fluid in the tub due to movement of the element.

16. Apparatus for treating articles with fluid in a tub comprising a fluid treating device adapted to be operatively disposed in the tub and arranged to be rectilinearly reciprocated with relatively short strokes therein and free of the wall thereof, the device including a hollow, elongated, substantially bell-shaped, rigid body having an enlarged open lower end, said end having a fluid propelling annular flange extending outwardly and downwardly at an acute angle to the axis of the body portion and joining the body portion with a smooth curve, a flexible annular, relatively short extension for the flange, and rectilinearly reciprocable supporting means for the body, stationary means for guiding the supporting means, and a seal of relatively thin, sheet-like and flexible material extending between and secured in fluid tight relationship at its terminal portions to the device and the stationary means and expansible and contractible upon reciprocation of

the device, the seal being disposed within the confines of the hollow body and the flange thereon.

17. Apparatus for treating articles with fluid in a tub comprising a fluid treating device adapted to be operatively disposed in the tub and arranged to be rectilinearly reciprocated with relatively short strokes therein and free of the wall thereof, the device including a hollow, elongated, substantially bell-shaped, rigid body having an enlarged open lower end, said end having a fluid propelling annular flange extending outwardly and downwardly at an acute angle to the axis of the body portion and joining the body portion with a smooth curve, a flexible annular, relatively short extension for the flange, and rectilinearly reciprocable supporting means for the body, stationary means for guiding the supporting means, and a seal of relatively thin, sheet-like and flexible material extending between and secured in fluid tight relationship at its terminal portions to the device and the stationary means and expansible and contractible upon reciprocation of the device, the seal being disposed within the confines of the hollow body and the flange thereon, the hollow interior of the device constituting an air chamber serving as fluid shock absorbing means, the device, supporting and guiding means and the seal being constructed and arranged so that on the downstroke of the device, fluid will enter the lower portion of the air chamber and compress the air therein, and at the end of the downstroke, the air compressed in the chamber will expel the liquid from the interior of the device, thereby extending the effective duration of the downstroke of the device and relieving strain on the means for reciprocating the device.

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