

Aug. 28, 1945.

G. W. DUNHAM

2,383,783

WASHING MACHINE

Filed Oct. 8, 1942

Fig. 1.

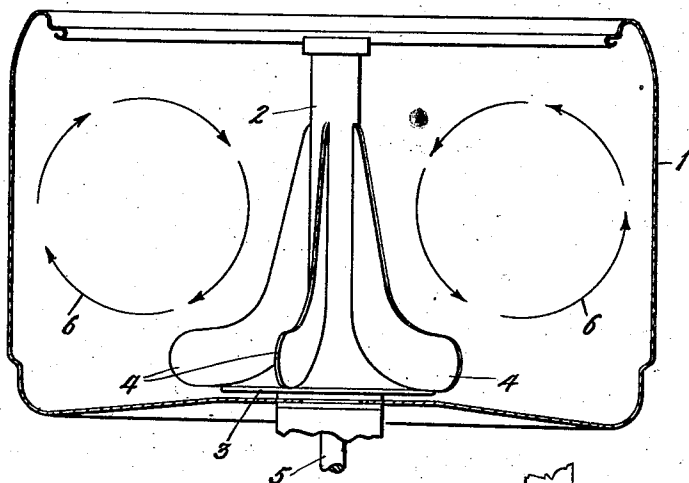


Fig. 2.

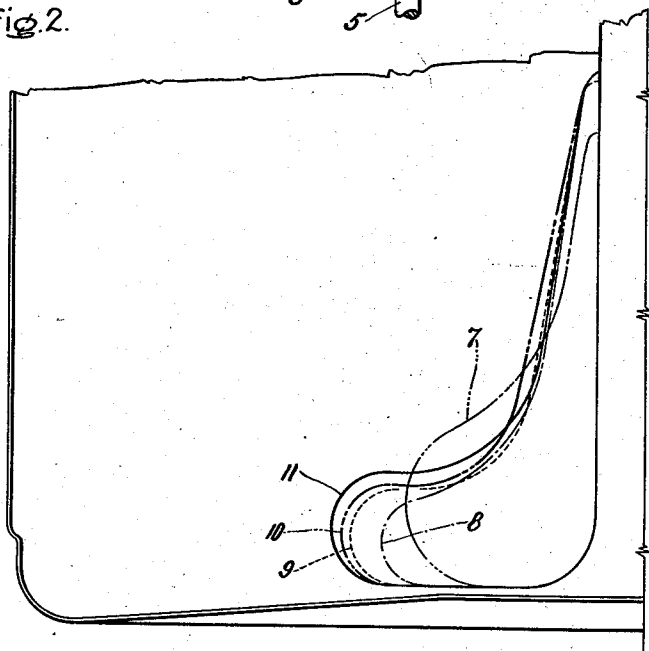
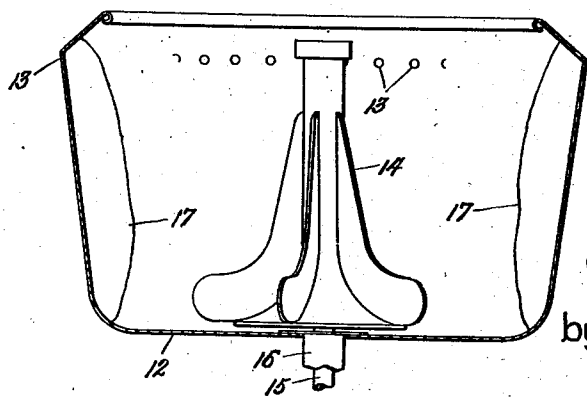


Fig. 3.



Inventor:
George W. Dunham,
by *Harry E. Dunham*
His Attorney.

UNITED STATES PATENT OFFICE

2,383,783

WASHING MACHINE

George W. Dunham, Westport, Conn., assignor to
General Electric Company, a corporation of
New York

Application October 8, 1942, Serial No. 461,256

4 Claims. (Cl. 8—159)

The present invention relates to the agitator type washing machine and is particularly concerned with the improvement in its operation by oscillation of the agitator at a high speed and a short stroke relative to the previously accepted practice.

The agitator type washing machine, in which the washing is carried out by an oscillatory agitator or dolly, has after a long period of development emerged as the predominant domestic washing machine. There has been suggested a wide variety of sizes and shapes of the agitator. The blades, the active portions of the agitator, have varied in number from one to fifteen or more and in shape from round pegs to blades having a width (or height) equal to the depth of the water in the tub. Some of the blades have been located at the top, some at the middle, and some at the bottom of the tub, the principal difference in each location being in the water currents set up by the agitator.

While there is some disagreement as to the theory of operation, it is generally agreed that the clothes are washed while in the immediate vicinity of the agitator blades (some say by rubbing contact with the blades) and that the oscillation of the agitator sets up water currents of sufficient force to suspend the clothes in the water and move them in the proper direction to cause a turnover or redistribution of the clothes so as to bring all of the clothes into cooperation with the agitator. Unless the water currents have sufficient force to cause the suspension and "turnover" of the clothes, the washing is confined to the clothes dragged through the water by the blades. These clothes are subjected to a harsh washing action, while the remaining clothes are not washed. Prior to the present invention agitators have been oscillated at a speed of from twenty-five to seventy complete oscillations per minute and through a stroke of from one-half to several revolutions.

The operation of the agitator requires more power than can be exerted by the average user so it is safe to say that the hand-operated machines have not been operated at speeds sufficient to produce water currents of sufficient "force" to cause the "turnover" necessary for satisfactory washing action.

The object of my invention is to provide an improved operation in the agitator type washing machine by a higher speed and a shorter stroke oscillation of the agitator. For a consideration of what I believe novel and my invention, atten-

tion is directed to the following description and the claims appended thereto.

In the accompanying drawing, Fig. 1 is a sectional elevation of a washing machine having a five-bladed agitator, Fig. 2 is a scale drawing of various blade shapes, and Fig. 3 shows an application of the agitator to an extractor type washing machine.

Referring to the drawing, there is shown a washing machine having a tub 1 at the center of which is an agitator having a hub 2 provided with a disk 3 adjacent the bottom of the tub and five equally spaced blades 4 projecting from the hub and disk. The agitator is oscillated at a speed of from slightly less than three hundred to more than four hundred complete oscillations per minute and through an angle of from sixty to seventy-five degrees by a vertical shaft 5 extending up through the bottom of the tub and suitably connected to the agitator. By the term complete oscillation as used herein, I mean one complete to and fro motion of the agitator. The mechanism for oscillating the shaft 5 forms no part of the present invention and accordingly is not illustrated.

During the oscillation of the agitator there is set up a toroidal circulation of water about the agitator, as indicated by the arrows 6.

The speed and stroke are radically different from the previously accepted practice of oscillating the agitator through a stroke of the order of one hundred eighty degrees and at a speed of the order of sixty complete oscillations per minute.

With the change in speed and stroke there is a marked difference in the operation. In the prior art agitators which operate at a slow speed and through a long stroke, the entire body of water in the tub tends to oscillate with the agitator. The clothes and water are dragged around the tub by the agitator. This oscillation, while of course not as great as the stroke of the agitator due to slippage between the water and the agitator blades, does not serve any useful purpose and, in fact, causes the clothes to move in S-shaped paths resulting in a tendency toward tangling or knotting of the clothes. The tendency toward tangling is most pronounced in the case of shirt sleeves, apron strings and the like.

In the present machine due to the shorter stroke the water currents are practically wholly confined to radial paths and there is substantially none of the objectionable oscillating movement of the entire body of liquid around the tub. Although many blade shapes and speeds of operation have

been tried, no tendency toward tangling has been observed.

Another advantage of the present machine is that the washing action is increased, this being the result of the better turnover and a nearer approximation of the hand scrub board. By increasing the washing action the capacity of the machine—the amount of clothes which can be washed at one time and in a unit of time—is also increased. In the present machine a satisfactory turnover has been obtained with loads which would not turn over with the low speed agitator. Apparently the rapid impulses (300 to 500 per minute as compared to 60 per minute) are more effective in starting and keeping the clothes in motion.

There is no mathematical formula for the number or shape of agitator blades. All blades (for the prior art slow speed agitator and the present high speed agitator) are designed empirically and the final shapes are chosen by balancing good and bad features. The differences in the number of blades and the blade shape can be explained as due to the element of judgment as to the relative weight to be given to the various factors.

Some idea of the procedure in designing a satisfactory agitator can be obtained from Fig. 2 which is a scale drawing of the blade shapes tried in arriving at the final design shown in Fig. 1 of the drawing. In this figure the blades are shown in relation to a standard size washing machine tub having a diameter of twenty-three inches which is intended to be filled with water to a depth of from nine and one-half to ten and one-half inches. The mechanism for oscillating the agitator was adjustable to strokes between sixty and seventy-four degrees, and to speeds between two hundred eighty-two and four hundred ninety complete oscillations per minute.

The blade indicated by the numeral 7, one of the first, was used on an agitator having twelve radial blades. This agitator had the characteristic washing action but with two defects, a tendency toward sluggish turnover, particularly on heavy articles such as sheets, and a tendency of the clothes to become wedged or lodged against the upper edges of the blades.

When clothes became wedged against the blades, the turnover became still less as the water circulation was restricted. The clothes restrict the flow of water to the blades. If the agitator is considered as a centrifugal pump, the wedging of the clothes against the upper edges of the blades is equivalent to clogging the pump inlet. The wedging tendency was partially corrected by removal of alternate blades—making a six-bladed agitator—but since this tendency still persisted, it became apparent that the blades were too wide. The change from twelve to six blades did not change the power required to oscillate the agitator or the water circulation set up by the agitator. For the particular tub and mechanism it was apparent that twelve blades were not necessary. The next step was a six-bladed agitator having blades indicated by the reference numeral 8. The decrease in blade width was to keep clothes from lodging against the upper edges of the blades and the increase in diameter was to increase the velocity of the water currents. If it had been convenient to change the mechanism the velocity of the water currents could have been increased by increasing the speed of oscillation instead of increasing the agitator diameter. This agitator

was quite satisfactory at the highest speed, but was less satisfactory at the lowest speed of the mechanism. To determine the best number of blades, this agitator was also made in seven, five, and four blades. The four-bladed agitator was poorer than the others (apparently the blades were too far apart to insure efficient water circulation), and since there was not much choice between the five-, six-, and seven-bladed agitators, the five-bladed agitator was chosen since it used less material. I have also tried three-bladed agitators and find them still poorer. The power input is substantially unchanged, is substantially the same for three, four, five, six, and seven blades, but the three and four bladed agitators have poorer washing action. The angle swept by the blade (the product of the stroke and the number of blades) apparently does not need to be greater than 360° and should not be too much less. Five-bladed agitators indicated by reference numerals 9, 10 and 11 were built to investigate the effect of still further increases in diameter. All gave satisfactory performance throughout the range of the mechanism. Blade 11 did the fastest washing, but, due to its greater area and diameter, took more power than was desired. Blade 10, shown in Fig. 1, was chosen since at the intermediate speed of the mechanism (62° stroke, 352 oscillations/min.) it took the desired amount of power.

In the foregoing design procedure, the agitator size was changed to fit a particular mechanism and tub. Obviously either the tub or mechanism may be changed to fit a particular agitator size—although it is usually more convenient to change the agitator.

The improved operation apparently is due to the fact that the high speed short stroke oscillation produces radial water currents with less of the objectionable oscillating movement of the water around the tub. The high speed results in a predominant centrifugal (radial) component, and, because the stroke is short, the main body of the water (and the clothes suspended therein) does not oscillate with the agitator (is not dragged around the tub). The rubbing action of the blade edges against the suspended clothes is accordingly increased. The blade shape and the number of blades are matters of design, and a poor design will obviously have poor operation.

In the foregoing design, I used flat radial blades with the major part of the blades at the bottom of the tub since, in my judgment, this general type of blade has the most satisfactory operation. Those who prefer non-radial blades (with or without special curves) or blades having the major part at the middle or top of the tub would naturally tend to follow their judgment as to the value of these features and their judgment would be reflected in their designs. There is no reason why these other types of blade shape could not be used.

While there is theoretically no upper limit to the speed of operation, the higher speeds and shorter strokes require a larger number of blades for efficient water circulation and are subject to the problem of clothes lodging against or between the blades.

In washing machines of the type in which clothes are washed and centrifugally dried in a spinner basket, the high speed agitator shows up to advantage compared with the prior art low speed agitator. One such machine is shown in Fig. 3 having a spinner basket 12 provided with

centrifugal discharge openings 13 which define the liquid level during washing. In the spinner basket is a five-bladed agitator 14 of the same construction shown in Fig. 1. The agitator and spinner basket are respectively connected to concentric shafts 15 and 16 which are respectively oscillated at washing speed or rotated at centrifugal drying speed by suitable mechanism, for example that shown in my co-pending Patent 2,346,669.

After centrifugal drying the clothes are packed against the side walls in a thin layer as indicated at 17. The clothes will retain in the interstices of the fabric some soapy water which can be removed by filling the basket with rinse water and oscillating the agitator. If the clothes were uniformly distributed in the rinse water, only a very short period of oscillation of the agitator would be necessary to remove the soapy water from the interstices of the fabric. Due to the unfavorable position, it has been found with the prior art slow speed agitator that turnover will not start (and accordingly effective rinsing will not begin) until long after the interval required for adequate rinsing. The rinsing time can be divided into a long interval of agitator oscillation required to dislodge the compacted layer of clothes from the spinner basket side walls and a short interval of agitator oscillation required to disperse the soapy water lodged in the interstices of the fabric. The time required to dislodge the compacted layer of clothes is greatly reduced with the high speed agitator. Apparently the short high speed impulses, which are more in the nature of a vibration, are more effective in dislodging and redistributing the clothes.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a washing machine, a stationary tub, an agitator in the tub having a central hub, a bottom disk, and five or more radially extending circumferentially spaced blades carried by the hub and disk, said blades having rounded lower outer ends and portions tapering from said rounded lower outer ends inwardly and upwardly along the central hub, and means for oscillating said agitator about its axis at a speed of the order of three hundred complete oscillations per minute and through a stroke of the order of sixty degrees whereby radial water currents are set up causing rapid turnover of clothes being

washed in the tub without effecting substantial oscillating circumferential movement of the water and clothes about the tub.

2. In a washing machine, a stationary tub, an agitator in the tub having a central hub, a bottom disk, and five or more radially extending circumferentially spaced blades carried by the hub and disk, said blades having rounded lower outer ends and portions tapering from said rounded lower outer ends inwardly and upwardly along the central hub, and means for oscillating said agitator about its axis at a speed of from three hundred to four hundred complete oscillations per minute and through a stroke of the order of sixty degrees whereby radial water currents are set up causing rapid turnover of clothes being washed in the tub without effecting substantial oscillating circumferential movement of the water and clothes about the tub.

3. In a washing machine, a stationary tub, an agitator in the tub having a central hub, a bottom disk, and five or more radially extending circumferentially spaced blades carried by the hub and disk, said blades having rounded lower outer ends and portions tapering from said rounded lower outer ends inwardly and upwardly along the central hub, and means for oscillating said agitator about its axis at a speed in complete oscillations per minute of the order of sixty times the number of blades and through a stroke of the order of sixty degrees whereby there is effected the production of radial water currents to cause rapid turnover of clothes being washed in the tub without causing substantial oscillating circumferential movement of the water and clothes about the tub.

4. The method of washing clothes which comprises producing in a stationary tub water currents which flow in closed radial paths with sufficient force to suspend and circulate the clothes, and oscillating through an angle of the order of sixty degrees and at a speed of the order of at least three hundred complete oscillations per minute about its axis, an agitator having rounded blades with which the clothes are brought into contact by the water currents, the blades intersecting transversely said paths whereby the blades serve to scrub the clothes and at the same time fan them out circumferentially thereby preventing tangling of the clothes.

GEORGE W. DUNHAM.